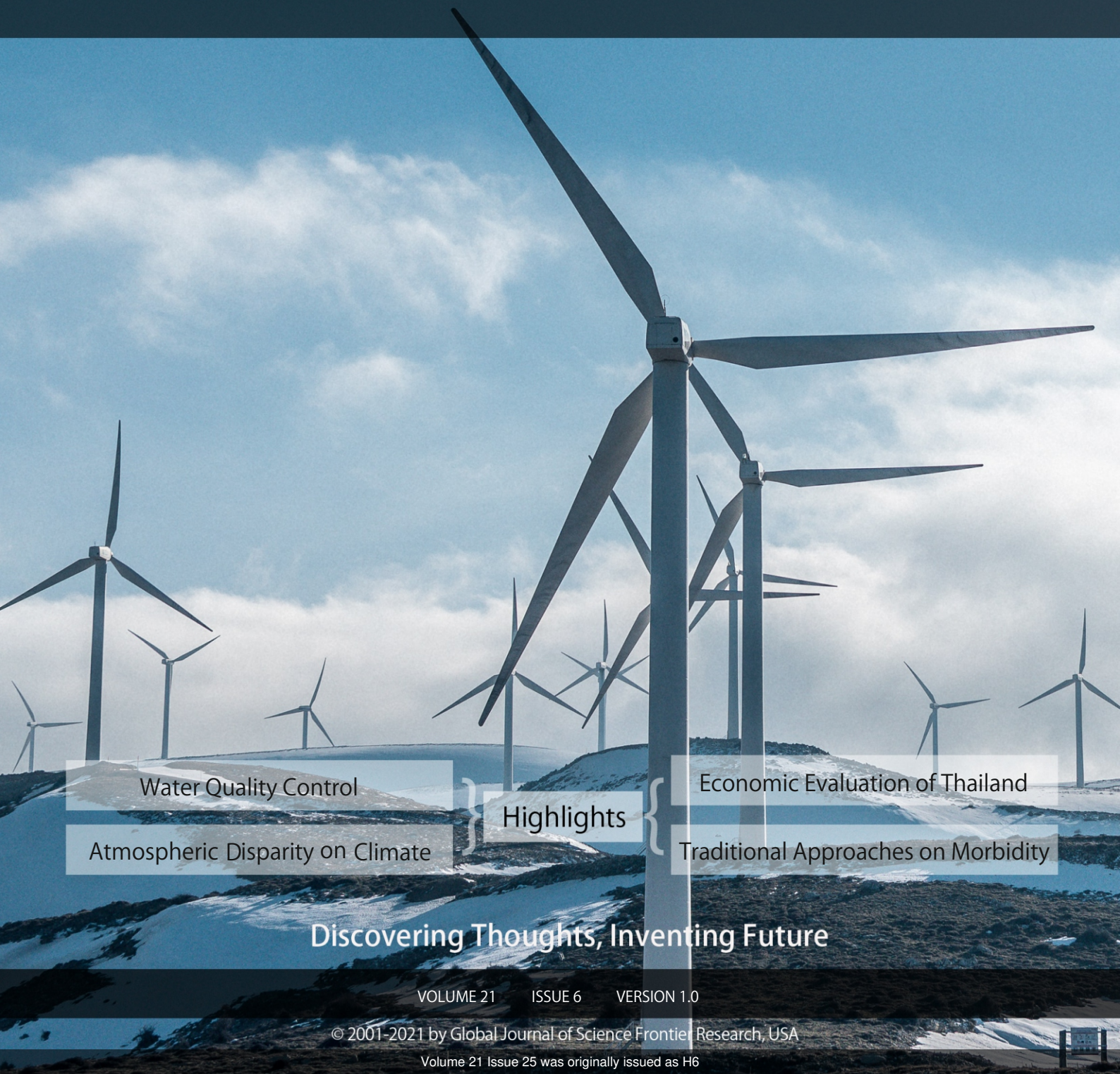
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Atmospheric Disparity on Climate

Highlights

Economic Evaluation of Thailand

Traditional Approaches on Morbidity

Discovering Thoughts, Inventing Future

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An Economic Evaluation of Thailand Juvenile Vocational Training Centers

By Natthaprat Nantiwatkun & Chompoonuh K. Permpoonwiwat

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Abstract- The main role of the Juvenile Vocational training center is to rehabilitate young offenders and support their social reintegration, including protecting communities from unsafe situations. Imprison offenders would be faced a real challenge at the time of their release unless efficient and effective programs are provided. The paper analyzed the cost per unit and examined the Economies of Scale of the 17 juvenile vocational training centers across Thailand. The analysis was based on a data set during 2016 - 2019 from the Department of Juvenile Observation and Protection. The average cost per unit in the center was $168 per month or $2,018 annually. The results revealed that both small- and large-scale centers were inefficient. Incidentally, this cost per unit paid for an offender was lower than the national comparing average cost of living. Therefore, the means of increasing operational efficiency in Juvenile Vocational Training Center must be exerted to avoid the internal diseconomies of scale.

Keywords: economies of scale; cost per unit; juvenile offenders, juvenile vocational training center (JVTC).

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An Economic Evaluation of Thailand Juvenile Vocational Training Centers

Natthaprat Nantiwatkun [α] & Chompoonuh K. Permpoonwiwat [σ]

Abstract- The main role of the Juvenile Vocational training center is to rehabilitate young offenders and support their social reintegration, including protecting communities from unsafe situations. Imprison offenders would be faced a real challenge at the time of their release unless efficient and effective programs are provided. The paper analyzed the cost per unit and examined the Economies of Scale of the 17 juvenile vocational training centers across Thailand. The analysis was based on a data set during 2016 - 2019 from the Department of Juvenile Observation and Protection. The average cost per unit in the center was $168 per month or $2,018 annually. The results revealed that both small- and large-scale centers were inefficient. Incidentally, this cost per unit paid for an offender was lower than the national comparing average cost of living. Therefore, the means of increasing operational efficiency in Juvenile Vocational Training Center must be exerted to avoid the internal diseconomies of scale.

Keywords: economies of scale; cost per unit; juvenile offenders, juvenile vocational training center (JVTC).

I. Introduction

Nowadays, there were continually decreasing in birth and mortality rate, developing children and adolescence to high potential was essential to the future of the country. Even as a group of juvenile offenders (The people are under 18-year-old who committed criminal assault, murder, rape, burglary, drug trafficking, etc.), the government must invest their potentials and not let them be left behind. When someone had committed a criminal crime and was prosecuted to a court trial and a prison sentence was issued. In that case, children and young adults will be sentenced to detention in Juvenile Vocational Training Center (JVTC). Under the Beijing Law [15] and the Convention of the Rights of the Child, the Vocational Center was organizing youth rehabilitation therapy, with the expectation that uncontrolled youths can grow into good Samaritans and helpful citizens of the country.

Following the law and international principle, Thailand Juvenile Vocational Training Center (JVTC), Department of Juvenile Observation and Protection (DJOP), Ministry of Justice, also must address treatment needs, develop skills, and rehabilitate juveniles that the court has ordered probation to protect the welfare and to improve the quality of life. Juvenile offenders were characterized by a high risk of recidivism, poverty-stricken, and low investment in potential development, so they were often unsuccessful in life and got set back because they were not well educated [12] and were not interested in studying, and often had to drop out of school [8]. Carter [2] explained that childhood laborers with a history of violent behavior and a previous offense were less successful in their lives than the youth without a history. Lower average incomes and the high unemployment rate are the results of improper nurturing, and growing up in an unsuitable environment. Therefore, the JVTC's juvenile rehabilitation therapy had divided the training activities into 3 modules: 1) the provision of compulsory education and professional training, 2) the adjustment of attitudes and cognitive behavior, and 3) the rehabilitation of physical health and lifestyle hygiene.

According to the Department of Juvenile Observation and Protection report [4], since 2015, they have received more than $ 59.4 million (exchange rate was ฿32: $1) from the government, an increase of approximately 2.4% per year. Except in the year 2019, there had been allocated a reduced budget. The number of juvenile offenders continued to decline by an average of 5%. About 34% of that budget was for JVTC, which had 21 locations spread across the country. Each center had different sizes to accommodate the youths. There were approximately 4,000-6,000 juvenile offenders in JVTC, from a total of 30,000 juvenile offenders, accounting for 0.9% of the total number of juveniles each year. The risk and the necessity of misdemeanor survey data [11] found that half of the youths were drug offenses. Most of them were abusive, violent, had improper parenting, and did not receive a good education.

Therefore, JVTC, a government facility, should have the mission of remediation and rehabilitation for juvenile offenders. They had behaviors and attitudes that affected social order and were difficult to correct. Child potential development required adequate and appropriate resources. However, the cost of the center was disproportionate to the youth when compared to the centers. Small centers with less than 100 youths had a cost that was equivalent to the large centers. The situation affected different qualities of youth rehabilitation therapy [8].

As mentioned, JVTC evidentially receives additional government funding, but the number of

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youths receiving treatment and rehabilitation decreased. There were also criminal behaviors and attitudes, and there was a cost difference between the centers and the youths. However, JVTC had a limited budget, so the arrangement of the center must be efficient. Knowing the efficient cost per unit and center size will help the manager of the Inspection Department to formulate appropriate sizes and cost per unit policies, providing JVTC with adequate and appropriate resources. The objective of the study was to analyze the performance of JVTC by using the concept of cost per unit, andEconomies of Scale analysis.

II. Literature Review

This paper analyzed the efficiency of JVTC in a remedial treatment of juvenile offenders by using a cost per unit, and Economies of scale analysis. A literature review of the relevant theory and research was as follows:

Efficiency theory [7] explained the ability to use rare resources of the manufacturer considering the relationship among the factors, the process, and the output. The production was efficient when the manufacturer used the least factor but produced a high quantity. The efficiency consisted of Technical Efficiency (TE), and Allocation Efficiency (AE). Therefore, the TE of the production factor was positively correlated with the output.

Allocation Efficiency described an operator's ability to select a combination of input factors or combinations of input $X = (x_1, \ldots, x_n)$. When there was no change in the production technique, but the maximum yield $(y_1, x_1) \in T_1$ by the combination $(x_{11}, x_{12}) \in x_1$. Subsequently, a mix of set input $(x_{21}, x_{22}) \in x_2$ was used. Setx_2 to be less than n x_1, but the yield was equal to y_2, which was greater than y_1. Therefore, ingredient utilization of input x_2 to have AE.

When the production achieved TE and AE. $[AE(x, y, w) * TE(y, x)]$ Therefore, Cost Efficiency (CE) at effective production volumes had the lowest cost per unit. CE was related to the price of the input factors. The production of output Y used input X, and the price of the factors was w. The cost of factors was calculated $w_x x$ from the n combinations of input factors that represented the lowest possible cost per unit of production. $C(y, x)$ was shown the relationship between the cost and the outputs. The factors of production and productivity gave the cost function $C(y, x) = \{w_x x : TP(y, x) \geq 1\}$. When the cost function was divided by the number of outputs, the average cost (AC) was obtained as $AC(y, x) = \frac{C(y,x)}{y}$. AC line creature with U-curve gave the lowest value. The minimum AC intersected with the marginal cost (MC) line ($MC(y, x) = \frac{d\, C(y,x)}{d\, y}$) or the supply line was drawn from the left to the right.

According to the Economics analysis of public service arrangements, the goal of utilizing factors of production was to provide people in society with the highest social welfare. Therefore, efficiency refers to the ability to make the most of resources for the people in society [13]. Economics analysis considered the benefits of the society from public services that were arising. Economics Analysis was distinctive from the private sector. Economics analysis in the justice system relied on the approach to analysis.

The review of theories and analysis for the efficiency of the work in the justice system was classified into 2 ways: 1) a minimum cost or a value of socio-economic losses, and 2) Economies of Scale analysis. The details were as follows:

The analysis of costs or the value of economic and social losses. The judicial policy can be classified into two categories: (1) Social welfare lost value analysis and research estimated the impact of severe narcotics policy based on the demand and supply curve of narcotics. The results of the study explained that the anti-drug policy was ineffective because the demand-supply did not decrease, but the price increased, resulting in high social welfare losses [1]. This guiding analysis also applied to cigarette tax policies, the study concluded that tax incremental policies were ineffective [17]. (2) Cost per unit analysis.The Washington State Institute for Public Policy [16] found that in 2003, the community-based program of community-based remedial juvenile offenders was effective and cost an average of $1,900-31,200. The study by Fowles, Byrnes, and Hickert [6] estimated the accounting costs of JVTC in Utah found 40% more recidivist rehabilitation costs than first-time offenders.

For Economies of Scale Analysis in the judicial process, Livingston, Stewart, Allard, and Ogilvie [9]analyzed economies of scale for police stations in Canada. Estimated cost and arrest data for criminals between 2001-2012, the mean cost equations of urban and rural police stations, together with demographic, economic, and social factors, it was found that urban police stations were economies of scale, but local police stations did not result in economies of scale. Hennebel, Simperet, and Verschelde [8] analyzed the scale of prisons in England and Wales, finding economies of scale of prisons should have a capacity of 554-1,187 people, with an annual cost of around £23-37 million per site. However, the researcher recommended that prisons focus on quality improvement and environmental management as prisons had a large number of inmates. The average cost was reduced, which affected the quality of remediation. Turner, Toor, Hollingsworth, and Anderson [14] used Economies of Scale analysis of community health counseling centers. The results explained that the consulting center did not generate economies of scale because the consulting mission was more than one mission.

