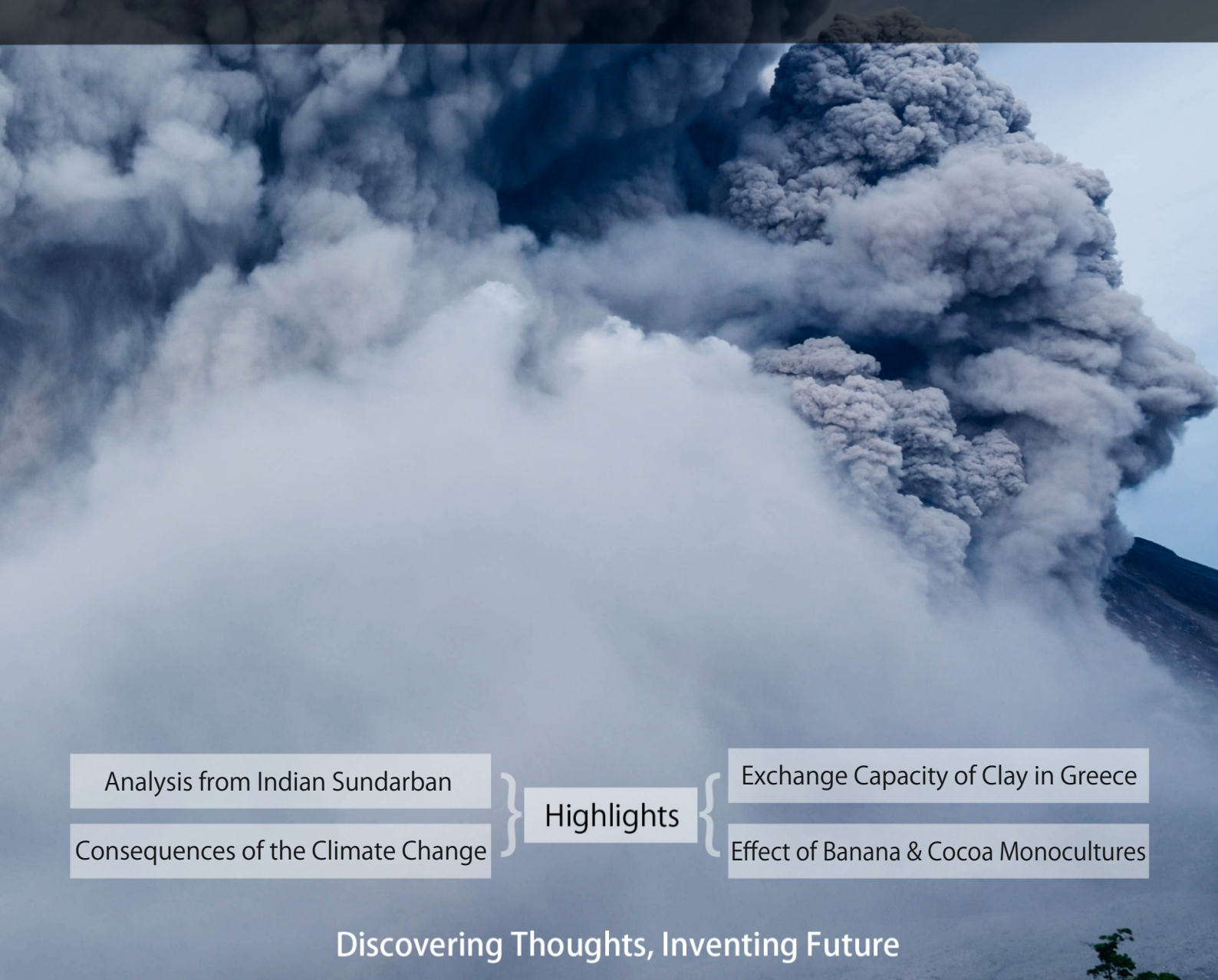
Online ISSN: 2249-460X
Print ISSN: 0975-587X
DOI: 10.17406/GJHSS

Global Journal

of Human Social Sciences: B

Geography, Geo-Sciences & Environmental Science & Disaster Management



Analysis from Indian Sundarban

Consequences of the Climate Change

Highlights

Exchange Capacity of Clay in Greece

Effect of Banana & Cocoa Monocultures

Discovering Thoughts, Inventing Future

VOLUME 22 ISSUE 2 VERSION 1.0

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Volume 22 Issue 22 was originally issued as B2

Global Journal of Human-Social Science: B
Geography, Geo-Sciences, Environmental Science & Disaster Management

Volume 22 Issue 22
Originally issued as B2

Global Journal of Human-Social Science: B
Geography, Geo-Sciences, Environmental Science & Disaster Management

Volume 22 Issue 2 (Ver. 1.0)

Open Association of Research Society

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USA Toll Free: +001-888-839-7392
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Offset Typesetting

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Contents of the Issue

i. Copyright Notice
ii. Editorial Board Members
iii. Chief Author and Dean
iv. Contents of the Issue

1. Cation Exchange Capacity of Clay in Greece. *1-11*
2. Consequences of the Climate Change in Iraq. *13-25*
3. Greenhouse Gas Emissions from the Waste Sector from Salvador: Comparative Analysis of the Results and Gaps Found in the First and Second Inventory. *27-36*
4. Energy and Climate Change. *37-50*
5. Degradación Hidrológica del Cantón Valencia, Provincia de Los Ríos Por Efecto de Los Monocultivos de Banano y Cacao. *51-62*
6. Intercultural Mediation in Conflict Situations: A Didactic- Methodological Conception for Tourist Guides. *63-69*
7. Change in Housing Structure to Cope with Natural Hazards: A Statistical Analysis from Indian Sundarban. *71-78*

v. Fellows
vi. Auxiliary Memberships
vii. Preferred Author Guidelines
viii. Index

Global Journal of human-social science: b
Geography, Geo-Sciences, Environmental Science & Disaster Management
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460x & Print ISSN: 0975-587X

Cation Exchange Capacity of Clay in Greece

By Christodoulias, John

Abstract- The soil samples which have been used to determine the CEC of the Greek swelling soil, were collected from 17 districts all over the country, and the ammonium acetate method (Schofield, 1949) was used because is a commonly used method by Chemists. Fifty-six clay soil samples were tested using the material passing the US sieve No 40. Each sample was washed three times with ammonium solution to saturate the exchange sites and the exchange ions in milliequivalents per 100 gr of dry soil were determined in the leached extract by a corne flame photometer. The soil pH determination was also measured according to BS 1377: Part 3: 1990 9: The results of the measurement from 300 soil samples of the Greek territory are reported. Additionally, one attempt was made to correlate the obtained CEC values with Liquid limit, Plasticity index and, montmorillonite percent.

GJHSS-B Classification: DDC Code: 813.54 LCC Code: PS3553.H15



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Cation Exchange Capacity of Clay in Greece

Christodoulias, John

Abstracts- The soil samples which have been used to determine the CEC of the Greek swelling soil, were collected from 17 districts all over the country, and the ammonium acetate method (Schofield, 1949) was used because is a commonly used method by Chemists. Fifty-six clay soil samples were tested using the material passing the US sieve No 40. Each sample was washed three times with ammonium solution to saturate the exchange sites and the exchange ions in milliequivalents per 100 gr of dry soil were determined in the leached extract by a corne flame photometer. The soil pH determination was also measured according to BS 1377: Part 3: 1990 9: The results of the measurement from 300 soil samples of the Greek territory are reported. Additionally, one attempt was made to correlate the obtained CEC values with Liquid limit, Plasticity index and, montmorillonite percent.

Résumés- Les échantillons de sol qui ont été utilisés pour déterminer la C.E.C. du sol gonflant grec, ont été prélevés dans 17 districts de tout le pays, et la méthode à l'acétate d'ammonium (Schofield, 1949) a été utilisée car c'est une méthode couramment utilisée par les chimistes. 54 échantillons de sol argileux ont été testés à l'aide du matériau passant au tamis américain n° 40. Chaque échantillon a été lavé trois fois avec une solution d'ammonium pour saturer les sites d'échange et les ions d'échange en milliéquivalents pour 100 gr de sol sec ont été déterminés dans l'extrait lessivé par un photomètre à flamme cornée. La détermination du pH du sol a également été mesurée selon BS 1377: Partie 3: 1990 9: Les résultats des mesures de 300 échantillons de sol du territoire grec sont rapportés. De plus, une tentative a été faite pour corréler le C.E.C. valeurs avec limite de liquidité, indice de plasticité et pourcentage de montmorollonite.

I. Cation Exchange Properties

Clay minerals and organic matter have negatively charged sites on their surfaces which adsorb and hold positively charged ions (cations) by electrostatic force. The number of negatively charged sites determines how many cations the soil can attract and is referred to as the soil's cation exchange capacity or CEC.

The primary ions associated with CEC in soils are the exchangeable cations calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}) and potassium (K^{+}). A soil's CEC is critical for supplying plant nutrients because many of these cations are also essential for plant growth. That is why, in general terms, soils with high CEC are considered to be more fertile or potentially more fertile.

The conditions essential to ion exchange were named by Kelley (1955) as physical accessibility of the ion and strength of the force by which the ion is held to the lattice. The crystal structure of base exchange materials has been summarized by Kelley (1955) as follows: Clay minerals are platy and characterized by a layer lattice structure. Layers are composed of planes or silicon ions in which each silicon ion is situated at the center of a tetrahedron formed by four oxygen ions, and planes of aluminum, iron, or magnesium ions surrounded by six oxygen or OH ions arranged in the form of an octahedron. Pyrophyllite, according to Kelley, is electrically neutral and unable to attractions except by weak forces. In the case of muscovite, potassium ions hold the layers together and are prevented from entering into an exchangeable form. In montmorillonite the (001) planes spacings are a function of water content and quicly enter to exchangeable condition.

II. Previus Work

From the international bibliography the cation exchange capacity reveals one soil with strong swelling potential. In the tables bellow we can see the variety of basic clay minerals.

Table 1: Gives one average ingrediencies of exchangeable cation of a clay soil (Jackson, 1962).

Table 2: Gives CEC for clay mineral after Thomson, 1957

Table 3: Revels the variation of exchange capacity for clay. (Woodward – Clyde and Associates, 1967)

Table 4: Reports CEC value for common clay minerals (after Mitchell, J., 2005)

Table 5: List of cation exchange capacities for clay, (after Grimm, 1955).

Table 6: List of cation exchange capacities by Jennings and Kinkner (1990).

Table 1: Average percent of cations in typical clay soil. (Jackson, 1962).

Typical cations of o clay	Me /100 gr of soil
Ca	10-15
Mg	3-5
Mn	0,02 - -
K	0,03 – 0,25
Na	0,2 – ίχνη
H	1,5 – 5

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Table 2: CEC of clay minerals and soil organics. (Thomson, 1957).

Type of Mineral	(CEC), me/100gr.
Organic pumice	250- 450 (350)
vermiculite	150- 170 (164)
Montmorillonite group	90- 130 (110)
Chlorite group	3- 7 (5)
Kaolinite group	3- 7 (5)
Mica group	3- 7 (5)

On table 3 we can see that montmorillonite is ten times more drastic than kaolinite. The season for this is the large specific area of the crystal surface and the negative charge in the surface of crystals.

Table 3: Variation of exchange capacity for clay.
(Woodward – Clyde and Associates, 1967).

	Kaolinite	Illite	Montmorillonite
Thickness of particles	0.5 –- 2 μm	0.003 - 01 μm	μικρότερο 9.5 Å
Diameter of particles	0.5 – 4 μm	0.5 – 10 μm	0.5 – 10 μm
Specific area m^2/ gram	10 - 20	65 – 100	50 – 840
Cation exchange Capacity meq/100 gr	3 -15	10- 40	70 – 100

Table 4: CEC value for common clay minerals (after Mitchell, J., 2005)

Clay Mineral	Kaolinite	Halloysite	Illite	Vermiculite	Smectite	Chlorite
meq/100g	5	12	25	150	85	4

Table 5: List of cation exchange capacities for clay, (after Grimm, 1955).

Clay mineral	C.E.C. meq/100g
Kaolinite	3.0—to -15.0
Hallusite	6.0—to—10.0
Illite	20.0—to—40.0
Attapulgite	25.0—to—30.0
montmorillonite	60.0—to—100.0

Table 6: Cation exchange capacities by Jennings and Kinkner, (1990).

Parent material	C.E.C. meq/100g
Talc	*1.0*
Albite	*2.0*
Anorthite	*2.0*
Biotite	*3.0*
Pyrophyllite	*4.0*
Orthoclase	5.0
Chlorites	6.0
Muscovite	10.0
Bentonite	126.0

Additionally, Weaver and Pollard (1973) propose that values CEC fluctuated between CEC =10 and CEC =15 meq/100 gr, reveal one soil with strong swelling potential.

Avery and Bullock (1977), reinforce the above explaining that the attraction of water molecules from the surface of clay particles is affected by cation exchange capacity (CEC) of clay and finally exchange them with cations dissolved in water.

Morin and Parry (1971) reports values CEC for Ethiopian soils between CEC =42 and CEC =95 meq, and in some other areas of the same country CEC values fluctuate from CEC =22 up to CEC =90 meq. More specific separated clay soil of Ethiopia in four categories, related to geomorphology and origin of clay. So, they reported,

- Black clay CEC = 42 - 95 meq.
- Red clay CEC = 42 - 77 meq.
- Lacustrine clay CEC = 22 - 90 meq.
- Alluvial clay CEC = 42 - 95 meq.

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Raymahashay and Sahu (1980) report values for CEC

- For kaolinite C.E.C =24 meq,
- For illite C.E.C =28 meq
- For montmorillonite C.E.C =70 meq.

Driscoll (1983), reports that measure values CEC for the British clay soil varied between CEC =20 meq. up to CEC =60 meq/100gr.

Attewell και Taylor (1986) gave CEC values for the British swelling soils varying between CEC= 30 meq. up to CEC= 56 meq.

Grilly (1990) after four years, also reports similar CEC values for the British swelling soils.

Karunaratne et.al. (2001), publish for Singapore clay soil mixtures with bentonite CEC =88 meq/ 100 gr. and for mixtures with kaolinite CEC =5 meq/ 100 gr.

Mitchell, J. (2005) measured the following values for basic clay minerals.

- Kaolinite = 5 meq
- Halloysite = 12 meq
- Illite = 25 meq
- Vermiculite = 150 meq
- Smectite = 85 meq
- Chlorite =4 meq

From the Greek bibliography are reported results similar to previous work. Mimidis and Peraki (1987) reports for Greek territory that cation exchange capacity fluctuates between CEC =30 up to CEC =85 meq.

From other research (Christodoulias, 2018), is reported similar cation exchange capacity CEC for several tested areas (Table 8), but the highest value in Greece was registered in Thiva city of Viotia province and is CEC =83 meq/ 100 grms of soil.

III. Ionic and Cationic Alternators

The discovery of cation exchange capacity of clay soils is benefit of the research of Thomson (1850) and Way (1852), after the observation that when one solution of ammonium salt passes through one soil column, all ammonium ions were captured by the soil and the calcium ions are released from the soil.

Natural alternators are mixtures of ions and cations in the soil similar to inorganic and organic compounds and similar to clay minerals as vermiculite, glauconite, montmorillonite.

Cation exchange capacity is defined as a soil's total quantity of negative surface charges, (Hendricks, 1945), It is measured commonly in commercial soil testing labs by summing cations (positively charged ions that are attracted to the negative surface charges in soil). Exchangeable cations include base cations, calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^{+}) and sodium (Na^{+}), as well as acid cations such as hydrogen (H^{+}), aluminum (Al^{3+}) and ammonium (NH_4^{+}).

Grim (1953,1955), Mitra and Rajagopalan (1952) reports that free negative forces in the crystal lattice of clay mineral are due to the following:

- α) isomorphous substitution of lattice octahedral with other ions having less strength. The result of this are free negative forces on the surface of crystals, but these free ions are neutralized by new free ions. This is a normal procedure for group of montmorillonite and mica.
- b) isomorphous substitution of Si ions on the tetrahedral from cations with small strength αργιλίου. Ninety percent of exchange capacity of montmorillonite and vermiculite are due to isomorphous substitution.
- c) broken crystal surfaces parallel to the C axis of total crystal lattice of clay minerals. The broken bonds of tetrahedral and octahedral leads to development of unsaturated electric forces, which are neutralized after absorption of new cations.
- d) to the agility of free H ions of circumference hydroxyls of the crystal lattice.

Prakash_Keshavamurthy (2016) reports that free negative forces in the crystal lattice of clay mineral are due to the following:

- Very weak van der Waals' forces in between the adjacent unit cells of the mineral.
- Appreciable isomorphous substitution during the clay mineral formation, leading to very high negative surface charges.
- Very high cation exchange capacity (i.e., 80–150 meq/100 g)
- Large specific surface (i.e., 400–900 m^2/g).

Schofield (1949), Rich and Thomas (1960) mentioned that one part of ionic exchange capacity depends on the influence of PH in the type of clay mineral. High values of exchange capacity are most common in areas having PH = 10.

Kelley (1948), Schofield (1949) and Mitra with Rajagopalan (1952), reports that free negative forces derive from acid ions of H+, which are the result of rupture silicon groups (SiOH) of clay particles.

According to Kelley (1955), the conditions essential to ion exchange were named as physical accessibility of the ion and strength of the force by which the ion is held to the lattice. This is electrically neutral and unable to attractions except by weak forces. In the case of muscovite, potassium ions hold the layers together and are prevented from entering into an exchangeable substitution.

IV. Cation Exchange Capacity (CEC)

The cation exchange capacity or the CEC level is the measure of isomorphic substitutions that occur with the clay minerals. The isomorphic substitutions are

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due to tetrahedral and octahedral sheets containing cations instead of an idealize structure (i.e., aluminum in the places of silicon, magnesium instead of aluminum, etc.). When the isomorphic substitution occurs, multiple cations are replaced with other cations of other valances within the structure to maintain equilibrium within the clay structure. (Cornel Univ., 2007). The ability to measure the cation replacement is computed as milliequivalents (meq) per 100 g of clay. The milliequivalents are determined by knowing the atomic weight, and the weight and valance of the element. The CEC value is a guide to estimate the predominant clay mineral. In addition, the CEC shows how stable the clay mineral is to isomorphic substitution (Cornel University 2007). When the measurable CEC increases the isomorphic substitution within the clay mineral also increases, Table 5 (after Grimm, 1955), outlines CEC values for common clay minerals. As one can see, kaolinite has the lowest CEC, while vermiculite has the highest CEC. Generally the shrink-swell soils have a relatively high CEC which range from 35-60 meq/100gr. The amount and type of clay, especially montmorillonite (smectite group) content is the determinating factor. Schollenberger and, Simon (1945), and Peech (1945) measured first the C E C of soils. Improvements were made by Chapman (1965).

The cation exchange capacity (CEC) of a soil is usually defined by the amount of a cation (such as NH) that a soil can hold when a buffered or unbuffered salt solution is leached through the soil. The most widely used salt is ammonium acetate buffered at pH 7, but BaCl 2 buffered at pH 8.2 is also used.1 M potassium chloride and 0.01 M silver thiourea are examples of unbuffered solutions used. Results obtained by these methods may vary considerably, depending on the variable charge characteristics of the soil. The variation in values between methods is related to the pH and ionic strength of the reagents used. What CEC actually measures is the soil's ability to hold cations by electrical attraction. Cations are positively charged elements, the positive charge indicated by a + sign after the element symbol. The number of + signs indicate the amount of charge the element possesses. The five most abundant exchangeable cations in the soil are calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^{+}), sodium (Na^{+}) and aluminium (Al^{+++}), ammonium (NH4), hydrogen (H), (Cornel University,2007). Cations are held by negatively charged particles of clay and humus called colloids. Colloids consist of thin, flat plates, and for their size have a comparatively large surface area. For this reason, they are capable of holding enormous quantities of cations. They act as a storehouse of nutrients for plant roots. The stronger the colloid's negative charge, the greater its capacity to hold and exchange cations, hence the term cation exchange capacity (CEC).

The precise definition of cation exchange capacity (CEC) of the soil samples, was measured with the method of ammonium acetate (Schollenberger, & Simon, 1945). For the final reading, the determination of exchangeable ions was measured with a corn flame photometer. Finally, fifty-two soil samples were tested, collected out of 17 districts, one from each area, and tested for CEC.

a) Cation Exchange Capacity (CEC)

i. *Ammonium acetate method CH3COONH4*

In the ammonium-saturation method for CEC, soil is leached with an excess of neutral, in ammonium acetate solution to remove the exchangeable cations and to saturate the exchange material with ammonium. After removal of the excess of ammonium present in the soil as the acetate, the exchangeable ammonium is determined.

The precise definition of cation exchange capacity (CEC) of the soil samples, was measured with the method of ammonium acetate (Schollenberger, & Simon, 1945). The soil samples which have been used to determine the C.E.C. of the Greek swelling soil, were collected from 17 districts and the ammonium acetate method was used because is a commonly used method by Chemists. For this reason, fifty-two clay soil samples were tested using the material passing the US sieve No 40. Each sample was washed three times with ammonium solution to saturate the exchange sites. For the final reading, the determination of exchangeable ions in milliequivalents per 100 gr of dry soil were estimated by a corne flame photometer.

Materials

(1) Centrifugation device 2500r/min
(2) 10 centrifugation tubes of 50 ml, diameter 2 cm, length 10 cm sealing with glass tap.
(3) Vibrating plate table
(4) 10 volumetric glass tubes of 100 cc.
(5) Glass funnel.
(6) Ammonium acetate 1N, or 770 gr. in 10 lit. water.
(7) PH of solution should be equal to 7.0, otherwise we add drops of acid or ammonia αaqueous.

b) Soil sample saturation with NH4

In each centrifugation tube of 50cc are placed 5,1 grams of dry soil, passing from US sieve No 40. After adding 33cc ammonium acetate (CH3COONH4), tube is sealed, and placed in the stirring device for 5 minutes. Afterwards the top sealing of each tube is taking away, and each tube is placed in the centrifugation device and rotates in 2500 terns/minute for 10 minutes.

The work of adding CH3COONH4, shaking, centrifuging, pouring, is repeated three times to achieve soil saturation with ammonium, (Figure .1.). After each centrifugation the ammonium extract is discarded. It is then repeated by adding 100% alcohol, shaking, centrifugation, transfusion, in order to flush the soil molecules from the excess ammonia salts.

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$$\begin{matrix} H+ \\ Na+ \\ Mg+ + \\ Ca^{++} \end{matrix} + CH_3COON_a \rightarrow \begin{matrix} Na+ \\ Na+ \\ Na+ \\ Na+ \end{matrix} \qquad CH_3COON_a \rightarrow \begin{matrix} NH_4 \\ NH_4 \\ NH_4 \\ NH_4 \end{matrix} + CH_3COON_a$$

Figure 1: Representation of cation exchange after accede acetate mixing.

Finally, each centrifuge tube is filled with 33cc sodium acetate, CH3COONa. It follows shaking, centrifugation, transference, and collection of the extract in a 100-cc volumetric flask and this task is repeated three times.

If the extract is found not to be clear, pour the centrifuge extract into the flask with a glass funnel and a filter. Then the volumetric glass bottle is refiled up to level 100 cc with distilled water, sealed and placed in refrigerator until the existing alternative cations Ca, Mg, Na, are identified by the method of the flame photometer.

c) *Identification of cation exchange with corne flame photometer*

Before we start the testing of solutions, is necessary to correct the scale of flame device. For this we immerse the electrode in a jar with standard solution Na+. In the scale of calibration for the flame device, distilled water is equal =0. The standard st=11 correspondents =100 of the scale. The in between checking steps are standard = 6 which corresponds to flame device scale=66 and the standard=3 which corresponds to flame device scale = 28. This is the procedure to check the sensitivity of flame corn flame testing device. (Photography 1).

In order to obtain samples and standards of the right concentration for aspiration into the flame, various levels of dilution will often be necessary. Good quality deionized water should normally be used for carrying out these dilutions and it is recommended that the same batch of water should be used for diluting the samples and standards.

Then, we baptize the electrode in every glass cup which contains ammonium extraction which came from tested soil samples. In order to avoid concentration higher than the scale of photometer before each testing all soil ammonium extractions are diluted up to 50% and the rest volume of each glass jar is completed with distilled water.

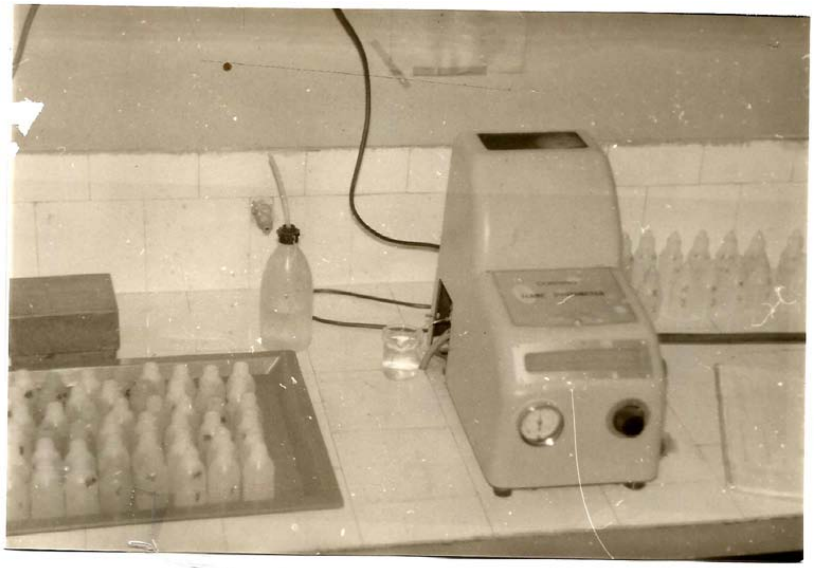


Photo 1, of corne flame flogophometer.

As soon as we complete the measurements, we apply the numerical results on the concentration curve of photometer and we identify in meq/lit the concertation of Na+ cations.

In order to calculate the total cation exchange for every sample we must know

(α) the concentration of the solution (Cx) and
(β) to make one reduction from 5 grams of weight of each sample up to 100 grams., that is:

5 grams corresponds to 100 cc
100 grams corresponds to X;

X = 20.000 cc

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Then follows the reduction of concertation (Cx) of 1000 cc, into 20.000 cc:

Concentration Cx is= : Cx.meq in 1000 cc
X ; in 20.000 cc

X = Cx 20.000 / 1000 = Cx .20

And because the dilution of solution *is decathonal, the concentration* becomes: Cx X 2 X 10.

C.E.C. = Cx. x 2 x 10 (readings of instrument curve) = Cx) (1)

More specifically, the flame photometer readings (in Na + ions) are placed on the concentration curve of the instrument and for each sample the concentration is in meq / 100 g of soil.

This result, i.e., the reading of the instrument curve for each sample, is multiplied by formula (1) by 2 and then by 10. Thus, the CEC value is in meq / 100 g. of each soil sample. (Table 8). For comparison two extra samples were tested, one of pure industrial bentonite as clay material with a high swelling capacity revealing CEC 72 meq/ 100gr and one of pure industrial kaolinite as a material with a low swelling capacity, revealing CEC 6 meq/ 100gr, (Table 8.). As it was identified, the CEC for the Greek swelling soils varied between 20 meq/ 100gr to 70 meq/ 100gr. One soil sample from Viotia province (Area 8) revealed CEC 70 meq/ 100gr, like that of industrial bentonite.

V. pH Determination

The soil pH determination was measured according to BS 1377: Part 3: 1990 9: The results of the measurements for 300 soil samples from the Greek territory are reported on Table 9. For each CEC test, several samples were collected in a distance of 100 cm from the surrounded soil and tested with a pH meter. As we can see, the recorded values are varying between pH=7.50 and 9.46. Sridharan (1999) and QJEG (1990) have reported similar values and said that soil pH is important for CEC of clay soil because as pH increases (becomes less acid), the number of negative charges on the colloids increase, thereby increasing CEC. Schofield (1949), Rich and Thomas (1960) and Rich (1962), reported that soils having pH values higher than 7, have high CEC values. Such soils are suitable for stabilization with lime and cement. Also, Kolias (1965) working for the Road Research Laboratory Transport, (TRRL), reports for UK pH values higher than 7. After all these, it is obvious that results reported on Table 9 concerning pH values for Greek clay soils varies between pH = 7.50 and pH = 9.46 and are close to those reported from other countries above.

VI. The Mineralogical Analysis of Clay Fraction X-ray

The crystalline mineralogical components of the clay soils were identified by the powder method of x ray diffraction analysis. The clay samples were tested using a Philips diffractometer, scanning with copper radiation and nickel filter (Cuka), and working with power of 40 KV and 20 mA. Before testing one US No 40 sieve was used to remove the non-clay minerals. The hydrometer method (BS 1377, part 2, para 7.4.) was also used to isolate the silt and clay fraction. The oxygen peroxide method (BS 1377, part 3) was used to purify each sample from organic content. In some clay samples was noticed that the three main clay minerals, montmorillonite, kaolinite, chlorite, were giving not clear peaks. In that case, the suggested by Wilson's (1987) method was used, and the samples were special treated with glycerin and heated up to 120° C, in order to distinguish the montmorillonitic peak. The mineralogical composition of 25 clay samples (Table 7) was determined by x ray diffraction analyses, one sample of each area, by the method described by Brindley and Brown (1980). The quantitative analyses were obtained by the method described by Bayliss (1986).

VII. Correlation of CEC, Liquid Limit, Plasticity Limit and Percent of Montmorillonite

In order for the reader to understand the importance of calculating the ion exchange capacity of clay (CEC), it was decided for the first time to make a correlation between important mechanical parameters of the clay soil. It should be emphasized that these laboratory tests are, on the one hand, expensive and on the other hand very specific, which are not performed in simple laboratories, but only in research centers, therefore they should be requested only for large and serious technical projects.

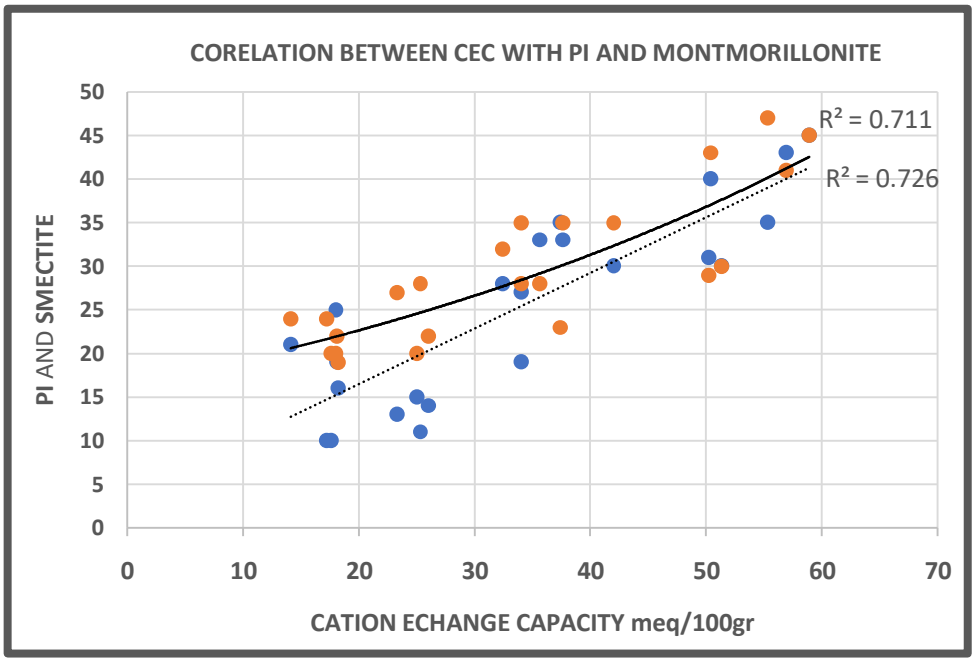
The correlation between the values of the ion-exchange capacity of clay and the Atterberg Limits (liquid limit and plasticity index) together with the montmorillonite percent, have been made in selected soil samples (Table 7). These samples were initially tested for CEC, and at the same time there were tested for montmorillonite percentage by the x-ray method, made at the IGME institute. From the results of the measurements on Table 7, the Graph 1 emerged, where the CEC values were placed on the x-axis, the Montmorillonite, and PI values were placed on the y axis, and as we can see, in Graph 1 there is a linear

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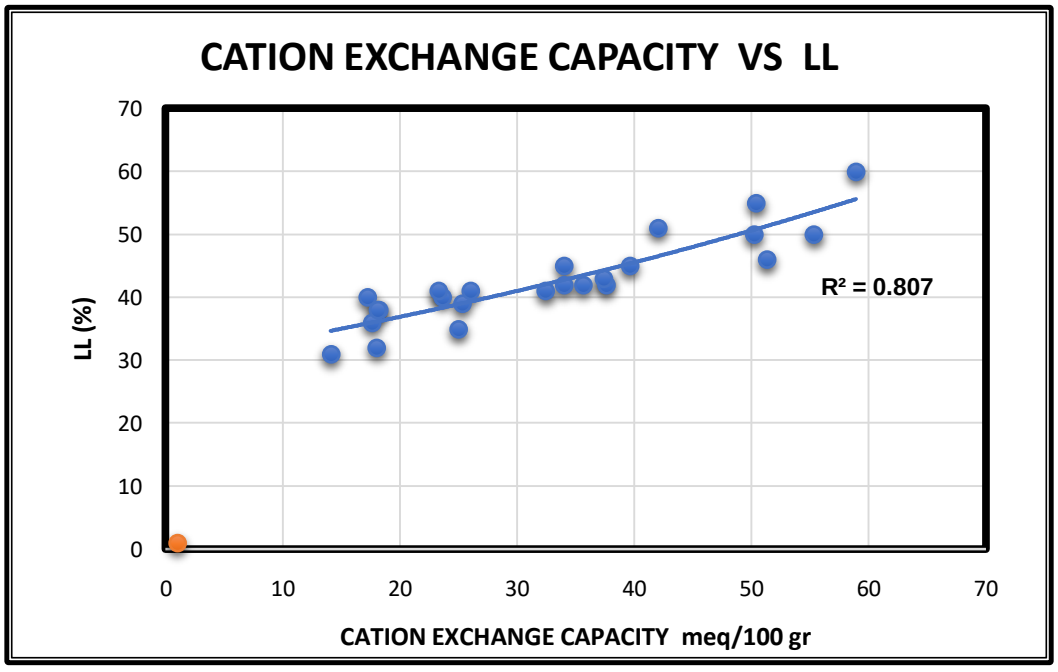
relationship of the form $Y = \alpha x + \beta$ with correlation coefficient R^2 moderately satisfactory, indicating that there is an influence on the mechanical properties of the soil, when it has a strong ion exchange capacity. In Graph 2 the CEC values were plotted versus Liquid limit values and we can see one exponential relation of the type $Y=\alpha b^x$ with strong coefficient of regression R^2.

From graphs one and two we can conclude

- In diagram 1 between percent of montmorillonite and CEC, there is one linear relation having the type $Y=\alpha x+\beta$ and medium coefficient of regression $R^2 = 0,7267$.
- In diagram 1 between plasticity index (PI) and cation exchange capacity (CEC) there is one linear relation of the type $Y=\alpha x+\beta$ and one medium coefficient of regression $R^2 = 0,7235$.
- In diagram 2 between liquid limit (LL) and cation exchange capacity (CEC) there is one exponential relation of the type $Y=\alpha b^x$ with a strong coefficient of regression $R^2 = 0,8178$.



Graph 1: One attempt of Linear relation among CEC, Atterberg limits and montmorillonite %.



Graph 2: One attempt of exponential relation among CEC and liquid limits

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Table 7: Correlation between CEC Liquid limit, Plastic limit and percent of montmorillonite.

CEC	Montm	PI
55,3	35	47
58,9	45	45
17,2	10	24
51,3	30	30
37,6	33	35
37,4	35	23
35,6	33	28
50,2	31	29
34	19	35
17,6	10	20
25,3	11	28
18,2	16	19
42	30	35
18,1	19	22
32,4	28	32
56,9	43	41
50,4	40	43
34	27	28
18	25	20
14,1	21	24
26	14	22
23,3	13	27
25	15	20

Table 8: Results of CEC with acid acetate method and flogophotometer.