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According to theory and literature review, the paper analyzed the efficiency by analyzing cost per unit and economies of scale from cost function determined by youth numbers of all centers, small and large cost functions. Thus, the average cost (AC) function was used to analyze the cost per unit and economies of scale for both small and large sizes.

III. Methods

The study was quantitative research, using data from 17 JVTCs out of 21,accounting for 81% monthly between December 2016 and December 2019, and classified as 10 JVTCs and 7 special JVTCs,compiling 629 months of secondary data, a total number of 16,000 children and youth. Costs were classified as follows: (1) fixed costs, (2) variable costs, (3) direct costs, and (4) indirect costs. Accounting expense data ofJVTC were classified into 2 groups as follows: (1) capital factors and (2) labor factors.

Estimating the cost equation using the polynomial function which had properties corresponding to 3 cost functions as follows: (1) the cost equation of all centers, (2) the cost equation of a small center with the number of youths less than 300, and (3) the cost equation of a large center with more than 300 youths. Set TC was the total cost per month, JO was the number of children and youth in the center, and X was the other independent variable [8][9], the proportion of youth drug offenses (No. Drug), murder (No. murder), the proportion of juvenile recidivism, the proportion of youth from poor households (Poor), juvenile density (JO density), and the level of risk and need for treatment (Level of risk and need to commit a crime). The cost equations were estimated with a multiple regression model using AIC (Akaike Information Criterion) analysis to identify the appropriate equation for forecasting. The correlation coefficient (R^2) was then analyzed and the hypothesis was tested with T and F statistics.

$$TC = \alpha_0 + \beta_1 JO + \beta_1 JO^2 + \beta_2 JO^3 + \cdots + \beta_n JO^k + \delta_h X_h + e_n$$

AC and MC equations were estimated by the cost function. AC curves were drawn to analyze cost per unit and Economies of Scale.

IV. Results

This paper analyzed the efficiency of the JVTC, DJOP, Ministry of Justice by analyzing cost per unit and Economies of Scale. The findings included the cost situation, cost function, cost per unit, and economies of scale. The details were as follows:

1) It was found that since 2017 the total cost was monthly $1.4 million, 2018 was $1.3 million, and in 2019 was $0.8 million. In 2019, costs classified by production factor approximately 50% were costs of capital factors. The capital costs were $5.5 million. The labor cost was $5.3 million. The direct costs of $10.4 million consisted of food, personnel, and materials for training activities. Indirect costs were $0.5 million, consisting of personnel welfare, youth personnel, external miscellaneous expenses, and personnel meeting and training expenses. Fixed costs accounted for 53% and variable costs accounted for 46%. Labor costs accounted for about half of the total cost, according to the regulations of the Department of Observation, which defined the structure, the position and number of personnel in the center of approximately 56 people and was included as civil servants, government employees, and permanent employees, resulting in most personnel expenses.

   While considering the cost according to the size of the center, it was found that there were small centers which included approximately children and youth of 1,520 people with a total cost of approximately$0.6 million. There were large centers with a total of 2,687 children with a total cost of $0.6 million. Small centers average a total cost of $0.1 million. The large center had a total cost of $0.1 million. The proportion of costs by the expenses comparing small to large centers were found to be no distinctive. Smaller centers with a small number of children in the center, their consumption costs (F) accounted for 33% and personnel costs (L) accounted for 37%.[Figure. 1]

2) The cost equation analysiswas divided into 3 cases: cost equations of all centers (TC), small centers (TC_S), and large centers (TC_L). It was found that the cost equations were estimated to have AIC from the quartic polynomial function of 19,660, which was the least and had the relative coefficient (R^2) of 0.17. From the total cost equation estimated to be equal to $TC = 3{,}515{,}000 - 48{,}980\,JO + 326.6\,JO^2 - 0.75\,JO^3 + 0.0006\,JO^4$. It was found that the fixed cost was $0.1 million. It means that the center did not have any youth, the center cost $0.1 million. [Table 2]

   The small cost equation was found that the AIC from the cubic polynomial equation was the lowest at 13,480.9, the R^2 was 0.112, and the total cost equation was $TC_S = 3{,}952{,}000 - 56{,}850\,J0 + 334.3\,JO^2 0.5316\,JO^3$. The fixed capital was $0.12 million. When the child increased by only one case, the total cost of the small center decreased by $1,755.

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Table 1: JVTC Cost Classified, Unit: $Million (%)

Types of costs	2017		2018		2019	
	Monthly	Annual	Monthly	Annual	Monthly	Annual
1) Capital	0.8 (58.9)	11.3 (54.5)	0.7 (54.1)	10.2 (50.4)	0.5 (55.3)	5.5 (50.7)
2) Labor	0.6 (41.0)	9.4 (45.4)	0.6 (45.8)	10.0 (49.5)	0.4 (44.6)	5.3 (49.2)
3) Direct costs	1.3 (94.4)	19.7 (94.6)	1.3 (95.2)	19.3 (95.3)	0.8 (94.8)	10.4 (95.6)
4) Indirect costs	0.1 (5.5)	1.1 (5.3)	0.1 (4.7)	0.9 (4.6)	0.0 (5.1)	0.5 (4.3)
5) Fixed cost	0.4 (30.1)	9.2 (44.0)	0.5 (35.6)	10.2 (50.3)	0.3 (35.3)	5.8 (53.2)
6) Variable cost	1.0 (69.8)	11.6 (55.9)	0.9 (64.3)	10.0 (49.6)	0.5 (64.6)	5.1 (46.7)
Total	1.4 (100)	20.8 (100)	1.3 (100)	20.3 (100)	0.8 (100)	10.8 (100)

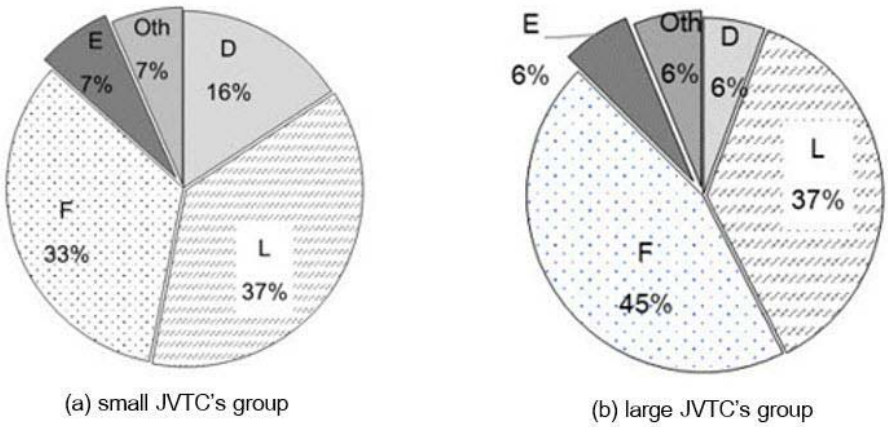


Fig. 1: Cost ratio classified by a center size group

Note: The personnel expenses (Labor wages and labor benefits: L), depreciation (D), the consumption and training activities (F), Utilities (E), and other expenses (O).

It was found that the optimal large cost equation was a linear regression equation. The lowest AIC was 6,103. The R^2 was 0.2. The total cost equation of the large center was approximately equal to $TC_L = 2{,}490{,}545 + 2{,}205\,J0$. Even there was only one additional youth, a large center would cost $69.

3) The cost per unit analysis was analyzed from the total cost equations used to estimate Average Cost equations, Average Fixed Cost (AFC), Average Variable Cost (AVC), and Marginal Cost (MC). It was found that the AC line was U-curved with point e being the lowest AC point with 518 children in the center [Figure 2]. The cost per unit was $168 (annually $2,018). At point e, it was the point where the incremental cost line crosses the mean cost curve and was the point of efficiency correction of juvenile rehabilitation.
4) Economics Size analysis was based on AC curve of AC, AC_S, and AC_L. In the case of the AC curve of a large center, all cost lines were straight-line equations, the additional cost per unit equal to AVC equally to $69. Therefore, the AC curve was parallel to the horizontal axis. From Figure 3, the AC_L was drawn down into the horizontal axis and intersected with all Center AC curves at point b. At this point, it was the lowest AC. The AC_S was U-curved, where the minimum AC was upper the AC. The point at which the minimum AC was pointe. The AC was equal to the MC with 518 youths and the cost per unit was $168. It was found that the operations of small and large centers did not have Economies of Scale analysis.

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Table 2: Estimated coefficients of TC all centers, TC_S and TC_L

Independent variable	TC (quartic eq.)			TC_S (cubic eq.)			TC_L (Linear eq.)		
	Estimate	p-value		Estimate	p-value		Estimate	p-value	
Constant	3,515,000	0.00	***	3,952,000	0.00	***	2,490,545	0.00	***
JO	-48,980	0.00	***	-56,850	0.04	**	2,205	0.09	*
JO^2	326.6	0.00	***	334.3	0.05	*			
JO^3	-0.75	0.00	***	-0.53	0.10	*			
JO^4	0.0006	0.00	***						
JO Density	261,100	0.07	*	253,400	0.17		416,291	0.04	**
No. Men	1,959	0.80		16,160	0.19		54,040	0.87	
No. Female	27,460	0.07	*	46,440	0.04	**	67,527	0.84	
No. Recidivism	-3,525	0.71		-11,200	0.39		-6,776	0.58	
No. Mudder	-7,931	0.37		-19,720	0.14		6,066	0.53	
No. Drug	5,701	0.16		-1,437	0.81		13,941	0.00	***
Punishment level	13,830	0.33		40,680	0.04	**	-37,331	0.03	**
Low risk	453.6	0.95		1,291	0.88		-19,049	0.95	
Under risk AVG	-1,691	0.74		-2,111	0.73		-66,460	0.84	
Upper riskAVG	3,313	0.71		6,925	0.51		-70,717	0.83	
Under need AVG	1,664	0.75		2,021	0.75		11,006	0.45	
Upper need AVG	-3,671	0.85		-16,390	0.49		127,136	0.01	**
Poor	-10,270	0.19		-22,390	0.07	*	-15,363	0.09	*
AIC	19,660.27			13,480.9			6,102.92		
R^2	0.168			0.112			0.20		
$\bar{R}^2$	0.145			0.08			0.14		
F value	7.29	(0.00)		3.26	(0.00)		3.34	(0.00)	
d.f.	614			413			187		

*Note - *p < .1. **p < .05. ***p < .01*

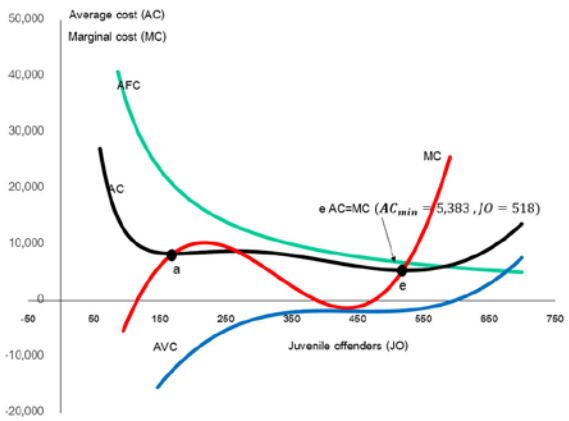


Fig. 2: Average fixed cost (AFC), average variable cost (AVC), average cost (AC), and marginal cost (MC)

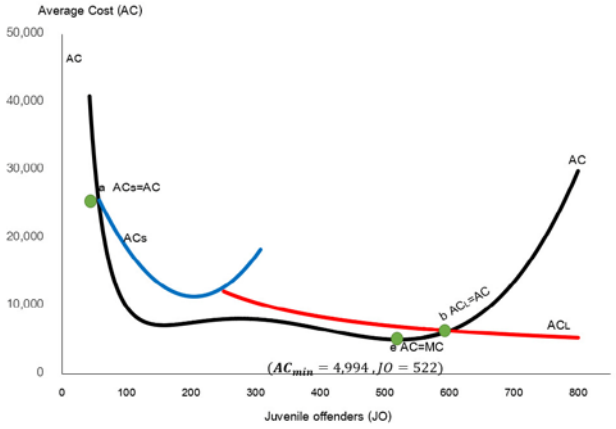


Fig. 3: Economies of scale of center

The results concluded that the costs of the centers with DJOP regulations were personnel structure determination, food tariff, and government procurement and procurement regulations. Most of the cost of JVTC being fixed costs incurred by the capital and labor factors as a part of the fixed cost. The cost per unit analysis showed that the size of the center with 518 youths was the lowest number of costs per unit, which was $168,which was higher than the cost per unit of a large center. The cost per unit of a small center was higher than the mentioned cost per unit, thus this reduces economies of scale for small and large centers.

V. Discussion

The study was the Economics Analysis of Juvenile Rehabilitation of JVTC, DJOP, the Ministry of Justice, whose mission was to correct, cure, and

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rehabilitate criminal juvenile offenders with two parts: cost per unit, and Economies of Scale analysis:

a) Cost per unit of Juvenile Rehabilitation Treatment

The cost per unit analysis of juvenile rehabilitation as part of the economics analysis cost, considering the relationship between AC curves and the cost per unit. According to the theory, the cost line properties were positively correlated with the number of youths and optimal input factors mixtures that provided the lowest cost while maintaining or increasing yields [8]. The results of the AC analysis revealed that the U-curve [8] and the additional MC curves had an N-curve characteristic. The minimum AC curve was pointed out at 518 youths and $168 of cost per unit, which was the point of cost-efficiency. In addition, the minimum cost of living in Thailand was $187 per month [10], and the cost of raising children was $292 monthly [3]. These costs were higher than the juvenile cost per unit. As a result, the quality of life of the youth in the center did not meet the standard level [15]. In the future, the juveniles who have lower human capital than the others will tend to commit reoffending [2].

b) Economies of Scale analysis

An analysis of economies of scale by Hennebel, Simperet, and Verschelde [8] presented a scale-out of the size of the prison: about 500 prisoners. On the other hand, JVTC has set the capacity of having juveniles in each center differently in Thailand. Some centers can take up to 697 youths, and in some centers, they can hold a maximum of only 34 youths. Therefore, three centers always had overcrowded people problems, and the others had juveniles less than what they were capable of. The study divided the centers into two sizes - small and large. ACS, ACL, and AC of all caseshave analyzed the economies of scale. It was found that the operation of these two sizes did not have economies of scale. The result was distinctive from others; Livingston, Stewart, Allard and Ogilivie [9] and Hennebel, Simperet and Verschelde [8]. The two sizes had no economies of scale as a result of a poor arrangement. There was no guideline for an average cost to arrange the resources for centers, and each center was assigned the same number of employees which is 56 even though they are distinctive in size. Besides, a small center had an average cost of about $840, whereas the large centers continued to decrease AC due to policy-making, the fixed personnel structure, and the Ministry of Finance regulations on procurement and government procurement with multiple stages. In addition, in the large centers, the food and beverage rate per unit of $1.6 a day was less than the average standard living cost.

VI. Conclusion

The study analyzed the cost per unit and Economies of Scale. It was found that the center had corrective and rehabilitative arrangements, not to Economies of Scale which had the lowest cost per unit of $168. This cost per unit was lower than the cost of living at $187 [10]. The life quality of youths was therefore not up to universal principles [15]. The executive of DJOP, the Ministry of Justice should do as follows: (1) increase the budget for the center for the youth to have a better life quality. The cost per unit should be between $187 and 292, which was consistent with the cost of child care and higher than the standard level of living. It also made the youth's life in line with international standards. (2) promote and support center administrators to improve the quality and provide a center environment that was conducive to remediation, therapy, and rehabilitation by supporting adequate and appropriate resources.

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Role of Solar & Atmospheric Disparity on Climate of Western India, Kota, Rajasthan, India

By Vinay Kumar Pandey

Abstract- In the last three decades, India has been facing the unusual weather condition that the affects the social-ecological balance. The summers are getting hotter; winters colder, drought, stronger storms, heat waves, floods, cloud burst, cyclones, and anomalous seasonal weather frequency and intensity have been historical expectations. Indian climate is affected by winds coming from the Indian Ocean as well as cold, dry northern winds along with atmospheric Hedley and Farrell cell wind and variation in these atmospheric winds. The change in solar radiation may impact these wind patterns, and extreme climatic events that happened globally. To better understand the impact and trend of solar and atmospheric disparities and associated climatic factors such as mean solar radiation, atmospheric pressure, precipitation, wind speed & wind direction and temperature, on extreme climatic conditions in Western India, selected the confluence area of Hedley and tropical wind. They divert at 30°N -25°N latitude as a variation of ITCZ, would be beneficial to understand the actual reason behind the increasing the extreme climatic condition. The city Kota is situated at 25°N latitude under the state of Rajasthan, India, selected for the study.

Keywords: Extreme weather condition, Solar Radiation, Atmospheric Pressure, Wind events, Temperature, Precipitation.

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Abstract- In the last three decades, India has been facing the unusual weather condition that the affects the social-ecological balance. The summers are getting hotter; winters colder, drought, stronger storms, heat waves, floods, cloud burst, cyclones, and anomalous seasonal weather frequency and intensity have been historical expectations. Indian climate is affected by winds coming from the Indian Ocean as well as cold, dry northern winds along with atmospheric Hedley and Farrell cell wind and variation in these atmospheric winds. The change in solar radiation may impact these wind patterns, and extreme climatic events that happened globally. To better understand the impact and trend of solar and atmospheric disparities and associated climatic factors such as mean solar radiation, atmospheric pressure, precipitation, wind speed & wind direction and temperature, on extreme climatic conditions in Western India, selected the confluence area of Hedley and tropical wind. They divert at 30°N -25°N latitude as a variation of ITCZ, would be beneficial to understand the actual reason behind the increasing the extreme climatic condition. The city Kota is situated at 25°N latitude under the state of Rajasthan, India, selected for the study. After the detailed data interpretation, it observed that the average solar radiation has decreased by 1.15%, 0.28%, and 2.33% for the yearly, Ist half, and IInd half-year, the atmospheric pressure has increased by 0.066%, 0.035%, and 0.097% in the yearly, Ist half and IInd half-year respectively, the precipitation has decreased by 26.16 % the yearly, 10.61% and 28.66% in the the yearly, Ist half and IInd half-year respectively from the year 1988-1997 to the year 2008-2019. The maximum and minimum temperature was increased by 3.29% and 4.62% from the year 1988-1997 to the year 2008-2019. The Ist half and IInd half-year average maximum and minimum temperature were increased by 3.91% & 4.09%, and 4.04% & 5.14% respectively. Based on data out comes, predicted the future climatic condition for the years 2051-2060 and possible extreme climatic conditions over Western India that could be helpful in mitigation and land use plan for the extreme climatic conditions.

Keywords: Extreme weather condition, Solar Radiation, Atmospheric Pressure, Wind events, Temperature, Precipitation.

I. Introduction

Earth receives energy from the sun and varies according to sun energy, which has been the main driver of climate change over the billion the years of geologic time. Climate change is a natural phenomenon, which happened several times in Earth's history. Major evidence of previous Climate Change has been deducted by glacier studies and geological deposition. A study of previous climate change data suggested that natural causes such as terrestrial factors, atmospheric and tectonic factors were responsible for it.

The last three decades, India has been facing unusual extreme weather condition that affects the social-ecological balance. The summers are getting hotter; winters colder, drought, stronger storms, heat waves, floods, cloud burst, cyclones, and anomalous seasonal weather frequency and intensity have been historical expectations.

Indian climate is affected by winds coming from the Indian Ocean as well as cold, dry northern winds along with atmospheric Hedley and Farrell cell wind and variation in these atmospheric winds affecting the Indian weather. The change in solar radiation may impact these wind patterns, and extreme climatic events happen in the affected area. The extreme weather condition involves high precipitation, extreme summer, heat wave, cold wave, cyclone, etc. Precipitation frequency may be high means most of the annual rainfall happens a very short duration and causes flood, flash floods, landslides, ground subsidence, and another disaster.

To better understand the role of solar and atmospheric disparities and associated climatic factors such as mean temperature, precipitation, wind speed, and wind direction on extreme climatic conditions in Western India, selected the confluence area of Hedley and tropical wind. They divert at 30°N -25°N latitude as variation of Inter Tropical Convergence Zone(ITCZ), would be beneficial to understand the actual reason behind the increasing the extreme climatic condition. The Kota city is situated at 25°N latitude, suitable for study. Based on data interpretation for solar and atmospheric disparities, predicted the future climatic condition and possible extreme climatic conditions over Western India that could be helpful in mitigation and land use plan for the extreme climatic conditions.

a) Previous studies

The Serbian geophysicist and astronomer Milutin Milanković (the year 1920) had developed the relationship between the terrestrial factor and climate change based on the study of Vostok Ice Core that relationship called Milankovitch cycles, that describe the collective effects of changes in the Earth's movements on its climate over thousands of the years.

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National Academy of Sciences (NAS, 1982) in his study, suggested that Solar induced changes in the stratosphere could have a variety of indirect influences on the troposphere and climate. Investigations with general circulation models (Kodera, 1991; Rind & Balchandran, 1995) suggest that variations in solar ultraviolet energy input modify the ozone and temperature structure of the stratosphere, affecting the latitude temperature gradient. The latitude temperature gradient, modifies stratospheric wind speeds and the ability of long wave energy to propagate out of the troposphere. Altered tropospheric stability affects various tropospheric dynamic processes, including the Hadley cell intensity at low and subtropical latitudes and low-pressure systems in the extratropics. (NRC, 1994).

Climate variability is amongst the major phenomenon occurring worldwide which has caused major changes in climate variables such as precipitation, air temperature, relative humidity, and solar radiation (Haskett et al., 2000; Bates et al., 2008; Yu et al., 2013). Because of these alterations, there is a consistent warming trend, clearly reflected by the increasing occurrence of extreme climate events like droughts, floods, and heatwaves (Meehl et al., 2007). Natural disasters worldwide are result from extreme events rather than just a variation of the mean climate (Plummer et al., 1999).

Many studies have been documented worldwide on extreme climatic events (Easterling et al. 1997; Gaffen and Ross 1998; Karl and Easterling 1999; Easterling et al. 2000; Frichet al. 2002; Zhai and Pan 2003; Aguilar et al. 2005; Alexander et al. 2006; Qian and Qin 2006; New et al. 2006; Klein Tank et al. 2006; Bartolini et al. 2008; Wei and Chen 2009; You et al. 2008, Pandey at el, 2016). They analyze variation in temp & precipitation patterns during extreme weather conditions & the impact of climate change on it. Frichet al. (2002) and Alexander et al. (2006) analyzed the global changes in daily climate extremes and concluded that there has been significant warming throughout the 20th century. Most of the temperature trend studies in India have focused on the analysis of mean maximum and minimum temperatures along with extreme weather conditions and concluded that increasing trends in both maximum and minimum temperatures over India (Hingane et al. 1985; Srivastava et al. 1992; Rupa Kumar et al. 1994; Arora et al. 2005; Kothawale and Rupa Kumar 2005; Dash et al. 2007; Pal and Al-Tabbaa 2010). Some of the studies have investigated extreme maximum temperature, and case studies of heat wave spell over some regions as well as over the entire country (Natarajan 1964; Raghavan 1966; Subbaramayya and Surya Rao 1976; Chaudhury et al. 2000; De 2001; Pai et al. 2004, 2013; De et al. 2005; Ray et al. 2013, Jaiswal A K, et at. 2015, Pandey et al 2015a). Singh, A et.al., 2000 had observed that the frequency of Tropical cyclones in the north Indian ocean has significantly increasing trends during November & May, which account for the maximum number of intense cyclones. Ugnar (1999) has shown that losses due to extreme events are increasing steeply especially in the last decade of the 20th century.

On a global scale, the Indian summer monsoon is considered as a part of the warm season northward migration of the Intertropical Convergence Zone (ITCZ) in the eastern Northern Hemisphere (Chao and Chen, 2001; Gadgil, 2003; Fleitmann et al., 2007) and is key circulation component that transports heat/energy from the tropical and subtropical regions to the high-latitude and polar region (Trenberth and Stepaniak 2003; Hazeleger, 2005). Among the studies that examined multidecadal variations in Indian monsoon, some have investigated and suggested the multidecadal variation in the solar irradiance as a possible cause (Mehta and Lau, 1997; Neff et al., 2001; Agnihotri et al., 2002; Burns et al., 2002; Fleitmann et al., 2003, 2004; Kodera, 2004; Bhattacharyya and Narasimha, 2005; Berkelhammer et al., 2010, Pandey et al., 2014; Pandey V. K.& Mishra Ajai 2015 b, 2015 c). These studies show that the solar irradiance and monsoon intensity variations have been comparable in phase at decadal-centennial timescales. Positive anomaly in solar irradiance corresponds to heavy monsoon rainfall. However, as also indicated by Neff et al. (2001), Burns et al. (2002), and Kodera (2004), a direct effect of changing solar irradiance on the monsoon is unlikely, and irradiance anomaly has to go through the lower boundary of the atmosphere, e.g., via the surface, including sea surface temperature anomalies, to influence the monsoon (Wu Qianru and Hu Qi 2014).

II. Objective and Methodology

Considering the above natural phenomena, it seems that solar variation and atmospheric disparities affect the extreme weather condition, and considering this point, proposed to find out the role of solar activity and atmospheric variation in extreme weather conditions in the Western India subcontinent. Every year it is noticed that weather pattern has been shifted. The time duration of the winter season is less and extremes for few days, summer break the previous years in its temperature record. It is also observed that low rainfall areas face the floods, while others are facing droughts like the Gangetic plan and another part of India. The Intensity and frequency of hydro-meteorological disasters have been increased and varied that affecting the socio-ecological losses.

The Role of solar activities and atmospheric variations has been observed and analyzed by the study the last 30 the years' solar variation data, atmospheric pressure data, and study the past 42 the years wind patter, precipitation pattern, and daily average temperature.