Samples	Location	Concentration of Na+	Readings of corne flame	C.E.C. meq /100 gr.
sample-10	Ritsona km= 64+000	79	2.73	55.3
SAMPLE-2	ATHINA-LAMIA -km=.73+300	84	2.93	58.9
SAMPLE-3	ATHINA-LAMIA-, km=.77+000	79	2.72	55.1
SAMPLE-4	ATHINA-LAMIA, km=.84+300	82	2.84	57.6
SAMPLE-5	ATHINA-LAMIA, km=.85+400	80	2.80	56.2
SAMPLE-13	Aliartos town--viotia	58	1.75	35.1
SAMPLE-12	THIVES-CITY	71	2.45	49.8
SAMPLE-17	Thespies-town--viotia	61	1.80	36.0
SAMPLE 17 A	Thespies town--viotia	58	1.68	27.8
SAMPLE-9	THIVES -CITY	31	0.85	17.2
SAMPLE-14	ORHOMENOS-CITY	60	1.79	36.7
SAMPLE-15	Anthohori town--viotia	92	3.50	70.0
SAMPLE-8	Kastro town--viotia	65	2.11	48.6
SAMPLE-7	Ypato town--viotia	77	2.58	51.3
SAMPLE-11	SXIMATARI--ATTIKHS	69	2.53	50.1
SAMPLE-16	Dombrena town.	64	1.88	37.6
SAMPLE-56	KOMARA-EVROS km=.3+500	63	1.86	37.4
SAMPLE-57	KOMARA-EVROS km=.4+500	64	2.07	41.2
SAMPLE-58	KOMARA-EVROS km=.6+500	65	2.17	43.4
SAMPLE-21	FERRES-CITY -EVROS	60	1.81	37.0
SAMPLE-18	ORMENIO-EVROS km 6+ 500	60	1.78	35.6
SAMPLE-19	ORMENIO-EVROS km 7+ 000	48	1.30	26.0

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SAMPLE-20	ORMENIO–EVROS km 7+ 450	38	1.13	22.7
SAMPLE-29	RODOS-ISLAND	72	2.56	50.2
SAMPLE-35	Livadi town--pieria	62	1.82	36.4
SAMPLE-36	Exohi town--pieria	64	1.94	39.6
SAMPLE-37	Keramidi town--pieria	60	1.70	34.0
SAMPLE-49	KIPARASSOS-KRETA	40	1.14	23.3
SAMPLE-51	Xinomilia--preveza	44	1.24	25.3
SAMPLE-52D	Despo --preveza	36	0.91	18.2
SAMPLE-22	Despo km= 60+500	68	2.12	42.4
SAMPLE-23	Despo km =. 58 +500	55	1.62	25.1
SAMPLE-34	ITEA - CITY	34	0.89	17.4
SAMPLE-40	Nestani—Tripoli =A	34	0.84	16.8
SAMPLE-41	Nestani—Tripoli =B	35	0.90	18.1
SAMPLE-42	Nestani—Tripoli =C	78	2.78	53.7
SAMPLE-27	EGINA ISLAND	82	2.86	57.2
SAMPLE-32	ARTA-CITY	56	1.62	32.4
SAMPLE-24	Agia Anna -Evia Island	50	1.38	27.4
SAMPLE-25	Agia Anna -Evia Island	81	2.84	56.9
SAMPLE-26	Agia Anna -Evia Island	46	1.22	24.4
SAMPLE-33	ERYTHRES-CITY	80	2.80	50.4
SAMPLE-44	Sterna town--korinthos	60	1.78	34.0
SAMPLE-38	Spathovouni--korinthos	33	0.88	17.9
SAMPLE-46	Agios Basilios --korithos	30	0.72	14.4
SAMPLE-39	NEMEA - km 5+700	42	1.18	23.6
SAMPLE-53	PATRA CITY	49	1.58	30.5
SAMPLE-31	LAMIA CITY	48	1.30	26.0
SAMPLE-54	LESVOS ISLAND	81	2.80	56.1
SAMPLE-50	AGIA GALINI - KRETA	35	0.90	17.6
SAMPLE-30	LARISSA CITY	57	1.63	25.2
extra	**Industrial Bentonite**	**94**	**3.60**	**72.0**
extra	**Industrial Kaolinite**	**14**	**0.30**	**6.0**

Table 9: Results of pH measurements in the areas where ion exchange was measured

Samples	Location	CEC meq /100 gr.	n	pH	N
Δ-10	Ritsona km= 64+000	55.3	1	8.45	6
Δ-2	ATHINA-LAMIA -km=.73+300	58.9	1	8,59	4
Δ-3	ATHINA-LAMIA-,km=.77+000	55.1	1	8,40	4
Δ-4	ATHINA-LAMIA, km=.84+300	57.6	1	8,10	3
Δ-5	ATHINA-LAMIA, km=.85+400	56.2	1	8.25	3
Δ-6	ATHINA-LAMIA, -km=.87+850	55.8	1	7.75	5
Δ-13	Aliartos town--viotia	35.1	1	8,30	5
Δ-12	THIVA-CITY	49.8	1	8,04	5
Δ-17	Thespies town-- viotia	36.0	1	8,28	6
Δ-17-A	Thespies--viotia	27.8	1	7.93	4
Δ-9	THIVA-CITY	17.2	1	7.95	4
Δ-14	Orhomenos town--viotia	36.7	1	8,17	4
Δ-15	Anthohori-town--viotia	70.0	1	7.90	5
Δ-8	Kastro-town--viotia	48.6	1	8,58	8
Δ-7	Ypato-town--viotia	51.3	1	8.53	8
Δ-11	SHIMATARI-ATTIKHS	50.1	1	7.65	5
Δ-16	Dombrena town--viotia	37.6	1	8.30	10
Δ-56	KOMARA-EVROS-km=.3+500	37.4	1	7.91	3
Δ-57	KOMARA-EVROA-km=.4+500	41.2	1	8,02	3
Δ-58	KOMARA-EVROS-km=.6+500	43.4	1	8,25	3
Δ-21	FERRES-EVROS	37.0	1	7.80	5
Δ-18	ORMENIO-EVROS km= 6+ 500	35.6	1	8.23	2
Δ-19	ORMENIO-EVROS, km= 7+ 000	26.0	1	8,16	2
Δ-20	ORMENIO-EVROS, km= 7+ 450	22.7	1	7.91	2
Δ-29	RODOS-ISLAND	50.2	1	8.73	3
Δ-35	Livadi town--pieria	39.6	1	7.96	3

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Δ-36	Exihi town--pieria	34.0	1	8.44	6
Δ-37	Keramidi town--pieria	36.4	1	8.68	3
Δ-49	KYPARYSSOS-CRETA	23.3	1	7.75	5
Δ-51	Xinomilia --preveza	25.3	1	8,01	3
Δ-52	Despo--preveza	18.2	1	7.94	3
Δ-22	Despo km= 60+500	42.4	1	8.20	3
Δ-23	Despo km= 58 +500	25.1	1	7.89	3
Δ-34	ITEA-CITY	17.4	1	8.26	6
Δ-40	Nestani-Tripoli--A	16.8	1	7.98	3
Δ-41	Nestani—Tripoli--B	18.1	1	8.09	4
Δ-42	Nestani—Tripoli--C	53.7	1	8.26	4
Δ-27	EGINA-ISLAND	57.2	1	8.53	3
Δ-32	ARTA-CITY	32.4	1	8.04	4
Δ-24	Agia Anna—Evia--Island	27.4	1	7.83	3
Δ-25	Agia Anna—Evia--Island	56.9	1	8.65	3
Δ-26	Agia Anna—Evia—Islan.	24.4	1	7.81	3
Δ-33	ERITHRES--CITY	50.4	1	7.90	5
Δ-44	Sterna town--korinthos	34.0	1	8.30	4
Δ-38	Spathvouni--korinthos	17.9	1	7.72	5
Δ-46	Agios Basilios--korinthos	14.4	1	8.40	9
Δ-39	Nemea km = 10+800	23.6	1	8.35	5
Δ-53	PATRAS-CITY	30.5	1	8.54	6
Δ-31	LAMIA-CITY	26.0	1	7.74	9
Δ-54	LESVOS-ISLAND	56.1	1	8.48	9
Δ-50	AGIA GALINI-CRETA	17.6	1	7.76	3
Δ-30	LARISSA-CITY	25.2	1	7.85	3
Extra	**Industrial Bentonite**	**72.0**	**1**	**10.5**	1
Extra	**Industrial Kaolinite**	**6.0**	**1**	**5.2**	1

n = number of tests CEC meq/ 100 gr per location
N = number of test pH in the vicinity of each sample.
PH = each pH value is the average of tests around each sample.*

VIII. Conclusions

- The results of the investigation indicate that a general relationship exists between the cation
- exchange capacity of a soil and variances of the liquid and plasticity limit values as well as for montmorillonite percent. The relation between cation exchange capacity percent and montmorillonite % with plasticity index is linear with a moderate coefficient of regression R^2 = 0,7267. The relation between cation exchange capacity percent and and liquid limit values is exponential with a strong coefficient of regression R^2 = 0,8178, as the clay content increased.
- As it was identified, the CEC for the Greek swelling soils varied between 20 meq/ 100gr to 70 meq/
- 100gr. One soil sample from Viotia province (Area 8) revealed CEC 70 meq/ 100gr, like that of industrial bentonite.
- The homogeneity of the PH measurements made in 300 soil samples is also remarkable (table 9). This
- fact means that in the Greek clay soils the PH values are similar with what is described in the International Bibliography.

Unaknowledges

For the fulfillment of the experiments the author wishes to say thank you:

(a) Public works central laboratory of the Ministry of Environment, Perseus street, Athens.
(b) Institute of national research of the Ministry for Agriculture, (ΕΘΙΑΓΕ), Likovricy suburb of Athens.

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Global Journal of human-social science: b
Geography, Geo-Sciences, Environmental Science & Disaster Management
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460x & Print ISSN: 0975-587X

Consequences of the Climate Change in Iraq

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Abstract- The Climate change is a global issue affecting different parts of our planet where we are living. However, the reasons of climate change and consequences differ at different parts too. In Iraq, including the Kurdistan Region, the reasons for the climate change are due to man-made and natural effects, where the rates of CO2 emission and those of other greenhouse gasses are increasing drastically, besides the global warming, decrease in the amount of water income in rivers and streams from Turkey and Iran, decrease of rain and snow fall, increase of population. All these have direct impact on the climate and accordingly the consequences are coming harsher and seriously effective on the daily life of the people. In this research, different man-made and natural effects, which directly affect the climate change are presented and described. Moreover, predictions and recommendations are given to decrease the consequences of the climate change in Iraq among them the status of awareness is one of the main reasons to climate change, besides the global warming.

Keywords: *climate change, annual rainfall, man-made effects, awareness.*

GJHSS-B Classification: *DDC Code: 551.60901 LCC Code: QC884.2.C5*



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Consequences of the Climate Change in Iraq

Varoujan K. Sissakian [α], Hamed M. Jassim [σ], Nasrat Adamo [ρ] & Nadhir Al-Ansari [ω]

Abstract- The Climate change is a global issue affecting different parts of our planet where we are living. However, the reasons of climate change and consequences differ at different parts too. In Iraq, including the Kurdistan Region, the reasons for the climate change are due to man-made and natural effects, where the rates of CO_2 emission and those of other greenhouse gasses are increasing drastically, besides the global warming, decrease in the amount of water income in rivers and streams from Turkey and Iran, decrease of rain and snow fall, increase of population. All these have direct impact on the climate and accordingly the consequences are coming harsher and seriously effective on the daily life of the people. In this research, different man-made and natural effects, which directly affect the climate change are presented and described. Moreover, predictions and recommendations are given to decrease the consequences of the climate change in Iraq among them the status of awareness is one of the main reasons to climate change, besides the global warming.

Keywords: climate change, annual rainfall, man-made effects, awareness.

I. Introduction

Climate is the average of different weather conditions at a certain point on the planet Erath, where we are living. Typically, climate is expressed in terms of expected temperature, rainfall and wind conditions based on historical observations. Climate change; however, is a change in either the average climate or climate variability that persists over an extended period (Riedy 2016).

Sociologists are also interested in the climate change because different activities including man and natural effects that are responsible for anthropogenic climate change are embedded in human social life. Daily social life activities like eating, working, conditioning our homes result in emissions of greenhouse gases that contribute to climate change. Responses to climate change also have social impacts that are unevenly distributed at different parts of the world. Consequently, climate change poses the first truly global social dilemma, and it is one that has proven politically intractable at multiple governance scales with different impacts, which certainly change at different countries based on: 1) Awareness of the people, 2) Governmental follow-up to the issued instructions and laws, 3) Living conditions level, 4) Governmental financial allocations to deal with the emitted greenhouse gases, and 5) The level and intensity of the emitted greenhouse gasses.

Currently, scientific observations and performed models indicate that the Earth's climate is now changing due to human activities. This is called "anthropogenic climate change" (Riedy 2016). The processes involved are complex but can be summarised as follows. 1) Human activities, including burning fossil fuel to produce electricity and power vehicles, 2) Deforestation for purposes of farming, cities, cultivating livestock, and other human uses, and 3) Release "greenhouse gases" into the atmosphere. The main emitted greenhouse gases are carbon dioxide, methane, halocarbons, and nitrogen oxides. The intensity of emitted gasses depends mainly on different human activities. The emitted gases accumulate in the atmosphere and allow radiation from the sun to pass through; however, they trap some of the heat radiating back from the Earth; accordingly increasing the temperature. This process is called the "greenhouse effect" because the principle is like a greenhouse, where the glass roof allows sunlight in but traps heat for growing plants (Riedy 2016).

The largest contributor to observed warming is the increase in carbon dioxide in the atmosphere and that it is "extremely likely" that human influence has been the dominant cause of this warming since the mid-20th century (Stocker et al. 2013).

a) Aim

The aim of this study is to deduce the impact of the climate changes in the Iraqi territory and their consequences over the community. Moreover, to shed light on the main reasons that are affecting and causing the climate changes as the Iraqi territory is concerned. Many recommendations are given to decrease the local effects on the climate changes.

b) Previous Studies

Studies concerning the consequences of climate change in Iraq are rare; however, some research works were published, which mainly dealt with the water shortage; especially in the Tigris and Euphrates rivers with their main tributaries. The following articles are the main published works: According to MoE (2010) about 31% of Iraq's surface is desert. Tens of years of inappropriate farming practices and mismanagement of

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surface and ground water resources have exacerbated the effects of an already dry climate and contributed to increasing rates of desertification (Fig. 1). Declining fertility due to shortage of water for irrigation, high soil salinity (Sissakian et al. 2020), erosion and the extension of sand dunes and sand sheets are serious problems. The Government of Iraq reports that 28% of the country's land is arable, of which an average of 250 km^2 is lost each year due to degradation (INDP 2010). Meanwhile, about 39% of the country's surface is estimated to have been affected by desertification, with an additional 54% under threat (MoE 2009). Due to declining soil moisture and accordingly lack of vegetative cover, during last decade, an increase in the frequency of vast dust and sandstorms have been witnessed, often originating in the western parts of Iraq.

A study carried out by IAU (2012) mentioned that apart from the mountainous regions of the north and northeast, most parts of the Iraqi territory experience either dry or semi-dry climate, which are characterized by less than 150 mm of rain/ year and high evaporation rates. Currently, the estimated available water for Iraq is 2400 m3 per person/year, this means that except for Turkey, Iraqis have more water available to them than their neighbours. However, the levels of surface-water in reservoirs, lakes, rivers, and other wetlands are diminished to critical levels due to decrease in the annual rainfall and water supply in the two main reivers with their tributaries. The minimal management of aquifers and their recharge has impacted the level and quality of groundwater supplies.

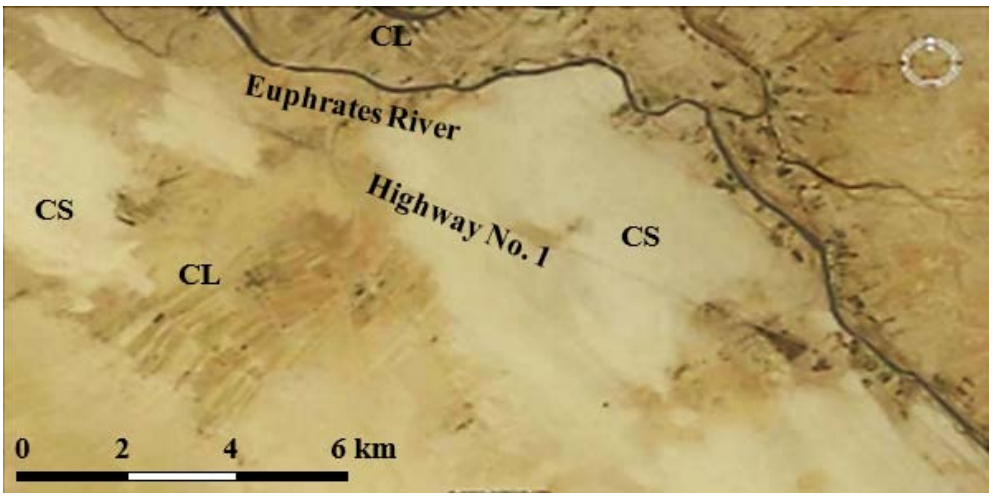


Figure 1: Satellite image showing creeping sand sheets (CS) and cultivated lands (CL).

Sissakian et al. (2013) mentioned that Iraq is one of the most affected countries in the Middle East concerning the occurrences of sand and dust storms. The frequency of the occurrence has increased drastically in the last decade, and it is increasing continuously. Abbas et al. (2016 a, b, c, d, and e) have published many articles about the impact of the climate changes on the tributaries of the Tigris River in Iraq (Khabour, Greater Zab, Lesser Zab, Al-Adhaim and Diyala rivers) and how the living conditions were changed along the basins of the rivers. Iraq was part of the extremely large famed Fertile Crescent, which was extending along both the Tigris and Euphrates rivers; not only in Iraq but extending to Syria and Turkey. The rising temperatures, intense droughts, declining precipitation, desertification, salinization, and the increasing prevalence of dust storms have undermined Iraq's agricultural sector, already long in decline (USAID 2017). Richardson and Hussain (2017) studied the impact of the climate change on the marshes and mentioned that although the Mesopotamian marshes had been almost destroyed before 2003, it became clear that they were restorable, since they are a true "river of grass," wetlands fed by rivers and dominated by the aquatic grass and other types of plants. Adamo et al. (2018a, b and c) have summarized some of the climate changes, which have hit the basins of the Tigris and Euphrates rivers in Iraq. Moreover, they presented the consequences of the climate changes on the whole Iraqi territory. One of the main infected parts in the southern part of Iraq are the marshes. They cover about (15000 – 20000) km^2; however, in the last decade of the last century, about 25 % of the marshes were dried for different reasons; mainly for oil exploration activities (Figs. 2 and 3). After 2003 parts of the marshes were restored, but due to drastic shortage in water supply in the Tigris and Euphrates rivers, large parts returned dry again (Figs. 2 and 3). Al-Ansari et al. (2019 a and b) also conducted two studies which dealt with the influence of water shortage and quality of water in the Tigris and Euphrates rivers. They presented sound data about the harsh consequences on the land degradation. Jassim et al. 2013 published research on the 'Pollution issues in Iraqi Kurdistan Region" due to emitted gasses (especially CO_2 gas) because of: Increasing numbers of used vehicles, increasing cement production, and

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increasing the capacities of oil refining. Jassim et al (2013) conducted a comparative study, which covered the period 2006 – 2011 dealt with the pollution in Iraqi Kurdistan Region. Jassim et al. (2015) investigated Iraqi DC power supply pollutants during the period 2007 – 2014, whereby they categorized the different pollutants over all Iraqi governorates.

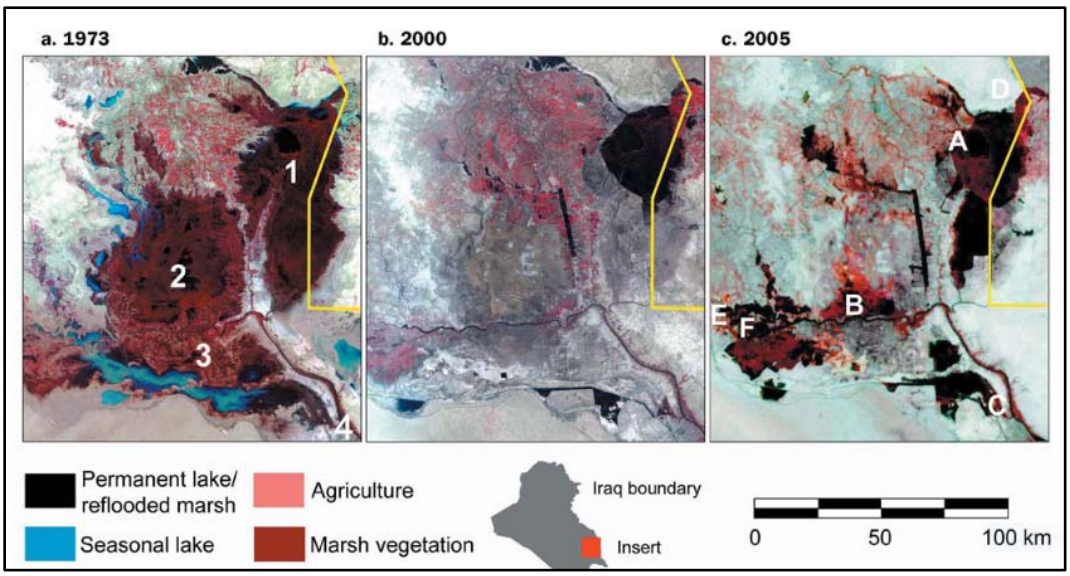


Figure 2: Changes in the coverage of the marshes' areas. 1 and A) Al-Huwaiza Marsh, 2 and B) Al-Qurna Marsh, 3 and B) Al-Hammar Marsh, C and 4) Al-Hammar, and D) Al-Sanaf, E) Abu Zarag, and F) Suq Al-Shuyukh marshes (From Richardson and Hussain 2006).



Figure 3: The southern mashes of Iraq, a) Before drying, b) after being dried.

II. Climate Changes in Iraq

Iraq, being one of the Middle East countries is under the influence of two main climatic zones (Fig. 4). These two zones are: 1) Hot and wet currents, which flow from the Indian Ocean passing through the southeastern parts of Arabia and the Arabian Gulf, and 2) Cold and dry currents, which flow from the Mediterranean Sea, and occasionally from Siberia. The Hemrin – Makhoul Range was where these two main climatic zones were colliding (Fig. 4 a), accordingly, the carried dust particles by the hot and wet currents were dropped along this range forming two main sand dunes fields, Baiji and Shari fields (Fig. 4 b). However, after eighties of the last century, this front was moved northwards for about 150 km (Fig. 4 c) where the two main currents are meeting and colliding. This means the hot and wet currents are crossing the Hemrin- Makhoul Range and larger parts of the Iraqi territory are under the influence of the hot and wet current, which are usually accompanied by dust storms.

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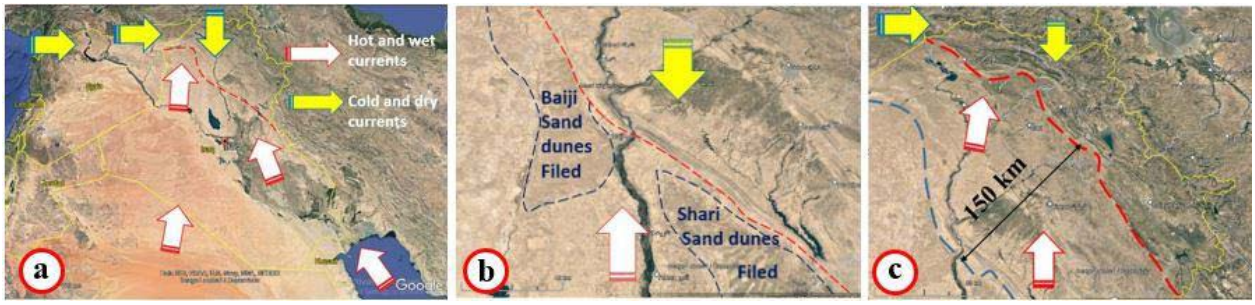


Figure 4: Satellite images showing the climatic zones in Iraq (4a), the developed two sand dune fields (4 b), and the current front, which forms the contact between the two zones (4 c).

III. Causes of Climate Changes

In all countries there are different causes of climate changes. However, the changes can be classified into two main categories, which can be applied in all countries, these are: 1) Natural Causes, and 2) Man-made causes. It is worth mentioning that in different countries one if these two main categories can be more effective than the other with more impacts on the living community and infrastructure. Hereinafter are the main two categories which are active in Iraq.

a) Natural Causes

The main natural causes, which are active and have caused serious climatic changes are mentioned hereinafter.

i. *Gasses Emission and Bitumen Seepages*

Emission of gasses and bitumen seepages are very common at different parts of Iraq. A good example for gas emission is at the Eternal Fire (Locally called Baba Gurgur), which is located NW of the Kirkuk city (Fig. 5a). The fire is attributed to large fractures in the Kirkuk Oil Field (Sissakian and Fouad 2015). The fire was mentioned by Herodotus (c. 484–425 BC), which means it is very old and is still on.

Bitumen seepages are also common phenomenon in Iraq at different places. One of them is the Hit town (Fig. 5 b), where bitumen seepages occur along the Abu Jir Fault Zone (Fouad 2015). Bitumen seepages and gas emissions are recorded along the zone indicating deep- seated fractures, which reach to a depth of few kilometres (Fouad 2015). Other locations such as Mosul, Qayara, Gulley Qeer are also exhibiting bitumen seepages from fractures which reach deep in subsurface.

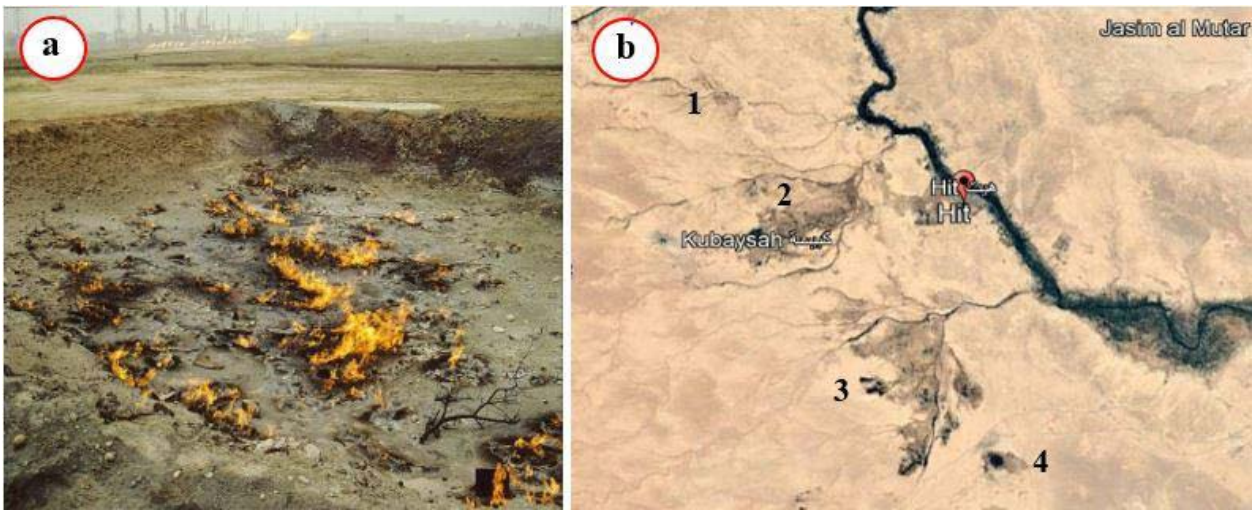


Figure 5: a) The eternal fire, NW of Kirkuk city, b) Bitumen and gas emissions in Hit town (The black patches at 1, 2, 3 and 4).

ii. *Sandstorms*

Sandstorms are very common in Iraq (Sissakian et al. 2013). The storms either blow from southwest to northwest or the reverse direction; however, the former is more frequent. They cover large parts of Iraq and extend even out of the country (Fig. 6 a). The dust storm reduces the visibility to few meters with high front that may reach 10 m (Fig. 6b). They also decrease the air temperature and increase desertification when they settle down on the earth surface by means of the carried particles of sand and even fine gravels.

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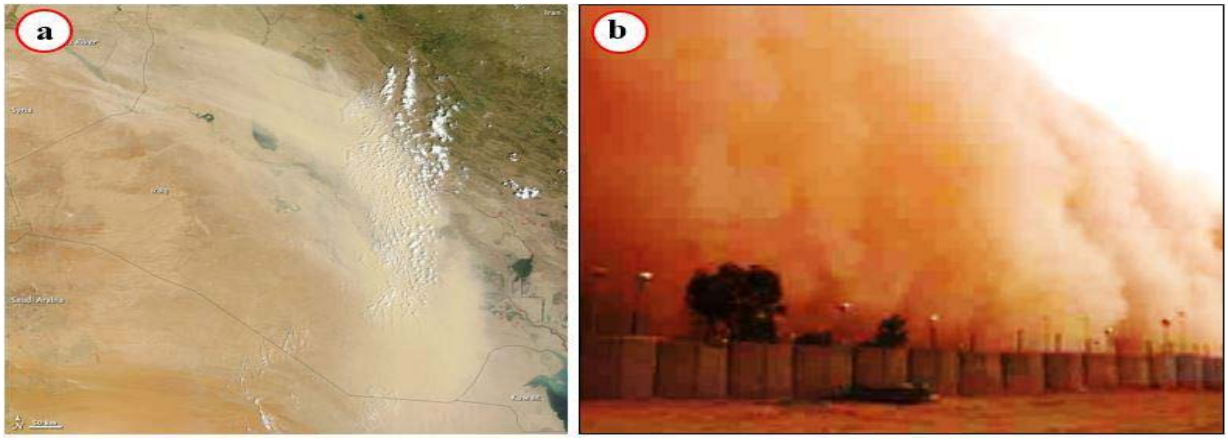


Figure 6: Sandstorms in Iraq, a) Satellite image showing massive sandstorm, note its extension towards Syria (NW), b) A sandstorm in south of Baghdad (2012), the height of the fens is about 3 m.

iii. *Sand Dunes and Sand Sheets*

Sand dunes are developed at different parts of Iraq (Sissakian and Fouad 2015). Some of them are developed due to collision of the southern hot and wet currents with those of the northern cold and dry currents, such as those of Baiji and Al-Shari sand dunes (Fig. 4 b). However, those developed in the Mesopotamian Plain are developed due to the weathering of the Tigris and Euphrates flood plain sediments (Yacoub 2011). The sand sheets are creeping in between the dunes covering large areas and increasing the desertification (Fig. 1). Sand dunes and sand sheets increase the concurrency of the dust storms; therefore, are considered as some of the causes of the climatic changes in Iraq.

b) Man-made Causes

These are local causes but have very high effect on the climatic change, moreover, they can be controlled and can be mitigated by the government and even local governors. The main causes are briefed hereinafter.

i. *Local Generators*

Due to the shortage of the supplied electric power in all parts of Iraq by the Iraqi Ministry of Electricity (the National Electric Power, NEP), people are using local diesel generators to provide them with electric power when the NEP is off, which ranges between (2 – 10) hours/ day. These diesel generators, which are installed at different residential and industrial sites, and public areas are usually one of the main and very effective pollutants due to the emitted gasses (Fig. 7a).

ii. *Burning of Bitumen*

Bitumen is burnt at different parts in Iraq to be used for different constructions. The emitted black smokes are also effective pollutants as the burning sites are locally in between residential sites.



Figure 7: a) local diesel generator, b) Burning of bitumen to be used in different constructions.

iii. *Oil Production Activities*

Iraq is one of the main oil producing countries in the Middle East. Therefore, oil production activities can be seen at different parts of Iraq. The activities are usually accompanied by burning of gasses (Fig. 8a) and /or spilling of crude oil in different facilities such as

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pipelines (Fig. 8b), tank yards, loading crude oil in tankers. All these activities are accompanied by gas emission which contributes to the environmental pollution and climatic changes.

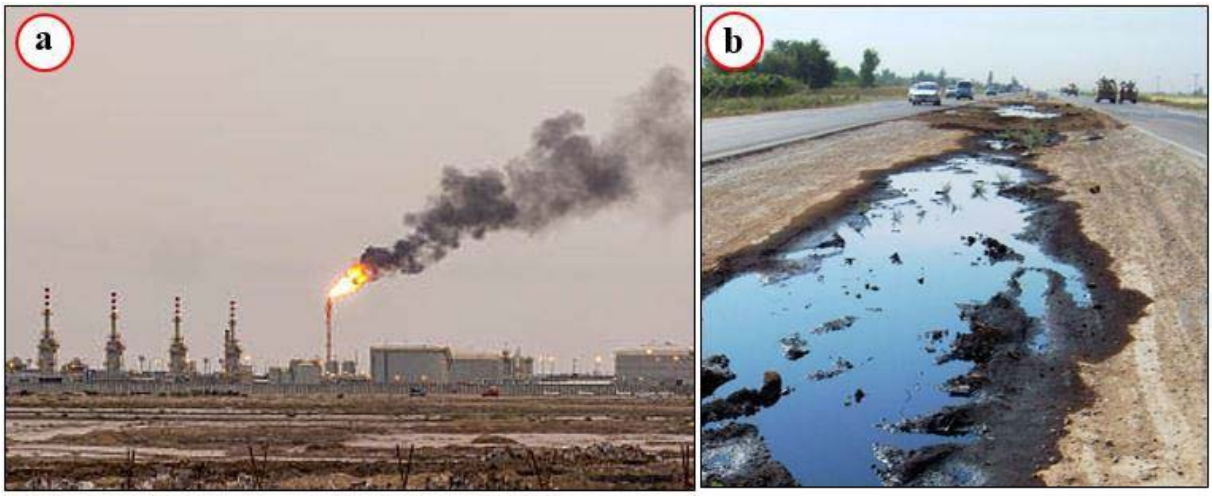


Figure 8: a) Tanks yard, degassing station and gas burning in the southern part of Iraq, b) Spilling of oil from a broken pipeline.

iv. *Cement Plants*

About 20 cement plants exist in Iraq, in Sulaimaniyah, Al-Anbar, Mosul, Al-Muthana, Karbala and Erbil governorates. The emitted dust (Fig. 9 a) forms one of the main pollutants that contribute to the climatic change, besides their limestone and clay quarries which, also contribute to emission of smokes (from the heavy equipment) and dust from the quarrying operations.

v. *Brick Plants*

Tens of brick plants occur in different parts of Iraq. Those which use crude oil in burning of the clay (Fig. 9b) are one of the most effective pollutants not only to the air, but to the soil and nearby living people causing severe health complications to them. However, there are some modern brick pants which use gas and electricity in their furnaces; therefore, they do not emit such gasses.

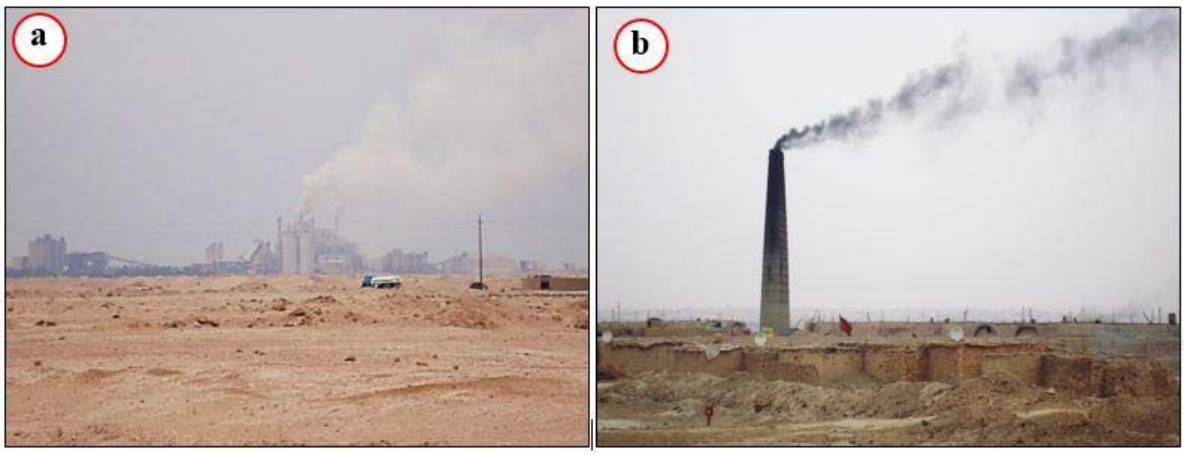


Figure 9: a) Al-Muthana cement Plant, b) Brick plant west of Najaf city.

vi. *Landfills*

The absence of scientifically constructed landfills (Fig. 10) in majority of Iraqi cities and towns is one of the main contributors to the climatic changes. This is attributed to the emitted gasses and the leached solutions, which may contaminate the shallow freshwater aquifers.

vii. *Dams*

Tens of dams are constructed in Turkey, Iran and Syria and others are planned for construction (Fig. 11). The constructed dams have reduced and will reduce the water income to Iraq by about (7 – 73) % (Adamo et al. 2108b). The shortage in water income has increased the desertification (Fig. 1), increased the annual rainwater, increased the dust storms occurrences, decreased the wetlands, and cultivated areas (Fig. 12), increased the migration from rural areas to cities and towns.