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This study might be comparing the amount of precipitation, daily temperature, wind flow, and solar variation in the event to similar past events to estimate the effect of atmospheric disparity and solar variation. The proposed study will be helpful for planning and interpretation of mitigation measures and land use patterns for future extreme weather condition.

a) Methodology

The methodology is the specific procedures used to collect, select, preparation of tools, and analyze information to obtain desired results of any problem. The solar and atmospheric raw data have been obtained from Indian Meteorological Department (IMD), Pune, India, and the internet (www.meteoblue.com) for study.

b) Data interpretation methodology

The collected daily data have been studied from January 1988 to December 2019 for solar radiation and atmospheric pressure and for the data of Precipitation, temperature, and wind data have studied from January 1978 to December 2019 (as per data availability). The row data have mentioned as daily maximum, minimum, and mean data for Ist half-yearly (January to June), IInd half-yearly (July to December), and the yearly wise. After that, data has compiled a ten year groups, i.e. the year 1978-1987, the year 1988-1997, the year 1998-2007 and the year 2008-2019.

Basis on research outcomes, predicted the next three-decades (i.e. the year 2051-2060) climatic conditions and probable natural disasters, extreme weather events, changes in precipitation patterns, atmospheric pressure, and solar radiation. This research work will help to open a new way to study the extremes climatic condition basis on atmospheric and solar disparities.

III. Data Interpretation

Summary of data interpretation have given below:

a) Solar Radiation Data for the year 1988-2019

Basis on of solar radiation observed from the year 1988-2019, prepared below table 1 a summarized sheet of data:

Table 1: Kota Solar Radiation summarized sheet from the year 1988 to the year 2019

The year	1988-1997	1998- 2007	2008-2019
Mean radiation for IstHalf-year(in Watt/square meter- W/m^2)	6244.65	6237.14	6227.02
Mean radiation for IIndHalf-year(in W/m^2)	4561.15	4833.11	4454.78
Mean radiation (W/m^2)	5402.90	5535.12	5340.90

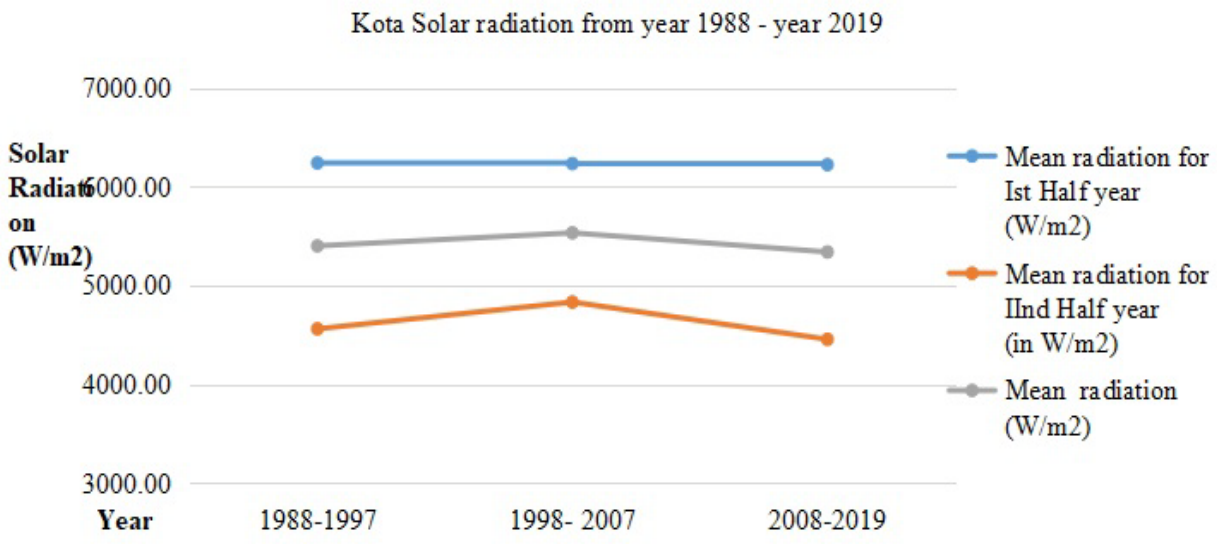


Fig. 1: Kota means line diagram for Solar Radiation for the year 1988-2019

From table 1, it is observed that mean Solar Radiation was increased in the year 1998-2007 compared to the previous period the year 1988-1997 and decreased in the year 2008-2019. For the Ist half-yearly Solar Radiation continues decreased from the year 1988 to the year 2019 and Solar Radiation increased in the year 1998-2007 compared to previous period year 1988-1997 and decreases in the year 2008-2019 for IInd half-yearly. The line diagram for Kota Solar Radiation for the year 1988-2019 has shown in figure 1.

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b) Atmospheric Pressure data for the year 1988-2019

Table 2: Kota atmospheric pressure summarized sheet from the year 1988 to the year 2019

The year	Mean Pressure for Ist half yearly (in hector Pascals - hPa)	Mean Pressure for IInd half yearly (in hPa)	Mean yearly Pressure (in hPa)
1988-1997	1007.34	1007.45	1007.40
1998- 2007	1007.53	1007.53	1007.53
2008-2019	1007.69	1008.43	1008.06

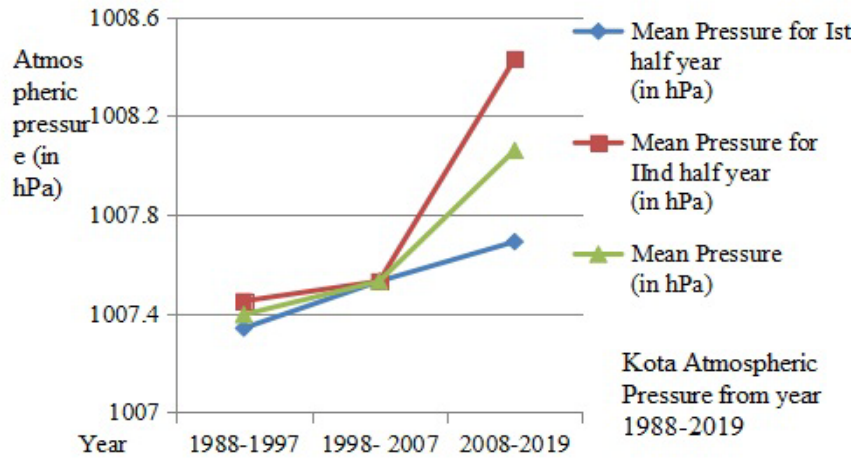


Fig. 2: Kota means line diagram for atmospheric pressure for the year 1988-2019

From table 2, it is observed that atmospheric mean pressure was continuously increasing. For the Ist half-yearly atmospheric pressure in the year, 2008-2019 were increased by 0.35 h Pa & 0.16 hPa compared to the year 1988-1997, and the year 1998-2007 respectively, and 0.98 hPa & 0.90 hPa pressure increased in the year 2008-2019 compared to the year 1988-1997, and the year 1998-2007 respectively for the month of IInd half-yearly. The yearly mean atmospheric pressure in the year 2008-2019 has increased by 0.66 hPa & 0.53 hPa compared to the year 1988-1997, and the year 1998-2007 respectively. The line diagram for atmospheric pressure for the year 1988-2019 has shown in figure 2.

c) Wind data for the year 1978-2019

Total 126427 wind data have been analyzed from January 1978 to Dec 2019. The wind data were observed twice a day, one at noon and second at 3 pm at a height of 10 m from ground level. The wind data have been shown by wind direction and wind speed.

The ten the yearly comparative wind data sheet is given in below table:

Table 3: A summary sheet of Wind data from the year 1978 to the year 2019 (N- North, NE-North-east, NNE-North-north-east, W-West, S- South, SW- South-west, NW- North-west, WNW- West-north-west, WSW- West -south-west)

The Year	Calm Wind %	I Highest wind % with direction	II Highest wind % with direction	III Highest wind % with direction	IV Highest wind % with direction	V Highest wind % with direction	% of Wind events >25 km/h/ maximum wind speed
1978-1987	13.90	18.49	16.73	11.15	9.50	7.63	1.56
		NW	NE	W	SW	N	95-100
1988-1997	19.56	12.19	10.77	10.73	8.17	7.66	0.25
		W	NW	NE	SW	N	95-100
1998-2007	36.50	9.27	9.10	8.8	8.10	7.60	0.30
		W	N	SW	NW	NE	95-100
2008-2019		14.35	12.17	7.97	7.37	7.29	0.03
		WSW	W	WNW	NE	NNE	25-30

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Based on the above table no 3, it is shown that the years 1978-1987 and the year 1988-1997 were affected by West and East direction winds. But in corresponding the year 1998- 2007 and the year 2008-2019, West direction winds events were increased. The year 1978-1987 were received winds in NW, NE and West direction, but in corresponding year 1988-1997, the west direction had received maximum wind events followed by NW, NE, and SW directions. In the year 1998-2007, West direction received the maximum wind events followed by North, SW, NW and NE, but in the year 2008-2019, WSW had received the maximum wind events followed by West, WNW, and NE, NNE direction. The events of calm winds have increased every period from 13.90% to 19.56% and 36.50% and the number of wind events speed more than 25 km/h is decreased every the year i.e. the year 1978-1987, the year 1988-1997, the year 1998-2007, and the year 2008-2019 respectively. It is also observed that the total numbers of wind event and extreme wind events are decreasing.

Comparison of wind event, and wind speed to know the variation in wind speed, prepare the below table 4:

Table 4: Comparison of wind events and wind speed

% Wind Events	1978-1987			1988-1997			1998-2007			2008-2019		
Wind Speed (km/h)	The Yearly	Ist half the year	IInd half the year	The Yearly	Ist half the year	IInd half the year	The Yearly	Ist half the year	IInd half the year	The Yearly	Ist half the year	IInd half the year
0-5	45.5	41.31	49.63	55.73	49.61	61.83	69.89	67.31	72.61	34.17	29.06	38.69
5—10	28.56	31.64	25.53	27.05	30.05	24.06	18.06	18.20	17.91	39	41.16	36.93
10—15	19.09	19.21	18.97	14.21	16.16	12.28	9.37	10.90	7.79	18.16	18.64	17.76
15-20	3.45	4.67	2.44	2.16	3.10	1.22	2.08	2.69	1.43	7.41	9.03	6.10
20-25	1.74	2.36	1.14	0.60	0.73	0.47	0.29	0.37	0.21	1.24	2.05	0.51
>25	1.56	0.82	2.30	0.25	0.36	0.14	0.32	0.54	0.09	0.03	0.06	0.01

The yearly wind events from speed less than 5 km/h had increased from the year 1978-1987 to the year 1998-2007 but decreased in the year 2008-2019. For remaining wind speed 5-10 km/h, 10-15 km/h, 15-20 km/h, 20-25 km/h were decreased from 1978-1987 to the year 1998-2007 but increased in the year 2008-2019. The wind events speed was more than 25 km/h, was continuously decreased from the year 1978- 1987 to the year 1988-1997, increased in the year 1998-2007 but again decreased in the year 2008-2019.

The wind event was received from Ist & IInd half-year are following the yearly trend. The wind events increased from the year 1978-1987 to the year 1998-2007 but decreased in the year 2008-2019. For remaining wind speed 5-10 km/h, 10-15 km/h, 15-20 km/h, 20-25 km/h decreases from the year 1978-1987 to the year 1998-2007 but increased in the year 2008-2019. The wind events for speed of 15-20 km/h increased from the year 1998 to the year 2019. The wind events speed was more than 25 km/h was continuously decreased from the year 1978-1987 to the year 1988-1997, increased in the year 1998-2007 but again decreased in the year 2008-2019.

d) Half-yearly wind data

For detailed wind data interpretation, prepared the six-monthly wind data observations and discussed below table 5 and 6 for the Ist & IInd half-year respectively.

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Table 5: A summary sheet of Wind data for the Ist half-year (the year 1978–2019)

The Year	Calm Wind %	I Highest wind % with direction	II Highest wind % with direction	III Highest wind % with direction	IV Highest wind % with direction	V Highest wind % with direction	% of Wind events >25 km/h/ maximum wind speed
1978-1987	12.23	22.27	17.52	10.57	8.97	8.35	0.82
		NW	NE	W	N	SW	95-100
1988-1997	13.90	13	12.44	11.75	9.8	7.2	0.36
		NW	W	NE	N	SW	45-50
1998-2007	34	10.70	9.93	9.82	7.90	7.05	0.54
		N	W	NW	NE	SW	95-100
2008-2019		14.73	13.42	10.62	8.34	7.08	0.06
		W	WSW	WNW	NW	NNE	

Table 6: A summary sheet of Wind data for the IInd half-year (the year 1978–2019)

The Year	Calm Wind %	I Highest wind % with direction	II Highest wind % with direction	III Highest wind % with direction	IV Highest wind % with direction	V Highest wind % with direction	% of Wind events >25 km/h/ maximum wind speed
1978-1987	15.54	15.95	14.76	11.71	10.63	6.31	2.30
		NE	NW	W	SW	N	95-100
1988-1997	25	12	9.70	9.10	8.60	8.10	0.14
		W	NE	SW	NW	WSW	95-100
1998-2007	39.10	10.70	8.56	7.31	7.28	6.30	0.09
		SW	W	N	NE	NW	95-100
2008-2019		15.10	10.04	8.11	8.05	7.42	0.01
		WSW	W	NE	SW	ENE	

Based on half-yearly wind data, it is observed that the Ist half the year; West direction wind was dominantly in the year 1978 to the year 2019, but from the year 1978 to the year 1997, east ward winds were dominant and NW direction received the maximum wind events. Events of the calm winds are increasing throughout the years. The wind intensity has decreased from the year 1978 to the year 2007 and increased in the year 2008-2019. The highest wind events had decreased in the year 1978 to the year 1998 and the year 2008 to the year 2019, but increased in the year 1998- the year 2007. The overall frequency of wind events is decreasing.

For IInd half-year, East direction winds were dominantly in the year 1978-1987 after that West direction winds were dominantly and NE wind events decreased. Events of the calm winds are increasing throughout the year. The wind intensity has decreased from the year 1978 to the year 2007 and increased in the year 2008-2019. The highest wind events had decreased throughout the years from the year 1978 to the year 2019. The wind events in the year 2008-2019 have increased. The wind event direction was variable between NE to WSW from the year 1978 to 2019.

e) Precipitation data for the year 1978-2019

Based on data analysis prepared half-yearly precipitation data with total average precipitation data tenyears' period and for the year 1978 to the year 2019. Data has mentioned in table 7:

Table 7: The half-yearly average precipitation data for the year 1978- 2019

The Year	Ist half-yearly average Precipitation (in mm)	IInd half-yearly average Precipitation (in mm)	Total average Precipitation (in mm)	Percentage precipitation received in Ist half-yearly	Percentage precipitation received in IInd half-yearly
1978-1987	104.67	608.50	713.17	14.68	85.32
1988-1997	114.88	715.82	830.70	13.83	86.17
1998-2007	108.29	443.31	551.60	19.63	80.37
2008-2019	102.69	510.68	613.38	16.74	83.26
Average precipitation from the year 1978 to 2019 (in mm)	107.63	569.58	677.21	15.89	84.11

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Based on half-yearly average temperature data following points have been concluded from the year 1978 to the year 2019. Refer to figure no 3.

i. *Ist half-year*

The wettest decade was the year 1998-2007 with 114.88 mm precipitation and the driest decade was the year 2008-2019 with 102.69 mm precipitation. The average maximum precipitation was decreased by 0.85 % in the decade 1988-1997 compared to the year 1978-1987 and increased by 5.80 % in the year 1998-2007 compared to the year 1988-1997 and again decreased by 2.89% in the year 2008-2019 compared to the year 1998-2007. The average precipitation in the year 2008-2019 were 2.91%, and 2.06% higher than the year 1988-1997, and the year 1978-1987 respectively. The average precipitation from the year 1978 to the year 2019, was 107.63 mm.

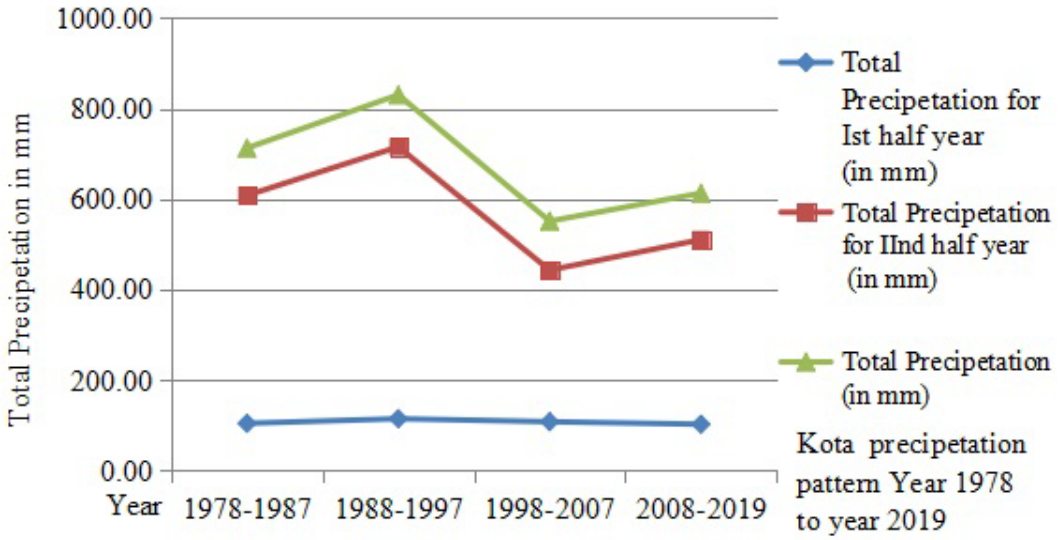


Fig. 3: Total precipitation with half-yearly precipitation graph for the year 1978-2019

ii. *IInd half-year*

The wettest decade was the year 1988-1997 with 715.82 mm precipitation and the driest decade was the year 1998-2007 with 443.31 mm precipitation. The average maximum precipitation was increased by 0.85 % in the year 1988-1997 compared from the year 1978-1987 and decreased by 5.80 % in the year 1998-2007 compared to the year 1988-1997 and again increased by 2.89% in the year 2008-2019 compared to the year 1998-2007. The average precipitation in the year 2008-2019 were 2.06% and 2.91% decreased compared to the year 1978-1987 and the year 1988-1997 respectively and 2.89% higher compared to the year 1998-2007. The average precipitation from the year 1978 to the year 2019 was 569.58 mm.

The decade 1988-1997 was recorded the highest precipitation with the average 830.70 mm and decade 1998-2007 was recorded with minimum precipitation of 551.60 mm.

f) Temperature data

Based on data it observed that the average maximum temperature was decreased in decade 1998-2007 for January to March, May, and June and again increased in the decade 2008-2019. The maximum temperature was increased throughout from the year 1978 to the year 2019 for April, November, and December. The average minimum temperature was increased from the year 1978 to the year 2019 for January, July, November, and December. The minimum temperature was increased from the year 1978 to the year 1997 and decreased in the year 2008-2019 for February, March, and October.

The yearly average maximum and minimum temperature data has prepared and given in table 9, showing that the year 1998-2007 were received maximum temp with 34.80°C and the year 2008-2019 were the lowest maximum temp 34.28°C. The average minimum temperature was maximum in the year 2008-2019 and the lowest were in the year 1988-1997 with 12.29°C, and 10.21°C, respectively. Further it shown that average minimum temperature was increased rapidly, the year 2008-2019 was recorded 1.44°C & 2.08°C temperature higher than the average temperature of the year 1978-1987, and the year 1988-1997, respectively. The average maximum temperature were decreased in the year 2008-2019 with 0.28°C, and 0.52°C compared to the year 1978-1987 and the year 1998-2007, respectively. The Graphical presentation of average maximum and minimum temperature is being given in figure 4.

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Table 9: The yearly average temperature data from the year 1978 to the year 2019

The Year	Average Maximum Temp (in°C)	Average Minimum Temp. (in°C)
1978-87	34.56	10.85
1988-97	34.37	10.21
1998-2007	34.80	10.98
2008-2019	34.28	12.29

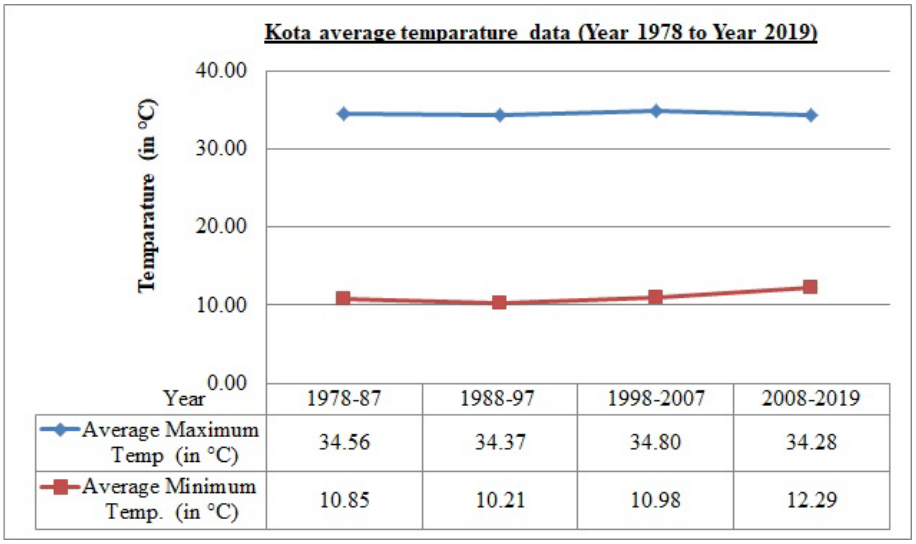


Fig 4: Kota average temperature data from the year 1978 to the year 2019

Table 10: Ist half-yearaverage Maximum and minimum temperature data for the year 1978- 2019

The Year	Average Maximum Temp (in°C)	Average Minimum Temp. (in°C)	Half-yearly	Temperature Variation (in°C) from last decades	
1978-1987	34.65	8.97	Ist Half-yearly	max	min
1988-1997	34.68	8.09		0.03	-0.88
1998- 2007	35.48	9.02		0.80	0.94
2008-2019	34.91	10.31		-0.57	1.29

Table 11: IInd half-yearaverage Maximum and minimum temperature data for the year 1978- 2019

The Year	Average Maximum Temp (in°C)	Average Minimum Temp. (in°C)	Half-yearly	Temperature Variation (in°C) from last decades	
1978-1987	34.47	12.74	IInd Half-yearly	max	min
1988-1997	34.06	12.34		-0.40	-0.39
1998- 2007	34.12	12.94		0.05	0.59
2008-2019	33.65	14.26		-0.47	1.32

Based on half-yearly average temperature data following point have concluded for the year 1978-2019:

i. *Ist Half-yearly*

The average maximum temperature of 35.48°C was recorded in the decade 1998-2007 and the average minimum temperature of 8.09°C was recorded in the decade 1988-1997. The average maximum temperature in decade 2008-2019 was increased by 0.26°C compared to the year 1978-1987 and decreased by 0.57°C compared to the year 1998-2007. The average minimum temperature in the year 2008-2019 was

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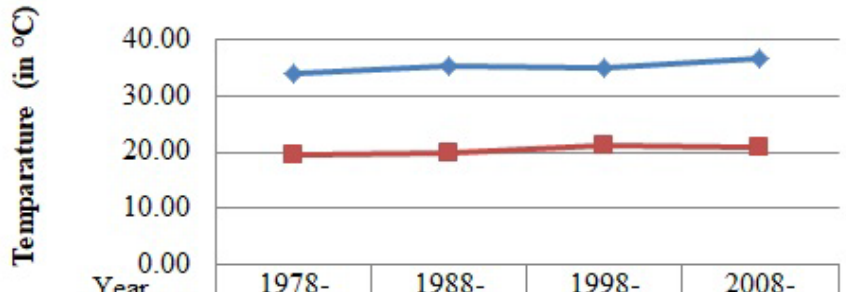
increased by 1.35°C and 2.23°C compared to the year 1978-1987 and the year 1998-2007.

ii. *IInd Half yearly*

The average maximum temperature was recorded 34.47°C in the decade 1978-1987, and the average minimum temperature of 12.34°C was recorded in the decade 1988-1997. The average maximum temperature was decreased by 0.40°C from the decade 1978-1987 to the decade 1988-1997 after that increased by 0.05°C in the year 1998-2007 and finally decreased in the year 2008-2019 by 0.47°C temperature. For the year 1978-1987 to the year 1988-1997, the average minimum temperature was decreased by 0.39°C after that increased by 0.59°C and 1.32°C for the year 1998 -2007 and the year 2008- 2019, compared to last period the year 1988-1997 and the year 1998-2007 respectively. The average maximum temperature was in the year 2008-2019 increased by 0.82°C compared to the year 1978-1987 and decreased by 0.41°C compared to the year 1988-1997. The average minimum temperature in decade 2008-2019 was increased by 1.53°C and 0.41°C, compared to the year 1978-1987 and the year 1988-1997.

Based on table 10 & 11 data, a line diagram has been prepared shown in fig 5 & 6; and concluded that the average maximum temperature was decreased continuously but the minimum temperature in increasing trend.