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Figure 10: Landfills, a) west of the Najaf city, b) Qani Qerjal landfill, west of Erbil city.

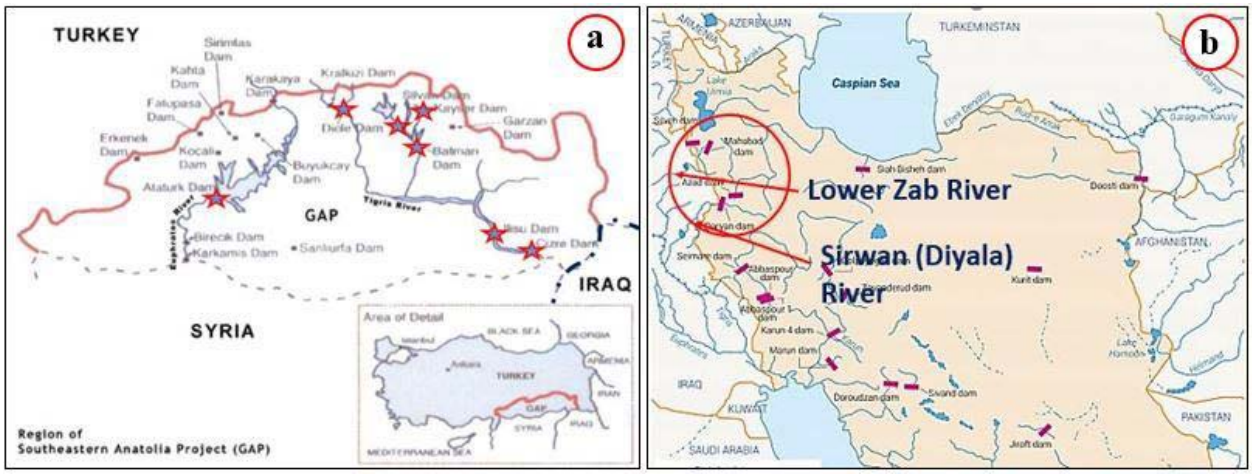


Figure 11: Constructed dams on the Tigris and Euphrates rivers and their tributaries.
a) The GAP Project in Turkey, b) In Iran.

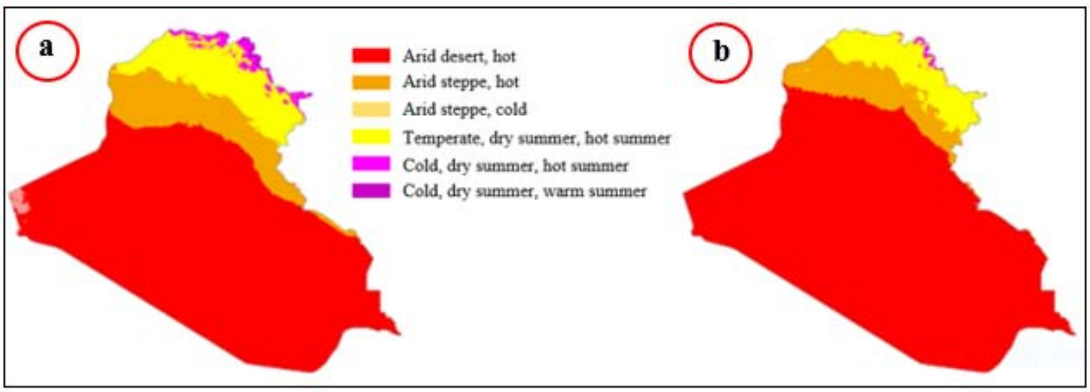


Figure 12: Current/past Köppen climate classification map for Iraq,
a) for 1980–2016, b) for 2071 – 2100 (After USAID 2017).

viii. *Absence of Sewage System*

Tens of cities and towns in Iraq lack sewage system. Instead of that every house and/ or building has its own constructed storage. The storages are usually leaking and contaminating the shallow water aquifers, which are normally used as a source for water supply to the people living around. Therefore, the aquifers are contaminated, and the used water is not suitable for domestic uses. Moreover, the aquifers may recharge nearby existing rivers, streams, springs, which means those wetlands also can be contaminated and the water becomes not suitable, accordingly, people may leave their lands, especially agricultural lands and this will increase desertification and/ or salinization.

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IV. Discussion

One of the main reasons for the climate changes, not only in Iraq but in the whole world is the emitted greenhouse gasses, both naturally and due to man-made activities. The emitted gasses cause global warming that has great effect on the reasons, which contribute to the climate change.

a) Natural Causes

The natural causes are mainly out of human's control; however, they can be mitigated; partly. For example, the bitumen seepages in Hit town (Fig. 5b), which flow in many valleys and merge with the Euphrates River can be controlled by diverting the flow to be dumped in specially constructed forms. However, the emitted gasses cannot be controlled, but the living people at nearby areas can be evacuated to areas far from the reach of the gasses.

The creeping sand sheets, sand dunes and sandstorms can be mitigated by different means, among them are: 1) Fixing and controlling the sand dunes, 2) Increasing the green areas by plantation of ever green trees around the influenced areas, 3) Encouraging farmers to increase their cultivated areas by means of using advanced irrigation methods, which need less water than the conventional old irrigation methods, 4) Implementation of better water management locally and regionally to ensure the required water flow in the rivers and streams, especially those which flow from out of the country, consequently supplying the required water quantities for irrigation, 5) Construction of small dams, especially on the tributaries of the Tigris and Euphrates rivers, and the main streams to store the excess water, which can be used for cultivation and plantation during water scarcity seasons.

b) Manmade Causes

Since these causes are manmade, then they can be controlled; however, a lot of instructions should be carried out by the government and local administration authorities to control the causes or to mitigate them.

The most significant issue to control the manmade cases is to increase the awareness of the people; not only to follow the issued instructions and/ or laws but to keep themselves as much as possible far from the existing manmade causes. Moreover, to decrease the influences of the causes when they are responsible for those causes. Figure (13) shows absence of the awareness in the behaviors of the people. Figure (13 a) is a dust storm that was hitting Baghdad in 2012 where the people were not concerned with the consequences on their health. Whereas Figure (13 b) shows a burning gas when a local farmer asked a drilling contractor to drill a water well. The drilled well accidently has hit a gas pocket in the Cham Chamal North oil field, the gas is burnt with the flowing water. These two examples with those mentioned in Section 3.2 are good evidence for the absence of the awareness, mostly in the Iraqi people.



Figure 13: Absence of awareness in the people, a) Two persons in a local market in Baghdad during a dust storm, b) Burning of gas in a drilled water well.

The local diesel generators (Fig. 7a) are the more dangerous since they are installed everywhere where people are living; however, they are the simplest to be controlled; among other man-made causes. Instructions to change all old generators by brand new and silent generators are the easiest action by means of which enormous amounts of emitted gasses can be minimized.

The burning of the hydrocarbon gasses (Fig. 8a) should be stopped in all oil production activities at different parts of Iraq. Instead of burning, the gasses should be used for electric power generation and other industrial uses. This should be controlled by issuing instructions by the Iraqi Ministry of Oil and Minerals, and the Ministry of Natural Resources in Iraqi Kurdistan Region and approve them by higher authorities.

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For the haphazard garbage dumping in landfills (Fig. 10), which are located without any scientific study, they should be abandoned totally. Relevant landfills should be used after carrying out required scientific studies (Sissakian et al. 2019) to prevent leaching of the contaminant, which contaminates the shallow water aquifers (Fig. 14a). If there is no natural barrier like claystone, gypsum, salt, massive igneous rocks, crystalline carbonates, then artificial barriers should be used (Al-Basam et al. 2011). The main reason is that at different parts in Iraq, the shallow water aquifers are used as main water supply sources, after being pumped out through drilled water wells (Fig. 14 a). However, before abandoning of the current landfills, the burning of the garbage should be stopped immediately by the local authorities. The Ministry of Environment bears the full responsibility of abandoning such landfills.

Brick plants, which use crude oil in burning of the clay to produce brick, should be abandoned and instead modern brick plants should be used (Fig. 14 b). Such modern brick plants use gas and electricity in the furnaces to produce bricks, they don't emit black smokes as those old brick plants do (Fig. 9b).

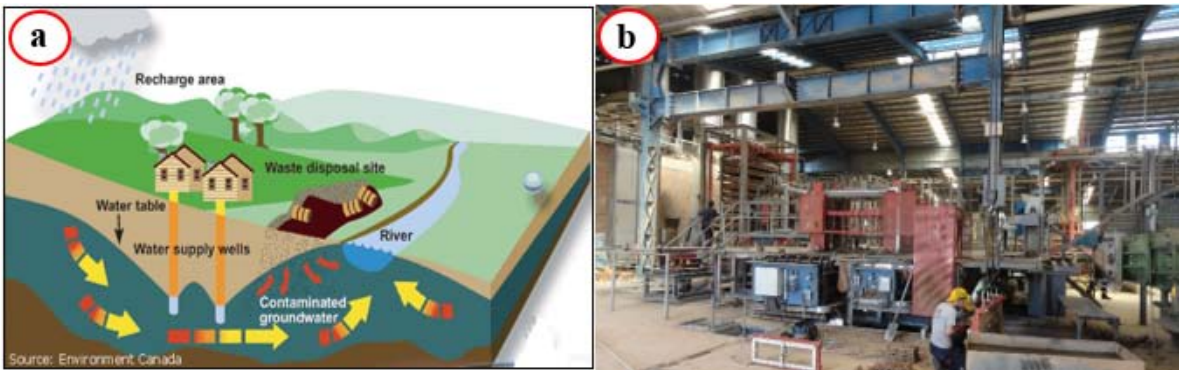


Figure 14: a) Schematic diagram of pumping water from contaminated aquifers from Haphazard garbage dumping site, b) Modern brick plant which uses gas and electric power in the furnaces.

Although most of the cement plants are constructed at areas far from cities and towns; however, locally, they are nearby to towns as in Bazian district southwest of Sulaimaniyah Governorate where five cement plants are constructed (Fig. 15a). The emitted dust from chimneys (From 9 a) and from the quarries should be minimized by different technical methods to keep the environment as clean as possible.

Burning of the bitumen in Hit (Fig. 7b) and Kubaisa towns should also be minimized. Moreover, building of houses (Fig. 15b) nearby to bitumen seepages should be prevented because the emitted gasses effect on the health of the people living nearby those seepages is very harsh, besides polluting the air, water, and soil.

The absence of the systematic sewage systems in many cities and towns is other main pollutant to the shallow ground water aquifers, almost the same method of the landfills (Fig. 14a). However, the effect of the absence of the sewage systems is more effective than the landfills because the local used waste storages are present at each home and building, moreover, they are cleaned by special tankers, and the collected waste materials are dumped haphazardly at different locations from each city and town. The dumped wastes are effective pollutant, emitting gasses (mainly Ethan), which are type of greenhouse gasses. Required solutions to overcome the effect of the absence of the sewage system are more difficult than the landfills, they are time consuming and cost wise. Therefore, the concerned authorities have to take actions as soon as possible to start construction of systematic sewage systems in all cities and town, even villages.



Figure 15: a) Five cement plants in Bazian district, b) Constructed houses near a bitumen seepage in Hit town.

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The most effective and significant manmade cause of climate changes is the construction of dams in Turkey and Iran (Fig. 11). The constructions of dams in Turkey and Iran have decreased the water income to Iraq drastically, it is predicted to be less than 150 m^3/ sec in 2030 (Fig. 16 a). Meanwhile, the average of the annual temperature is increasing, and it is predicted to be 50 C° during 2080 – 2090 (Fig. 16 b). The decrease in water income with increase in the annul temperatures is accompanied by increase in population in Iraq, and it is predicted to be 45 million before 2040 (Fig. 16 c). Therefore, more water will be needed to continue normal living conditions with the increased population in Iraq. However, the predicted statistics about the water uses in different sectors (Fig. 16 d) show that the deficiency in required quantities is 31.12 $X10^9$ m^3, and this will increase with the increasing population and water scarcity, not only in Iraq but also in Turkey and Iran.

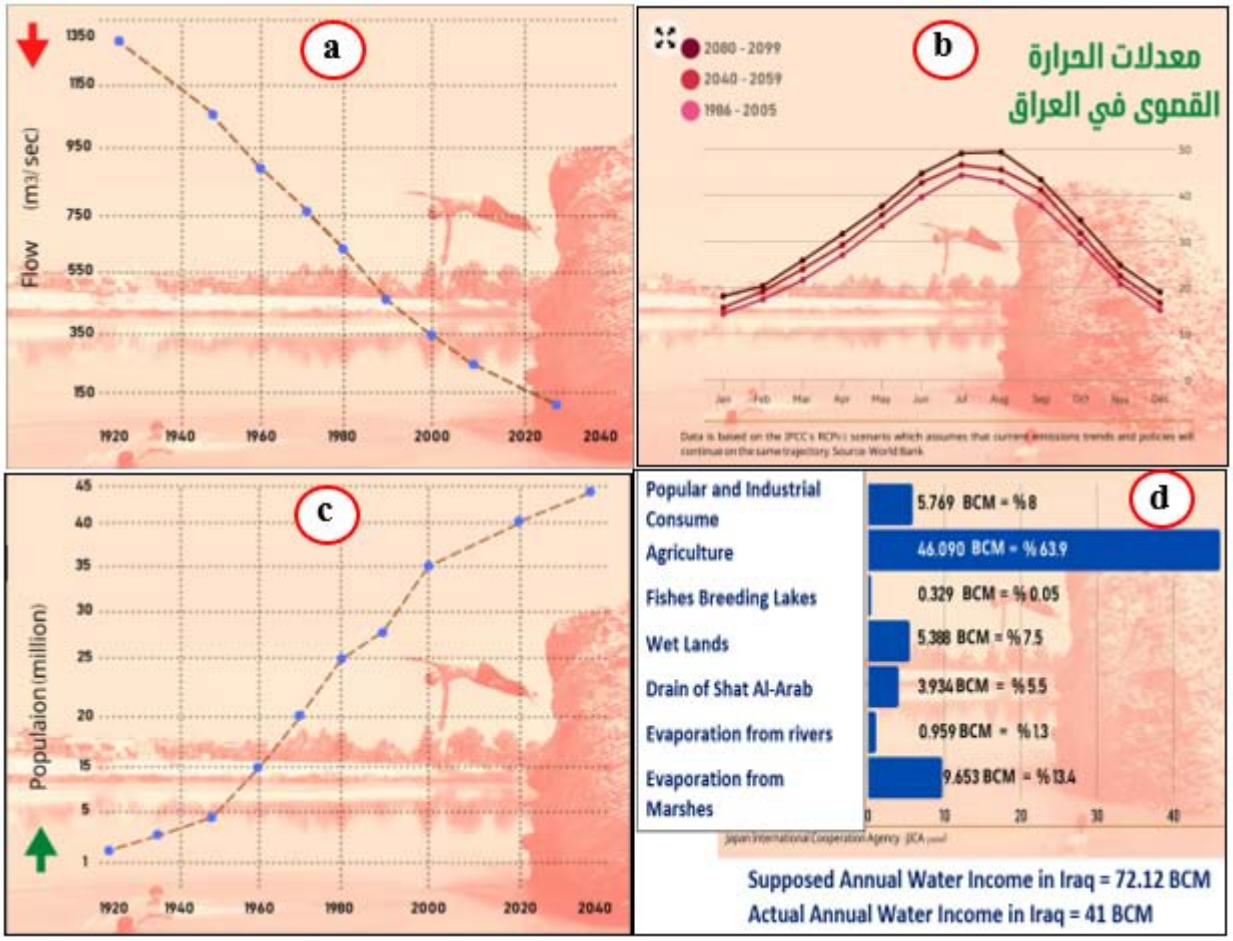


Figure 16: a) Average of water income to Iraq, b) Average of annual temperatures in Iraq, c) Population growth in Iraq, and d) Statistical data for water uses in Iraq (From Khalaf, 2021).

The water scarcity in Iraq will have impact on different living sectors among them are the marshes (Fig. 17a), where the dried parts will increase (Fig. 17b) causing immigration of the living people in the marshes to nearby villages, towns, and cities. Moreover, the annual temperature will increase with increase of dust storms and desertification, and the buffaloes; the main living animal in the marshes will start extinction. However, another very significant fact due to drying of the marshes is the increase of sea water intrusion from the Arabian Gulf towards Iraqi lands increasing the salinity of the soil and decreasing the depth of the water table. Moreover, decreasing of the evaporation which will decrease the opportunities of rainfall. The effect of the sea water intrusion will also affect the socio-economic sector too (Amed and Al-Zewar 2020). This is attributed to the natural hydraulic balance that exists between the marshes, Shat Al-Arab and the Arabian Gulf.

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Figure 17: Iraqi Marshes, a) Normal marsh, b) Dried marsh.

The threat of water scarcity will affect the Iraq's water security, which is based on two declining rivers, the Tigris and Euphrates, their main tributaries and main streams, especially those which flow from Iran. Turkey, Iran, and Syria lie up-rivers and rely heavily on the two rivers and their main tributaries. From 2007 to 2009, Iraq and Syria endured their worst droughts since 1940, with precipitation levels dropping up to 70 percent below annual averages. This followed a drought of nearly equal impact in 1998–2000 (USAID 2017).

The water scarcity in Iraq is related to the decrease of the annual rainfall and decrease of the water income in the two rivers, their tributaries, and main streams. The water income can be treated by signing agreements between the Iraqi Government with Turkish Government and Iranian Government, each alone. International laws suggest such agreements between riparian countries along each river. Although such agreements exist already; however, both Turkey and Iran are ignoring the signed agreements.

From the presented data, the consequences of the climate changes in Iraq are related to natural and manmade cause. In all cases, the emitted greenhouse gasses are increasing drastically word-wide, and not only in Iraq (Fig. 18). A main decline in the rates of the emitted greenhouse gasses can be seen in the year 2019, where all activities were almost banned due to covid-19 spreading. Also, the burning of fossil fuel (Fig. 9a) and cement production (Figs. 8a and 15a) are two main causes for the global warming and consequently causing climate changes.

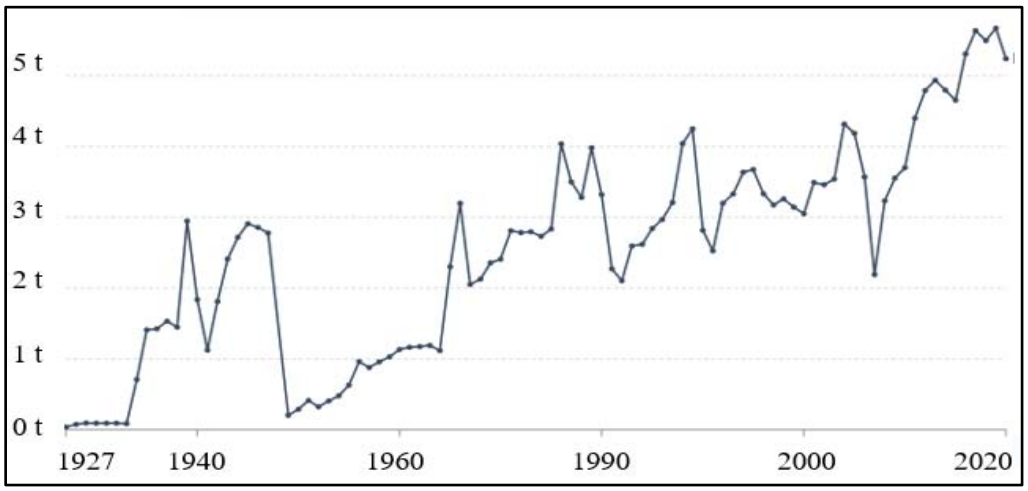


Figure 18: Carbon dioxide (CO_2) emissions from the burning of fossil fuels for energy and cement production. Land use change is not included (After Ritchi and Roser 2020).

V. Conclusions and Recommendations

The consequences of the climate changes in Iraq are related to two main causes, which are Natural and Manmade. The former causes are very difficult to be mitigated; however, their impacts can be decreased by taking urgent actions by the government and increasing the awareness of the people. The latter causes can be controlled; however, awareness of the Iraqi people is needed to help controlling the manmade causes. Another very significant issue to control the manmade causes depends on the government by issuing required laws and legislations to control the manmade causes. Moreover, very urgent actions should be carried out by

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the government to sign new agreements with Turkey and Iran to ensure the water inflow in the Tigris and Euphrates rivers and their tributaries, and the main streams as required to have normal living conditions.

Acknowledgment

The authors would like to express their sincere thank to the responsible authorities in the University of Kurdistan Hewler (Iraq), the Tishik International University (Iraq), the Lulea University of Technology (Sweden) for their continuous support during carrying on the current research.

Statements & Declarations

The authors would like to declare the following statements.

Conflict of Interest

All authors declare that there is no conflict of interest.

Funding

This research work has no funding.

Competing Interests

All authors declare that they have no financial interest.

Author Contributions

The first draft of the manuscript was written by Mr. Varoujan Sissakian and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript. Local examples and photographs are presented by Mr. Varoujan Sissakian.

Data Availability

The datasets generated during and/or analysed during the current study are all presented in the current manuscript.

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Global Journal of human-social science: b
Geography, Geo-Sciences, Environmental Science & Disaster Management
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460x & Print ISSN: 0975-587X

Greenhouse Gas Emissions from the Waste Sector from Salvador: Comparative Analysis of the Results and Gaps Found in the First and Second Inventory

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Abstract- Salvador is seeking to implement new low carbon technologies and establish a process for managing the risks and opportunities represented by climate change since it published its first inventory about of the Greenhouse Gas Emissions in 2016. The continuity of these actions is seen with the publication of its second inventory, in 2020. The existing bibliography on urban inventories of Greenhouse Gas Emissions (GHG) proves the importance and potential of cities to contribute to tackling climate change. The inventory is the instrument for monitoring and controlling these emissions, so its quality is fundamental to support the proposal of mitigating actions. One of the challenges pointed out by the scientific community is the comparability of urban GHG inventories. This work has as main objective to carry out a comparative analysis of the results of the Waste Sector presented in the first and second Inventory of Emissions of Greenhouse Gas Emissions in Salvador and to identify important gaps that still exist.

Keywords: *GHG emissions inventory; GPC; waste, Salvador.*

GJHSS-B Classification: *DDC Code: 635.048097471 LCC Code: SB85.N68*

GREENHOUSEGASEMISSIONSFROMTHEWASTESECTORFROMSALVADORCOMPARATIVEANALYSISOFTHERESULTSANDGAPSFOUNDINTHEFIRSTANDSECONDINVENTORY

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Greenhouse Gas Emissions from the Waste Sector from Salvador: Comparative Analysis of the Results and Gaps Found in the First and Second Inventory

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Abstract- **Salvador is seeking to implement new low carbon technologies and establish a process for managing the risks and opportunities represented by climate change since it published its first inventory about of the Greenhouse Gas Emissions in 2016. The continuity of these actions is seen with the publication of its second inventory, in 2020. The existing bibliography on urban inventories of Greenhouse Gas Emissions (GHG) proves the importance and potential of cities to contribute to tackling climate change. The inventory is the instrument for monitoring and controlling these emissions, so its quality is fundamental to support the proposal of mitigating actions. One of the challenges pointed out by the scientific community is the comparability of urban GHG inventories. This work has as main objective to carry out a comparative analysis of the results of the Waste Sector presented in the first and second Inventory of Emissions of Greenhouse Gas Emissions in Salvador and to identify important gaps that still exist. Thus, it is intended to contribute to promoting improvements in its next revisions and updates. Considering the measurement methodology adopted and after analyzing the results presented, opportunities for improvement were identified for the Waste Sector, considered insufficient in the two inventories in Salvador.**

Keywords: GHG emissions inventory; GPC; waste, Salvador.

I. Introduction

The concern with the social, environmental and economic impacts of climate change has led Brazilian public and private sectors to discuss and engage in initiatives related to mitigating greenhouse gas emissions (GHG) and to adapt to new climate risks (Salvador, 2016).

Carbon dioxide, the most important greenhouse gas produced by combustion of fuels, has become a cause of global panic as its concentration in the Earth's atmosphere has been rising alarmingly (GUPTA, 2022). Urban centers, especially, are regions of concentration of people that demand the development of various activities that meet their needs. A significant part of these activities, such as energy consumption, transport systems, industrial and agricultural activities, the use and modification of the soil and the generation of waste, emits GHG. This makes it important for cities to participate in tackling climate change (Kennedy et al., 2012).

Urban emissions from residues result from their incineration, biological and effluent treatments and the decomposition of organic residues when they are landfilled, which is a major contributor to the intensification of the greenhouse effect (Castrejón-Godínez et al., 2015; Scharff and Jacobs, 2006). The waste sector can be considered strategic for reducing gases, considering that, although its emissions are directly linked to the amount of waste generated, the technologies used in its management can avoid significant amounts of GHG, in addition to contributing to the generation of energy (Ibrahim et al., 2013).

One of the first steps towards establishing a process for managing the risks and opportunities represented by climate change is the elaboration of an inventory of GHG emissions and removals. There are several methods to develop GHG inventories on a municipal scale, including the consumption-based life cycle and accounting approach (Davis and Caldeira, 2010). However, the adoption of different methods and approaches can make it difficult to compare emissions between cities and raise doubts about the reliability and security of information. One of the challenges pointed out by the scientific community is the comparability of urban GHG inventories. Comparability can be interpreted as a way to improve the inventory because it allows expanding knowledge based on the identification of differences and the observation of opportunities for improvement from other experiences (Alves, 2017).

The city of Salvador published its first GHG Emissions Inventory in 2016, with 2013 as the base year for accounting. The publication of its update was carried out in 2020, having as base years 2014 to 2018. It can be considered that the data on emissions from the Waste Sector was not sufficient in the two inventories. Therefore, this work has as main objective to carry out a comparative analysis of the results of the Waste Sector between the two Inventories of Greenhouse Gas Emission in Salvador, to identify important gaps and to contribute to the improvement of its next revisions.

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II. Theoretical Framework

Among the environmental problems of the contemporary world, climate change is one of the most challenging as it interferes with the dynamics of biomes and affects life on the planet (Andrade et al., 2017). The emissions inventory is a key tool for establishing a general and detailed overview of GHG emissions, subsidizing decision making, by identifying priorities and enabling the adoption of the most appropriate measures to reduce emissions (CETESB, 2013).

Municipal inventories based on the GPC (Global Protocol for Community-Scale Greenhouse Gas Emission Inventories) methodology, developed in 2014 by ICLEI (Local Governments for Sustainability), WRI (World Resources Institute) and C40 (Climate Leadership Group), can be aggregated at subnational and national levels, considering different sectors and subsectors. The GPC method establishes five principles for drawing up inventories. Following these principles is necessary for an inventory of sufficient quality and consistency to be used as a tool for decision making. Are they:

- *Relevance:* The inventory must appropriately reflect the government's GHG emissions and must be organized so as to reflect the areas over which the municipality exercises control and has responsibility;
- *Scope:* All GHG and activities that cause emissions within the borders chosen for the inventory must be accounted for, whose exclusions must be justified;
- *Consistency:* Consistent methodologies must be used to identify borders, collect and analyze data and quantify emissions;
- *Transparency:* The relevant issues must be considered and documented in an objective and coherent way, in order to enable the tracing for future reviews and replications. The data sources and assumptions assumed in the inventory must be made available;
- *Accuracy:* The quantification of GHG emissions should not be systematically under or overvalued.

According to a study published by Leão et al. (2019) analyzing 24 Brazilian cities, several gaps were identified in their GHG inventories. Seventeen inventories did not adequately reflect the emissions that occur as a result of the city's activities and consumption patterns. Twenty reports showed a lack of transparency about assumptions, input data, source of input data, emission factors, methods and or limitations in the calculations. Such information is of great importance to support the elaboration of new GHG inventories with a greater basis, as well as to allow the implementation of mitigation and adaptation measures related to each evaluated sector.

The GPC methodology establishes six major sectors of activity that potentially emit GHG: (i) Stationary Energy, (ii) Transport, (iii) Waste, (iv) Industrial processes and product use (IPPU), (v) Agriculture, forest and land use (AFOLU) and (vi) Other Indirect Emissions. These sectors are still broken down into subsectors, according to the activities developed in each location. The inventory must group the emissions through different but complementary approaches: emissions by scope and emissions induced by the city.

a) *Emissions by scope:* distinguishes emissions that occur within the city boundary (Scope 1), emissions that occur outside the city boundary (Scope 3) and those that result from the use of electricity supplied by the grid (Scope 2). This allows inventories from different cities to be more easily aggregated, through Scope 1, avoiding double counting of emissions.

b) *Emissions induced by the city:* account for emissions from production and consumption activities that occur in the city, including some emissions that occur outside the city limit but are due to internal activities. Depending on the relevance and availability of data, these emissions can be considered at two levels: (i) BASIC: Includes Scope 1 emissions for stationary energy, transport and waste; Scope 2 emissions for stationary energy and transport; and Scope 3 emissions for waste; and (ii) BASIC+: It involves more challenging data and calculations, also including emissions of IPPU and AFOLU (Scope 1), as well as emissions from losses in the distribution of electricity and intercity transport (Scope 3).

The level of complexity of the data collection approach and calculation methodology is represented by the rigour classes or tiers. Usually, three types of tiers are established. Tier 1 is the basic and aggregate method; Tier 2 is intermediate and Tier 3 is the most demanding method. Tiers 2 and 3 are also called superior tiers and are considered more accurate.

Emissions should also be reported for inventoried gas. The GPC methodology proposes that the seven cases reported in the Kyoto Protocol be inventoried: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). It is also recommended to report biogenic emissions separately. Biogenic emissions correspond to emissions from burning biomass, for example, for the production of biofuels.

GPC divides the Waste Sector into four Subsectors: (i) Disposal of Solid Waste, (ii) Biological Treatment, (iii) Incineration and (iv) Waste Disposal and Treatment. According to the Intergovernmental Panel on Climate Change (IPCC, 2006), total waste disposal is

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responsible for about 3 to 4% of anthropogenic GHG emissions in the world. Although the contribution of the Waste Sector is lower in relation to other factors, the activities developed for its management generate gases that cause the greenhouse effect and contribute to aggravating climate changes.

Solid waste management is associated with GHG emissions in several ways. In the case of disposal in a landfill, the decomposition of waste releases, above all, carbon dioxide, methane, ammonia and hydrogen sulfide (Brasil, 2015). In the case of recycling, the process involves the consumption of energy, water, and the operation of equipment. Organic waste is an important source of GHG for the atmosphere. The form of final disposal or treatment of this waste is decisive in the amount of GHG that is emitted. The IPCC (2006) considers Biological Treatment to be composting, anaerobic digestion of organic waste and biological mechanical treatment (ABRELPE, 2018). Regarding incineration, nitrous oxide and carbon dioxide are released into the atmosphere, among other gases. In all cases, it is necessary to transport the waste from the generating source to the treatment or disposal site, and consequently, this transport consumes fossil fuels that also release GHG (Matos et al., 2017). There are also emissions of gases in the treatment of domestic sewage and industrial effluents, carbon dioxide, by the fossil fraction of the incinerated solid waste and nitrous oxide, also by the incineration of waste (CETESB, 2013).

The vast majority of waste currently produced in Brazil has no sanitary and environmentally appropriate destination. Although there has been progressing in the last twenty years, waste is still deposited in open pit dumps, the so-called dumps, in more than half of the country's municipalities (IBGE, 2010). In addition, the lack of an efficient management system and waste disposal without proper separation contributes to GHG emissions through the decomposition of the organic fraction, resulting in the acceleration of the end of the landfill's useful life and social and economic losses for the valuation of solid waste (Van Elk, 2007). In sewage treatment, two types of GHG are also generated and accounted for, methane and nitrous oxide. These emissions come from the fraction of organic matter removed in the treatment process and the remaining fraction of organic matter and nitrogenous compounds present in the treated effluent, which is released into the receiving bodies (CETESB, 2013).

Several actions are being taken by Brazil to tackle climate issues. With the commitment to consolidate a low carbon economy and to keep the global average temperature rise below 2 °C above pre-industrial levels, the country aims to expand the use of renewable energy sources in the domestic market, increasing the share of wind, biomass and solar energy to a minimum of 23% by 2030 (BRASIL, 2015). In addition, different programs created by the Federal Government aimed at diversifying the energy matrix, transforming waste into a source of energy and income, in addition to complying with global environmental program standards, such as the Kyoto Protocol and the Clean Development Mechanism (CDM) (Alves, 2017). The CDM is one of the instruments established by the Kyoto Protocol, whose objective is to assist in meeting the goals of reducing GHG emissions. There are currently several projects under the CDM developed in landfills in the country, whose objective is to reduce GHG emissions by mitigating methane emissions (Takimura, 2009).

III. Methodology

For the preparation of this article, documentary research and revision of the technical and scientific literature related to the theme were carried out, in addition to thorough consultation of the two GHG emission inventories in Salvador. The comparisons of the inventories were carried out comparing the results obtained between the total emissions of the sectors by the scope approach and by the induced emissions approach, as well as the emissions of the four subsectors that make up the Waste Sector: Solid Waste Disposal, Treatment Biological, Incineration and Waste Disposal and Treatment. The data were compiled in tables and later transformed into graphs to be compared. The Biological Treatment Subsector was not evaluated in the two inventories because its emissions were considered insignificant.

The first Inventory was prepared between 2014/15 and published in 2016, with 2013 as the base year. Its preparation was carried out by the consulting company Pangea Capital, as a result of a partnership between the WRI (World Resources Institute) and the Municipal Secretariat of Sustainability, Innovation and Resilience of Salvador (SECIS), with funds from the British government. The Inventory update was carried out by Way Carbon, in partnership with ICLEI and WWF (World Wide Fund for Nature), contracted by the Municipality of Salvador through the Municipal Secretariat for Culture and Tourism (SECULT), within the Programa de Desenvolvimento do Turismo (PRODETUR). The second Inventory was prepared in 2019 and published in 2020 having as base years 2014 to 2018.

The methodology used for the elaboration of the two inventories was based on the GPC method, previously mentioned, specific for evaluations at the community level. As explained, the method determines different sectors in which the issuing activities can be allocated. The first Inventory in Salvador did not include the sectors "Industrial Process and use of products" (IPPU) and "Agriculture, forests and land use" (AFOFU), because, according to the City Hall, emissions from these sectors are not relevant, due the absence of large

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industries or industrial centers and large agricultural activities and the irrelevant rate of deforestation in the municipality in 2013, the base year of the Inventory (Salvador, 2016). The second Inventory started to include emissions from the AFOLU sector but did not consider emissions from the IPPU and "Other Indirect Emissions" sectors, as no sources of these emissions were identified in the period from 2014 to 2018 (Salvador, 2020).

According to the inventories, the choice of emission factors used for the calculation of emissions prioritized the use of values consistent with the Brazilian reality, classified as Tier 2 by the IPCC. However, in some cases, specific and reliable values for Brazil have not been identified and, therefore, default emission factors (Tier 1) published by internationally recognized organizations in the area of climate change were used. Therefore, Level 3 or Tier 3 was not adopted in the inventories of Salvador (Salvador, 2016; Salvador, 2020). According to Almeida (2011) and IPCC (2006), Tiers 2 and 3 are the most complex, as they require more detailed and specific information and allow more advanced approaches and, therefore, are more accurate.

IV. Results and Discussion

Next, in view of the objective of this article, the results of the first and second Greenhouse Gas Emissions Inventory in Salvador, with a focus on the Waste Sector, will be detailed and discussed.

a) *Results of the First Greenhouse Gas Emissions Inventory in Salvador*

The estimated population for calculating the first Inventory was 2.902.927 inhabitants and GDP was R$ 39.66.168. Biogenic emissions are reported in a separate category. In relation to the assessed GHGs, the main emissions are from carbon dioxide, followed by methane and nitrous oxide. The calculations of these emissions are performed using the measurement of "tons of carbon equivalent gas" (tCO_2e), that is, all gases are compared to carbon dioxide in terms of impact on the greenhouse effect, in order to use a single measure. No HFC, PFC, SF_6 and NF_3 emissions were identified. Considering the report by scope, in 2013, the city of Salvador issued a total of 3.698.964 tCO_2e, of which 3.242.166 tCO_2e (88%) are Scope 1 emissions; 366.395 tCO_2e (10%) Scope 2; and only 90.402 tCO_2e (2%) of Scope 3. Biogenic emissions totaled 1.454.344 tCO_2e.

To report the induced emissions, the BASIC method was used, which covers the main emission sources in Salvador. The total induced emissions were 3.661.647 tCO_2e. It was considered that 11% of the waste emissions that occur within the geographic limits of the municipality do not come from their own activities (this is waste generated by another municipality and disposed of in the landfill of Salvador, which also receives waste from the municipalities of Lauro de Freitas and Simões Filho). Table 1 presents a compilation of data on total emissions by scope approach and induced emissions approach from the first Salvador Inventory for the base year 2013.

Table 1: Total emissions by scope approach and induced emissions approach from the first inventory in Salvador (2013)

Sector		Total by scope			Total by Induced emissions
		Scope1	Scope 2	Scope 3	BASIC
Stationary energy		303.734	366.395	-	670.129
Transport		2.729.700	-	-	2.729.700
Waste	Raised in the city	205.218	-	90.402	261.818
	Raised outside the city	3.515	-	-	-
Total per Scope		3.242.166	366.395	90.402	3.661.647
Total		3.698.964			

Source: Salvador, 2016

Salvador's solid waste is treated at landfills in the municipality. At the time the first Inventory was prepared, incineration was carried out by the SERQUIP company, located outside its territory. However, as reported, Salvador landfill also receives waste from other municipalities. These emissions occur within the municipality of Salvador, but are not induced by their activities; therefore, they were not included in the total emissions. Emissions from the incineration of waste from health services are the only Scope 3 emissions considered in the Inventory since this waste was generated in Salvador and treated outside the geographic limits of the city.

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In relation to the sectors, the Transport Sector was the main GHG emitter (74%), followed by the Stationary Energy Sector (18%) and, finally, by the Waste Sector, which emitted 299.135 tCO_2e, corresponding to 8% of participation in emissions. For the Waste Sector, emissions from the disposal of solid urban waste in landfills, from waste destined for incineration and from the treatment of sanitary effluents were considered. The Waste Disposal subsector was responsible for 11% of emissions in 2013, totalizing 31.103 tCO_2e, followed by the Domestic Effluent Disposal and Treatment subsector, representing 59% of emissions, with 177.630 tCO_2e and then the Incineration subsector, which contributed with the emission of 90.402 tCO_2e, which corresponds to 30% of the Sector's emissions.

i. *Waste Disposal*

The disposal of solid urban waste in landfills contributed 31.103 tCO_2e in 2013 in the city of Salvador.

Through the analysis of activity data from the inventory and the results presented in the 2013 Diagnosis of Urban Solid Waste Management, available in the National Sanitation Information System (SNIS), it was observed that there is a divergence between the data presented in the Inventory and SNIS. According to the data reported in the Inventory, in 2013, 840.443 tons of solid urban waste was disposed of at the Metropolitan Landfill Center (AMC), as well as 107.069 tons of waste generated outside the city, but landed in Salvador. This was due to the AMC also receiving the waste generated in the municipalities of Lauro de Freitas and Simões Filho. However, according to the Diagnosis available at SNIS, AMC received a total of 914.099.60 tons of waste from the city of Salvador, 87.918.70 tons from the city of Lauro de Freitas and 25.491.80 tons from the city of Simões Filho in 2013. Therefore, there is an opportunity to improve the validation and consolidation of data with the official information systems available to ensure greater precision of calculations.

According to the Basic Urban Cleaning Plan (PBLU) of 2012, most of the waste generated in Salvador is organic and potentially recyclable waste. However, according to the SNIS, in 2013, the coverage rate for selective door-to-door collection in relation to the urban population was only 1.25% and the composting unit in Salvador was not in operation. Therefore, despite the potential for composting and recycling solid urban waste (MSW) in Salvador, they are predominantly sent to the landfill.

Regarding the biogas generated at the landfill, the existence of the Termoverde Salvador plant, which was inaugurated in 2011, was not considered in the Inventory. The plant can serve a city of about 219 thousand inhabitants and all the energy generated is sold independently of the Electricity Company of the State of Bahia (Coelba) (Pasini, 2011). There was also no mention of the existence of a CDM project at the landfill, implemented in 2004 for the burning of methane and the generation of carbon credit that was developed by Vega Engenharia Ambiental SA through BATTRE, responsible for the administration of AMC, in Salvador.

Another point to be considered is the treatment of leachate generated in the landfill. According to data presented by LIMPURB, the manure is treated by Cetrel S.A., a company specialized in the treatment of waste and effluents located at the Industrial Pole in Camaçari and, subsequently, it is sent to the ocean through a submarine outfall. It was not mentioned in the Inventory if the leachate treatment is being considered in the calculations for the reported emissions.

ii. *Treatment of Liquid Effluents*

Emissions from the Liquid Effluent Treatment accounted for 59% among the subsectors, with a total of 177.630 tCO_2e in the first Inventory. The number of emissions of effluents generated and treated through data obtained from the Bahia Water and Sanitation Company (EMBASA) was presented in the Inventory. However, data from these activities were not identified in the calculation tool in the period evaluated.

iii. *Incineration*

A total of 90.402 tCO_2e generated by incineration were reported, representing 30% of emissions between the assessed sub-sectors. About 396.45 tons of Health Services Waste (RSS) were subjected to thermal treatment by incineration in 2013. However, the calculated emissions considered only the RSS destined for heat treatment by incineration performed by a single company, SERQUIP Treatment Waste, located in Simões Filho. However, Salvador has other providers of this service, whose contributions were not considered. It should also be noted that the SNIS does not have the mass of RSS collected per capita in 2013 for Salvador, whose data could also be considered to improve the calculation of emissions. The possible emissions from Class I (industrial) waste treatments generated in Salvador in the base year were also not accounted for in the Inventory, such as lubricating oils, waste contaminated by oils and greases, cutting fluids, paints, among others which are demanded by the civil construction, mechanical maintenance, machining companies and mechanical workshops in the municipality. In this sense, evaluating and determining the providers of RSS and industrial waste treatment services generated in the municipality of Salvador that perform incineration and co-processing, as well as quantifying their contributions to GHG emissions, can be considered opportunities for improvement for future inventories in Salvador.

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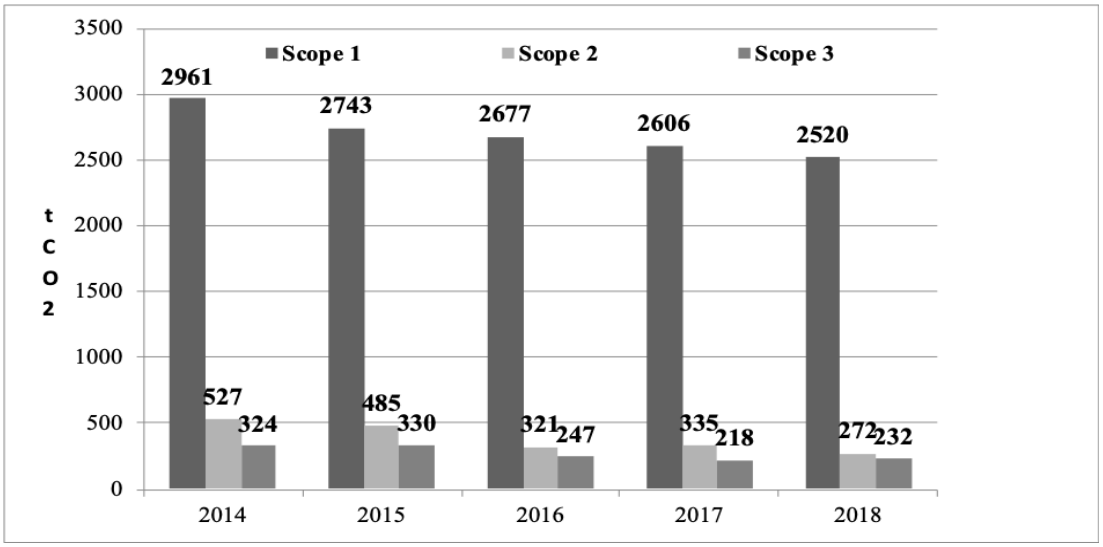
b) Results of the Second Inventory of Greenhouse Gas Emissions in Salvador

Emissions from the municipality of Salvador assessed between 2014 and 2018 totalled 16.797.5 $MtCO_2e$. The estimated population for calculating the first inventory was 2.872.347 inhabitants and a GDP of R$ 21.231.48. Considering the report by scope, the city of Salvador emitted 16.978 tCO2e, of which 13.507 tCO_2e (80%) are Scope 1 emissions; 1.940 tCO_2 (12%) Scope 2; and 1.351 tCO_2e (8%) of Scope 3. Biogenic emissions totaled 5.709.201 tCO_2e. The renewable emissions from the GHG Inventory in Salvador comprise emissions from the burning of biogas at the Termoverde Salvador plant for power generation. For the transport sector, renewable emissions come from burning anhydrous ethanol (mixed in gasoline) and hydrated, and biodiesel present in the diesel composition. For the Waste Sector, the emissions come from burning biogas in the metropolitan landfill. Scope 1 emissions from renewable sources were also accounted for.

Data on MSW generation and treatment location were sent by LIMPURB. The waste data sent for incineration was sent by the company TRR only for the years 2017 and 2018, for the years 2014 to 2016 the data were estimated considering the representativeness of the waste for incineration compared to the total waste generated in the municipality. Wastes not collected in the municipality were also considered, obtained through the waste collection rate available at SNIS. Data on gas recovery at the landfill and flare and at Termoverde Salvador were provided by BATTRE.

The total induced emissions were 2.643.622 tCO_2e, since, as in 2013, part of the emissions from the Waste Sector that occur within the geographic limits of the municipality does not come from its activities (waste generated by another municipality and landfill in Salvador).

Considering the emissions of the different sectors evaluated, the Transport Sector was the main GHG emitter (65.6%), followed by the Stationary Energy Sector (21.9%) and, finally, by the Waste Sector, which in turn, issued 409.424 tCO_2e, corresponding to a 12.6% share in emissions. The AFOLU sector contributed -0.1% of emissions. Figure 1 presents data on emissions by scoping the approach to Salvador's second inventory.



Source: Own elaboration based on (SALVADOR, 2020)

Fig. 1: Total emissions by scope approach of the second Salvador Inventory

As mentioned, the Salvador landfill receives waste from other municipalities, therefore, these values were not included in the total emissions in the two inventories. Additionally, in the second Inventory, the waste that is not collected and is disposed of in irregular landfills in the city was estimated through the information on the waste collection rate for Salvador available on the SNIS. Emissions from these non-collected wastes and disposed of in illegal places in the municipality represent 6.6% of the total emissions from the solid waste disposal sub-sector.

The Waste Disposal subsector is the most representative, responsible for and 58% of emissions, totalling 1.123.793 tCO2e, followed by the Domestic Wastewater Treatment and Disposal subsector with the emission of 690.194 tCO_2e and then the Incineration subsector, with 12.7343 tCO_2e. The biological treatment of waste was also not included in the second Inventory due to the low representativeness of these treatments.

i. *Waste Disposal*

The second inventory reported a total of 1.123.793 tCO_2 generated by the disposal of solid waste in the period from 2014 to 2018. The solid waste generated in Salvador is sent to the AMC landfill in Salvador and landfills outside the city (landfill of inert waters) Águas Claras and Hera Ambiental landfill).

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The AMC landfill has a biogas recovery station that recovers about 60% of the biogas, guaranteeing a methane flaring of around 99% in the flares and 95% in the engines of the Termoverde Thermoelectric Plant for power generation. The carbon dioxide generated by the burning of biogas is categorized as renewable, so fugitive biogas emissions from the landfill and the inefficiency of burning were considered, and the portion of biogas used for energy generation will be reported in category I. Stationary Energy and the remaining portion is reported in category III. Waste. For solid waste treated outside the city limit, emissions from the Hera Ambiental landfill were considered, as the Águas Claras landfill receives inert waste from construction (Salvador, 2020).

For the calculation of emissions from the disposal of solid waste in landfills, the quantities of waste generated in the municipality and destined for landfills within and outside the limits of the municipality were collected, and the waste from other municipalities that are received at the landfill located on the limits of the municipality. County. The waste generated outside the municipality of Salvador and destined for the Metropolitan Landfill of the Center was measured, but the emissions were not added to the inventory. However, these were reported from a territorial perspective and are detailed in Annex F of the Inventory. Considering the data presented, there is no detail on the sources of emissions considered for the calculations and also on the exclusions of sources of emissions. Also, data on the quantity of MSW (in tons) that were disposed of at the AMC landfill between 2014 and 2018 were not presented, as demonstrated in the first Inventory.

The physical characterization of the urban solid waste of Salvador used for the elaboration of the second Inventory had as reference the average gravimetric composition of the residues for the year 2010. Therefore, it is essential that the gravimetric analysis of the MSW is made for each inventory, due to the importance of understanding the different forms of waste composition.

ii. *Treatment of Liquid Effluents*

Emissions from Effluent Liquid Treatment accounted for 31% between the emissions of assessed sub-sectors, with a total of 126.106 tCO_2e.

The premise was adopted that no effluent treatment station in the municipality of Salvador has methane recovery systems. However, some stations perform methane recovery and burning and have not been considered. For the population not covered by sanitary sewage, EMBASA estimates for the municipality of Salvador per year were used. In these cases, it was considered the direct release of raw sewage into the drainage network or directly into the water body adjacent to the residence, as it is a more conservative profile of emissions estimates. It is noteworthy that the methane produced in the untreated effluent and released into open sewage was estimated, as well as the methane produced in the outfall and other decentralized systems. However, the limitation is that the number of inhabitants considered for the calculations was estimated by EMBASA. Another limitation is the lack of knowledge of the portion of inhabitants served by pits, whose data collection is the responsibility of the municipality.

iii. *Incineration*

Health and Class I (industrial) waste generated in the municipality of Salvador is incinerated by the company TRR, in the municipality of Itabuna. 127.343 tCO_2e from waste incineration were reported in the period from 2014 to 2018, which represented 7% of emissions between sub-sectors. Analyzing the evolution of emissions in the categories of the Waste sector between 2014 and 2018, it is observed that there was a significant reduction in emissions from the Incineration Subsector in 2017 and an increase in 2018. However, there is no detail of the data and no explanation or comment on the data presented.

The incineration of RSS is a factor of great relevance for the calculation of emissions from the Waste Sector, however, there is no sub-item with comments, important information such as the amount of waste incinerated and its classification was not presented. Another limitation observed was the lack of information on incineration in the period from 2014 to 2016. The data were estimated because the company TRR provided only the data from 2017 to 2018.

c) *Comparison of results obtained for the waste sector from the first and second Inventory of Salvador*

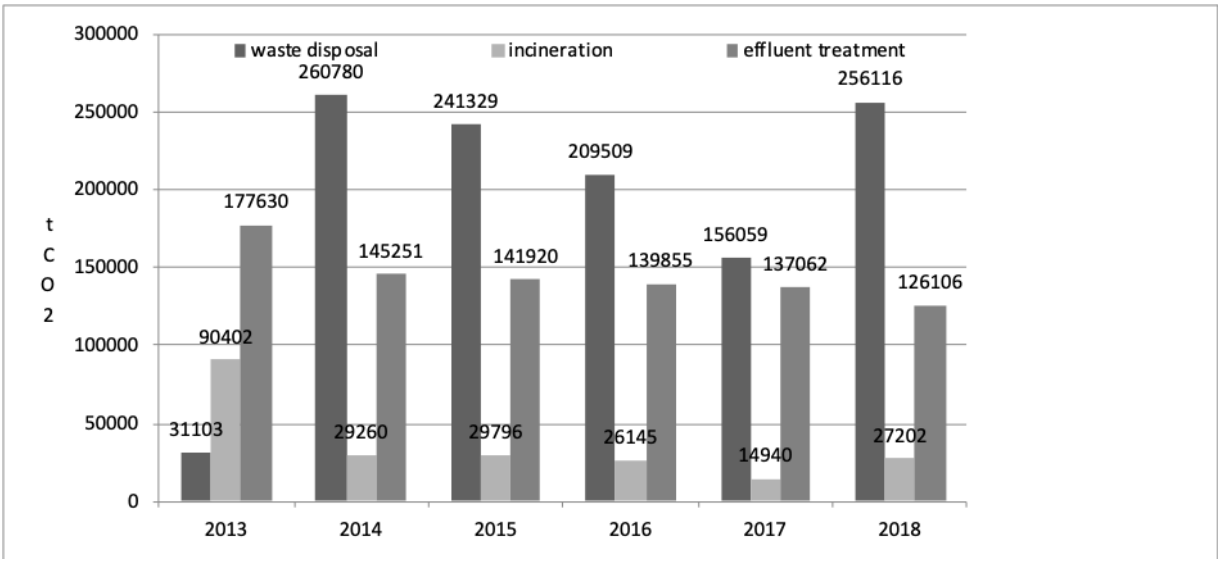
Regarding the results obtained by sectors, in the two inventories, the Transport Sector was the main GHG emitter in the municipality of Salvador, followed by the Stationary Energy Sector and finally, the Waste Sector. Comparing the proportion of emissions for the Waste Sector, an increase of 8% to 12.6% is observed between the first and second Inventory. This increase is not due to the growth in emissions, but to the decrease in Salvador's total emissions, which have been reduced over the years due to the drop in GDP.

Analyzing emissions from waste disposal and incineration, it can be seen that the figures were very different for 2014 compared to 2013. There was, therefore, an underreporting of data for 2013 for the subsectors of waste disposal and incineration. Therefore, it was identified the need to make the data obtained in the two Inventories compatible, as well as to present the information in a detailed way to meet two important principles that the inventories must meet: accuracy and transparency.

In both Inventories, the emissions generated by the Biological Waste subsector were not measured due to the low representativeness of these treatments. It is suggested that, in future inventories, this subsector be

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included for the quantification of emissions, as determined by the IPCC guidelines on the structure of the Waste Sector, in order to improve data collection. Organic waste represents the largest proportion of MSW, being of great importance for the quantification of MSW and for calculating GHG emissions. Comparing the emissions of the sub-sectors between the two Inventories, it is observed that, in the first Inventory, the disposal of waste in landfills contributed with 11% of the emissions, while in the second, the emissions of this sub-sector represented 62%. Effluent treatment contributed 59% of emissions in 2013 and 35% in the second Inventory. The data reported for the incineration subsector represented 30% of emissions in the first Inventory and 7% in the second (Figure 2). However, there is no detail and availability of information that allows the reader to analyze the data in-depth, and there was also no information on the amount of waste disposed of in landfills, the waste from incinerated health services and on sewage treatment plants.



Source: Own elaboration based on Salvador (2016) and Salvador (2020)

Fig. 2: Emission results obtained for the subsectors of the Waste Sector between 2013 and 2018.

i. *Waste Disposal*

According to the data presented in Figure 2, there is a great difference between the values obtained for the Waste Disposal sub-sector in 2013 compared to 2014. Possibly there was an underreporting of the amount of waste sent to the landfill in 2013 because the emissions of 31.103 tCO_2 in 2013 increased to 260.780 tCO_2 in 2014 and then remained constant until 2017 when there was a reduction in the figures presented. However, there is no comment or explanation for the information presented, as well as data on the quantity of MSW disposed in landfills between 2014 and 2018 were not presented. Therefore, improving data collection is of great importance to ensure greater accuracy of calculations in the next inventories.

ii. *Treatment of Liquid Effluents*

Comparing the data reported in the two Inventories, there is a significant reduction in emissions generated in the treatment of effluents. In 2013, emissions represented 59% among the subsectors; for the period from 2014 to 2018, they now represent 35%. There is no comment on the reduction of emissions in this subsector between the years 2013 to 2018.

The 2013 Inventory presents the results by type of gas, information that was not presented for the years 2014 to 2018. The first Inventory mentions only the source of effluent treatment without considering that there is a difference between the treated and the untreated fraction, as well as the types of treatment. In this sense, there was an advance in the second Inventory.

The data collection for the second Inventory considered aspects that were not addressed in the first Inventory, but as an opportunity for improvement, the characteristics of each EMBASA station should be better presented, informing the flow, type of treatment and average MCF (Correction Factor Methane) for each one. Other important information that should be included in the data collection for future inventories is the survey of which stations have a methane recovery system, add data on the destination of the sludge from the sewage treatment stations and elaborate scenarios for the emissions considering the expansion of the population served with sewage collection and a possible decision by EMBASA to deactivate decentralized treatments.

iii. *Incineration*

In the first inventory, a total of 90.402 tCO_2e were accounted for the incineration of waste. However, the emissions recorded in the second inventory are significantly lower, with 27.202 tCO_2e being reported.

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There are no comments on this significant reduction in emissions in the second Inventory, just as there is no sub-item with the detailed presentation and explanations about the data obtained for this subsector in the two inventories.

The two inventories used emission data from a single incineration company, SERQUIP in the first Inventory and TRR in the second Inventory. However, it is important to know if all RSS and all hazardous waste generated in Salvador are incinerated only at TRR and to account for possible emissions from other sources. This important indicator was one of the main limitations observed in the first Inventory and there were no improvements in the second Inventory. Other opportunities for improvement identified for the next inventories are the compatibility of the results obtained and the standardization of the data presentation method. As an advance observed in the second Inventory, emissions from industrial waste treatment generated in Salvador were also accounted for. In the first Inventory, only RSS was considered.

V. Conclusion

The city of Salvador stood out in the scenario of Bahia and Brazil from the first GHG Emissions Inventory in 2016, since most Brazilian municipalities had not yet inventoried their emissions. The municipality is currently seeking to implement new low-carbon technologies and establish a process for managing the risks and opportunities represented by climate change.

There have been some advances in the quality of the second Inventory when compared to the Inventory base year 2013, but some important gaps have been identified that contradict the principles of the inventories, mainly the accuracy and transparency. The inventories provide only the data of the emissions generated, but not the inputs, making it impossible to reproduce the methodology used for the calculations and violating the principle of transparency. As opportunities for improvement, the data collection system for municipal activities should be improved to increase data robustness and calculation accuracy, include other sources of Scope 3 emissions, in addition to the development of specific performance indicators related to GHG emissions, in order to monitor the impact of projects and management programs on Salvador's emissions.

There is a great need for a detailed survey of information on the contribution of the Waste Sector, which was not well presented and discussed in the two inventories. It is necessary to present the data in a more transparent and objective manner, as well as to include detailed information on the quantification of all waste generated in the municipality and its destination.

It is also considered of great importance to include the Biological Waste Treatment subsector for the quantification of emissions as determined by the IPCC guidelines on the structure of the Waste Sector in future inventories in order to improve data collection. Organic waste represents the largest proportion of MSW, being of great importance for the quantification of MSW and for the calculation of GHG emissions.

To calculate the emissions from the disposal of solid waste in landfills, it is necessary to seek information on all sources of waste disposal in the municipality (including irregular disposal points), analyze the gravimetric composition of the MSW generated in the municipality annually, due to the importance understanding the different forms of waste composition, as well as elaborating scenarios for the generation of waste. It is also necessary to evaluate and determine the providers of RSS and industrial waste treatment services generated in the municipality of Salvador that carry out incineration and co-processing, as well as quantifying their contributions to GHG emissions.

For the Liquid Effluent Treatment sub-sector, the collection of data for future inventories should include a detailed survey of information on sewage treatment stations and the elaboration of scenarios for emissions, considering the expansion of the population served with sewage collection and a possible decision by EMBASA to deactivate decentralized treatments. It is also an opportunity to recommend that the sanitation plan of the city that is under development, expand the coverage of sanitary sewage aiming at a reduction of the emissions originated by this source in Salvador.

Obtaining reliable and up-to-date data on the Waste Sector can support the preparation of more accurate calculations on the emissions generated by this sector, in addition to collaborating with the City Hall and the bodies involved in the implementation of public policies aimed at waste management, development of clean technologies and/or alternatives to final disposal in landfills (composting, incineration) and encouraging social participation in waste management and management.

The reflections brought here are important not only for the municipality of Salvador. It is necessary that cities and their respective governments increasingly understand their role in reducing GHG emissions, in order to contribute to tackling climate change. In this way, being able to rely on the example of the comparison made on the Waste Sector of the inventories of Salvador can be extremely useful so that other municipalities, when carrying out their accounting, already do so considering all the essential aspects for effective management of environmental risks by through correct waste management.

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Global Journal of human-social science: b
Geography, Geo-Sciences, Environmental Science & Disaster Management
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460x & Print ISSN: 0975-587X

Energy and Climate Change

By Koumbakis Basilios

Abstract- This paper deals with the issue of energy consumption and climate change, their relationship with carbon dioxide, the Greenhouse Effect and Renewable Energy Sources and new trends in climate change reduction with new energy tools. A historical report introduces the initial view of the Greenhouse Effect, while data from the greenhouse gases and solar radiation prove the irrelevant connection of the accused gas with the accusations. In this paper are examined factors that contribute to the increase in ambient air temperature and their contribution to this increase is calculated. The operation of the most widespread renewable energy sources and their contribution to the increase of air temperature as well as to severe weather phenomena are examined. New electro and hydrogen-driven trends and their possible effects are examined. This paper responds substantially to the causes of climate change and asks questions about the policy pursued in this area, in order to solve the problem or reduce its effects. The purpose of this work is a documented critique to the actions taken to solve climate change, which is also documented by the technological failures of humanity that are known to us.

Keywords: *climate change, greenhouse effect, renewable energy, electricity, hydrogen.*

GJHSS-B Classification: *DDC Code: 333.794 LCC Code: TD195.E49*

ENERGYANDCLIMATECHANGE

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Introduction

An important issue in modern societies is the management of energy reserves and the perceptible changes in climate globally that are considered to be due to human activity associated with the burning of fossil fuels. The production of mechanical work and easy-to-use energy such as electricity is linked to the emission of fossil fuels that emit emissions, such as CO_2, and is considered to be one of the important factors influencing affect climate change with the greenhouse effect. From the changes of the gases included in the "greenhouse gases" is judged the development of technological developments for the energy equipment that is produced and used. Despite the significantly organized effort worldwide and actions to reduce the negative effects on the climate, such as the participation of Renewable Energy Sources (RES) (currently in Greece is 28,7% [8]) in electricity production, the rate of increase in temperature in planet is not shrinking and more often intense weather phenomena occur. In addition to Renewable Energy Sources, electrical technology was used in the movement of vehicles as well as the transition to the so-called hydrogen H_2 era to solve climate change. The ineffective measures taken globally is why we can question the entrenched perception of the real cause of climate change and what the consequences will be if the same policy is pursued locally and globally. The purpose of this work is to substantiate the interconnectedness of climate change with CO_2, presenting data on factors that affect climate change, the function of renewable energy sources, their relationship with climate change, the intense weather phenomena that are been observed recently and expected effects from the use of electric propulsion and hydrogen. It is a work in progress contrary to the prevailing currents of perception on the subject of energy and climate change at the international level.

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I. Climate Change and Greenhouse Effect

a) Historical Data

The French mathematician *Joseph Fourier in 1824 spoke for the first time about an increase in the temperature of a planet.* The Swedish chemist *Svante Arrhenius* in 1896 in his doctoral dissertation considers that: *"The rapid increase in industrial activity emitting carbon and other pollutants into the air may not differ, in terms of impacts on climate change, from the elements released into the atmosphere by the eruption of the volcano Krakatoa in the Indonesia in 1883"* [1] calling this process a "Greenhouse Effect". Explaining the phenomenon, he likened the effects of industrial emissions and fossil fuel combustion in general to the emissions of black dust from the 1883 Krakatoa volcano. At that time the fuel was coals, which by their incomplete combustion in the hearths of industries and means of transport (trains and steamboats), released into the environment unburned carbon C in the form of flying black dust. The black color of which absorbed 98% of the energy of the sun's rays on the surface it covered, converting it into heat and increasing the temperature of the air in the environment, as were the effects of the black dust that flew into the atmosphere of the Krakatoa volcano. The Greenhouse Effect is not only due to industrial and transport emissions, it is a natural phenomenon in which components of the atmospheric air and water vapor it contains, retain thermal energy, contributing to the temperature rise on the earth's surface, making our planet habitable. Svante Arrhenius predicted that the effects on Earth are the same regardless of natural (volcanic) or artificial causes (industrial-scale fossil fuel burning). The energy issue that arises in human societies is how the solar energy that falls on the Earth create favorable conditions for our living, without overcoming them and making the Earth

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uninhabitable. In other words, the "Pythagorean cup" is sought in order to maintain the favorable living conditions on planet Earth with the logic of "*all in good measure*".

b) Data of solar radiation, greenhouse gases and atmospheric air

Solar radiation is a group of electromagnetic emissions consisting of ultraviolet, visible and infrared radiation in percentages that shown in Table 1.

Table 1: Data of the solar radiation spectrum (by Kondratyev)[7]

Solar radiation	Ultraviolet radiation	Visible radiation	Infrared radiation
Energy 100%	9%	44%	47%
Wave length	150 - 400 nm	400 – 740 nm	740 – 4000 nm

The infrared radiation of the sun by falling on a solid body is converted into heat. The visible radiation, depending on the color of the body in which it falls, is partially absorbed converting into body heat and is partially reflected in the form of light, perceiving us the corresponding color. White surfaces absorb 65% of visible solar radiation while black ones absorb 98%.

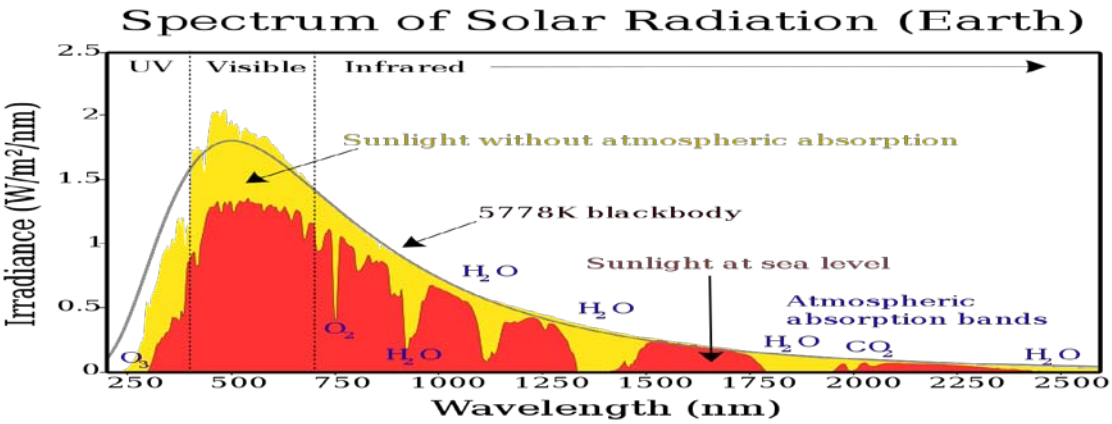


Figure 1: Spectrum of solar radiation and the behavior of the atmosphere [1]

Figure 1 shows that atmospheric gases such as ozone O_3, oxygen O_2, water vapor H_2O absorb radiation at specific emission frequencies as well as CO_2 carbon dioxide which absorbs low-intensity infrared radiation, below 0,5 W/m²/nm specific frequency range. Atmospheric gases are transparent or translucent for solar radiation and infrared earth emission into space at specific electromagnetic emission frequencies. Their degree of transparency is shown in Figure 2 where it appears that CO_2 carbon dioxide does not have a large contribution to the greenhouse effect as H_2O water vapor which in a wide range of frequencies show opacity contributing significantly to the increase of air temperature.

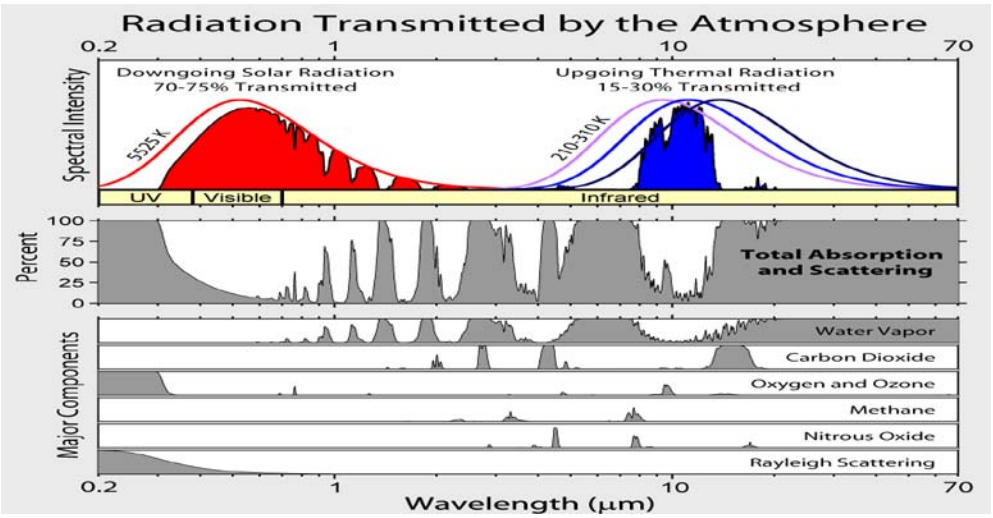


Figure 2: Radiation absorption and refraction at different wavelengths by gases [4]

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In the 19th century, solid fuels such as coal were used to produce energy, in the 20th century we switched to liquid fuels and today in the 21st century to gaseous fuels, so that black dust emissions, if not eliminated, were significantly reduced. But carbon C, or rather today CO_2 carbon dioxide, is still being blamed for the greenhouse effect and climate change on planet Earth.

The carbon dioxide CO_2 is an odorless, colourless, and tasteless gas [3], the product of the combustion of hydrocarbons, which they put into greenhouse gases and are shown in Table 2.

Table 2: Greenhouse gases with high increase in their concentration in atmosphere [1]

Gas	Level the 1750	Level the 1998	Increase	Percent increase	Contribution in W/m²	Density kg/m³
Water vapor (H_2O)	Values changing geographically and by time					
Carbon dioxide (CO_2)	278 ppm	365 ppm	87 ppm	31%	1,46	1,8 in 25°C
Methane (CH_4)	700 ppm	1,745 ppm	1,045p	150%	0,48	0,717
Nitrous oxide (N_2O)	270 ppm	314ppm	44ppm	16%	0,15	

Atmospheric gases absorb only certain energy wavelengths but they are transparent as shown in Figure1. The Carbon dioxide CO_2 is one of the natural components of the ambient air we breathe, which are presented in Table 3 and its participation is not accidental.

Table 3: Composition of dry air[6]

Component gas in atmosphere	Chemical symbol	Content		Density kg/m³
		% by volume	% by weight	
Nitrogen	N_2	78,08	75,51	1,250
Oxygen	O_2	20,95	23,14	1,429
Argon	Ar	0,93	1,30	1,786
Carbon dioxide	CO_2	0,03	~0,04	1,977
Other gases		0,01	0,01	
Summary		100	100	

From the ambient air plants use CO_2 carbon dioxide to perform photosynthesis with solar radiation. Process in which carbon C is captured in plants and O_2 oxygen is released into the environment. The air in the forest is pleasant because it is rich in oxygen O_2 that is expelled by the trees in their photosynthesis. Trees bind carbon C from the air and with the H_2 hydrogen of the earth's water they create chemical compounds that form their trunk. From these trunks humanity was supplied with energy for thousands of years (since the time of Prometheus), from these trunks are formed over millions of years in the bowels of the Earth hydrocarbons, coals, oil, natural gas and we use them today. Plant production in the Earth depends on CO_2 carbon dioxide in the atmosphere, and the reduction of the percentage of CO_2 carbon dioxide in the air reduces plant production on Earth and vice versa or an increase in it offers the possibility of increasing plant production. It is a well-known fact for greenhouse workers that impoverishing the greenhouse atmosphere with CO_2 slows down the growth of plants and reduces their production, because CO_2 in the air is food for plants. So they bring in CO_2 tanks and artificially supply the plants with the food necessary for their growth. In southern countries such as Greece, in case of lack of CO_2 in the greenhouse air, enter clean air rich in CO_2 from its openings, due to the favorable weather conditions. Agronomists know that a concentration of 1000 ppm CO_2 in the air accelerates plant growth by up to 50%.[3]

The same thing happens in nature, reducing the percentage of CO_2 in the atmosphere reduces plant production, but it is better not to do such an experiment, because we will all be hungry. Nature has determined that CO_2 has a high specific gravity (see Table 2) to be directed to the surface of the earth where plants need it as food for their growth. At high altitudes in the mountains, trees that require large amounts of CO_2 do not thrive, where the vegetation decreases, moss and lichens prevail, up to the complete lack of plants.