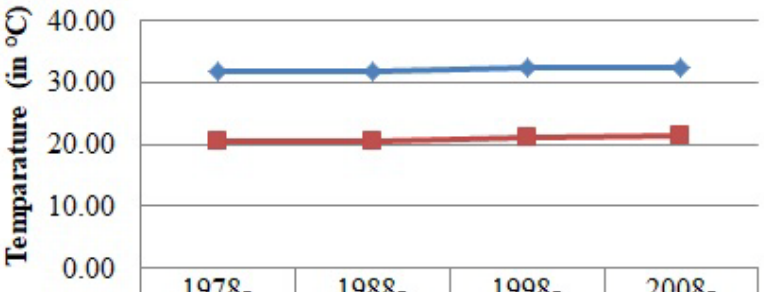
Kota Average temparature data for Ist yearly (Year 1978 to Year 2019)



Year	1978-1987	1988-1997	1998-2007	2008-2019
Average Maximum Temp (in °C)	34.00	35.20	35.02	36.58
Average Minimum Temp. (in °C)	19.58	19.89	21.28	20.70

Fig. 5: Kota average temperature data for Ist half-year1978- 2019

Kota Average temparature data for IInd yearly (Year 1978 to Year 2019)



Year	1978-1987	1988-1997	1998-2007	2008-2019
Average Maximum Temp (in °C)	31.69	31.65	32.45	32.47
Average Minimum Temp. (in °C)	20.35	20.37	21.19	21.42

Fig. 6: Kota average temperature data for IInd half-year1978-2019

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IV. Discussion

After the individual interpretation of data, needs to be done overall correlation of studied data to predict the future climatic condition. For best correlation of data, we should find out the percentage variation from last time decades. Stepwise data have given below:

Table 12: Kota Solar Radiation percentage variation from last decades

The Year	Mean radiation for Ist half-year (W/m2)	Mean radiation for IInd half-year (W/m2)	Mean yearly radiation in (W/m2)	Percentage variation from last decade Ist half year	Percentage variation from last decade IInd half year	Percentage variation from last decade (yearly)
1988-1997	6244.65	4561.15	5402.90			
1998- 2007	6237.14	4833.11	5535.12	-0.120	5.962	2.447
2008-2019	6227.02	4454.78	5340.90	-0.162	-7.828	-3.509

Table 13: Kota atmospheric pressure percentage variation from last decades

The Year	Mean Pressure for Ist half-year (in hPa)	Mean Pressure for IInd half-year(in hPa)	Mean Pressure (in hPa)	Percentage variation from last decade Ist half-year	Percentage variation from last decade IInd half-year	Percentage variation from last decade (yearly)
1988-1997	1007.34	1007.45	1007.40			
1998- 2007	1007.53	1007.53	1007.53	0.019	0.008	0.013
2008-2019	1007.69	1008.43	1008.06	0.016	0.089	0.053

Table 14: Maximum observed wind event direction with speed the yearly, Ist half and IInd half-yearly

Items	1978-1987			1988-1997			1998-2007			2008-2019		
	The Yearly	Ist half	IInd half	The Yearly	Ist half	IInd half	The Yearly	Ist half	IInd half	The Yearly	Ist half	IInd half
MWD	NW	NW	NE	W	NW	W	W	N	SW	WSW	W	WSW
HWES	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	5--10	5--10	0-5

HWES: Highest Wind Event Speed

Table 15: Kota precipitation percentage variation from last decades

The Year	Average Precipitation for Ist half-year	Average Precipitation for IInd half-year	Average yearly Precipitation (in mm)	Percentage variation from last decade Ist half-year	Percentage variation from last decade IInd half-year	Percentage variation from last decade (yearly)
1978-1987	104.67	608.50	713.17			
1988-1997	114.88	715.82	830.70	9.75	17.64	16.48
1998-2007	108.29	443.31	551.60	-5.74	-38.07	-33.60
2008-2019	102.69	510.68	613.38	-5.17	15.20	11.20

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Table 16: Kota the yearly percentage temperature variation from last decades

The Year	Average Maximum Temp (in°C)	Average Minimum Temp. (in°C)	Average Maxi. Temp. Percentage variation from last decade	Average Mini. Temp. Percentage variation from last decade
1978-87	32.85	19.97		
1988-97	33.43	20.13	1.76	0.82
1998-2007	33.73	21.23	0.92	5.49
2008-2019	34.52	21.06	2.34	-0.82

Table 17: Kota Ist half-year percentage temperature variation from last decades

Ist half-year	Average Maximum Temp (in°C)	Average Minimum Temp. (in°C)	Average Maxi. Temp. Percentage variation from last decade	Average Mini. Temp. Percentage variation from last decade
1978-1987	34.00	19.58		
1988-1997	35.20	19.89	3.52	1.56
1998- 2007	35.02	21.28	-0.52	7.01
2008-2019	36.58	20.70	4.45	-2.73

Table 18: Kota IInd half-year percentage temperature variation from last decades

IInd half-year	Average Maximum Temp (in°C)	Average Minimum Temp. (in°C)	Average Maxi. Temp. Percentage variation from last decade	Average Mini. Temp. Percentage variation from last decade
1978-1987	31.69	20.35		
1988-1997	31.65	20.37	-0.14	0.11
1998- 2007	32.45	21.19	2.53	4.01
2008-2019	32.47	21.42	0.07	1.09

a) Overall Data Interpretation and Future Climatic Condition

It is observed that the average solar radiation decreased by 1.15%, 0.28%, and 2.33% for the yearly, Ist half and IInd half-year compared between the year 1988-1997 to the year 2008-2019. The atmospheric pressure has increased by 0.066%, 0.035%, and 0.097% in the yearly, Ist half and IInd half-year respectively. The precipitation has decreased by 26.16 % the yearly, 10.61 %, and 28.66% in the yearly, Ist half and IInd half-year, respectively. The maximum and minimum temperature was increased by 3.29% and 4.62% from the year 1988-1997 to the year 2008-2019. The Ist half and IInd half-year average maximum and minimum temperature was increased by 3.91% & 4.09%, and 4.04% & 5.14%, respectively.

The expected average Solar radiation for the decade 2051-2060 would be 5279.59 W/m^2, 6209.46 W/m^2, and 4350.89 W/m^2 for the yearly, Ist half, and IInd half-year, respectively. The expected atmospheric pressure would be increased by 0.67 hPa, 0.35 hPa, and 0.98 hPa and reached by 1008.73 hPa, 1008.04 hPa, and 1009.41 hPa for the yearly, Ist half and IInd half-year, respectively. The average precipitation would be 452.92 mm, 91.80 mm, and 364.32 mm for the yearly, Ist half-year and IInd half-year, respectively.

The maximum and minimum temperature for the decade 2051-2060 would be increased by 1.14°C & 0.97°C for the yearly and reached by 35.66°C & 22.03°C. For the Ist half-year average maximum temperature would be increased by 1.43°C, and reached by 38.01°C and the average minimum temperature would be increased by 0.85°C and reached by 21.55°C. For the IInd half-year, the average maximum and minimum temperature would be increased by 1.31°C and 1.10°C and reached by 33.79°C & 22.52°C, respectively.

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Table 19: Expected climatic condition in the year 2051-2060

Factors	The Yearly	Ist half-year	IInd half-year
	Comparison between the year 1988-97 to the year 2008-2019 (in percentage)	Comparison between the year 1988-97 to the year 2008-2019 (in percentage)	Comparison between the year 1988-97 to the year 2008-2019 (in percentage)
Solar Radiation	(-1.15)	(-0.28)	(-2.33)
Atmospheric pressure	0.066	0.035	0.097
Precipitation	-26.16	-10.61	-28.66
Temperature (Avg Maxi. Temp /Avg. Min. temp.)	3.29/4.62	3.91/4.09	4.04/5.14
Expected in next three decade (The Year 2051-2060)			
Solar Radiation (in W/m2)	5279.59	6209.46	4350.89
Atmospheric pressure (in hPa)	1008.73	1008.04	1009.41
Precipitation (mm)	452.92	91.80	364.32
Temperature (°C) (Avg Maxi. Temp /Avg. Min. temp.)	35.66/22.03	38.01/21.55	33.79/22.52

V. Conclusions and Suggestions

In the present synthesis of available data and analysis, it observed that the average solar radiation and precipitation pattern have decreased during the past 32 the years (the year 1988-2019). The atmospheric pressure and mean temperature have increased during the past 32 the years. Due to changes in atmospheric pressure, wind events and intensity of extreme wind events have decreased from the decade1978-1987 to the decade 2008-2019. The speed of extreme wind events decreased from 95-100km/h in the decade 1978-1987 to 25-30 km/h in the decade 2008-2019. The wind calm events were increased from the year 1978 to 2007 but decreased in the year 2008 to 2019.The precipitation received in Ist half-year has increased concerning the total precipitation.

The above interpretation, it is indicating that variation in wind flow happened due a change in atmospheric pressure. The continued variation in atmospheric pressure indicates that the thickness of atmosphere is decreasing at Kota due to present climate change. It also seems that the arid winds are moving towards Kota and increasing the temperature, decrease the precipitation with more calm winds. The change in wind flow and increase in minimum temperature may increase the probability of Hydro-meteorological disasters.

It is observed that the highest winds events direction might shift towards West and South direction and causing the hot and humid weather with the decrease in precipitation. Extreme wind events have increased as well as calm wind events have increased.

It is predicted that the confluence zone of the Heddle Cell and mid-latitude Cell is shifting/fluctuating towards the equator, and the confluence zone is receiving the maximum calm wind events and extreme weather conditions. It is also possible that during the Ist half-year, the Heddle Cell may move more towards the North and due to it, more precipitation received in Ist half-year and high temperature/extreme summer. The Mid-latitude cell moves towards the equator during IInd half the year, which is cold and dry, decreasing the precipitation and temperature. But the yearly impact of these winds shows a decrease in the precipitation, increase in the temperature and calm winds, variation in wind events, and frequency of extreme weather events will be increased. We can take pre-disaster mitigation measures for hazard-prone areas and identify the new prone-area. Public awareness, disaster prediction, hazard mitigation structures, and communication methods would be helpful for saving the ecosystem.

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A Sustainable Territorial Challenge: The Irreversible Impressions on Waste and Residue Management from Functional Community Workshops

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Abstract- The goal of this article is to present a special thought on the strategy of capacitation workshops, as the means for self-awareness and decision making on waste, having a different perspective towards the subject. That way, the research that generated the present document, was established from the research-in-action, generating knowledge and new experiences by ways of physically meeting the waste collectors from the city of Matinhos - Paraná, which was made possible through ANCRESMAT and AMAGEM associations. We dove deep in the sustainable development bibliography, in recent researches that stand for education as the essential means for awareness in regards of the environmental issues experienced during current days.

The workshops allowed us to notice that there are special ways to enter those land spaces, interact, and thus, transform actual lives, through an enhanced look to waste and its potential.

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A Sustainable Territorial Challenge: The Irreversible Impressions on Waste and Residue Management from Functional Community Workshops

Zago, Marcia Regina Rodrigues da Silva [α], Dullius, Alexandre [σ], Silva, Maclovia Correa da [ρ], Munaretto, Elisangela Christiane de Pinheiro Leite [ω] & Favorito, Andressa Rando [¥]

Abstract- The goal of this article is to present a special thought on the strategy of capacitation workshops, as the means for self-awareness and decision making on waste, having a different perspective towards the subject. That way, the research that generated the present document, was established from the research-in-action, generating knowledge and new experiences by ways of physically meeting the waste collectors from the city of Matinhos - Paraná, which was made possible through ANCRESMAT and AMAGEM associations. We dove deep in the sustainable development bibliography, in recent researches that stand for education as the essential means for awareness in regards of the environmental issues experienced during current days.

The workshops allowed us to notice that there are special ways to enter those land spaces, interact, and thus, transform actual lives, through an enhanced look to waste and its potential.

I. Introduction

The matter associated to waste in Brazil, as a whole, is addressed by The National Solid Residue Policy, as a result of the Federal Law 12.305/2010 (WALDMAN, 2012; ZAGO et al., 2018). The aforementioned law establishes that inhabitants must make the proper storage of waste in their homes, so to make it possible the collect of that waste, making it mandatory the correct separation collect at their address, in the towns where the selective collect process is established (KONRAD; CALDERAN, 2011; ZAGO et al., 2018).

Starting from the Federal law aforementioned, the union's states laws are based on the Federal law to reinforce actions, having the main objective to fully establish the management of waste, in addition to the implementation of the law in all towns within the respective state. In the state of Santa Catarina, for instance, Law 14.675 established the use of state's Environmental State Code, reversed by Law 16342/ 2014. By doing so, the solid waste management is addressed on the situations that cause environmental degradation (BRASIL, 2010).

According to Diniz (2011), approximately 40% of waste generated in the country are dumped outdoors or in an inappropriate fashion in dumping grounds around town (QUERINO; PEREIRA, 2016). In sight of that, Ramos (2010) warns us around the urgent need of awareness from part of the population to generate less waste, as well as learning to sort out correctly their waste, driven by the recycling and reuse of that waste.

With that in mind, it's very important the creation of a mobilizing process of awareness about the necessity to change the notion that general waste serves no purpose anymore. We now know that a lot of that waste can increase their presence in the world, if they're creatively and properly recycled or reused. They're powerful material that, if well reused, can even result in new income for those in need.

The narrative of the activities presented in this article aim to debate about the urgent need to reverse the impression that general waste is useless, taking as measure the amplitude feasibility view from the workshops standpoint. By doing so, the collection of data and the case study led to this research having an exploration emphasis, by which the data presented herein comes from the three workshops that took place at the "ANCRESMAT and AMAGEM" Waste Collectors Associations, in the city of Matinhos-PR. The research was performed between the months of April and September of 2019.

This study design was made from the research of applied nature, having as the main objective, problem solving in the reality environment of the researchers. This action research coming from a real problem/situation aims practical results, being able to contribute as much as for a real improvement of the

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situation, as also, generating changes in the context in which it lies. In regards of theory fetching references for this study, it was done via bibliographical research (GIL, 2017, p. 25 apud ZAGO, et al., 2018, p. 3).

Promotion of practices and investigations are considered, having the workshops characterization and the possibility of supply maximization, moving towards the development of the sustainability culture and the income generation perspective with the use of waste. On the other hand, we have noticed that in order for that to happen, it is necessary an increase of actions and government policies that aim the feasibility of the concept of sustainable development in our country. We believe that research is one of the ways to change that culture.