In figure 3 it is shown the recorded increase the carbon dioxide CO_2, the methane CH_4, the Nitrous oxide N_2O and some Chlorofluorocarbons (CFC's), observed in the last 45 years.

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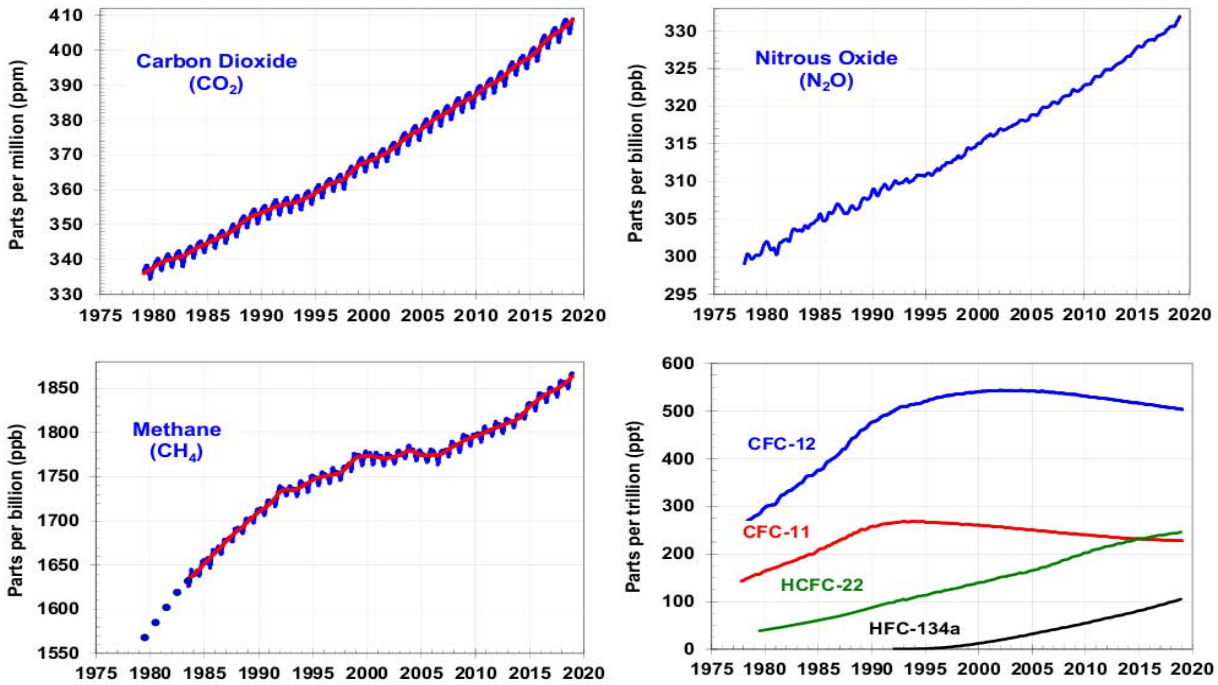


Figure 3: Carbon dioxide CO_2 change, methane CH_4, nitrous oxide N_2O & Freon [1]

The Figure 4 then shows the flows of CO_2 carbon dioxide from earth's activities and the atmosphere according to the IPCC, in which it appears that the sources of carbon dioxide emissions are not only the combustion of fossil fuels, but there are other natural sources that emit it.

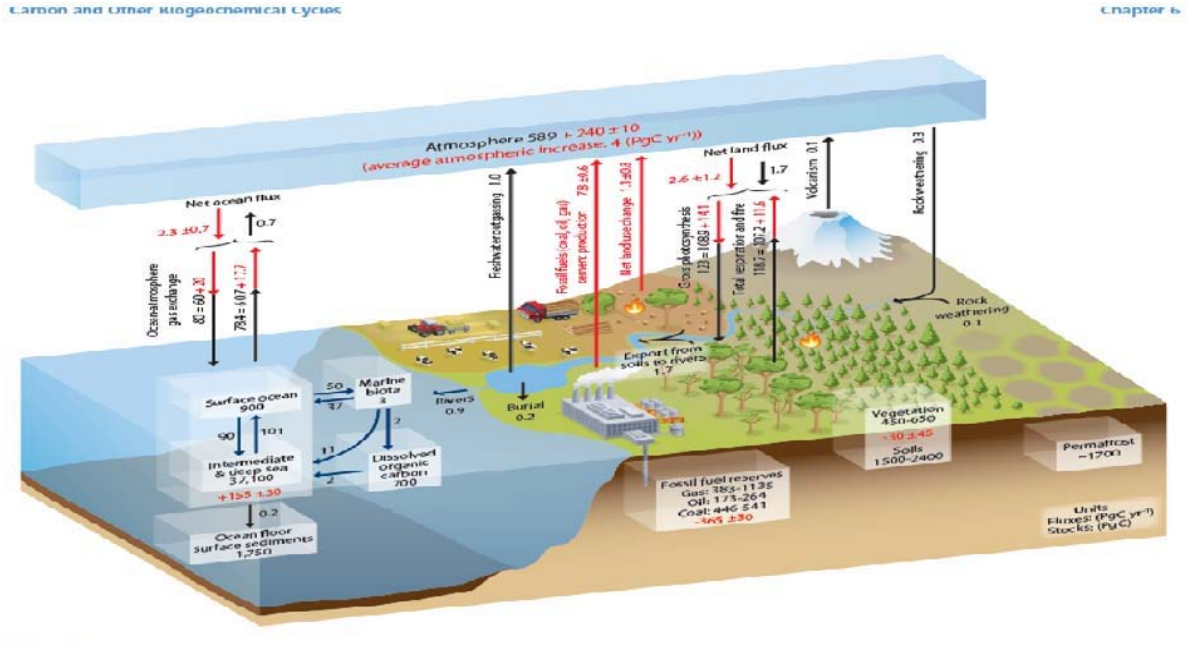


Figure 4: Illustration of CO_2 carbon dioxide flows between earth and atmosphere [4]

The oceans emit 78,4 units of CO_2 and receive 80 units, i.e. they receive 1.6 units more CO_2 than they emit. On land, 1,0+7,8+1,1+118,7+0,1=128,7 units of CO_2 are emitted to the atmosphere while 123,3 points, 5.4 points surplus are taken. This difference, however, may be due to reduced consumption of carbon dioxide and not necessarily to its increased emission. The 5,4 – 1,6 = 3,8 points surplus of CO_2 is 0,9% of its moving quantities in the atmosphere.

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Table 4: GLOBAL WARMING POTENTIAL (GWP) Source IPCC [4]

Greenhouse Gases		GWP
Carbon Dioxide	CO_2	1
Methane	CH_4	25
Nitrogen Protoxide	NO	298
HidroFluoroCarbons	HFC	124 – 14.800
PerFluorCarbons	C_nF_m	7.390 – 12.200
Sulfur HexaFluoride	SF_6	22.800

In table 4 provided by the IPCC shows the effects of greenhouse gases with strong action compared to carbon dioxide CO_2 obtained as 1 unit, the table shows that the reported gases are, tens to thousands of times more effective in the effects of global warming than in carbon dioxide CO_2.

In 2020, the United Nations World Meteorological Organization (WMO) states in a report that despite global lockdowns and declining industrial activity, transport and expected CO_2 emissions, its level of September 2019, which was 408,6 ppm, increased in September 2020 to 411,5 ppm, indicating that the change in this gas content is clearly not commensurate with actions to reduce the effects of climate change [10] . It seems that reducing CO_2 emissions from industry and transport, which is only 7,8 units[4], does not mean that its appeal to the atmosphere will stop because:

- We do not stop the CO_2 emissions from forest fires which are ~ 118,7 units
- We do not stop the CO_2 emissions from carbon water sources that are 1 unit.
- We do not stop the CO_2 emissions of volcanoes which is 0,1 units
- We do not count the CO_2 exhaled by humans and animals, (~1 kg CO2 / person per day)
- We do not count the CO_2 from champagnes, beers, soft drinks, carbonated waters and cigarettes.

If CO_2 emissions from the combustion of fossil fuels are reduced to zero, it will be established after some time that this reduction from industries and transport does not have the expected effect on its participation in the ambient air because carbon dioxide emissions are not only made by burning fossil fuels. Each person emits about 1 kg of CO_2 into the atmosphere a day, but this is not a pollutant, it is our participation in the C carbon cycle on Earth. [3]

The release of methane CH_4 into ambient air has a similar upward trend to CO_2 as shown in the diagrams in Figure 3, where the almost parallel increase in the two gases is not explained by the burning of fossil fuels which is said to be due to climate change because the combustion of fossil fuels and any combustion does not emit methane CH_4. Figure 5 below shows the emissions of methane CH_4 into the atmosphere according to the IPCC [4] and it appears that methane CH_4 has only emissions, there are no consumers. It is known that any decomposition of organic matter results in CH_4 methane such as materials in landfills, livestock waste, dead biomass in forests, swamps and generally in the countryside. The largest increase in CH_4 methane in relation to CO_2 carbon dioxide (~2.5 times) in the atmosphere, according to Table 2, may be due to the forest biomass abandoned by modern societies, which is not used as it used to be as an energy source.

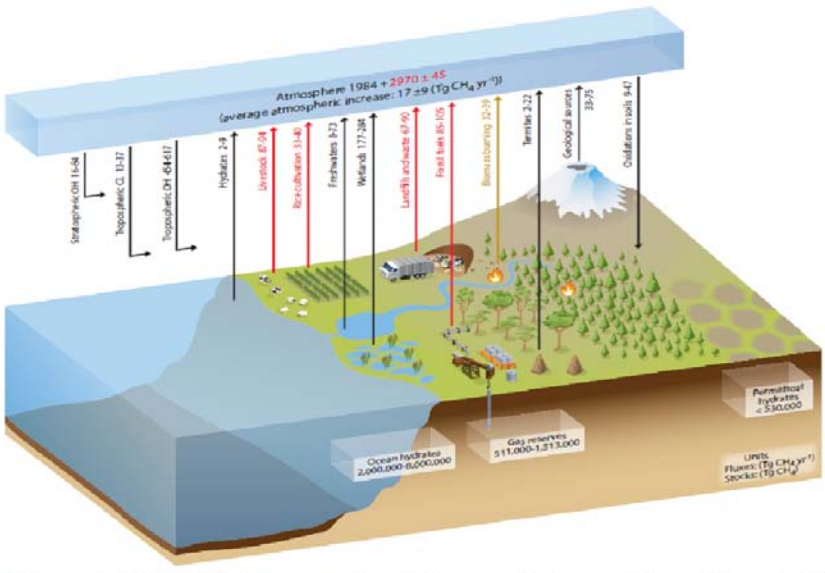


Figure 6.2 | Schematic of the global cycle of CH4. Numbers represent annual fluxes in Tg(CH4) yr−1 estimated for the time period 2000–2009 and CH4 reservoirs in Tg (CH4); the

Figure 5: Illustration of CH_4 methane flows between earth and atmosphere [4]

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Biomass that was previously intended (before the middle of the 20th century) for burn and which would have CO_2 emissions is now abandoned in the forest and with its decomposition emits CH_4 methane into the atmosphere. The energy that would have been produced from this forest biomass again emits CO_2 carbon dioxide, but today it comes from fossil fuels. This explains the greater increase in CH_4 methane relative to CO_2 carbon dioxide and the increase in forest fires since the middle of the 20th century. After the II World War, the energy model changed significantly, the forest was abandoned as an energy source and it was transferred to the oil fields of the Persian Gulf. In the forests now accumulates the discarded dead biomass, good fuel and despite the increase of modern mechanical equipment to combat forest fires, huge areas of forest are now being burned throughout the developed world.

c) The natural function of carbon dioxide CO_2

The naming as a "pollutant" of the CO_2 carbon dioxide that all humans, fauna and flora exhale is probably due to the reading of Svante Arrhenius' doctoral dissertation as it was understood in the 19th century. Carbon dioxide CO_2 exists in the atmospheric air before humans appear at the forefront of planet Earth's history. It is a gas emitted by natural organisms (flora, fauna and people) producing the energy necessary for their lives. Thermal machines are the people, as well as animals, thermal machines are also the engines of our means of transport. We operate at 36,6°C, the engines at a higher temperature. Carbon dioxide CO_2 emits to all of us lives as well as the engines of vehicles and machinery to produce work. CO_2 is eliminated in the air by its producers and consumed by plants for their growth. In ambient air, CO_2 carbon dioxide exists as an intermediate storehouse. It enables plants with their photosynthesis to develop and the increase of plant production (agricultural crops and forest vegetation) requires increased amounts of CO_2. Of course, it does not mean that excessive CO_2 emissions in the urban environment will increase crop production in the fields, it only means difficult living conditions in cities. The European Union stipulates that in cities the green surfaces should be $10m^2$/inhabitant, while in Thessaloniki they barely reach $2m^2$/inhabitant [9] Therefore, it is not the consumption of fossil fuels that is to blame for the increase of CO_2 carbon dioxide in the city, but the negligence of the municipal authority to take care to increase its parks, which may consume it.

It is a fact that the engines of the means of transport emit significant amounts of carbon dioxide CO_2. Their manufacturers offer new technology engines and with more noble fuels such as LPG and natural gas reducing fuel consumption and CO_2 carbon dioxide emissions. Existing technological solutions that have not been adopted by many companies. Some prefer to create software to mislead the control authorities when checking their vehicles rather than reduce the emissions of their vehicles, especially if this ensures increased sales and profits. Other companies such as Urban Transport Organizations are more likely to request an increase in the price of the ticket for environmental reasons than to use natural gas on their buses.

The balance between emissions and consumption of CO_2 carbon dioxide in the atmosphere has been broken in recent years. Significant areas of forests that consume quantities of this CO_2 gas on a global scale are being destroyed (Siberia, Canada, America, Amazon and forests in Europe and Greece) reducing the ability to balance the emission and consumption of CO_2 carbon dioxide into the atmosphere.

The reduction in the consumption of CO_2 carbon dioxide by forests combined with the burning of fossil fuels leads to the effect of increasing co2 carbon dioxide in the atmosphere as shown in the diagrams of the figure.

The increase in the world's population, however, requires an increase in the available food, thus an increase in plant production, which means increased consumption of CO_2 by plants. Therefore, increased amounts of carbon dioxide CO_2 in the ambient air are required to balance the increased consumption with its increased production and not the reduction of CO_2 as attempted.

II. Increase in the Atmosphere Temperature

They say that the increase in the temperature of the environment is caused by CO_2 dioxide from the combustion of fossil fuels while as shown in Table 3 its specific gravity is great so that it orient CO_2 in the high layers of the atmosphere with the greenhouse effect so that it is responsible for the increase of the temperature of the atmosphere and any contribution to this increase is much less than the participation of water vapor H_2O as shown in Figure 2. However, there are not the entries from:

- Forest fires. (in Greece annually burned 500,000 to 1,000,000 acres of forest emitting huge amounts of black dust)
- The combustions from self-ignition of landfills with negative effects on air quality.
- The waste heat in the environment from internal combustion engines, Steam Power Stations, domestic heating, air conditioning and other technologies.

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a) Technologies produced useable work and temperature of atmospheric air

The involvement of the various technologies available in the increase in air temperature with their heat expelled in the environment is shown in Table 5.

Table 5: Comparison of the degree of energy conversion of different technologies [13]

Useful engineering, thermal or electrical power generation technologies	% conversion to useable power	% thermal waste	Summary
Engine Otto	~ 28%	~ 72%	100%
Engine Diesel	~ 40%	~ 60%	100%
Engine Atkinson-Humphrey	~ 45%	~ 55%	100%
Engine Brayton gas turbine	~ 35%	~ 65%	100%
Engine Stirling	~ 35%	~ 65%	100%
Installation Rankine steam machine	~ 15%	~ 85%	100%
Installation Rankine steam turbine	~ 30%	~ 70%	100%
Installation Brayton–Rankine gas-steam turbine	~ 60%	~ 40%	100%
Photovoltaic system only electric	~ 18%	~ 82%	100%
Photovoltaic system electric and thermal	~ 80%	~ 20%	100%
Fuel cell	~ 50%	~ 50%	100%
Solar thermal system	~ 70%	~ 30%	100%
Electric boiler	~ 100%	~ 100%	100%

Table 5 shows that the technologies used discharge more heat into the environment than the useful work for which they were built. An important contribution to the heating of ambient air is the technology of electric power generation.

The ambient air in Greece is a parallelepiped 1000km long, 1000km wide and 3km high that contains 1.000.000 * 1.000.000 * 3.000 * 1,25 = 3,75. 10^{15} kg air. According to the equation Q = m.cp.ΔT the mass 3,75. 10^{15} kg air with heat capacity cp = 1kJ/kg ° K will increase its temperature by 1 ° C with heat 3,75 . 10^{15} kg* 1kJ/kg°K* 1°C = 3750 . 10^{12} kJ or 3750. 10^{12}/3600 = 1,04. 10^{9} MWh.

Annually, on average in Greece, 50. 10^{6} MWh of electricity are produced, which with an energy conversion rate of 35% Steam Power Plant means that 1-35% = 65% of the primary energy of fuels is discharged into the atmosphere, lignite in our case, or 50. 10^{6} /0,35 = 142,8. 10^{6} MWh of primary energy of lignite and in the environment are expelled 142,8. 10^{6} MWh * 0,65 = 92,8 MWh heat capable of increasing our air temperature mass 3,75. 10^{15} kg by 92,8. 10^{6}/1040. 10^{6} = 0,08°C per year.

The increase in air temperature results only from the waste heat for the production of electricity by the Steam Power Plant every year. Adding both the fuel consumption for movement and heating as well as the heat from fires, it makes sense to continuously increase the air temperature that we cause with the selected technologies.

Heat into the environment is also expelled by machines that are not in operation, such as black cars (state limousines). Without black cars operating, only parked and exposed to the sun in the summer with an intensity of 1000 W/m^2 (countries with significant sunshine) and vehicle dimensions 4,5 m long and 1,6 m wide emit 4,5m* 1, 6m = 7,2m^2 => 7, 2 m^2* 1000 W/m^2 * 0, 98 = 7,0 kW heat Converting 98% of the solar radiation that falls on them into heat, expelling it into the air, increasing its temperature, as is the case with black surfaces. That's why in Greek tradition most of the objects are white and light colored such as the houses with white walls and ceilings especially on the islands, white boats, white traditional costumes, clothes and even the monuments are made of white marble.

Carbon dioxide CO_2 in the air is been accused, the component with 0,03% in volume or 0,04% in weight (see table 2) of air that causes the increase in temperature on Earth. So, after finding the "culprit" of climate change and convincing a large percentage of the population, a method of storing CO_2 is now being sought to build and install the necessary equipment, producing typical profit. As a profit is currently generated by selling and buying CO_2 emission allowances.

There is also a simpler methodology for storing CO_2 carbon dioxide, such as the example of China, which planted trees and greened the 42200 square kilometres of The Maowusu Desert. An arid inhospitable region of the last 1000 years today produces oxygen O_2 by binding the carbon dioxide CO_2 of the atmosphere to the trunk of its trees. In this way, China is fulfilling its obligations to reduce carbon dioxide CO_2 imposed by its international commitments and by improving the living conditions of its citizens. Since the Chinese managed to green desert so it is possible.

- to reforest conventional lands and grow trees in cities
- to clean forests from its dead biomass, protecting them from fires
- not to abandon forests as an energy source;

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– to demand responsibility from those responsible for invalidly extinguishing forest fires;
– not to regard as a GDP increase the repair of damage from forest fires;

b) The thermo insulation and the temperature of atmosphere

Thermal insulation has been applied for many years to reduce heating energy consumption and residential air conditioning. The method works well in countries with little sunshine. Thermal insulation is strong resistance to the energy flow between the living space and the environment, ensuring thermal comfort in the building thus due exclusively to purchased energy. In the south, however, as in Greece and other countries, the sun god Apollo also provides high sunshine during the winter season. Buildings constructed up to the beginning of the 20th century provide conditions of thermal comfort throughout the year without high-tech heating and air conditioning systems. Thermal insulation protects against thermal energy losses but isolates the building from the ability to accept free solar energy in winter and not have large air conditioning needs in summer. This seems to have been known in antiquity and shaped with different thickness the walls to the south that assumed the role of a heat storehouse derived from solar energy, as was shown in archaeological excavations where walls with different thicknesses were found towards the different orientations. The large mass hinders the thermal flow between the living space and the environment, improving thermal conditions and reducing energy consumption. With the external thermal insulation that is applied lately, the thermal mass of the wall that the sun sees decreases, its temperature rises rapidly and emits the energy that ~~it~~ had been converted from the sun to the environment into a form of heat resulting in a further increase in the temperature of the air all year round. Increasing the temperature of the air in the environment, a result of external thermal insulation, increases the required energy for the operation of air conditioners. Because they expel the heat they receive from inside the building at the highest temperature of the ambient air. An increase that means a general increase in electricity consumption, an increase in the use of primary energy with their associated emissions. Do not be surprised by the increase in temperature in the environment and the climate change that we are causing on our own in order to have secured customers and sales of energy supply companies. We may learn from our ancient ancestors by diversifying the thermal behavior of each surface of the building, utilizing the free energy that the sun offers to all of us free of charge, as well as the modern technology of insulation materials, but adapted to the real needs of the building, integrated into its respective environment.

III. The Renewable Energy Sources

Developed countries are turning to new technologies for the production of useful, easy-to-use forms of energy such as electricity from renewable energy sources, independent of fossil fuels. The most widespread of these are the photovoltaic panel parks and the wind turbines with which the work is then engaged.

a) Photovoltaic power plants

The production of electricity with photovoltaic cells that was intended for space applications is been applied to earthly ones since the beginning of the 21st century. Their manufacturers report that the degree of conversion of solar radiation to electricity, with a solar radiation intensity of 1000 W/m^2 is 150 to 180 Wp[12] which means a maximum electrical power of up to 180 W/m^2 from the available 1000 W/m^2. The degree of utilization of 18% of solar energy by photovoltaics is a good grade, considering that 30% is the maximum theoretical limit that can be achieved with this technology according to Shockley–Queisser. [14]

The 80% of solar energy is converted into heat due to the dark color of the solar panels, eliminating heat directly into the ambient air, plus about 2% reflected in light form. Installed photovoltaic panels of 1000 m^2 on the ground produce 180kWp (maximum 180kW) electricity for the grid and 800kW of heat for the ambient air. Thermal energy greater than the waste heat of conventional electricity generation systems with an Steam Power Plant of equivalent power. The photovoltaic panels increase the air temperature on them to a degree of 100m according to Q = m.cp.ΔT by 800 kW / (1000m^2 * 100m * 1,25kg/m^3 * 1 kJ/kg°K) = 8,0 /1250 = 0,0064 °C/sec.

This increase is not noticeable in the field of photovoltaic installation because the upward thermal current of air that is created, brings neighboring cold air masses. If all the electricity in our country is produced with photovoltaic parks i.e. the produced electricity every year of 50,106 MWh electrically, on average, it means that from the primary energy of the sun 50. 10^6 MWh/ 0,18 = 277,7. 10^6 MWh. heat will be expelled in the environment 277, 7. 10^6 MWh * 0, 8 = 222, 2. 10^6 MWh vs. 92, 8. 10^6 MWh of heat expelled by the Steam Power Plant with lignite fuel.

The waste heat of photovoltaic parks can increase the air temperature mass 3, 75. 10^{15} kg by 222, 2.10^6/1040. 10^6 = 0, 2°C per year. Compared to lignite, the increase in air temperature of the atmosphere in the era of environmentally clean technologies will be 222,2/92,8 = 0,2/0,08 = 2,4 times faster. While the participation of lignite and carbon in general decreases (in Greece to 10.9%), the participation of renewable energy sources increases (in Greece at 28,7%), the measures to combat climate change are not working

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and the increase in the temperature of the environment continues.[8]

What is dangerously worrying is that the possibilities for intervention are diminishing, because in the era of CO_2 emissions there is the possibility of neutralising CO_2 with increased consumption by forests, crops, etc. If we intent to and we increase the areas, protect the forests and crops, there is a possibility. With the increase of the air temperature by photovoltaics there is no possibility of neutralizing the increased air temperature achieved because heat is the lowest form of energy and there are no available technologies for its consumption.

The solar rays that fall on earth are converted inside the soil into heat absorbed by the huge mass of the soil maintaining it until it is slowly expelled when the ambient air requires it, thus regulating the ambient air temperature. It is heated in the summer and delivers this stored energy late in the winter to the air, mitigating the large temperature fluctuations it would have had without the stored solar energy. The photovoltaic surfaces are inserted between the sun and the ground so that the solar energy is directly converted into heat in the ambient air increasing its temperature without being stored in the soil covered by the photovoltaic surfaces to function normally as an energy storage of solar energy. The extreme reactions of nature appearing as intense weather phenomena are none other than the response of nature to the interventions on its natural function that we cause ourselves and which we are obliged to pay dearly.

We are talking about an increase in the temperature in the environment while there is a drop in temperatures, in the winter months, to very low unusual temperatures for the regions. This is because with our activities we orient the solar energy to heat the atmospheric air which small mass increases its temperature. The soil in which solar energy can be stored, which balances the temperature changes of the air, is not heated, and thus, in the end, the sharp fluctuations of the climate are observed.

Photovoltaic are also installed on roofs of buildings in which solar rays are converted into electricity and heat for the environment at the same rates. In the summer these protect the building from solar rays falling on its roof, reducing the thermal load of its air conditioning installation. While in winter the photovoltaics act as additional insulation reducing the effect of winds especially when photovoltaics are an integral part of its roof. The heat produced by rooftop photovoltaics is not considered additional heat for the environment because anyway the incident solar radiation in each building is eliminated in the form of heat in the air, so that the comparative daily thermal balance is neutral.

Photovoltaic producers also offer more environmentally friendly proposals such as complex photovoltaic-thermal panels that produce electricity and thermal energy covering domestic hot water needs, building heating and electricity, utilizing solar energy up to 80%.

With the complex photovoltaic-thermal panels, the large photovoltaic parks are not constructed, which are intended to take advantage only of the favorable legislation for electricity production, converting only 18% of the available solar energy for the electricity grid and 80% for heating the environment. Photovoltaic parks on the ground do not take into account the harmful effects on the environment that they cause with their thermal emission. We pay for the solar energy that falls on the producer's soil and turned it into beneficial, while we ignore the energy from the same sun that falls on our house.

b) Wind turbine power plants

The use of wind energy is not a new technology it has been around for thousands of years, offering the ability to produce energy for grinding wheat in windmills. The current exploitation of wind has nothing to do with the old technology of harnessing the energy of the wind producing beneficial mechanical energy where it is consumed. The wind of the area was exploited in the property itself and not the flow of air masses that pass at high speed from critical points of the Earth's surface.

The winds are the result of a difference in pressure of different areas, with High and Low Barometric (HB-LB) that have a different intake of heat and thus creates the air current that we call wind. The purpose of the wind is not to turn the blades of windmills and wind turbines but to thermally balance areas with different pressures and temperatures. In the old windmills, the wind, after having fulfilled the heat transfer that is its main mission, it would dispose the rest of its energy in the windmill.

Modern wind turbines bind airflows at critical points of its flow, with high speed to deliver maximum energy to the wind turbine. With a theoretical maximum of 59% they detach up to 40% of the wind's energy, so for every 1 kW of electricity from wind, resistance is created in its path equal to 1/0,4 = 2,5 kW or 250% greater than the generated power. When resistance is inserted in the wind flow (such as a wind turbine park), the difference between the atmospheric pressures of the different areas remains high and the time of weakening of the wind is lengthened. High temperature differences are maintained between the areas in relation to the natural course of the wind attenuation phenomenon. The maintenance of high differences in atmospheric pressures and temperatures cause more intense movement of the air masses and appear as the unexpected, intense weather phenomena.

Wind turbines do not emit pollutants, but contribute directly, to a high degree, to the maintenance of high temperature differences between wind-creating

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areas. They contribute to the increase of the time of balancing temperatures on the Earth's surface by participating in the intensification of climatic phenomena. That is why, while the participation of renewable energy sources in our energy supply is increasing, at the same time the intense weather phenomena in the unusual residents and their infrastructure that are not adapted for this are increasing. But this is direct climate change and not indirect as in the burning of fossil fuels accused of being responsible for climate change.

The installations of wind turbines on the ridges of the mountains may be legal according to the legal texts issued by the beneficiary, but even this procedure is commonly accepted as a change of use. The conventional use of mountains for thousands of years was the residence of fauna and flora of the area while the current change of use turns the area into an industrial use of electricity generation. A change that is not temporary, it is a permanent burden on nature, something that we do not have the right to do because we were not given that right. It is being seized by the force of the "lawful" act. Nor do we have the right as intelligent societies to endanger the lives of wild birds that, unable to cope with the high speeds of movement of fins, fall on them, resulting in their death

Wind turbine with a diameter of 100m and 1 rotation/sec has velocity at the edge of the $V = \pi . D =$ 3,14*100 = 314 m/s = 1130 km/h. Such speeds cannot cope with birds, and their collision with the wind turbine fins means their certain death. On the highways there are fences preventing such collisions of our moving civilization with wildlife, but in wind turbines there is no such possibility.

An important factor in turning to renewable energy sources was the expected reduction of energy costs and correspondingly the cost of the final product, but with the wind turbine and photovoltaic parks, exactly the opposite can be seen. This is because while in traditional windmills the cost of energy did not participate in the formation of the price of the product, in modern wind turbines the cost of energy participates in the formation of the price of the product as an energy cost, while its VAT has a negative role in the available liquidity of the company. We also see it in the electricity bills in houses and businesses with the increase in the price of electricity. The only beneficiaries of the implementation of RES are the power companies with wind turbines, photovoltaics and the state that ensures revenues from VAT.

IV. New Direction for Energy use

For the protection of the environment, new directions are currently being chosen, such as electro mobility and hydrogen power, which, as promised by those responsible, will solve problems in the environment. It so happens that these two forms of energy have common characteristics and both do not exist in nature. Electricity is not free in nature, nor is hydrogen free in nature. Electricity and hydrogen are in fact energy carriers, systems for the production, transport, storage and use of an easy-to-use form of energy. An attempt is being made to change a large part of the world economy, because until now we have been buying energy from the one who has the deposits and reserves and now we will be buying from the one who has the technology. This is very dangerous because, as explained, the increase in temperature on earth will happen faster without the possibility of corrective intervention. Since it was produced and sold, electricity has been intended for stable energy consumers due to technology, and only nowadays has it approached mobile energy consumers, while hydrogen seems to be intended for mobile energy consumers.

a) Electro mobility

The electro mobility existed in the past such as in the subway, trams, trolleybuses and electric motor vehicles on golf courses. What is being attempted today is the expanded use of electromobility to the extent that it becomes the only form for cars, mopeds, etc. The necessity came from the unfavorable conditions of the atmospheric air in large cities, where due to overcrowding and long distances, daily transport is by cars that have thermal engines that emits quantities of exhaust gases.

With the experience of electric cars and mopeds on the road today they promise that we will have a clean atmosphere in our cities in the future. Yes, in cities the atmosphere can become clean but where this energy is produced the atmosphere will have increased carbon dioxide emissions. The amounts of energy required will also be greater because energy losses will have to be ensured during its transport.

From a decentralized system of carbon dioxide emissions production we will move to a concentrated emission system. In some areas there will be oversaturation in carbon dioxide emissions and in others a CO_2 deficiency. Unfortunately, oversaturation will not be where there is a need for CO_2. Renewable energy sources cannot consistently meet energy needs since their sources are not stable. The big change in the model that is being prepared is intended to bring many jobs to a specific branch of industry, opening up a huge market and the flow of money and in this case will again have a direction, towards the specific companies that prepared the scenario. The benefit to the environment will be local oases, in city centres, accompanied by local over-concentration of emissions in energy power plants.

However, what is not taken into account are the thermal emissions from the electromechanical equipment for the production and consumption of electricity. Thermal emissions that regardless of whether

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they are from electrical or mechanical equipment if they are for the production or consumption of electricity will continue to exist. The dangerous thing about thermal emissions is that we will realize their consequences when it is already too late, that is, when the temperature of the environment has risen and in some areas living conditions will become unbearable. Thermal systems are inertial and there is no possibility of intervention in them to deal with the consequences since they expel their heat in the environment.

The problem created by vehicles in large cities came from the traffic and the number of vehicles turned it into an environmental one and today it is being attempted to be solved by changing the energy from chemical to electric. However, the traffic problem in the cities will continue to exist, something that does not exist in the countryside and in small towns or villages. So it is not the problem at its root that is solved, but its symptoms, which means that it will appear again in a different way. So electro-mobility is not the solution, is an aspirin.

b) Hydrogen mobility

Another attempt to exploit modern technologies to tackle climate change is the transition to the hydrogen economy or hydrogen power. Hydrogen H_2 has the highest calorific value of all fuels, for example gasoline contains 44 MJ/kg energy, propane 46,4 MJ/kg and hydrogen H_2 140 MJ/kg i.e. 3 times more energy than propane. This property as well as the fact that in its combustion only produced H_2O water is what have led us to exploit this energetically also. The disadvantage, however, is the very low density of 0,09 kg/m^3 while the density of gasoline is 850 kg/m^3 and in order to be usable it must be stored in bottles with a pressure of more than 200 bar.

The low density causes a serious problem by reducing the efficiency of the internal combustion engines because the fuel occupies a large volume in the cylinder of the engine reducing the capabilities of the production of mechanical work. Figure 6 shows comparative data on the volume of fuel and air in a conventional petrol engine, an atmospheric hydrogen engine and an supercharged engine. Figure 6 shows that an engine with hydrogen will have a 16% reduction in the energy with which the cylinder is filled due to the low density of H_2 hydrogen. This requires more work for compression and the only solution that reliably improves the situation is the technology of direct injection of H_2 hydrogen into the cylinder. This technologically limits the possibilities that future vehicle engine manufacturers will have by making the product even more expensive.

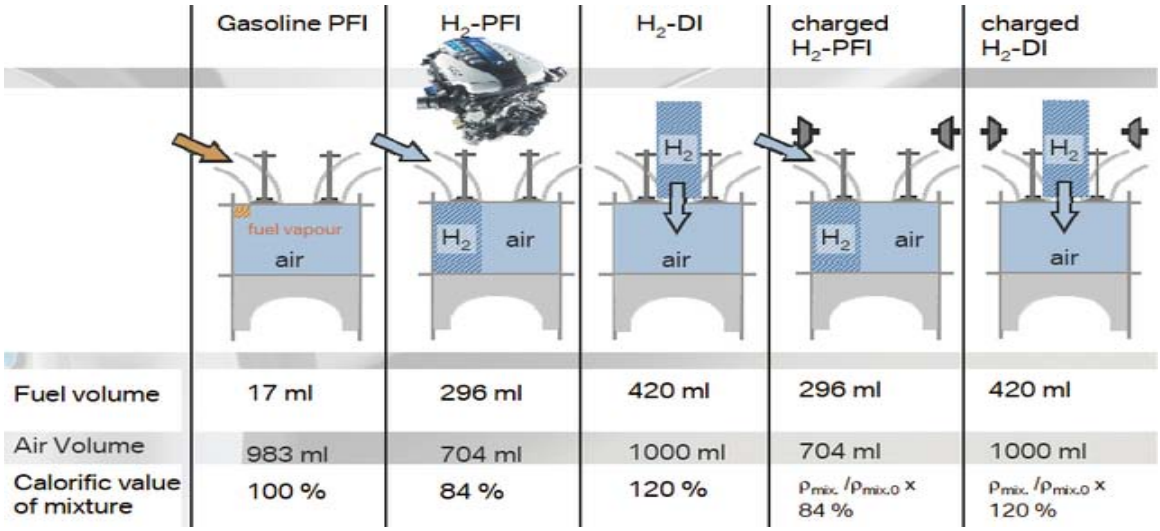


Figure 6: Comparison conventional engine and hydrogen engines [15]

With hydrogen mobility, the environment will be freed from CO_2 carbon dioxide and replaced with H_2O in gaseous form i.e. water vapor. However, figures 1 and 2 have shown that the contribution of H_2O water vapor to the containment of heat on planet Earth is greater than any effects that CO_2 carbon dioxide can cause. It seems that the situation in the environment will probably get worse if we move on to hydrogen power while we have made huge investments in our transition to the hydrogen economy. In addition to increasing the air temperature which will be a side effect of the hydrogen-powering process, the percentage of carbon dioxide of CO_2 necessary for the photosynthesis of plants on Earth will be reduced, thus reducing our food.

The big problem that is often referred to as climate change is the warming of the environment. However, one of the most important factors for this increase is the effluent heat from the cooling of the thermal machines of mechanical engineering, such as internal combustion engines. The change of fuel with hydrogen however does not change the degree of conversion of the energy of the fuel into a mechanical

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work, this degree remains the same and quite low if we take into account that hydrogen power is applied to engines of the thermodynamic cycle Otto or ~ 28%. As shown in Table 5, the Otto engine used in cars has one of the lowest degrees of utilization of fuel energy. In fact it is a good heating system of the environment that as a sideline gives us the ability to move.

There are other thermodynamic cycles but for the economy of production of mechanical equipment, the Otto cycle is chosen, without seeing that the cheap equipment cost very dearly by paying more fuel and the consequences caused to the natural environment. Figure 7 presents the 4 basic thermodynamic cycles and it is easily established that the mechanical work produced by the Atkinson-Humphrey thermodynamic cycle is much larger and yet in practice it has very little application. Initially this was done because of the established level of technology and then because of established legal texts. The generalized use of the Atkinson-Humphrey thermodynamic cycle today with the existing fuels could show an improvement in the current situation from an environmental point of view, but unfortunately solutions are being chosen whose application promises greater profits.

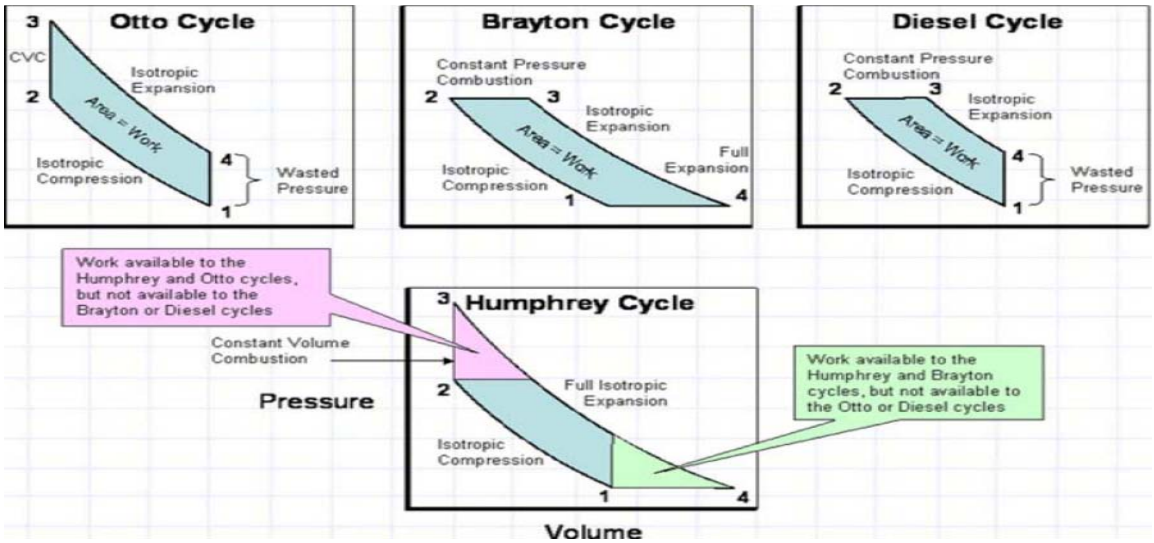


Figure 7: Comparison thermodynamic cycles Otto, Brayton, Diesel and Atkinson–Humphrey [4]

As it seems, however, the most difficult thing is to establish actions that really benefit the inhabitants of this planet and their environment.

V. Technological Failures in Human History

It is not the first time that humanity has been plagued by the wrong decisions that people make about themselves.

In the Middle Ages in North-Western Europe people died without explanation about the cause of their death. Modern research on the bones of old cemeteries finds that the deaths came from a high lead content. A toxic heavy metal used in the mixture to make food dishes and drinking bowls. It seems that on their own they were taking in small doses every day of the poison they were preparing for themselves. A technology cheaper than ceramics used in the Mediterranean for the same purpose where no deaths from heavy metals were observed. In the second half of the 20th century we added tetra-ethyl-lead to gasoline to increase the power of the engines. Deaths from the inhalation of the heavy toxic metal were not recorded, so that the crime is not seen, but fortunately with the new century its use was banned.

The great sea discoveries lasted a long time because the deaths from scurvy were more than the deaths from shipwrecks and naval battles and made it difficult to make long journeys. The disease was caused by the sailors themselves who ate only meat to give them strength. The lack of vitamins from vegetables and fruits caused the disease that today we have forgotten. James Cook's success in making a three-year journey to discover Australia without losing his sailors is due to the diet of the crew he had chosen, including sour cabbage on the menu.

1952 is considered the year with the worst air pollution in the UK, due to London's large cloud "The Great Smog" from which 12,000 people died in a matter of weeks. The phenomenon of photochemical clouds known as "Los Angeles type" pollution as it first appeared in 1943 in this city, had described 100 years earlier, in 1852, the English chemist R. Smith studying the air pollution of Manchester. The scientific knowledge of the phenomenon, however, did not prevent the loss of the 12,000 lives unjustly in the exacerbation of the phenomenon created by the combustion of solid and liquid fuels with a low degree of exploitation in the densely populated city of London.

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After the Second World War, humanity had the impression that it is in a new era of energy production with inexhaustible possibilities, the era of nuclear energy. At first it seemed that environmental pollution had been combated, even though it was known that the nuclear fission power system is a system of unstable equilibrium. It was only after the major accidents at Chernobyl in 1986 and Fukushima in 2011, with the consequences of hundreds of direct deaths and pollution of the regions for hundreds of years, that a review began that nuclear fission can solve the problems with environmental pollution and the growing demand for cheap energy, turning societies towards other energy sources.

The great epidemics in human history that sent over a hundred million people to death such as plague and cholera were the result of the unhealthy modes of operation of water and sanitation systems in the middle ages. In other words, it was a technological inadequacy of the time. At the same time in the universities they taught basic theology, law and philosophy and secondarily they were engaged in the natural sciences. Thus, they could not give society scientific executives worthy of solving problems of natural origin. Meanwhile, the level of hygiene in ancient Greece was known, such as that in ancient Olynthos 2500 years ago drinking water came with a clay pipe to the city from the mountain and every house had sanitation.

Sultan Bayezid II, mocked the King of Spain Ferdinand and Queen Isabella, in 1492 for the persecution of the Jews, saying "Call Ferdinand a wise ruler, the one who bankrupted his own country and enriched mine." The Jews expelled from Spain engaged in trade in the Ottoman Empire and enriched themselves and the Sultan's state. But what the sultan does not say is that the irrelevance of the Spanish kings was largely due to his military power, because the Jews were good craftsmen of gunpowder, an art they had learned from the Arabs of Spain. The largest gunpowder operation of the Ottomans was in Thessaloniki, in the Jewish city of the empire and supplied the sultan's army with gunpowder throughout the Balkans. Spain 80 years later, i.e. in 1571, had to cooperate with all the Christian naval forces of the Mediterranean to face the Ottomans in the Battle of Nafpaktos, fortunately successfully.

Germany started a war in 1940 and lost it to its technological inadequacy. Its tanks, Panzer IV, had a 300 HP petrol engine with a 670 Lit fuel tank ensuring a range of up to 200 km and a maximum speed of 40km/h requiring 3,3 Lit/km, were pitted against the Russian T-34 tanks that had a 500 HP diesel engine with a 560 Lit fuel tank ensuring a range of up to 465 km with a maximum speed of 55 km/h requiring 1,2 Lit/km. The movement of German "high" tanks required 3,3 gasoline/1,2 diesel = 2,75 times more fuel of better quality. The enormous fuel demand of the German army led him to Africa, breaking his forces, something contrary to the theory of the German general Carl Philipp von Clausewitz [16] described in his famous book “About War”.

VI. Conclusions

The conclusions may sound contrary to what has been said about climate change by the media, governments and scientific voices, but the reader can judge their correctness with the data and reasoning mentioned in this paper. From the above detailed description it seems that:

1) The increase in temperature in the atmosphere is largely due to the expelled heat from the energy equipment we use.
2) The thermal insulation of buildings ensures that the thermal comfort within the building is due only to the purchased energy, excluding the contribution of free solar energy that falls on it. It is imperative that the thermal insulation be adjusted with the orientation of the structural elements and the environment of the building.
3) Carbon dioxide CO_2 is not a waste, it is a natural component of ambient air and its reduction in the atmosphere leads to a decrease in plant production.
4) Photovoltaic power plants, while presented as "green ecological" installations, contribute to the increase of the temperature of the ambient air. The use of photovoltaic surfaces that offer electrical and thermal energy supply directly to the final consumer, placed in the building-consumer is a more appropriate use of solar energy technology.
5) Wind turbine power plants are not "green" facilities as they are presented but participate in the emergence of severe weather phenomena.
6) Technologies are to be used for the benefit of citizens, meeting their needs and not to ensure the operation of businesses.
7) The choices of the applied technologies and their use are one of the causes of deregulation of the normal functioning of nature that naturally reacts with the intense weather phenomena that now occurring more often.
8) Programmable electro and hydrogen moving may bring the planet to a state of deadlock because they contribute to its warming.
9) It is imperative that the study of energy production and management technologies is now done at a higher quality level, not as a repetition of older, established perceptions but with a modern scientific approach adapted to the particularities of each subject, with the primary aim of protecting humankind and the natural environment in which we live. Planet Earth is one and so far seems the only one with living conditions, so it is essential that we

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protect it effectively in order that our children live pleasantly on it.

In the theory of stupidity of the German thinker Dietrich Bonhoeffer [17] it is stated that "people when they cannot judge something on their own, due to lack of knowledge, prefer to do what others do". Thus, a misconception becomes the property of the great masses, establishing it as truth, and whoever questions it is positioned as the heretic of society. With this mechanism of creating the truth, important events were recorded in history such as the killing of Hypatia [18] dismembering her in Alexandria in 415 and the waiting of humanity 1000 years for Johannes Kepler [19] to reach the same conclusions that Hypatia worked. Giordano Bruno [20] was burned at the stake in 1600 because he supported the sphericality of the earth, something that Eratosthenes [21] had calculated around 200 BC and today is common knowledge for the students of the schools.

This is a small sample of the results of misconceptions that at the time were not disputed. Humanity today repeats the same mistakes, only now the power of tools, actions and possible mistakes is so great that we may not be able to return to normality anymore. The great philosopher Plato [22] had said that: "the world will become a better place if kings philosophize or philosophers reign."

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Global Journal of human-social science: b
Geography, Geo-Sciences, Environmental Science & Disaster Management
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460x & Print ISSN: 0975-587X

Degradación Hidrológica del Cantón Valencia, Provincia de Los Ríos Por Efecto de Los Monocultivos de Banano y Cacao

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Abstract- The anthropic pressure for the provision of irrigation of extensive monocultures of banana and cocoa from the surface hydrographic network of the Valencia canton has substantially reduced the flow and the water mirrors of the main surface water bodies of the canton. The need to generate foreign exchange to maintain the socioeconomic functioning of the country must face both internal and external factors such as rapid population growth and the growing international demand for tropical agricultural products, which has led to the conversion of large areas of land for production. intensive agriculture of several monocultures not only in the study area but throughout Ecuador.

The present investigation entailed an extensive field inventory work of the global study area to select a specific sampling area that is representative of the central problem of the present investigation, it entailed the collection of extensive digital geoinformation for its subsequent processing in a Systems environment.

Keywords: monocultures, banana, cocoa, hydrographic network, GIS, sampling.

GJHSS-B Classification: DDC Code: 813.54



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Degradación Hidrológica del Cantón Valencia, Provincia de Los Ríos Por Efecto de Los Monocultivos de Banano y Cacao

Arturo Cristhian Vélez Meza [α], José Luis Muñoz Marcillo [σ], Roque Vivas Moreira [ρ] & Betty Gonzales [ω]

Resumen- La presión antrópica para la dotación de riego de extensos monocultivos de banano y cacao a partir de la red hidrográfica superficial del cantón Valencia ha disminuido sustancialmente el caudal y los espejos de agua de los principales cuerpos superficiales de agua del cantón. La necesidad de la generación de divisas para mantener el funcionamiento socioeconómico del país debe encarar factores tanto interno y externos como el rápido crecimiento demográfico y la creciente demanda internacional de productos agrícolas tropicales, lo cual ha propiciado la conversión de extensas áreas de tierra para la producción agrícola intensiva de varios monocultivos no solo de la zona de estudio sino de todo el Ecuador.

La presente investigación conllevó un amplio trabajo de inventario en campo del área global de estudio para seleccionar un área específica de muestreo que sea representativa del problema central de la presente investigación, conllevó la recopilación de amplia geoinformación digital para su posterior procesamiento en un entorno de Sistemas de Información Geográfica, destacándose el tratamiento digital espacial de las coberturas agrícolas principales del cantón Valencia dominadas por los monocultivos de banano y cacao para determinar su expansión territorial en el tiempo y espacio, así como el análisis temporo-espacial de la variación de los espejos de agua de los ríos San Pablo y Quindigua y la modelación del caudal de la microcuenca hidrográfica del río Quindigua que se encuentran presentes en el área de muestreo.

Adicionalmente se incluyó el análisis de caudales en un período de diez años por cada mes del año a partir del río Quevedo que es alimentado por los ríos San Pablo y Quindigua con el propósito de demostrar la disminución de caudales diferenciada y constante en el sector durante el período de invierno – verano.

Palabras claves: monocultivos, banano, cacao, red hidrográfica, SIG, muestreo.

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Abstract- The anthropic pressure for the provision of irrigation of extensive monocultures of banana and cocoa from the surface hydrographic network of the Valencia canton has substantially reduced the flow and the water mirrors of the main surface water bodies of the canton. The need to generate foreign exchange to maintain the socioeconomic functioning of the country must face both internal and external factors such as rapid population growth and the growing international demand for tropical agricultural products, which has led to the conversion of large areas of land for production. intensive agriculture of several monocultures not only in the study area but throughout Ecuador.

The present investigation entailed an extensive field inventory work of the global study area to select a specific sampling area that is representative of the central problem of the present investigation, it entailed the collection of extensive digital geoinformation for its subsequent processing in a Systems environment. of Geographic Information, highlighting the spatial digital treatment of the main agricultural coverage of the Valencia canton dominated by monocultures of banana and cocoa to determine its territorial expansion in time and space, as well as the temporal-spatial analysis of the variation of the mirrors of water from the San Pablo and Quindigua rivers and the modeling of the flow of the hydrographic micro-basin of the Quindigua river that are present in the sampling area.

Additionally, the analysis of flows was included in a period of ten years for each month of the year from the Quevedo river, which is fed by the San Pablo and Quindigua rivers, with the purpose of demonstrating the differentiated and constant decrease in flows in the sector during the period. winter-summer period.

Keywords: monocultures, banana, cocoa, hydrographic network, GIS, sampling.

I. Introducción

El agua es vital para la supervivencia, la salud y la dignidad humana y es un recurso fundamental para el desarrollo. Los recursos de agua dulce del mundo se encuentran bajo presión creciente y muchas personas carecen aún de un suministro de agua adecuado para satisfacer sus necesidades básicas. El crecimiento de la población, el aumento de la actividad económica y de los estándares de vida, han conducido a un aumento en la competencia y en los conflictos relacionados con los recursos limitados de agua dulce.

La expansión del monocultivo para exportación en los países de Latinoamérica constituye un ejemplo de las "actividades extractivas" o "extractivismo" que

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impulsó el neoliberalismo a partir de la década de los noventa (Gudynas, 2013; Seoane, 2013). De esta manera, las corporaciones transnacionales recibieron múltiples incentivos por parte del Estado cobijadas en el supuesto de que constituyen la vía más rápida al progreso económico (Svampa, 2008). En la práctica se dio paso a la mercantilización y apropiación privada de los bienes naturales en territorios con una legislación ambiental deficitaria (Silvetti, Soto, Cáceres & Cabrol, 2013).

En Ecuador, la producción agrícola en las décadas de 1920 y 1930 fue dominada por el cacao y a partir de la década de 1950 hasta la actualidad, el banano ha sido el producto de exportación agrícola más importante. La superficie dedicada a estos cultivos de exportación ha ido en aumento, de manera que entre 1980 y 2000 el área de cosecha se ha incrementado, llegando a 165.000 hectáreas en banano y 433.00 hectáreas para el cacao (MAGAP, 2012). La diversificación agrícola como base del cambio en el proceso productivo a nivel de provincia es muy compleja de llevar a cabo, debido principalmente a que se utiliza exhaustivamente factores de producción como mano de obra, tierra y capital y tecnología agrícola básica Pacheco, Ochoa-Moreno, Ordoñez, & Izquierdo-Montoya (2018).

Cuando el suelo del cantón Valencia se convierte de secano a condiciones de riego, el rendimiento del cultivo aumentará debido a una aplicación constante de agua durante todo el desarrollo de este. Espinosa & Rivera (2016) indican que no seguir un equilibrio adecuado del agua del suelo y aplicar una dosis de riego adecuada en un momento dado puede provocar escasez o exceso de riego. Hasta la fecha, en Ecuador todavía existe una gestión inadecuada del agua para el riego. Los agricultores del cantón Valencia producen en gran medida para el consume nacional y las exportaciones, como el caso del arroz y plátano que son monocultivos que reúnen asociaciones de productores agrícolas que les dan un mayor acceso a los mercados nacionales e internacionales (Gaybor, Ramos, Tamayo & Arroyo, 2008).

Del agudo proceso de concentración de agua de pozos que entre las 20 empresas (de las 47) de Reybanpac y 3 empresas del Grupo Noboa (de las que se tiene información) acaparan el 73 % del caudal concesionado, localizado principalmente en la provincia de Los Ríos. De acuerdo con comunicaciones de informantes clave dedicados a la producción de bananos, una hectárea de cultivo de banano en producción requiere ser regada por aspersión subfoliar tres veces por semanas durante dos horas en cada ocasión. Los aspersores subfoliares alcanzan un caudal de 680,21 L/hora siendo el espaciamiento entre ellos de 12 m x 14 m, con eficiencia de aplicación de 90 % (Caicedo et al., 2016).

II. Materiales y Métodos

El método constituye la serie de pasos que el investigador sigue en el proceso de producción del conocimiento, incluye una serie de operaciones, reglas y procedimientos establecidos de manera voluntaria y reflexiva, para alcanzar un determinado objetivo. De esta manera, las técnicas cualitativas obedecieron en esencia a lectura y análisis de diversas fuentes bibliográficas, análisis crítico de normativas y documentos gubernamentales. Mención importante merece el trabajo de campo con la finalidad de contrastar los resultados del análisis de fuentes alternativas con aquellas que se generan en la realidad concreta. Particularmente importantes fueron las entrevistas con un enfoque cualitativo realizadas a funcionarios y responsables, agentes económicos y usuarios de la cuenca del río Vinces en un contexto jerárquico focalizándose en las instituciones que tienen un accionar más directo sobre la cuenca.

Para la consecución de los objetivos de la presente investigación se siguieron los siguientes pasos metodológicos:

1. Para elaborar el marco conceptual se analizó la bibliografía y los documentos institucionales relacionados con la presión de los monocultivos en los recursos hídricos.
2. Para realizar la caracterización física–natural del cantón Valencia se empleó información cartográfica básica y temática a escala 1:100.000, 1:50.000 y 1:25.000 provista por el Instituto Geográfico Militar (IGM), Instituto Espacial Ecuatoriano (IEE) y Ministerio de Agricultura y Ganadería (MAGAP). La información cartográfica antes mencionada se trabajó en el programa de Sistemas de Información Geográfica (SIG) ArcGIS Desktop 10.1.4.
3. Para determinar el área de estudio específica dentro del cantón Valencia se definió un área de muestreo que recogiera la problemática fundamental del presente estudio.
4. Para establecer la evolución del Espejo de aguas de los principales cursos superficiales del cantón Valencia se realizó procesos de percepción remota y teledetección al área de estudio considerando los meses de verano para evitar el sesgo en los resultados por comparación de entre meses de verano e invierno.
5. La determinación del cambio en la extensión de la cobertura agrícola de los monocultivos de banana y cacao en el cantón Valencia se realizó a partir de la compilación de estudios de coberturas de uso del suelo generados por el Ministerio de Agricultura y Ganadería (MAG) y Ministerio de Agricultura, Ganadería, Acuacultura y Pesca (MAGAP) para los años 1990 y 2014, complementado con el procesamiento digital de imágenes satelitales

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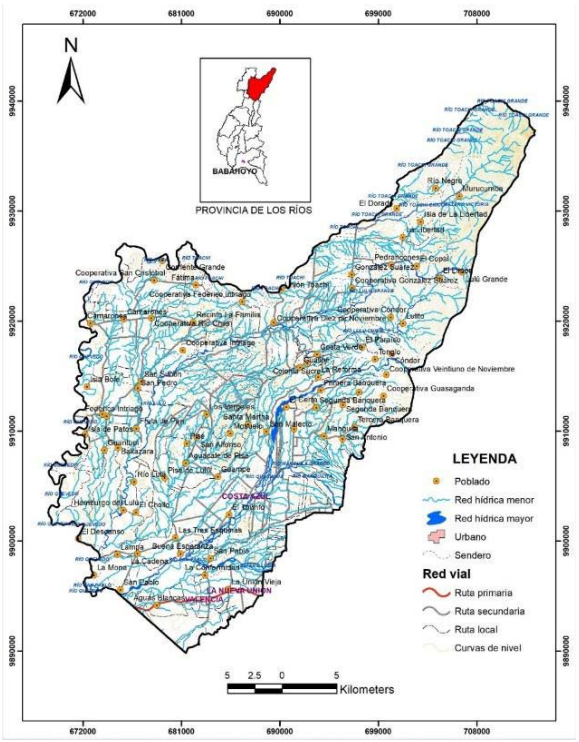
Landsat de los meses de octubre del año 1990 y el mes de noviembre del año 2014. Para cada una de las fechas analizadas se realizó un procesamiento diferencial, en el entorno de Sistemas de Información Geográfica (SIG) mediante el software ArcGIS 10.4.1:

- Año 1990: Se tomó como base la cobertura analógica del suelo realizada por MAGAP la cual fue sometida a un proceso de digitalización y conversión al Datum vigente oficial en el Ecuador, WGS84, posteriormente se la mejoró realizando una sobreposición con imágenes para el año 1990 con el programa Google Earth Pro y una clasificación supervisada empleando una imagen del satélite Landsat 5.
- Año 2014: Se tomó como base la cobertura digital del suelo realizada por el MAGAP - SENPLADES la cual fue complementada con información cuantitativa de los censos de banano y cacao realizados por el MAGAP en el año 2013 y con verificación en terreno de los cultivos de banana y cacao.

6. Para la determinación del volumen de agua para riego que demandan los monocultivos de banano y cacao en los meses de verano, se consideró la superficie sembrada dentro de la microcuenca del río Quindigua, en donde se relacionó los litros de agua que consume cada planta diariamente en relación a la población total presente por unidad de hectárea en cada monocultivo.
7. Para mostrar la disminución del caudal del río Quindigua se realizó la modelación hidrológica del caudal en verano (mes de octubre) mediante la aplicación del modelador hidrológico HEC-HMS.

El HEC-HMS ® es utilizado para obtener, por medio de simulación, los caudales hidrológicos en una cuenca hidrográfica (Silva et al., 2005). Para ello, el programa requiere la especificación de los modelos de cuenca, modelos meteorológicos, especificaciones de control y datos de entrada, para crear corridas de precipitación o de la proporción de flujo. Su aplicación es muy amplia, cuyos hidrogramas generados pueden ser utilizados directamente o con otros programas para el estudio de disponibilidad de agua, problemas relacionados a inundaciones, cálculo de drenaje urbano, pronósticos de flujo, impacto de futuras urbanizaciones, diseño de aliviaderos para represas, predicción de inundaciones, reducción de daños por inundaciones, entre otras.

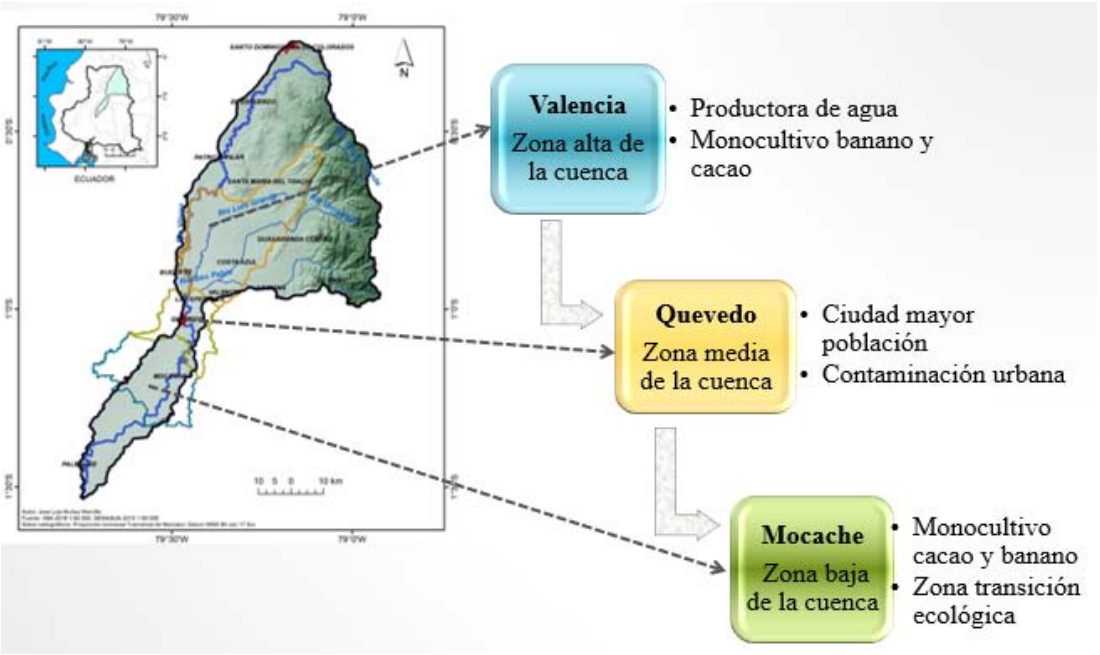
El cantón Valencia se ubica a partir de los 0°32'0" latitud sur y 79°29'00" longitud oeste, abarcando una superficie de 978,21 km2 (Fig. 2). El cantón Valencia se ubica en la zona norte de la provincial de Los Ríos y en la parte nororiental de la cuenca del río Vinces (Fig. 3), presenta una red amplia de cursos superficiales de agua en donde destacan los ríos, Lulo, Quindigua, San Pablo y una amplia red de esteros.



Fuente: Elaborado propia

Figura 2: Cantón Valencia

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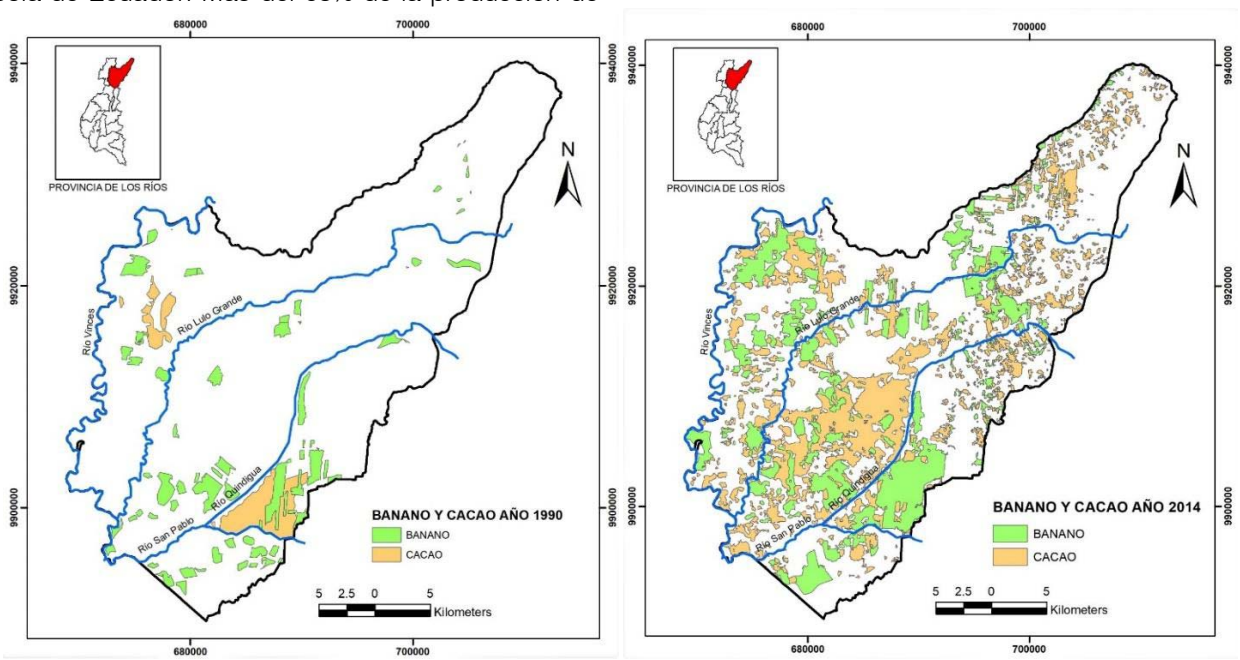
Fuente: Elaborado propia

Figura 3: Cantón Valencia en relación a la Cuenca del río Vinces

III. Resultados

El uso del suelo es principalmente agrícola (sistemas agrícolas intensivos altamente tecnificados), las principales actividades, son el banano, el cultivo de arroz, café, cacao, maíz, palma africana, frutas tropicales como, mango, naranjas, melón, caña de azúcar, entre otras. La subcuenca del río Daule es una de las zonas de mayor concentración de producción agrícola de Ecuador. Más del 68% de la producción de los cultivos se originan en áreas irrigadas de tierras bajas en la costa central ecuatoriana (Borbor- Cordova, Boyer, McDowell & Hall, 2006)

Cultivo de banano y cacao en el cantón Valencia El análisis de las coberturas agrícolas de los monocultivos de banano y cacao en el cantón Valencia para los años 1990 y 2014 se pueden apreciar en las figuras 4 y 5.



Fuente: Elaborado por el autor

Figuras 4 y 5: Superficie de monocultivos de banano y cacao en el año 1990 y 2014

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Se puede apreciar que la superficie de los monocultivos de banano y cacao en el cantón Valencia tuvo un aumento del 291% y 663% respectivamente, Tabla 1.

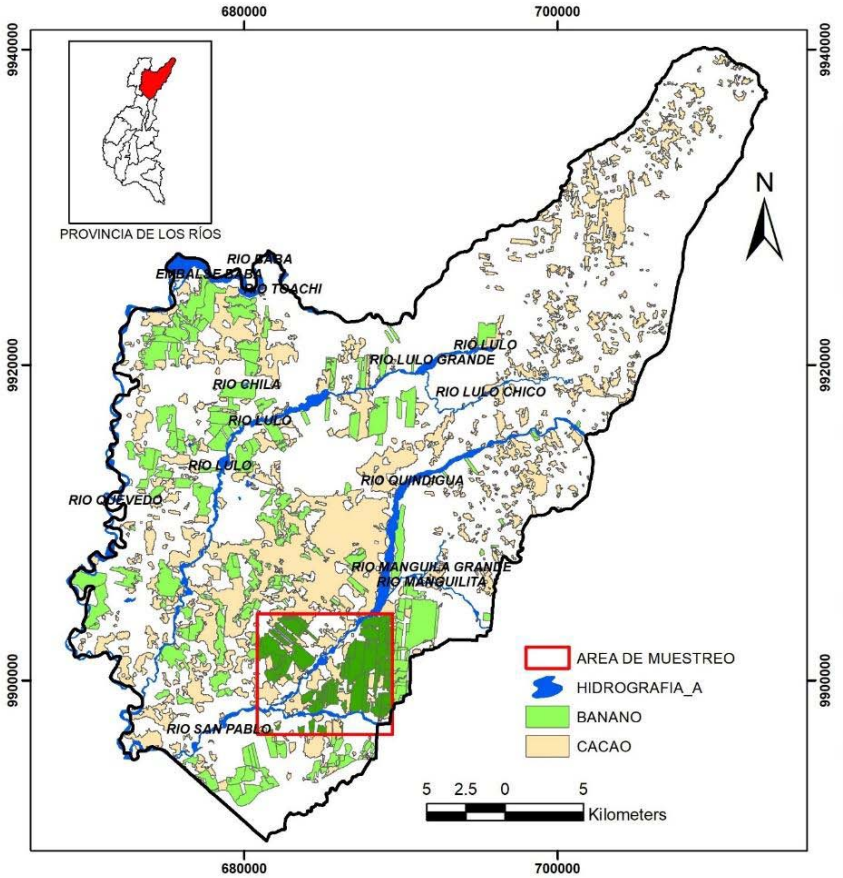
Tabla 1: Superficie de monocultivos de banano y cacao

MONOCULTIVO	AÑO 1990 ÁREA (HA)	AÑO 2014 ÁREA (HA)	% Aumento
BANANO	5335.05	15559.71	291
CACAO	2911.42	19306.07	663

Fuente: Elaboración propia

a) Área de muestreo

Por considerar la superficie total del cantón Valencia como muy amplia al extenderse por 978,21 km^2 se seleccionó un área muestral de 66,12 km^2 en la que están presentes los ríos San Pablo y Quindigua y en cuya área de influencia existe presencia de extensos monocultivos de banano y cacao, Fig. 6.

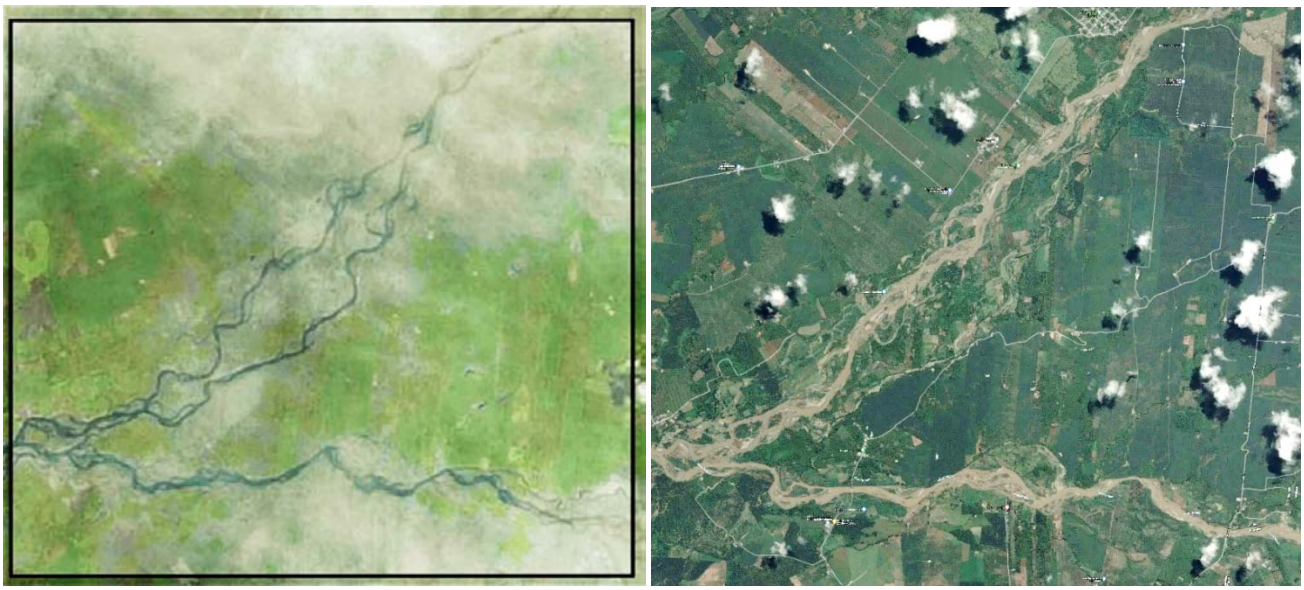


Fuente: Elaborado propia

Fig. 6: Determinación de área muestral

La determinación de la variación de los espejos de agua de los ríos San Pablo y Quindigua en el área específica de estudio se realizó a partir de dos ortofotos correspondientes a los meses de octubre de los años 2005 y 2014 respectivamente, fechas que corresponden con la época de verano en el Ecuador, figuras 7 y 8.