II. The Sustainable Development Perspective in the Recycling Context

The sustainable development is a widely spread concept, however, it is not well comprehended and, therefore, not well applied in Brazil. Since that concept functions on the perspective of alignment and fairness between the environmental, economic and social matters, it is necessary a very wide understanding for its practical and effective enforcement (HÜLLER; HÜLLER; FORIGO, 2017).

As a general analysis, there is a great interest on the matter of the sustainability concept. Its applicability relies a lot on the given strategies related to its field of action, for example engineering, economy, business and ecology, where each specific science sees and understands it with more or less excitement, according to each part of this equation (CHICHILNISKY, 1996).

That way, even in current days, it is possible to note that the concepts of sustainable development and sustainability provide different interpretations and actions. With that said, writers Dovers; Handmer (1992) state that sustainability is capable of generating a human system, natural or mixed, that may adapt or also resist to the endogenous or exogenous change for some time. Whereas sustainable development means intentional change that improves the current situation, depending on the respective population needs.

Enterprises, on the other hand, need to contribute with that sustainability since it involves environmental, economic and social balance. From a business standpoint, it is necessary for enterprises to provide the technology and financial skills to make the sustainable development possible (ELKINGTON, 2001). With all these facts in mind, the writers discuss yet, the importance of expanding and incorporating these concepts adopting a family and personal analysis, so that the environmental awareness process can be well accepted and get the real engagement of the general public.

According to Elkington (2001), the sustainable development has a definitive real reach for sustainability, since real researches point out that the sustainability understanding factor with its real use in human life and its comprehension goes a lot further than plain related facts to the environment preservation.

Sachs (2002), as well as other authors, believe that the sustainable development will depend on the social-economic and environmental process, in which the given society is inserted. In this scenario, it can be understood that the environmental sustainability would be the economic activities dematerialization.

In addition, according to Sachs (2002), economic sustainability is essential for the non occurrence of the so called economic degrowth, which translates into social equality, growth and access to general goods, assets, services and jobs. Therefore, it is necessary to let go of the idea of environmental sustainability focused solely on natural resources preservation, for not considering the economic matter, which moves our current society, the path will demand a lot more effort to get to the desired sustainability scenario.

So, it is possible to define sustainability into three different points of interest: interest on the current generation perspective, economic sustainability direction; interest on the search for equality; and the interest involved in the building process with future generations of people that will take it to a broader environmental sustainability.

It is noted, then, that the issue related to the solid waste production in Brazil has a very close relation to the concept of environmental sustainability, especially in regards of recycling. Following that argument, waste collectors' role is of high importance in this process, that through the recycling process they are a part of, they play a major social role, generating income and decreasing the environmental impact effects that such waste would cause if they were simply disposed out in the environment (HÜLLER; PERSIGO; RAUBER, 2010).

Taking all that into account, such actions must be taken seriously by all players, especially by institutions and the reinforcement of government policies aimed at this area and the proper qualification of those involved through initiatives aiming the environmental awareness and education.

Based on these facts, it is expected that the belief that waste is useless in our environment, is finally surpassed. However, it is necessary to be reminded of the urgent necessity of also overcoming other obstacles to stimulate the perception around the environment and its wholeness, as we will address now.

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III. The Importance of a Broader and Self-Conscious Analysis toward the Environment Concept

As a whole, the perception about the environment is changing. We have observed the process of debunking the conception that the environment is directed only and solely as something regarding nature in its physical form: trees, rivers, parks and natural sources. Being so, the understanding that the environment is a place where an individual is inserted and also interacts with, reinforces the idea that human beings need to establish a sustainable way of development, so that the human race won't collapse (SANTOS, 2008).

Researches have shown the influence media and communication channels have on the environment, and as the higher level of education the individual possesses, the greater the interest in obtaining more knowledge and awareness regarding environmental issues. Knowing that, the population in medium and larger cities are quite more informed and interested in the subject, increasing their education, and by doing so, they get more involved in opportunities related to how the society can help owning a bigger responsibility with sustainable development (SANTOS, 2008).

We also noted the tendency of material goods consumption in the world, which calls out for a gradual change, not by factors associated with the "environment awareness", but for the quality of life that implies in healthier habits. That lifestyle results in less harm for the environment. References?

However, we believe that the intellectual evolution, in addition to a conceptual evolution is necessary, focusing on the means to perceive the environment. Only through that awareness, the population will realize that the matters related to recycling, for instance, go together with the concept of environmental sustainability.

Following that path, besides the population awareness towards a higher perception of the environment, government leaders comprehension is also necessary to work on public policies and measures to support the recycling initiative.

IV. Government Policies Related to the Waste Collectors, The Social Inclusion and the Environmental Sustainability

Looking at the current context of Brazil's public policies, it is noted that the waste collector's status is one of the most discussed about, especially in the social productive inclusion category. Therefore, it has turned out to be an analytical strategy in order to be able to understand the obstacles that separate the public policies conceptions from their practical execution (LIMA, 2018).

The work of waste collectors in the Brazilian context is very significant and there are some public policies directed to the low-income population currently. However, it is important to note that those policies are normally associated and directed to the unions and associations, which is very similar to the ways other countries' governments treat the situation (RABOSSI, 2011).

The origin of legal standards and parameters for the waste collectors category was structured and placed on the streets or landfills, and also the so called "dump grounds". The unions and associations are ways found to make this activity legal, with a touch of social inclusion and citizenship. Such requirement has become mandatory so that this workers' union could apply for the support programs sponsored by national and international non-governmental organizations, as well as government policies (LIMA, 2018).

According to Carenzo; Míguez (2010), the social inclusion of waste collectors was made official when there was the conversion of waste collector workers in uprooting and vulnerability situations working for public enterprises as well as other associations.

The waste collectors that work alone are not exempt from the idea of exclusion, uprooting and absence of options. That is the case of waste collectors on the streets and "dump grounds". On the other hand of this trend, the collectors that work in groups, through institutions, unions and associations have the opposite outcome than the individual workers (LIMA, 2018).

It is accurate to say that the collective work of the waste collectors are based on cooperation, compassion and equality of rights. To the collectors, in general, it is possible to understand that the economic outcome is achieved as well as the adoption of requirements to respect 'nature' in an equal and supportive way (CARENZO; MÍGUEZ, 2010).

In general, laws enforced on the organizations and institutions must be based on the standard processes of informal practices, keeping in mind that the job categories are then recognized and approved by the State. Therefore, the legal framework represented by the National Policies of Solid Waste (PNRS in Portuguese), would help in this scenario, starting from the law of the collectors' activities in different venues such as dump grounds, landfills, unions and associations (IPEA, 2013).

Currently, those professionals that work with recycled materials in Brazil have an essential role on the solid waste management chain, their work is very much in place. That is an attribute they already carried before the establishment of solid waste management public policies. Taking that into account, we understand they already did develop a very important environmental work before those policies (CARENZO; MÍGUEZ, 2010).

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The environmental work they perform adds a lot to the return of materials to the recycling process, generating energy and raw materials savings, all aiming the prevention of material return to local dump grounds and landfills (CARENZO; MÍGUEZ, 2010).

Recognition on the reusable and recyclable solid waste matter is essential for the waste collectors. It is an economic asset that has social value. Such materials are income sources that help the reusable and recyclable waste collectors, as they are part of the shared actions chain for the lifecycle of goods (IPEA, 2013).

The inclusion of recycled material collectors in the solid waste management process in local towns, makes it possible for the implementation and selective collect, joined by the cooperative institutions and also individual citizens with low income. Whereas the exclusion of the recycled material collectors is defined as a great problem, for it shadows the visibility of this important social segment (LIMA, 2018).

On the other hand, it is known that material collectors, as a whole, are inserted in this process in order to get work, however, they are often removed from it due to the poor working conditions they are subjected to. That way, mostly often, the collectors are placed in a side economy position, which in turn, is usually determined by the poor working conditions it offers.

A social imbalance is seen because of the frequent waste build-up, because on one side an individual will dispose waste because one consumes it, and on the other side one will only consume it because the individual collects the waste for their own survival. That is seen because of the consumption disorder, which means, this disorder excludes people, according to the capitalism rationale (MENDES, 2014).

That way, money goes around in society in several ways, from coins all the way up to credit cards, making the capacity of coming up with goods today very high, that reality being one of financial intelligence ways to sell goods, and that will generate more waste (SANTOS, 2008).

In general, the waste fetched by the collectors, is able to grant them as little as pennies. This is a reality of many Brazilians that live off of collecting recyclable materials, making a living of what the general public discards. In the eyes of the government, collectors bring benefits, since they help keep cities clean, decrease the volume of waste at local dump grounds, they are a cheaper labour, they also help prevent floods and pollution caused by the accumulation of trash, but such incentives are still not compatible with the appreciation the waste collectors' work should have (MENDES, 2014).

Collectors, in general, are placed at the margin of society, and as they face the need to find work, they see on the waste opportunity, a possibility for a faster income. That generally forces them, to work for someone who will provide them with a waste kart and will pay them pennies for all the waste collected around town (GONÇALVES, 2006).

However, there are those who benefit from these workers' hard labour, especially factories and manufacturers, for it is not necessary to establish any work relationship ties with the collectors, since the hiring process is made through intermediate agents. Therefore, the waste collectors have little economic perspective, since they have a very low power of negotiation with the intermediate agents (GONÇALVES, 2006). In addition, when there is an increase of price paid by the industry, which more often than not, is not extended and paid in full to the collectors, whereas when prices go down, collectors get the full impact. When the distance between the scraper and the buyer is longer, material pricing often gets lower, and as a result, cost is deducted from the earnings collectors make (MENDES, 2014).

Industries take advantage of the waste collectors who undergo the aforementioned conditions to obtain the means for their families and their own survival. Institutions play a major role in this scenario, when the waste collectors look for organizations, institutions or cooperative organizations, they can provide a better work and living condition to those individual collectors who, being unemployed, lacking an academic degree, having no professional records are therefore, not considered in the labour market (GONÇALVES, 2006). The inclusion of waste collectors in those institutions, associations or cooperative associations, and therefore into the labour market, assure to a certain extent, their social well-being. In this scenario, the enactment 7.405/10 establishes the For Collectors Program, that supports the waste collectors, provides them with a better working condition, in addition to a social and economic reality a lot closer to a steadier life.

V. Program for-Collectors

The For-Collectors Program was established by the Federal Enactment 7.404/2010, having its main goal on legally implement the National Policy for Solid Waste, along with Enactment 7.405/2010 that established the For-Collectors Program aiming to unite Federal Government's actions directed to the collectors of recycled and reusable material. It was redirected to the support and aid of the collectors production chain organization (BENSEN, 2012).

Aiming to improve the recycling and waste collectors working conditions; expand the opportunities for social and economic inclusion; and enable the expansion on the selective collect of solid waste, reusables and recycled materials made possible by the action of this labour segment. Execution and tracking of

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the For-Collectors Program, including the social and economic inclusion of the waste collectors is headed by CIISC (BENSEN 2012).

Considering this scenario, the program also gathers actions comprehending qualification, education, technical consulting, social enterprises, support, researches and studies about the lifecycle of goods. The qualification and social inclusion workshops are very common and provide the opportunity to raise awareness from the population and those involved with the environment and sustainability cause.

VI. Successful Study cases on the Environmental Sustainability Initiatives through Workshops

Most of the workshops about recycled materials available in Brazilian towns are used as an educational form of "garbage" reuse and transformation into products that will get a second chance to still exist. The main goal is to make the engaged population aware of the environment cause, so that all participants can understand the importance of this process and make it easy to see how valuable that waste is. Taking this important point of discussion into consideration, the workshops need to develop an Environmental Education system for all ages, in an integration form, with low cost (MEDEIROS, 2015). In addition, according to the author, that initiative can be carried out to schools, or right in local communities and interested families.

These are suggested measures that, through educational methods, go against the extreme consumerism of the current society, making it a conscious invitation to look at the serious harms we are causing, if we so continue to act this way, towards the environment. With that in mind, it is possible to foresee the implantation of an Environment Educational system that can bring awareness and interest to students in order to protect and take good care of the environment they live in.

A great support that schools have been providing is the workshops of plastic PET bottles, providing ideas and knowledge around the environment preservation, recycling process, the pollution impact, attention to our planet, among other related subjects. Such initiatives cause awareness and thought on students, even those who do not know or discuss the subject in their family households or did not have the opportunity yet to think about the subject. The school environment is the ideal place to spread those ideas and attitudes.

Looking at this scenario, it is possible to identify that if the environmental problems are caused by human intervention, it is necessary, through interactive and ideology ways, to pass on the idea of the need that each individual has to become a co-responsible agent for everyone's quality of life (DIAS, 2004). Looking at this new thought in regards of society's waste management, it is clear to see that it is possible to remediate one of these waste management issues, by the method of its selection and reuse, making it possible to move forward on the matter of the environmental sustainability.

In accordance to Dias (2004), the Environmental Education's objective is gaining social support, equality and the respect towards the diversity through democratic ways, so that all of the efforts made can actually generate positive outcomes through continuous initiatives. Still through these arguments, the measures chosen to develop the Environmental Education initiative are limited, when it is necessary to be effective as soon as possible, when taking little isolated actions, narrowed down to small groups, they are not sufficient to serve the respective community since such actions are meant to be a collective and collaborative action.