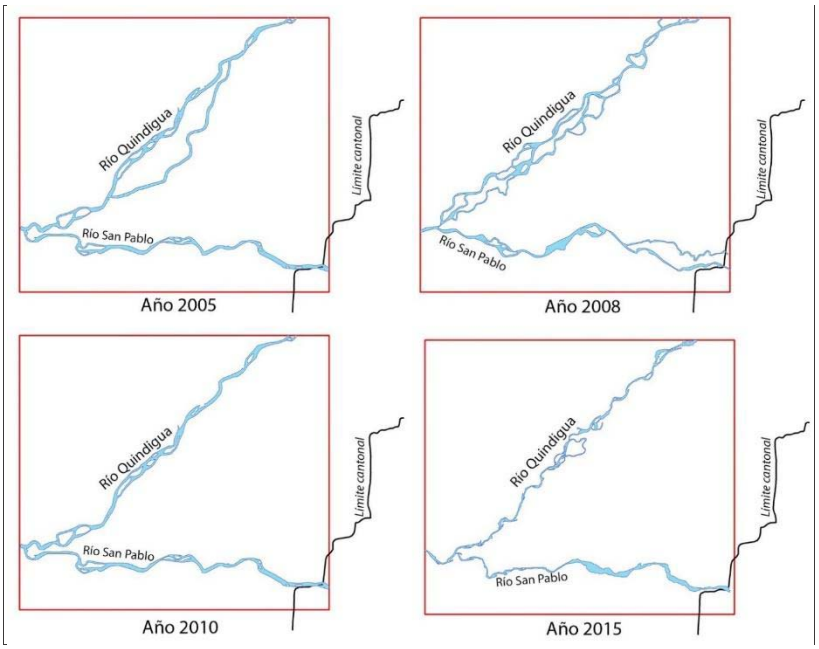
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Fuente: Instituto Espacial Ecuatoriano

Figuras 7 y 8: Ortofoto del año 2005 y 2014

En la figura 9 se puede apreciar la degradación física de los ríos San Pablo y Quindigua expresada en la disminución de sus espejos de agua en los meses de octubre (verano) de los años 2005, 2008, 2010 y 2015.



Fuente: Elaboración propia

Figura 9: Degradación física de los ríos San Pablo y Quindigua

La presión del riego para los monocultivos de banano y cacao durante los ocho meses de verano ha provocado una disminución en los espejos de agua de los ríos San Pablo y Quindigua, Tabla 2.

El cultivo de banano en el largo período de verano precisa de un promedio de 26 litros de agua diarios por planta para mantener su productividad, llegando una hectárea a tener 1800 plantas mientras que el cacao con 1000 plantas por ha llega a consumir un 40% menos de la cantidad de agua que demanda el banano.

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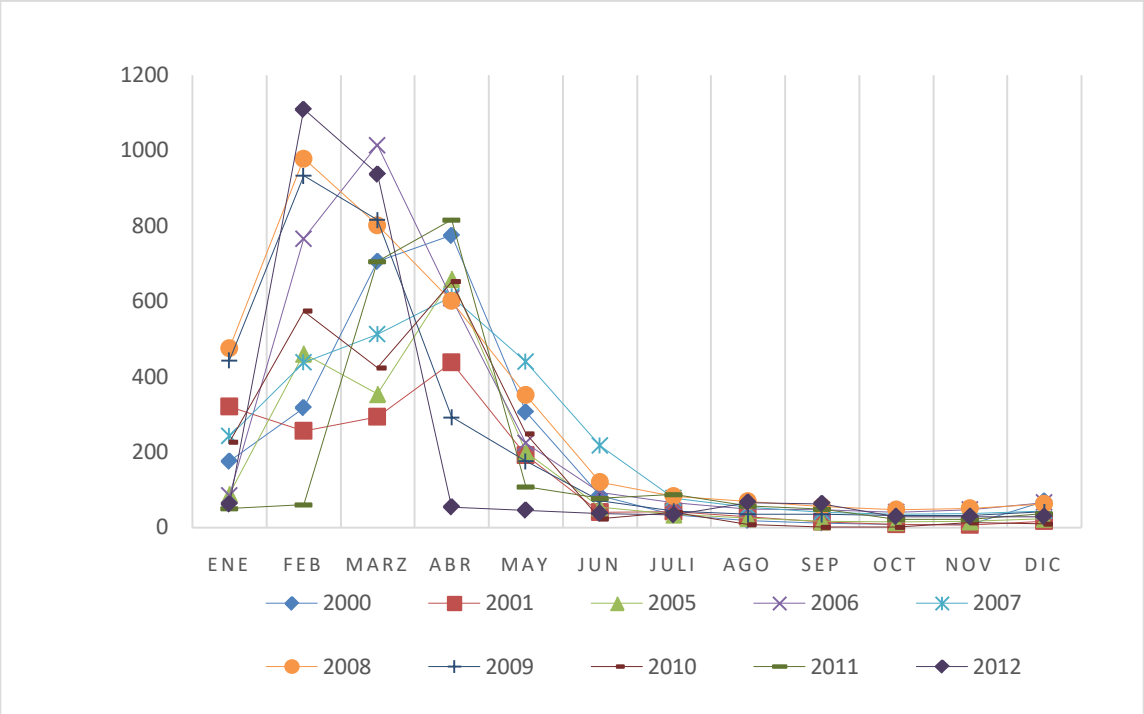
Tabla 2: Degradación física de los ríos San Pablo y Quindigua

RIOS	AÑO 2005 ESPEJO DE AGUA ÁREA (HA)	AÑO 2008 ESPEJO DE AGUA ÁREA (HA)	AÑO 2010 ESPEJO DE AGUA ÁREA (HA)	AÑO 2015 ESPEJO DE AGUA ÁREA (HA)
QUINDIGUA SAN PABLO	229,59	213,59	192.02	125,50
Disminución de espejo de agua en %		7,00 %	16,36 %	45,33 %

Fuente: Elaboración propia

El río Quevedo que se alimenta por las aguas de los ríos San Pablo y Quindigua presenta variaciones de caudales que guardan relación con el periodo de invierno y verano, como se puede apreciar en la Fig. 10 el caudal promedio de los años 2000 – 2012 para los meses de enero – abril correspondientes a los meses de invierno es de 500 m3/seg mientras que para los meses de estiaje comprendidos entre mayo – diciembre es de 66 m3/seg.

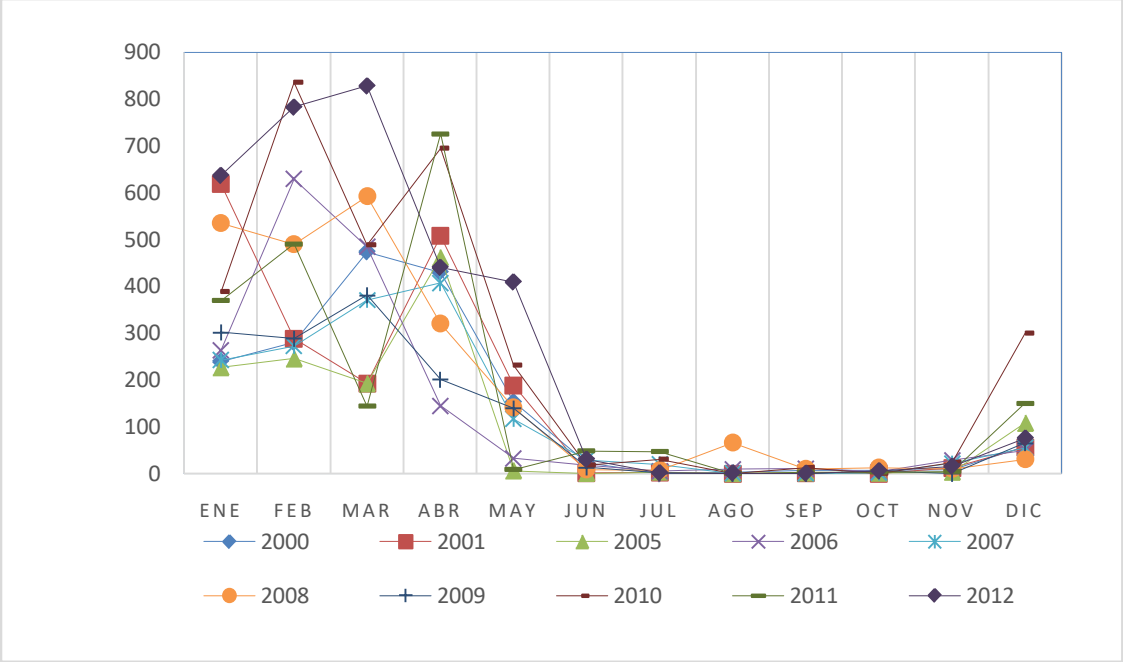
El régimen de precipitación en el cantón Valencia se distribuye de acuerdo a las estaciones de climáticas de invierno con cuatro meses de duración y de verano con una duración de ocho meses. En la fig. 11 se puede apreciar que la precipitación promedio de invierno en el período comprendido entre los años 2007 – 2016 es de 422 mm por mientras que en verano la precipitación para este mismo período de años es de 75 mm.



Fuente: Elaborado propia en base a INHAMI, 2016.

Figura 10: Caudales promedios (m^3/seg.) año 2000-2012 en río Quevedo

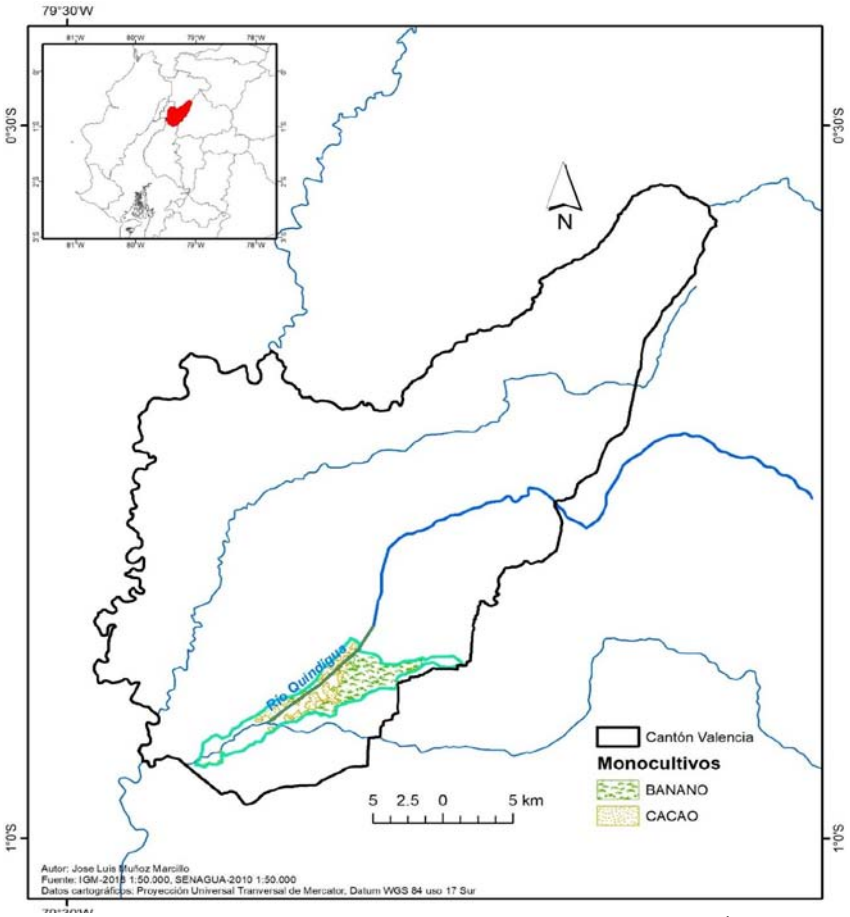
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Fuente: Elaborado propia en base a INHAMI, 2016.

Figura 11: Precipitación promedios (mm) años 2007-2016 en río Quevedo

En la Tabla 3 se puede apreciar el consumo por ha de agua para riego durante los 8 meses de verano por parte de los monocultivos de banano y cacao en la cuenca del río Quindigua, Figura 12.



Fuente: Elaboración propia

Figura 12: Microcuenca hidrológica de río Quindigua

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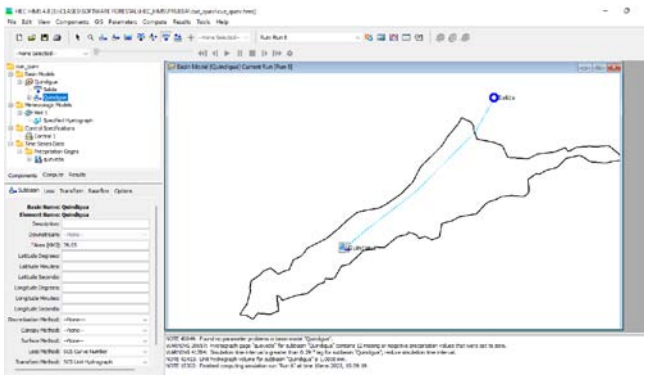
Los monocultivos de banano y cacao presentes en la cuenca del río Quindigua ejercen una presión por el agua para riego durante los 8 meses de verán,o Tabla 3, época del año en que son más productivos y en donde precisan de un riego permanente, llegando a necesitar tasas de riego diarias por planta de 20 litros y 8 litros respectivamente.

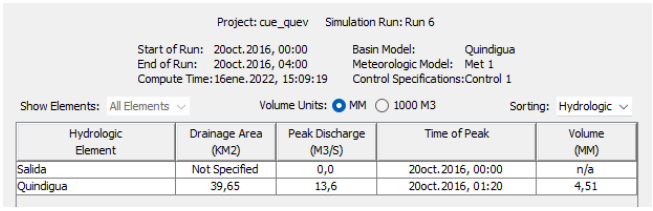
Tabla 3: Consumo de agua de monocultivos de banano y cacao

Cultivos	Superficie (ha)	Plantas (ha)	Consumo de agua en verano (m^3)
Banano	1492	1500	11'458,560
Cacao	682	1000	1'636,800

Fuente: Elaboración propia

La simulación del caudal del río Quindigua a partir de la aplicación del modelador hidrológico HEC – HMS en la microcuenca del antes mencionado río nos permitió apreciar la importante disminución del caudal del río Quindigua en la temporada de verano, Figura 13.





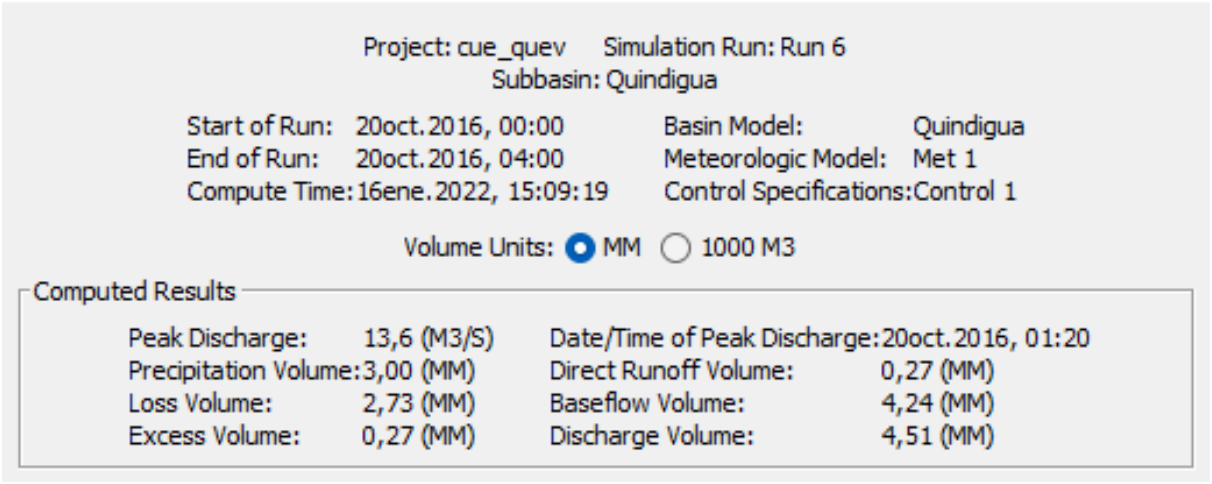


Figura 13: Modelación hidrológica de cuenca del río Quindigua en software HEC – HMS

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Project: cue_quev Simulation Run: Run 6
Subbasin: Quindigua

Start of Run: 20oct.2016, 00:00 Basin Model: Quindigua
End of Run: 20oct.2016, 04:00 Meteorologic Model: Met 1
Compute Time: 16ene.2022, 15:09:19 Control Specifications: Control 1

Time	Date	Precip (MM)	Loss (MM)	Excess (MM)	Direct Flow (M3/S)	Baseflow (M3/S)	Total Flow (M3/S)
00:00	20oct.2016				0,0	12,0	12,0
00:05	20oct.2016	0,00	0,00	0,00	0,0	12,0	12,0
00:10	20oct.2016	0,00	0,00	0,00	0,0	12,0	12,0
00:15	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
00:20	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
00:25	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
00:30	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
00:35	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
00:40	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8
00:45	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8
00:50	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8
00:55	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8
01:00	20oct.2016	0,00	0,00	0,00	0,0	11,7	11,7
01:05	20oct.2016	0,17	0,15	0,01	1,2	11,7	13,0
01:10	20oct.2016	0,17	0,15	0,01	1,8	11,7	13,5
01:15	20oct.2016	0,17	0,15	0,01	1,9	11,7	13,6
01:20	20oct.2016	0,17	0,15	0,01	2,0	11,7	13,6
01:25	20oct.2016	0,17	0,15	0,01	2,0	11,6	13,6
01:30	20oct.2016	0,17	0,15	0,01	2,0	11,6	13,6
01:35	20oct.2016	0,17	0,15	0,01	2,0	11,6	13,6
01:40	20oct.2016	0,17	0,15	0,01	2,0	11,6	13,6
01:45	20oct.2016	0,17	0,15	0,01	2,0	11,6	13,5
01:50	20oct.2016	0,17	0,15	0,01	2,0	11,5	13,5
01:55	20oct.2016	0,17	0,15	0,01	2,0	11,5	13,5
02:00	20oct.2016	0,17	0,15	0,01	2,0	11,5	13,5
02:05	20oct.2016	0,08	0,08	0,01	1,4	11,5	12,8
02:10	20oct.2016	0,08	0,08	0,01	1,1	11,5	12,5
02:15	20oct.2016	0,08	0,08	0,01	1,0	11,4	12,5
02:20	20oct.2016	0,08	0,08	0,01	1,0	11,4	12,4
02:25	20oct.2016	0,08	0,08	0,01	1,0	11,4	12,4
02:30	20oct.2016	0,08	0,08	0,01	1,0	11,4	12,4
02:35	20oct.2016	0,08	0,08	0,01	1,0	11,4	12,3
02:40	20oct.2016	0,08	0,08	0,01	1,0	11,3	12,3
02:45	20oct.2016	0,08	0,08	0,01	1,0	11,3	12,3
02:50	20oct.2016	0,08	0,08	0,01	1,0	11,3	12,3
02:55	20oct.2016	0,08	0,08	0,01	1,0	11,3	12,3
03:00	20oct.2016	0,08	0,08	0,01	1,0	11,3	12,2
03:05	20oct.2016	0,00	0,00	0,00	0,4	11,6	12,0
03:10	20oct.2016	0,00	0,00	0,00	0,1	11,9	12,0
03:15	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
03:20	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
03:25	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
03:30	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
03:35	20oct.2016	0,00	0,00	0,00	0,0	11,9	11,9
03:40	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8
03:45	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8
03:50	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8
03:55	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8
04:00	20oct.2016	0,00	0,00	0,00	0,0	11,8	11,8

Fuente: Elaboración propia

Se puede apreciar que el caudal del río Quindigua para el 20 de octubre del 2016 se mantiene de entre 11,8 a 13,6 m^3/seg, lo cual supone una disminución por debajo de los 28,493 m^3/seg que registró la estación hidrológica de río Quindigua en ese mismo mes en el año 2012.

IV. Discución

El monocultivo intensivo de banano se ha expandido principalmente por los grupos económicos de poder cuyos lotes superan las 100 hectáreas, lo que genera una presión muy alta por el recurso hídrico de la cuenca para el riego. Frecuentemente se puede observar que no respetan los caudales concesionados por la autoridad ambiental y en muchos casos han sido sancionados económicamente, pero pagan sus multas y siguen a provechando clandestinamente el agua para riego en el cantón Valencia. Esta realidad vivida en la cuenca no es muy diferente a lo que ocurre en el área rural de Bogotá, donde la ampliación de la frontera

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agrícola ha llevado a la desaparición casi total de las áreas de amortiguación del páramo, esto se relaciona con las formas de aprovechamiento económico del suelo, debido a varios latifundios que han venido siendo arrendados a terceros, precipitando el deterioro ecosistémico e hídrico de la cuenca (Hernández, Rojas & Sánchez, 2013).

Los resultados del estudio temporo-espacial de la cobertura agrícola del cantón Valencia permitió identificar las tendencias recientes en los patrones de la ocupación del suelo. Morales, Carrillo, Farfán & Cornejo (2016) indican que el análisis espacial cuantitativo sobre los cambios en la cobertura vegetal y el uso del suelo entre 1979-2013 en la región de Bahía de Banderas, México, generó información valiosa para el monitoreo de los recursos naturales con implicaciones en el ciclo hidrológico, la biodiversidad, la erosión del suelo y el clima local, entre otros aspectos relevantes. Asimismo, Florez-Yepes, Rincon-Santamaría, Cardona & Alzate-Alvarez (2017) manifiestan que la aplicación del análisis multitemporal permite determinar los cambios e impactos ambientales más significativos a través del tiempo permitiendo conocer las interrelaciones entre los elementos que lo componen y las actividades antrópicas

V. Conclusiones

El Poder y las prácticas dudosas que con frecuencia se realizan en el país facilitan a grandes compañías productoras y exportadoras el otorgamiento de grandes caudales para riego sin un control eficaz de su uso con la anuencia y cierta complicidad del estado debido a su dependencia de los ingresos de divisas de las exportaciones que generan precisamente los cultivos para producción agropecuaria de exportación, CPAE por sobre los cultivos que garanticen la soberanía alimentaria, CGSA, distinción que tiene que ver con la aparición del concepto de agricultura familiar y más allá de las transiciones y los casos mixtos, encierran al estado en un dilema imposible de resolver, desequilibrando el sistema político e impactando en la calidad de vida y el buen vivir.

La gestión del recurso hídrico en el cantón Valencia sufre una fragmentación debido al variado número de entidades que tienen ciertos niveles de competencias para el manejo de los proyectos de riego, siendo el caso del MAGAP, el MAE, GAD's provinciales y GAD's cantonales derivando esta situación en un manejo deficiente del recurso hídrico que se puede comprobar en la realidad del campo donde son recurrentes los conflictos por el uso de agua para riego sobre todo con los pequeños productores.

El Ministerio del Ambiente del Ecuador conoce de los daños que ocasionan las plantaciones intensivas de banano de exportación a los cursos superficiales de agua del cantón Valencia, sin embargo, lo único que se ha hecho hasta la actualidad es la promulgación de la "Ley para estimular y controlar la producción y comercialización del banano, plátano (barraganete) y otras musáseas afines, destinadas a la exportación" que menciona en el Art. 25 "Queda prohibido realizar nuevas siembras de banano". Las plantaciones de banano calificadas como orgánicas serán inscritas con la superficie sembrada no serán motivo de sanción alguna". Nótese que la intención de esta restricción solo obedece a un interés económico que busca controlar la producción de banano de exportación para evitar la caída del precio de comercialización de la caja de banano por sobreproducción. Este articulado de ley en la práctica no ha funcionado, dado que los grupos de poder siguen sembrando nuevas plantaciones de banano de exportación.

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Global Journal of human-social science: b
Geography, Geo-Sciences, Environmental Science & Disaster Management
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460x & Print ISSN: 0975-587X

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By Dr. C. Alberto Alejandro Morales Domínguez
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Abstract- This study investigates the treatment of conflict situations of an intercultural nature in the professional framework of tour guides. Intercultural competence is considered not sufficiently studied within the framework of the postgraduate improvement of the language for professional purposes in the Cuban tourism sector. The objective is focused on developing a didactic-methodological conception and the creation of a conceptual framework towards the development of intercultural competence in tour guides, by making use of the theory of mediation. The article focused on a new definition of intercultural competence and analyzed some reflections on the creation of a conceptual platform to evaluate this competence. In the development of this study, the conceptual model of the Macro Intercultural Competence Coping is presented, suitable to base the intercultural components through the treatment of conflict situations. Its application will facilitate a greater awareness of the characteristics of one's own culture, the reactivation of cultural knowledge and the development of critical thinking for mediation in conflict situations.

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GJHSS-B Classification: DDC Code: 791.095 LCC Code: PN2860



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Intercultural Mediation in Conflict Situations: A Didactic-Methodological Conception for Tourist Guides

Mediación Intercultural en Situaciones de Conflicto: Una Concepción Didáctico-Metodológica Para Guías de Turismo

Dr. C. Alberto Alejandro Morales Domínguez

Abstract- This study investigates the treatment of conflict situations of an intercultural nature in the professional framework of tour guides. Intercultural competence is considered not sufficiently studied within the framework of the postgraduate improvement of the language for professional purposes in the Cuban tourism sector. The objective is focused on developing a didactic-methodological conception and the creation of a conceptual framework towards the development of intercultural competence in tour guides, by making use of the theory of mediation. The article focused on a new definition of intercultural competence and analyzed some reflections on the creation of a conceptual platform to evaluate this competence. In the development of this study, the conceptual model of the Macro Intercultural Competence Coping is presented, suitable to base the intercultural components through the treatment of conflict situations. Its application will facilitate a greater awareness of the characteristics of one's own culture, the reactivation of cultural knowledge and the development of critical thinking for mediation in conflict situations.

Keywords: intercultural mediation, conflict situations, didactic-methodological conception, tourguides.

Resumen- Este estudio investiga el tratamiento de situaciones de conflicto de índole intercultural en el marco profesional de los guías turísticos. Se considera a la competencia intercultural no suficientemente estudiada en el marco del perfeccionamiento del posgrado de la lengua con fines profesionales en el sector turístico cubano. El objetivo se centra en desarrollar una concepción didáctico-metodológica y la creación de un marco conceptual hacia el desarrollo de la competencia intercultural en los guías turísticos, al hacer uso de la teoría de la mediación. El artículo se centró en una nueva definición de competencia intercultural y analizó algunas reflexiones sobre la creación de una plataforma conceptual para evaluar esta competencia. En el desarrollo de este estudio se presenta al modelo conceptual de la Macro Competencia Intercultural Afrontar, adecuado para fundamentar los componentes interculturales mediante el tratamiento de las situaciones de conflicto. Su aplicación facilitará una mayor conciencia de las características de la propia cultura, la reactivación de los conocimientos culturales y el desarrollo del pensamiento crítico para la mediación en situaciones de conflicto.

Palabras Clave: mediación intercultural, situaciones de conflicto, concepción didáctico-metodológica, guías de turismo.

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I. Introduction

The Humanity currently lives in the age of communications and relationships. Thanks to the established exchange between individuals from different cultures, it is possible to achieve new levels of contact between foreign tourists and tourism professionals. In this context it becomes possible to raise awareness about the diversity of interests and expectations that make up mutual cooperation and understanding; being this diversity of interests and expectations not assumed, in the same way, by Cuban professionals linked to the tourist sphere. That is why when applying various instruments such as observations, interviews, analysis of film strips, the existence of various conflict situations that gravitate against the satisfactory levels of contact between tourists and tour guides is demonstrated.

The author argues that the solution to conflict situations in this framework must be based on the development of intercultural competence of students. This assessment contributes to the elaboration of a didactic-methodological conception aimed at developing this competence of tourist guides, specifically, of the German language. Under the conditions of this work, conflict situations are defined as "circumstances that gravitate against satisfactory levels of contact between tourists and tour guides. The discrepancies produced in an intercultural exchange, based on different realities and perceptions". What demands the application of strategies for its solution. When considering in this statement the use of strategies for conflict resolution, the definition of strategy by Rodríguez (2006) is assumed, described as "a management tool that facilitates procedures and techniques, which when used, contribute to the achievement of effectiveness in meeting the needs of students.

From the methodological point of view, the qualitative paradigm and the ethnographic method are assumed in this work. This method is assumed in attention to appropriating techniques to collect and analyze information and for the description of students with previous professional experience within the training courses for tourist guides. The results allowed to finding

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the internal perspective of the participants in this type of courses. To this end, it was decided to frame as an object of study of this work the intercultural competence in the postgraduate improvement of the German language in the training course for tourist guides of the Cuban tourist training system, while its objective was concentrated on elaborating a conception didactic-methodological study for the development of this competence in German language tour guides.

II. Methodology Material and Methods

This study establishes that the appearance of conflict situations is inevitable. The persistence of misunderstandings and the non-development of strategies for conflict resolution have been evidenced and there is no single strategy to resolve conflict situations. Therefore, it is vital to consider the diversity of aspects that characterize each of the circumstances and carry out a detailed analysis that allows the strategy to be adapted to each situation.

This analysis has edges in common with the criteria expressed by the authors Cloke and Goldsmith, (1995) in their strategies for conflict resolution, by focusing on the settlement with concessions (occurs when each party to the conflict tries to cede some ground), collaboration (used when there is an intention of the parties in conflict to resolve the mishap by clarifying differences), competition (when the individual seeks satisfy their interests without caring about the impact it has on the other people involved in the conflict), complacency (misused by some guides, sometimes, by trying to calm their clients over their interests; it is seen as a part that sacrifices their interests) and evasion (assuming an attitude of acknowledgment of the existence of a conflict situation and one of the agents or even both, wishes to withdraw or suppress it).

These criteria are related to strategies based on professional experiences, applicable to this context and explicit in the guide profession; namely: competence can be used in decisive and quick actions; evasion, in order to reduce tensions or regain serenity during the guided tour; complacency, when one of the parties is wrong; trade-offs to reach expeditious solutions under time pressures; and collaboration, when the goal is to learn to gain commitment by consensual decision-making, to encourage one or both participants.

This work is based on the assessment that the solution of conflicts must be based on intercultural competence, supported by the knowledge that arises from decision-making and the active exchange of experiences among students, their knowledge and behaviors. Through this knowledge, students can develop certain strategies that allow maintaining, establishing and repairing communication between people of different languages and cultures and putting into practice appropriate behaviors. Addressing ways to solve conflict situations contributes to the development of a conception to develop this competence. In this context, there is a lack of a conception that promotes this intercultural exchange in German language guides.

Conflict Situations: Way to approach the didactic-methodological conception

The necessary didactic-methodological conception is defined by Morales (2013) as the "global notion of the internal logic that must go through the process of knowledge and transformation of reality. Through its development, it contributes to the actors involved critically appropriating reality to transform it into the creation of a design for educational purposes, assuming a given methodology.

The behavior between two cultures in the sphere of tourism is not always manifested in a cordial way. In order to provide an explanation and assume it as a vital task within this work, it was necessary to extend a critical evaluative inventory on frequent conflict situations of an intercultural nature, exposed by the researchers Costa and Ravetto (2018) and linked to the exchange between German and German language guides. German customers, expressed in the following situations:

- On a trip it may be necessary to make changes and adapt to unexpected situations. These situations cause immediate stress to German clients, who follow the program received at travel agencies in their country to the letter and do not take situations where they have to improvise with pleasure.
- Failure to keep a certain distance from travellers, translated into pretending to be intimate with some members of the group and constantly appealing to issues related to religion, politics and sex can easily offend their sensibilities.
- Non-compliance with the planned schedule for the tour.
- Reactions when several interlocutors are interrupted or speak at the same time.
- The misuse of different registers in a given conversation.
- Not taking into account the client's perspective, adopting hegemonic positions and egocentric attitudes.
- Deficiency of knowledge or disinterest in taking into account certain cultural perceptions about cleanliness, non-verbal signals, familiarity, speed of service, interference in private life, planning and organization.
- Absence of experience in the use of direct/indirect expressions.

These situations were expanded by the author of the work as a result of the application of surveys, of

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the investigation of the tangible and hypothetical needs, of the deficiencies and the wishes of the participants in other trainings for tourist guides. The situations are exemplified in the maladjustment to unexpected changes, in the difficulty of assuming improvised situations, in the different perception in the face of compliance with the established norms and in the non-preserving of distance in communication. Likewise, conflict situations are found in the disagreements caused by different interpretations about punctuality, planning, organization and excessive compartmentalization of the representatives of a certain culture, the dismissal of the client's perspective, the adoption of hegemonic positions and egocentric attitudes and in the ignorance of the use of some phrases and implicit.

The Conflict situations may be caused by the poor performance of the tour guide, his cultural and/or linguistic ignorance, misunderstanding, extreme opposition and lack of motivation to recognize, externalize and react to perceptions expressed differently by representatives of other cultures or could also be caused by other external causes linked to the sphere of services. These situations are basically manifested by the professional's lack of knowledge of how to react, behave or manage a situation; or because of misunderstanding, discrepancies and different perceptions about the phenomenon itself, which is interpreted differently by representatives of other cultures.

The highlights have a decisive influence on the behavior of customers who travel to Cuba. This prevents them from becoming repeaters, mediates the results of their stay, the fulfillment of their expectations, the dissemination of the experience upon their return and the persuasion for others to visit us. This situation would be reversed if these aspects were taken into consideration, from the training process of these professionals.

At present, societies are becoming increasingly heterogeneous and individuals and their professional interests come into conflict due to the contradictory nature of their objectives and their modes of action. This consideration is valid when discovering, interpreting and negotiating the behavior of different individuals in situations close to their professional reality, as is the case of the tour guide. In a communicative act within this sphere of action with representatives of other cultures, the appearance of conflicts can be considered inevitable. Every tourist guide dedicates a good part of his time to providing solutions and answers to these. Therefore, in the elaboration of the didactic-methodological conception it was necessary to specify certain aspects that contribute to the treatment of these situations and the strategies already declared to solve them; aspects that are consistent with the interests reflected in the applied instruments.

The strategies will be considered in activities within a training to be designed. The aspects that contribute to the treatment of conflict situations will be expanded upon applying a first experience. These aspects are directed, for example, to the study of a conflict situation that can emerge from diverse behaviors between German professionals and clients as a feature of cultural identity, as well as to question to what extent dialogue between cultures is achieved through different perceptions. on the same subject and that can lead to conflicts. The adaptation of conflict situations linked to non-verbal communication and work with the differences in the perception of courtesy between the representatives of both cultures is also conceived.

Thanks to access to diverse conflict situations, it was possible to verify that tour guides with little experience showed few resources before them. This action led to the diagnosis of strategies for conflict resolution, previously exposed, and their subsequent use. In parallel, they provided a pattern of how they should facilitate the elimination of communication barriers between the tour guide and the tourist.

Mediation in Conflict Situations: Approach from a conception for guides and its application through the Transversal Intercultural Competences Model

Future tour guides will face various conflict situations in their daily professional work, so it will be propitious that in the training to be designed various situations of interaction and disagreement are exemplified that stimulate decision-making in students. The success or failure in this type of interaction will depend, to a great extent, on the perceptions of the differences that separate them. Differences should not be viewed as insurmountable barriers. The important thing is to find points of contact that allow the best understanding.

It is also considered accepted for this work what was stated by Bachmann (2017) on the intercultural approach, as it is considered a relevant element in the foreign language classroom, since "it allows the student not only to reflect from himself and from his own identity, but also to have a positive vision of difference as something enriching for their formation as an individual".

In the elaboration of the conception, the use of various skills by the student will also be considered, as will be exemplified below. It is based on three transverse intercultural macro skills called: diagnose, relate and cope. It is proposed to focus on the latter, that is, on the macro transversal intercultural competence to face (CIT A), according to the characteristics of this study, the CIT model is declared as the most appropriate to measure the cultural knowledge of the participants in the training to design and is exposed, in addition, to the cross-cutting intercultural macro competence to face as an appropriate way to develop creative solutions to conflict situations.

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Transversal Intercultural Competencies (CIT), according to the researcher Aneas Álvarez (2003) are made up of knowledge, skills and attitudes that allow diagnosing personal aspects and demands generated by cultural diversity. These skills allow negotiating, communicating and working in intercultural teams and dealing with incidents that arise through intercultural self-learning and problem solving that consider other cultures". This author defines them as "those knowledge, skills and attitudes that allow negotiating, communicating and working in teams and dealing with incidents that arise through intercultural self-learning and problem solving that consider other cultures".

In the scenario linked to the development of job skills (Sánchez, A., 2017) of the student, the promotion of the CIT model is proposed for the diagnosis of the needs generated by intercultural communication and teamwork.

In correspondence with the assumed criterion, concrete actions were achieved that correspond to the macro competencies described in the CIT Model, by directing this work to enhance self-learning capacity, the development of cognitive, affective and emotional strategies to deal with discrepancies and deal with conflict situations, through creative solutions.

The Transversal Intercultural Competence of coping (CIT A) describes the relationship of coping behaviors, together with specific problem-solving strategies, negotiation, participation, decision-making, reward, etc. Coping is assumed in this work as a component of the transversal intercultural macro competence to face intercultural situations, through self-learning, solving problems and developing solutions that take into account the other or other cultures. This macro competence is considered the most appropriate to support the proposed intercultural components on it. The future application of the CIT model is expected to contribute to the measurement of students' cultural knowledge. The cross-cutting intercultural macro competence coping is considered adequate to deal with conflict situations and develop creative solutions for their treatment, applied to this professional sphere.

In this context, it is an assertion about those conducts and behaviors related to the social and technical system that would form part of the repertoire of the macro transversal intercultural competence to face and could be conceived as the list of behaviors to face, together with some specific problem-solving strategies, negotiation, participation, decision making and reward. In this reflection, related elements were found, such as knowledge, strategies and attitudes, indicated in the description of the concept of intercultural competence. What has been expressed favors this conception and will allow the reinsertion of cultural knowledge through the treatment of conflict situations of an intercultural nature.

In future research it will be possible to place the concept of intercultural competence on the basis of this model and this macro competence, in order to then channel, develop and evaluate significant aspects of the research not considered up to now, such as teamwork, progress of learning and decision-making in conflict situations. Although this work focuses its analysis on the transversal intercultural macro competence to face, it does not fail to consider the importance of the other macro competences: diagnose and relate, since the correct diagnosis of the situation must allow to propose the analysis, the goals and the feasible strategies, implemented in interpersonal relationships.

The author of the work values that the student throughout his professional training must acquire knowledge, strategies and assimilate attitudes, which will allow him to diagnose the social and technical requirements linked to his job and the organization in which he operates.

The student will have resources backed by experience or learning from it. The resources available to her must encompass cognitive elements, strategies, behaviors and the affective dimension. These elements will make up the set of the macro transversal intercultural competence to face (CIT A), which is distinguished by three types of components: cognitive, behavioral and emotional, which are exemplified below:

- *The Cognitive Components:* They are related to the knowledge that the student must have to be considered interculturally competent. They are linked to the approach with which intercultural competences are addressed. To achieve intercultural and professional competence, it is considered essential to combine knowledge of beliefs, values and norms (especially in the professional field) and elementary aspects of intercultural communication and the foreign language (FL) for their comprehensive training.
- *Behavioral Components:* They emerge when the shared culture has already been defined and its influence on the relationships of individuals and their social practices have been analysed. An interculturally competent professional, in addition to knowing the existence of these components, must be able to use them.
- *The Emotional Components:* They share the presence of emotional traits related to the psychological characteristics of the individual; the affective treatment generated in each culture through phenomena of threat, attraction or rejection based on insecure relationships, which occur in a visit to a foreign tourist destination, emotional aspects that must be managed competently.

What has been expressed is in accordance with the assumptions assumed for the adjustment of the CIT

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model, focused on the promotion of cultural sensitivity. According to the German researcher Müller-Jacquier (2017), cultural sensitivity is presented as "a process of self-development and a resource in conflict situations in which the abandonment of ethnocentrism is required". This process is a significant component of the cross-cutting intercultural macro competence to face, which enables the subject to intervene on a problem and have the probability of solving it. In other words, within the framework of intercultural exchange in the tourism sector, the interculturally competent individual must understand the responses and behaviors of the foreign interlocutors with whom he interacts, as well as his own responses, resulting from the development of his cultural sensitivity.

It is exposed that the adaptation to this professional scenario of the macro transversal intercultural competence to face (CIT A) enables the individual to intervene and solve unforeseen conflict situations. What is expressed implies professional performance and the strategies to be assumed in the face of negotiation, participation and decision-making, when leading a group with representatives of other cultures and when feeling prepared to establish intercultural mediation, understood by the researcher Fuentes (2007) as the "actions to transform reality from relationships with subjects from other cultures. A professionalized resource that aims to contribute to better communication, relationship and integration between people or groups present in a territory, and belonging to one or more cultures". The evaluations exposed also support the imminent elaboration of the didactic-methodological conception, based on the theoretical assumptions presented.

III. Results and Discussion

In the professional field, intercultural mediation is increasingly necessary due to everything that the globalization process has implied. Specifically, in this sphere of client-tourism professional relationships with different cultures, diversity sometimes leads to a mutual ignorance of both parties and as a consequence clash or conflict occurs. Conflict is a phenomenon that often occurs in interpersonal relationships.

According to the German researcher Wierlacher (2018), the resolution of conflicts will lie in the "ability that the people involved have to analyze them, solve them and take them as a reference to achieve greater mutual understanding". When consensus is not reached between the parties involved, mediation is necessary. When the conflict affects two groups of different nationalities and a mutual agreement is not reached, the prevailing need is to seek intercultural mediation that brings both parties closer together and helps them achieve greater mutual understanding.

When developing mediation in the sphere of tourism, a series of particularities that distinguish it are observed, such as those of a minority group that lives with the values and beliefs of a majority group or a minority group that demands its right to have a hegemony cultural. For this reason, it is essential that this minority group have access to knowledge of the values and beliefs of the majority in order to achieve greater knowledge and development of the target culture.

Sometimes communication between groups is interrupted by stereotypes and prejudices or by an insufficient level of mastery of the target language. Hence, the need for mediation and the mediator as a flexible element that helps to overcome these obstacles and allows more fluid communication between the affected parties. It then appeals to what Sommer (2018) calls impartiality in conflict resolution and not end up acting as an intermediary. The mediator must verify the availability of the parties to address the conflict and must ensure the conduct of the process, which includes creating harmony between the parties and maintaining it throughout the entire process.

In this study it is pertinent to address a new paradigm of organizational culture, by relating it to mediation and conflict resolution. According to Novel (2010) this paradigm must be implemented through a "global system of attention to diversity, differences and conflict from a cost-efficient perspective that provides elements of penetration in the organization of a culture of mediation and provokes the desired changes in the short, medium and long term and this through commitment to people, processes and results".

An organizational culture must bet on the use of the power of the parties to deconstruct the conflict, establish processes of peaceful dialogue to improve relations between people and, from various trainings, design a structure, proposed globally and systemically, for the prevention and positive conflict management.

This work agrees with the observations of the researcher Held, G. (2019) when highlighting that the resources directed to the deconstruction of a conflict must be directed to "provoke a change in the modes of communication, in order to face the differences and include different levels of acting". These should be aimed at building an organization to achieve the promotion of relational health between clients and users, through the training of mediation skills, the creation of collaborative and communication skills in difficult situations. It is considered feasible that the treatment of the conflict should be carried out through the intervention of a care system, with people trained to function as mediators who help prevent its escalation and associated costs, all together with an intervention of specialized care services.

Mediation is also related to the management of changes and the search for quality in relationships within organizations. In order to implement this culture of mediation within the organization and achieve change,

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the Novel researcher (2010) proposes the development of certain strategies aimed at micro-managing the conflict, introducing improvements in communication and transferring knowledge to use tools mediators in people and groups that produce value learning, through the establishment of a system of primary attention to the conflict.

The presented study highlights its uniqueness by specifying a conceptual framework for the elaboration of a conception expressed in a training, according to the pedagogical, technological and design parameters necessary to become an effective means of teaching, based on overcoming students and is aimed at developing their intercultural competence in performance as tour guides.

The current situation stands out in the incursion into an underdeveloped and under-researched area in the context of professional training, specifically, in language improvement courses for professional purposes focused on the development of intercultural competence of tour guides. It is also declared that the work goes into an area that is little investigated in the context of professional training in Cuba, specifically, in language improvement courses for professional purposes focused on the development of intercultural competence of tour guides.

In this context, there is no background on the design of a course to develop this competence in these students. The results of the applied instruments and the description of the selected context confirm that the development of it in overcoming postgraduate courses with professional tourism purposes can be promoted from the elaboration of the didactic-methodological conception. The design of the conception expands the training of the tourist guide student in their cultural knowledge from mixed learning conditions; underdeveloped principle in this context in Cuba.

His contribution to the theory lies in formulating a new definition of intercultural competence based on this context of postgraduate improvement. An adaptation of the Transversal Intercultural Competences Model is proposed for the measurement of cultural knowledge at the beginning of the training course for tourist guides. Its contribution to the practice will be verified in the influence that it will be able to exert on students who begin a training stage as tourist guides and attend training in the context of postgraduate improvement.

IV. Conclusions

The reflections exposed in this study have prepared a base to evaluate, from it to the intercultural competence of tourist guides and the theory of mediation in the tourist context. These reflections are expected to contribute to further research on the role of this competence in the work of the tour guide.

- The outlined conceptual framework suggests the transversal intercultural competencies (CIT) model as the most appropriate to support the intercultural components.
- In the adequacy of the cross-cutting intercultural competence macro, which is part of this model, similar elements were found such as knowledge, strategies and attitudes that favor this research and will contribute to reinserting cultural knowledge through the treatment of conflict situations. .
- On a practical level, it is hoped that the factors of intercultural competence can be applied in training to design, according to the needs as well as in experimental behaviors that help to regenerate and further expand the growing flow of visitors from the German market to our country.
- Intercultural mediation should be part of the postgraduate training and improvement programs in the teaching of foreign languages for professional tourism purposes in order to develop their intercultural competence. In this training, intercultural mediation can be exercised through simulations or analysis of cases in which real conflicts are shown so that students can demonstrate that they have assimilated the knowledge in the teaching-learning process.
- As a fundamental recommendation, the study and expansion of the critical evaluative inventory of conflict situations of an intercultural nature that is presented, according to the cultural differences of the different representatives of the German-speaking market, from a broad national or individual perspective, is pointed out, recognizing the cultural character of these markets.

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Global Journal of human-social science: B
Geography, Geo-Sciences, Environmental Science & Disaster Management
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Change in Housing Structure to Cope with Natural Hazards: A Statistical Analysis from Indian Sundarban

By Rituparna Hajra & Sanjib Kumar Gupta

Abstract- Deltas are always being favourite destination for human due to rich biodiversity and abundant resources yet at the same time; they are highly vulnerable to the impacts of natural hazards. Despite their proneness to hazards, coastal people make relentless efforts to cope with severe impacts through age-old indigenous knowledge and practices. Dwelling structures are directly being influenced by extreme events. The purpose of this study is to assess the association between natural hazards and housing pattern to combat extreme consequences in the islands of Indian Sundarban Delta (ISD). The western boundary of the ISD is the major focus of this study specifically Sagar, Ghoramara and Mousani Islands which are prone to regular occurrence of erosion, cyclone, storm surges, saline water inundation and flooding. This study attempts to estimate the influence of particular hazard on the housing structure by means of multinomial regression using collected primary survey data from randomly selected households within these islands.

Keywords: quantitative assessment; multinomial regression; housing structure; delta; sagar; ghoramara; mousani; indian sundarban delta.

GJHSS-B Classification: DDC Code: 549 LCC Code: QE366.8



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Rituparna Hajra [α] & Sanjib Kumar Gupta [σ]

Abstract- Deltas are always being favourite destination for human due to rich biodiversity and abundant resources yet at the same time; they are highly vulnerable to the impacts of natural hazards. Despite their proneness to hazards, coastal people make relentless efforts to cope with severe impacts through age-old indigenous knowledge and practices. Dwelling structures are directly being influenced by extreme events. The purpose of this study is to assess the association between natural hazards and housing pattern to combat extreme consequences in the islands of Indian Sundarban Delta (ISD). The western boundary of the ISD is the major focus of this study specifically Sagar, Ghoramara and Mousani Islands which are prone to regular occurrence of erosion, cyclone, storm surges, saline water inundation and flooding. This study attempts to estimate the influence of particular hazard on the housing structure by means of multinomial regression using collected primary survey data from randomly selected households within these islands. The result suggests that seawater ingression often collapses the mud wall of the coastal houses and houses having thatched roof are vulnerable to cyclonic storms. The survey findings show that finished materials are preferable for roofs to that for wall and floor to protect houses form the cyclonic storm. The result further suggests that mud is commonly used for wall and floor due to easy availability from river, creeks, and ponds. Comparatively Sagar Island has lowest percentage of kachcha houses than other two islands which can be explained by the fact that Sagar has a better infrastructural setup. Given the importance of delta regions as centre of attraction for diverse anthropocentric activities, this study also tries to offer a number of concrete policy recommendations to reduce housing vulnerability from natural hazards.

Keywords: quantitative assessment; multinomial regression; housing structure; delta; sagar; ghoramara; mousani; indian sundarban delta.

I. Introduction

Safe and affordable shelters are the basic needs for sustainability of any place. Achieving safe and resilient habitat is one of the main goal among Sustainable Development Goals post 2015 proposed by UN (2014). Settlements can be categorized as rural and urban in broad sense. Environmental impact often influences the individual choice of house types (UN Habitat, 2010) and this impact is significant on rural settlements. India is primarily rural in character where nearly 72% of the Indian population lives in rural areas (Census, 2001). NSSO (2010) 65th round report estimated that nearly 55% and 92% of the rural and urban households lived in pucca structures, around 28% and 6% of the rural and urban households lived in semi-pucca structures and approximately 17% and 2 % of the rural and urban households lived in kachcha structures. According to Ministry of Rural Development, Govt. of India and National Family Health survey by International Institute for Population Sciences (IIPS) (2007) house types have been classified as Kachcha (both wall and roof made of natural material), Semi-pucca (either wall or roof made of finished or rudimentary materials), and Pucca (both wall and roof made of finished material) (Table 1). Indian rural settlements show a typical pattern with mud wall carrying the roof load with a support of two bamboo post in corner (World Housing Encyclopedia Report, 2002). The total number of census- houses have increased from 24.9 crore (2001) to 33.1 crore (2011) which is around 33% higher than 2001 housing stock (Census, India). Empirical evidences show that better rural housing always has a positive correlation with creation of wealth and raises productivity in the rural sector in particular and hence augments social welfare too. In West Bengal about 50% rural and 8% urban households live in kachcha houses. 34% rural and 28 % urban households live in semi- pucca and 16% rural and 64% urban households live in pucca houses (IIPS, 2010). Structures of house are directly associated with the household income as nearly 24% of the rural households in the bottom quintile class based on monthly per capita expenditure mainly live in kachcha houses (NSSO, 2010) in India.

Climatic changes and extreme weather events have negative impact on settlements. Indian Sundarbans is very much prone to natural disasters like tidal surge and cyclones. But all the blocks in Sundarban except in Joynagar-I, less than 30% households live in pucca or partially pucca houses with no security of living during disaster (HDR, S 24 Parganas, 2009) which requires urgent attention because it is associated with security of human life and property. The present study aims to assess the associations between natural hazards and housing

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pattern in (ISD) mainly focussing on Sagar, Ghoramara and Mousani islands (Figure 1). The area is a low, flat, alluvial plain intersected by a large number of tidal rivers, estuaries, and creeks with dynamic flow patterns of tidal water, along with the erosion accretion of land, have built up a complex geomorphology (Das, 2006). Climate change, induced sea-level rise, changing rainfall patterns, and changes in the frequency and intensity of extreme weather events have had significant impacts on the islanders of ISD (Danda, 2010). Half of the households of the islands of ISD experiences extreme events like cyclone, inundation and surges, land erosion among which almost 23% of households reported loss from these hazards (Hajra et al., 2017). Cyclonic storm surges can damage embankments followed by saline water intrusion and flooding and lead to damages of property including mud wall of houses, cracks in structures; salinization and crop failure (Hajra and Ghosh, 2018; Hajra et al., 2017). Although earlier studies investigated the impacts of natural hazards on society in these islands (Hajra et al., 2017; Hazra et al., 2014), there is limited research examining the connections between vulnerability to natural hazards and change in housing pattern to combat extreme consequences. This study aims to fill this gap by examining on the housing structure and impact of each natural hazard on house types at a household level in the ISD and offer a number of concrete policy recommendations to reduce vulnerability to natural hazards.

Table 1: Rural households' material – India (Source: IIPS, 2007)

Category	Building materials		
	Natural	Rudimentary	Finished
Wall	polythene/cane/palm/trunks/ bamboo/mud/grass/reeds/thatch	bamboo with mud/stone with mud/plywood/cardboard/un burnt brick/raw wood/reused wood	cement/concrete stone with lime/cement burnt bricks cement blocks wood planks/ shingles gi/metal/asbestos sheets
Roof	thatch/palm leaf/reed/grass mud/sod/mud and grass mixture plastic/polythene sheeting	rustic mat palm/bamboo raw wood planks/timber unburnt brick/loosely packed stone	metal/gi wood calamine/cement fiber asbestos sheets rcc/ rbc/ cement/concrete roofing shingles tiles slate burnt brick
Floor	mud/clay/earth sand dung	raw wood planks palm/bamboo brick /stone .	parquet or polished wood vinyl or asphalt ceramic tiles cement carpet /polished stone/ marble/ granite

II. Data and Methods

Data have been collected for this study through direct interviews with households within the study area of ISD. In order to assess the impact of natural hazards on the different yard stick of housing structure of the study area a two-stage sample survey was conducted in three islands of Sundarban -Sagar, Ghoramara and Mousani during March 2012 to October 2013. In the first stage, using Tippett's random number tables mouzas were selected from all three islands; in the second stage, a systematic sampling procedure is applied where a first house was selected randomly using random number table in each mouza and remaining were chosen maintaining a prescheduled constant gap of the houses. Sagar Island has 42 villages under 9 Gram Panchayat of Sagar Block. Ghoramara is a single mouza under Sagar Block and Mousani has 4 villages. The survey was carried out through direct interviews in 52% of the inhabited mouzas of Sagar Block, including Ghoramara (23 mouzas out of 42) and 100% of the inhabited mouzas (4 mouzas) of Mousani Gram Panchayat of Namkhana Block (Figure 1). In our survey 59% of mouzas were selected with members of 783 households from 27 villages of the study area. The margin of random error (Fox et al., 2009) was obtained close to 3% at 95% confidence interval for the selected number of sample.

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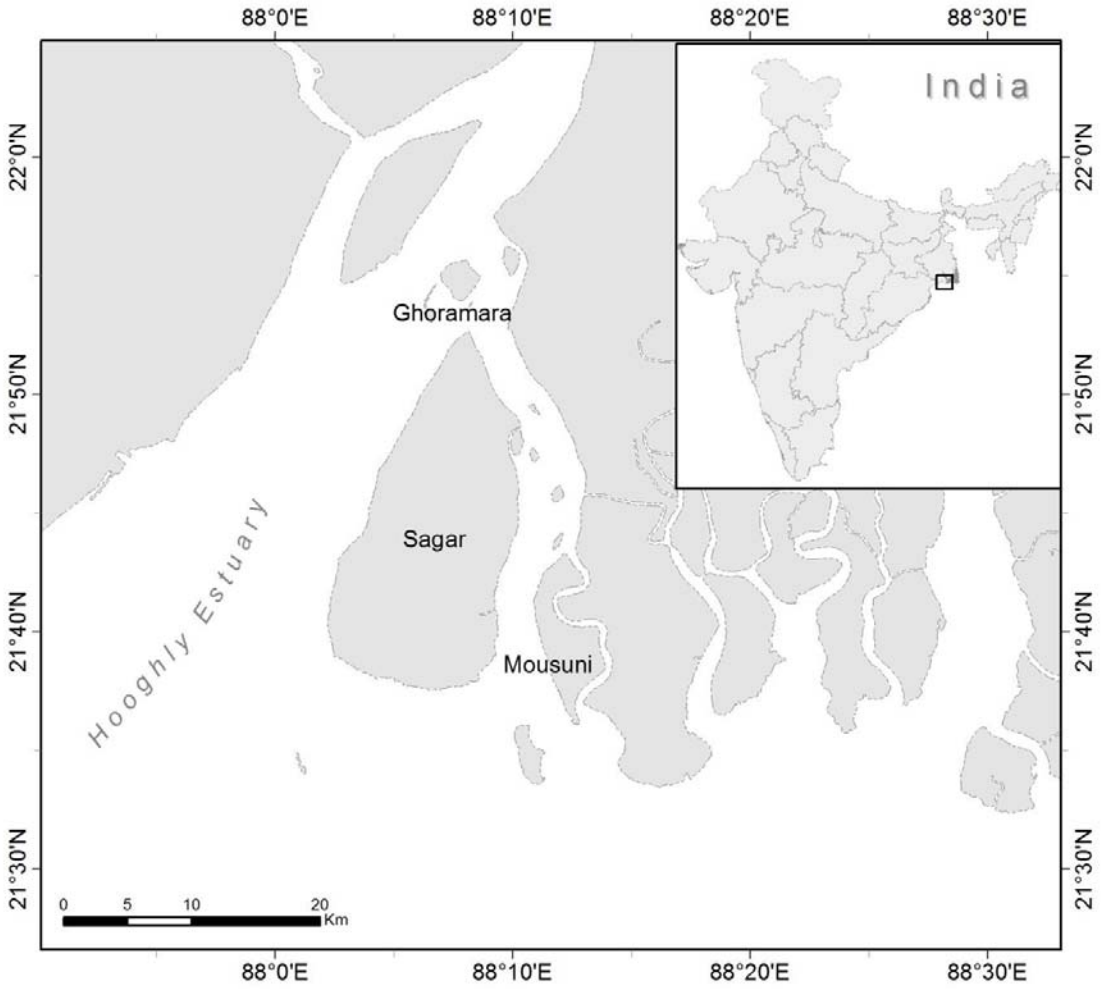


Figure 1: Location map of the study area (Hajra et al. 2017)

Respondents were asked if they felt the impact of climate change i.e. some questions covered whether they affected by the different natural hazards or not. Questions were also asked to get the type of the housing structure of the inhabitants to cope with natural hazards. The main aim of this study has been to assess the linkages between some key explanatory variables related to natural hazards of interest such as surge (S), Inundation (I), cyclone (C) and erosion (E) with housing variables through statistical models. Housing variables for our study are the main materials used for the construction of walls (W), floors (F) and roofs (R) among the surveyed households. Each housing material is divided into categories of natural, rudimentary, and finished. This study has also considered the height of the floor (H) from the land. In our analysis, the hazards variables were assigned as 1 or 0 accordingly the response of the inhabitants was yes or no, respectively. Study also consider different place or land (L) as a control variable. The numbers 1, 2, and 3 were assigned if Sagar, Ghoramara and Mousani were considered. Similarly, the response variables wall, roof and floor materials are categorical and 1, 2, and 3 accordingly have been assigned if made by natural, rudimentary, or finished material. Height of the floor is also assigned 1, 2, and 3 if the height is less than 1 ft, between 1 ft to 2 ft and more than 2 ft respectively. Study uses 4 different models to analyse the result. In model 1, wall material was taken as dependent and surge, inundation, erosion, and cyclone were considered independent variables, controlling the control variable land. The independent variables are same for all other models. The housing variables Roof type, Floor type and Height of floor are the dependent variable for the respective models 2, 3 and 4. In all the models dependent and independent variables were used to identify the associations as stated in the aims of this study. The response variables, i.e., the housing variables being categorical in nature and these dependent variables are of different layers, so multinomial logistic regression has been performed to test the effects. This analysis has been done in SPSS software.

In general, If the dependent variable y is categorical and takes 1,2,…, *l* values, $x_1, x_2, ..., x_k$ are

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the explanatory (independent) variables and π_i =Probability (y=i) with $\Sigma\pi_i$=1, then the log model is:

$$\pi_i = \frac{\exp(B_{i_o} + B_{i1}x_1 + ... + B_{ik}x_k)}{1 + \exp(B_{io} + B_{i1}x_1 + ... + B_{ik}x_k)}$$

and hence,

$$\ln\left(\frac{\pi_i}{1-\pi_i}\right) = B_{i0} + B_{i1}x_1 + ... + B_{ik}x_k$$

Here B_{i0}, B_{i1},..., B_{ik} are the coefficients of the regressors corresponding to i-value of y and let outcome*i*s chosen as pivot. The *Maximum Likelihood* Method is used to obtain these estimates.

Thus, for models 1, 2, 3 and 4 y represents respectively house material, roof type, floor type and height of floor.

p-values were measured to test the impact of the hazards on the different parameters of the housing structure. If p-values $\leq \alpha$ (0, 0.001, 0.01, 0.05, 0.1), then the explanatory variables have a significant effect at the level α. Generally, up to α=0.05, here consider higher significant effect. However, if α=0.1 then one can also say the corresponding factor has a small significant effect.

III. Results

In order to examine the association between housing structure and natural hazards, household level data have been used in this study from Sagar, Ghoramara and Mousani islands of ISD. Result of descriptive analysis (Table 2) shows that inhabitants of Sagar and Mousani are suffered more from the inundation and tidal surge whereas the people of Ghoramara suffered maximum from erosion. It is also observed that among households 49% and 11% in Sagar, 42% and 33% in Ghoramara, 37% and 7% in Mousani have been suffered from two and three types of hazards respectively. Only a rare section of the inhabitants are never been affected from any natural hazards. This confirms the pivotal role of natural extreme events on these islands in line with previous literatures (Hajra et al., 2017; Hazra et al., 2002; Gopinath, 2010). Study observes that most of the inhabitants either loss land or house or both land and house. Estimation of losses (Table 2) shows that the people of Ghoramara are suffered more from losses than other two islands as 50% of households lost land, 22% of households lost both land and house while these figures are lower in Sagar and lowest in Mousani. This suggests the importance of studying hazard parameter that related to the day to day life of the inhabitants. However, this study restricted to analysing the influence of natural hazards on housing pattern and the changes made on housing structure to prevent these extreme natural events.

Table 2: Summery table

Descriptive statistics (% of households)				
Natural hazards		Sagar	Ghoramara	Mousani
Categories of natural hazards	Surge	59	46	49
	Inundation	60	58	87
	Cyclone	43	21	43
	Erosion	17	75	21
Number of categories faced by households	One	16	18	33
	Two	49	42	37
	Three	11	33	7
	Four	5	0	15
Types of Losses	Land	11	50	4
	House	6	2	4
	Land and house	13	22	10
Housing structure				
Wall material	Natural	80	92	70
	Rudimentary	06	04	20
	Finished	14	04	10

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Roof material	Natural	31	25	34
	Rudimentary	06	00	00
	Finished	63	75	66
Floor material	Natural	60	91	90
	Rudimentary	04	00	00
	Finished	36	09	10
Floor height	<1ft	24	29	39
	1-2 ft	48	67	52
	>2ft	28	04	09
Number of rooms	1	63	50	75
	2	30	42	23
	More than 2	09	08	02

This study finds that 73%, 53% and 57% households live in semi- pucca houses and 17%, 43% and 34% households live in kachcha houses in Sagar, Ghoramara and Mousani respectively whereas only 9% houses in Sagar and Mousani and 3% houses in Ghoramara are of pucca structures. Descriptive analysis on housing structure shows that in all three islands natural materials are most preferred for wall and floor construction. 80%, 92% and 70% households used natural material for wall and 91%, 60%, 90% households used natural material for floor in Sagar, Ghoramara and Mousani respectively. Being riverine islands, mud is easy available from river, creeks and ponds and used as wall and roof material (Ugbomeh, 2016). Finished materials are preferable for roof among the inhabitants including 63% in Sagar, 75% in Ghoramara and 66% in Mousani Island. This can be explained as these islands are prone to cyclonic hazards, peoples try to stabilize the roof by finished materials like asbestos, tiles to protect form cyclonic storm (Ugbomeh, 2016; Das et al., 2012; Paul and Routray, 2011; Pinelli et al., 2004). 48%, 67%, and 52% households of Sagar, Ghoramara and Mousani Island have houses with floor height between 1 ft to 2 ft to avoid the storm surges and tidal water inundation and destruction of housing structure. Sagar Island being affected more from inundation has 28% houses having floor height more than 2 ft. The inhabitants of these islands are mostly poor, so having only one room among majority households (Table 2). The impact of natural hazards are more on the poor community (Hajra et al., 2017), hence they tried to maintain discussed housing pattern to minimise losses from natural hazards. In the next section of analytical part multinomial logistic regressions are considered to identify the associations between the natural hazard and different characteristic of housing structure. Four separate tables (Tables 3-6) show the results of four separate models that tested our hypotheses.

Table 3: Multinomial regression of wall material on surge, Inundation, cyclone, erosion and land

Wall material	Variable	Estimates	Standard Error	p-value
1.00	Intercept	1.928	0.577	0.071
	[Surge=0]	-0.333	0.377	0.057
	[Inundation=0]	0.250	0.410	0.031
	[Cyclone=0]	0.069	0.378	0.085
	[Erosion=0]	0.369	0.408	0.036
	[Island=Sagar]	0.027	0.484	0.096
	[Island=Ghoramara]	1.134	1.161	0.082
2.00	Intercept	0.252	0.702	0.719
	[Surge=0]	-0.333	0.450	0.075
	[Inundation=0]	0.653	0.473	0.016
	[Cyclone=0]	0.040	0.451	0.092
	[Erosion=0]	0.765	0.518	0.014
	[Island=Sagar]	-0.361	0.559	0.098
	[Island=Ghoramara]	1.02	0.99.	0.072

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In order to examine the relationship between the wall material with inundation, erosion, cyclone, controlling for other variables included in the model, regression analysis was performed (Model 1 – Table 3). The p-values of the coefficients corresponding to the key variables including inundation, erosion, and cyclone shows that all the hazards have a more or less significant effect on different structure of the wall. The place also has a small significance effect. Among the hazards erosion along with inundation have the higher significant affect for wall material. Here the Goodman and Kruskal's γ coefficients has calculated between wall type and erosion, inundation and the place and they are -0.71, -0.57 and -0.29 respectively.

Table 4: Multinomial regression of roof material on surge, Inundation, cyclone, erosion and land

Roof material	Variable	Estimates	Standard Error	p-value
1.00	Intercept	-0.426	0.380	0.263
	[Surge=0]	-0.207	0.256	0.420
	[Inundation=0]	0.356	0.267	0.182
	[Cyclone=0]	-0.315	0.260	0.022
	[Erosion=0]	0.014	0.304	0.593
	[Island=Sagar]	-0.960	0.305	0.512
	[Island=Ghoramara]	-0.273	0.563	0.628
2.00	Intercept	-40.401	1.616	0.428
	[Surge=0]	1.251	1.050	0.634
	[Inundation=0]	.287	1.076	0.279
	[Cyclone=0]	18.699	.000	0.039
	[Erosion=0]	-0.057	1.189	0.096
	[Island=Sagar]	1.646	0.467	0.667
	[Island=Ghoramara]	-0.667	0.500	0.942

In Table 4 - Model 2 multinomial logistic regression of roof type on inundation, erosion, cyclone, and the place has been done. Table 3 also shows that only cyclone influences different type of roofs. This is why to cope with impact of cyclone most of the inhabitants use finished product for their roof in ISD. Here the γ coefficient between roof type and cyclone is 0.34.

Table 5: Multinomial regression of floor material on surge, Inundation, cyclone, erosion and land

Floor material	Variable	Estimates	Standard Error	p-value
1.00	Intercept	61.100	3288.180	0.985
	[Surge=0]	14.694	1749.781	0.099
	[Inundation=0]	12.855	2084.671	0.099
	[Cyclone=0]	-14.602	1863.908	0.994
	[Erosion=0]	13.252	2067.913	0.009
	[Island=Sagar]	-14.531	0.481	0.375
	[Island=Ghoramara]	-12.442	4890.915	0.824
2.00	Intercept	42.050	4348.924	0.992
	[Surge=0]	-14.813	1749.782	0.096
	[Inundation=0]	13.458	2084.671	0.075
	[Cyclone=0]	-14.845	1863.909	0.994
	[Erosion=0]	-14.621	2067.914	0.034
	[Island=Sagar]	0.252	2846.227	0.560
	[Island=Ghoramara]	-13.357	7614.820	0.999

Table 5- Model 3 illustrates regression analysis considering floor type, inundation, erosion, cyclone, land. The p-value indicates that erosion has most influential for floor material. Surge and erosion have also some impact on the material of floor. Here γ coefficients between floor type and inundation, surge and erosion are respectively -0.27, -0.14 and -0.61.

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Table 6: Multinomial regression of height of floor on surge, Inundation, cyclone, erosion and land

Height of floor	Variable	Estimates	Standard Error	p-value
1.00	Intercept	1.405	0.640	0.028
	[Surge=0]	0.748	0.377	0.047
	[Inundation=0]	0.633	0.393	0.011
	[Cyclone=0]	-0.898	0.408	0.328
	[Erosion=0]	-0.221	0.445	0.022
	[Island=Sagar]	-0.479	0.502	0.074
	[Island=Ghoramara]	0.510	1.217	0.097
2.00	Intercept	2.017	0.615	0.001
	[Surge=0]	-0.130	0.356	0.071
	[Inundation=0]	-0.002	0.375	0.049
	[Cyclone=0]	-0.604	0.398	0.129
	[Erosion=0]	-0.171	0.429	0.049
	[Island=Sagar]	-0.081	0.488	0.067
	[Island=Ghoramara]	1.304	1.172	0.095

In Table 6- Model 4, an attempt has been made to find out the associations between height of the floor and inundation, erosion, cyclone, and land. This table reflects that among the hazards erosion and inundation have highly significant effect on the height of the floor. The island also has an effect on planning on height of the floor. Sagar has the more proportion of the houses having above 2 ft height of the floor than other islands which can be explained by the diurnal flooding from tidal spill (Hajra and Ghosh, 2018). Here the γ coefficients between floor height and inundation, erosion and land are respectively 0.42 and 0.53 and -0.18.

IV. Discussion and Policy Implications

Islands of ISD are highly vulnerable from natural hazards. In addition, large proportions of the households in the study area are poor and thus have limited access to resources and facilities (Ghosh, 2012). In this context, the main objective of this paper is to examine the association between natural hazards and housing pattern to combat extreme consequences in these islands of ISD. The results of the study confirmed that there is significant association between natural hazards and housing structure. In line with previous literature (Hajra et al., 2017; Hazra et al., 2002) this study also finds that most of the households are suffered from more than one type of natural hazards. Results of multinomial logistic regression show that erosion and inundation has significant impact on the wall and floor material similar with findings of previous literature (Chand et al., 2012; Paul and Routray, 2011; Hutton and Haque, 2003). Again in line with other literature (Ugbomeh, 2016; Das et al., 2012; Paul and Routray, 2011; Pinelli et al., 2004) this study suggests that finished materials are preferable for roof among the inhabitants to stabilize and protect the roof form cyclonic storm. Height of the floor is also maintained above 1 ft to 2 ft. This can be explained by the fact that the households try to protect the houses from storm and tidal surge and inundation (Hajra et al., 2017; Hazra et al., 2002; Ghosh et al., 2001).

Based on the findings of this study few policy recommendations are provided for improving the residential structures including wall, floor and roof material. Planned housing structure is needed especially in coastal mouzas. For this to effectively occur, programs must become more responsive in promoting constituency-building and lobbying among the poorest and most vulnerable. The implication of the 'Indira Awas Yojona' and other Government schemes under the supervision of the local Panchayat should be taken with utmost priority to the vulnerable mouzas mainly Ghoramara, Sapkhali, Baliara etc. Along with the proper maintenance of housing structure natural hazards management planning is also necessary to prevent further losses. Development of community infrastructure can increase societal resilience, and reduce the intensity of natural hazard impacts on households. Establishment of flood shelters, maintenance of embankment, development of wireless networks, and improvement of warning system could enhance the societal resilience.

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18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.
Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

19. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

20. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

21. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

22. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

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Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



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Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



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Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

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Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

A

Abundant · 4, 71
Aggregated · 27
Assertion · 67
Assumptions · 27, 68

C

Combustion · 26, 37, 38, 40,
Consolidation · 30

D

Deionized · 5
Dissertation · 37, 42
Drought · 23

E

Egocentric · 65, 66
Expelled · 39, 43, 44, 45, 50

G

Gravels · 16
Gravimetric · 32, 35

I

Imperative · 50
Incineration · 26, 28, 30,
Inevitable · 65, 66

N

Negligence · 42

P

Plagued · 49
Predictions · 13
Preferable · 71, 75, 77
Province · 3, 6, 11
Pursued · 36, 37

R

Relevant · 27, 29, 66
Rudimentary · 71, 73
Rupture · 3

S

Sludge · 34

T

Territorial · 32, 52
Thrive · 39

V

Validation · 30
Vermiculite · 2, 3, 4
Vulnerable · 71, 77



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ISSN 975587

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