Therefore, the learning process through workshops is essential, because through educational classes about disposable materials and recyclable goods, the workshops can be assessed to manufacture several other products using recyclable materials (OLIVERA; SILVA, 2018). According to the aforementioned authors, a great portion of the workshops assessed by students can promote the manufacturing of overstuffed cushion pouffe, making use of plastic PET bottles and tyres, as well as recycled paper to recreate, recycle and reuse those materials.

Thus, we believe in the great potential of recycled goods for generating income through the manufacturing of useful products, having the workshops as a starting reference and also having the recycling, reutilising and decreasing of volume if necessary, as their main founding principles for the Environmental Education initiative.

This is a way of acting that provokes reality change, since through the Environment Education, the education professional can work on an integration: humans and environment, making people aware that the human being is nature itself and not just a part of it. So, the understanding of the environment student or the oriented individual in the corresponding workshop about the selected garbage cannot be focused only on the theory that waste is completely useless and therefore, harms nature as a whole, but above that, that waste can be reintroduced in this process, being also an income trigger agent and social inclusion factor, an essential criteria for the environmental sustainability initiative. (OLIVEIRA; SILVA, 2018). Having such perspectives as the principle adopted in this study, let us discuss next, the experience obtained with the workshops in Matinhos - Paraná.

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a) Workshops at Ancresmat and Amagem Associations

There is a specific and very successful study case that, deserves a significant credit due to its importance in this process, which happened through workshops at the Solid Waste Collectors and Pickers Association of Matinhos (ANCRESMAT). For those events, collectors from Matinhos' Environmental Agents Association (AMAGEM) and ANCRESMAT attended, having a local craftswoman as the lead workshop agent.

This particular experience presented us with the expansion of ideas, proactiveness of the attendees, as well as their interest on the opportunity to learn and also teach about environmental matters. It comprised of all its interactive forms, ranging from the understanding of materials' importance to the environment, all the way up to the supply and the sharing of food during coffee breaks and intermissions. There was a feeling of belonging to the location where the workshop was held, for the placement of the selected material, tables where meals were served and all the space around blended in with the attendees' routine, behaviours, attitudes, values and views of the world.

Considering the above, the workshops provided ANCRESMAT with a new view for the use of the facility where they worked and had meals, when the symbolism of the new reality could be observed, especially when analysing the choices made by the attendees. Among the final result of things, it was possible to see that there was a contagious union established amongst everyone, when they could realize how powerful they are as people as well as their combined feelings when they knew they were giving someone a gift. There was a grandmother who manufactured a fish to her grandson, claiming that her grandson loves fish, whereas another person decided to make a dog for their partner, another made a rabbit's head and thought they would not make the entire body, and yet another person felt challenged to make a doll with a lot of difficulty, requiring the assistance of the local instructor. The feeling of helpfulness and cooperation involved in this workshop process was explicit. This gives a significant support for the collectors to achieve their autonomy on their decision-making process. Actions to extend discarded materials' life enabled them to rediscover talents and enhanced opportunities to regain therapeutical habits, as well as providing the possibility to use their free time to work on craftsmanship activities.

Another workshop was entitled: *The Umbrella Project: cushions, aprons and handbags.* The idea to use discarded umbrellas' fabric is directly related to the economic, environmental and social sustainability issues. Looking at the economic side, the manufacturing costs for the storms shelter vary according to its various models, lifespan and raw materials. On the environmental side, impacts occur, above all, for the inappropriate disposal and the different types of materials used to make the object. On the social side, the umbrella is used by all those who are on the streets during rainy days and do not want to get wet or have their belongings wet and soaked in water.

Ideas were discussed and the main goal was to encourage, explore and support the waste collectors. They came across with this same type and other types of waste during the collect action with little or almost no economic value. As an example, most of umbrellas' handles are made of a hard-plastic type of material that is difficult to commercially negotiate. A wooden clothes hanger set was manufactured using scraps of medium density fibreboards (MDF) coming from experiments of mould and parts used by the Design undergraduates from UTFPR University.

Other social elements that played a big role during this session were the attendance of their family members, the connection and their life stories that were also part of the manufacturing process of their handicraft pieces. Art, eating and conversation make up for the main satisfaction factors revealed by this workshop's attendees. The products manufactured and originated from this workshop are displayed on photo 1 below.

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Source: The authors (2019).

Photo 1: Products manufactured from *The Umbrella Project: cushions, aprons and handbags*

We would like to point out about another workshop held at AMAGEM. We believe it is of high importance due to the fact that this association, despite their 20 years of operation in Matinhos, had never had the means to host a training session workshop. We had the opportunity to have a waste collector from Matinhos itself, as the workshop host, who contributed significantly with her handicraft skills, sharing her knowledge to those involved about art objects manufacturing. Alongside with other local craft artists, she has her work displayed at the reserved hall from the Culture Bureau, showing her work using the material found in trash bins around town. In addition to that, nature has provided her with other types of material, such as: hay, vines, seashells and seeds - all being part of her manufacturing process. We can perceive that waste collectors can earn their living through the processing of recyclable waste along with their craftsmanship.

That is an example that gets us thinking about the relations between the society of consumption and allocation of nature resources, for they go against the waste collection methods. However, in order for people to be respected in their activity and be able to find the means for survival, PNRS set as their goal to shut down waste landfills, places prohibited by law in Brazil. That action has enabled a significant increase of waste collectors on the streets of several cities in the country, since the collectors do not have proper professional qualification and, therefore, are not seen as trained and qualified workers to fulfil the criteria demanded by the work market. They are also very distant from educational institutions where they would be able to obtain such skills and competencies at universities or schools. That way, they are left off wondering around towns and at times excluded from society.

In the light of these events, we understand it is necessary to give voice to the waste collectors, and coming from that point of view, we decided to take on the leadership of the workshop agent on this proposal. She then, chose to work using the African doll Abayomi. This doll carries a historical context that takes us back to the colonization times in Brazil (1500-1800), when the Portuguese traded African slaves to work in the newly discovered land of Brazil. The African families travelled for months aboard crowded ships, known as the Negro ships, until the trip reached its final destination. The mothers of those families used to tear up their dresses to make dolls in an attempt to entertain their children.

And powered by all these indicators we can safely state that the workshops showed, provoked, and provided a lot of exchange and knowledge. Following the guidelines given by the workshop agent as well as the material provided, those who attended were able to make choices on colours and fabrics for the dolls' clothes. Firstly, the body with the head was started by giving it a knot. Following that, the two next knots resulted on the legs, and the final two knots gave the connection to the body of the doll. At least two little dolls were made by each participant. There were those who enjoyed the activity so much that they decided to make many more. All dolls were placed inside a cardboard box and recognized by the attendees and researchers, as they can be seen in photo 2 below.

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Source: The authors (2019).

Photo 1: Abayomi dolls manufactured by recycled materials collectors

There was another extension workshop that discussed about knowledge and skills entitled "Manufacturing of cement vases using discarded fabrics", which happened in two phases at ANCRESMAT. The first phase comprised of the manufacturing of vases and the second phase addressed the growing of flowers.

The main goal of this workshop was to supply the institution with vases, so that they could grow unconventional edible plants (PANC's). Those are native and seasonal plants and they will grow in selected parts of the country. They can feature some menus; healing of diseases and they can also decorate the area where the waste collectors sort out the materials.

The participants used discarded towels and fabrics that were damped and submerged in liquid cement. They filled the moulds then, which were spread out on top of plastic canvas, taking the shape of a vase (Photo 3).



Source: The authors (2019).

Photo 2: Manufacturing of vases and growing of unconventional edible plants workshop (PANC's)

This was a Social Environmental Education initiative in which drew the university closer to the association of recycled material collectors and pickers, both essential institutions for the sustainability of our planet. The collectors, while they are working on the collecting and picking of the recyclable materials, are regular citizens that live and protect the environment through their work and have a very broad idea of how important their work and those materials are to the environment.

The reuse of wasted materials expresses a meaningful contribution in order to achieve the goal of the sustainable development of our planet. The vases will occupy very little room in households or work

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environments, they can decorate the environment and are definitely ornament objects. They can be made of different heights, geometric shapes and sizes.

The spread and sharing of knowledge can turn a recyclable material sorting space into workshops of leisure and art. ANCRESMAT is established in a neighbourhood where people live and work using recyclable materials. It is situated in an area where it is part of a preservation site, with reminiscent vegetation of the Atlantic forest.

Some inhabitants from the area came to attend the workshop and felt immediately familiar with the space where they have lived for more than 25 years. Many stories were told by the people around the vases, one of which how the space originally looked like, in the past, when very few people lived in the area, thus showing the feeling of belonging the people felt for the space.

VII. Final Considerations

Recycling main attribute is the reuse of waste, that is, this is an activity in which materials that are considered to be garbage or materials placed in a garbage bin are then sorted and processed in order to obtain their raw material to manufacture whole new products.

Processed materials obtained at recycling enterprises have a higher cost than the original raw material, giving logistics the main job to economically analyse the shipping and storage of such products, resulting on the decrease of environmental harm.

Logistics helps to establish the waste flow, resources and discarded goods, whether it is for the end of its lifecycle or for its reuse, be it in or out of its original manufacturing chain, then helping minimize the environmental impacts. Therefore, the logistics system is a corporate tool that aims to provide the technique on how to do it properly, providing the incentive of sustainability for the manufacturing chain.

The immersion on this investigative action needs the help of a set of techniques that can make course training sessions possible, such as workshop agents, physical spaces, chat sessions, food, engagement and others. The training workshop methodology proved to be a successful way to observe and interact with the recyclable material collectors' lives. It provided us with a systemic view of the individual and group relation that, in addition to previous knowledge of the participants, manufactured another type of craft with other recyclable materials, for instance.

Through the workshop sessions, the main objective is a challenge to all attendees. It is necessary to eliminate the idea that waste generated by people are useless, unusable, and impossible to be recovered. We could show that waste is not the end, but the rebirth of other opportunities, an attitude that we should all urgently uphold and stand for.

The workshops were able to create an atmosphere of connections between people's emotional lives and the stories they told. Participants expressed their feelings, memories, situations they remembered from past experiences that brought them all together and the feeling of belonging to the place finally arose.

The workshops caused, provoked and awakened a lot of exchange of knowledge and experience. Participants were able to make choices, chat and they felt as the main agents on the action of turning waste into products that can have their lifecycle extended. However, there is much of that to be done still in regards of sustainable local development. We understand the real need of amplifying the reach of ideas such as these, especially towards the care and attention to those involved, in this case the waste collectors and pickers, since they are the main agents in the development of an inclusive and sustainable system, through their work, as well as their feeling of belonging and opportunity to excel.

Therefore, we understand local schools' role as they contribute with the spreading of the idea that trash can be reused, by establishing the selective collect, especially because schools hold the largest volume of waste, such as: paper and disposable packaging. Schools must get students to engage in the environment initiative, bringing awareness around this subject through creative activities so that students can get involved in the matter by making banners, taking part on theatre plays, trash recycling workshops, among other initiatives. Environmental Education can be inserted in schools' programs, in order to get students talking about it, so that they can raise awareness on this important issue through waste recycling and their reuse.

The public policies for the recyclable waste collectors must take into consideration the guarantee of their working conditions and a dignified living standard for these workers. After all, these men and women are the responsible for the mitigation of pressure on those natural resource materials, since they are the ones who keep those materials from becoming useless trash, providing raw materials to the manufacturing business, which in turn decreases waste of materials and energy.

Following that analysis, it is necessary to pass other different policies for the recyclable material collectors, in conjunction with the Solid Waste National Policy Department, with special attention in regards of education, so that these men and women can have their rights assured.

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Analysis of Rainfall and Temperature Patterns on Yam Yield in Lafia, Nasarawa State, Nigeria

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Abstract- Analysis of rainfall and temperature patterns on yam yield in Lafia, Nasarawa State, Nigeria. Variability is one of the serious environmental challenges that has received a lot of complaints. This study therefore sought to examine the effects of climate variants on yam yield, data were collected for a period of 15years from the Nigerian Meteorological Agency (NIMET) and the Nasarawa Agricultural development Project (NADP) in Lafia, capital of Nasarawa State. The data were analyzed using the Pearson correlations and linear regression analysis and the trends in temperature, rainfall on yam yields. The result of the study shows an increase in maximum and minimum temperature at 0.168^0C and 0.413^0C respectively, coupled with unreliable rainfall of 0.079 over the investigated period (2001-2015), while the standardized coefficient Beta was 0.075. The study indentified poor yield as the major effect of rainfall and temperature variations on yam yield. Maximum temperature had a weak (0.168) positively significant relationship on yam yield for the investigated period, minimum temperature had a weak (0.413) positive significant relationship on yam yield which is more advisable and rainfall had the weakest (0.079) positive significant relationship and it cannot be held responsible for higher crop yield, except if joined with other factors like soil fertility, soil moisture, soil pH, and so on for the 15 years period.

Keywords: rainfall, temperature, pattern, yam, yield.

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Analysis of Rainfall and Temperature Patterns on Yam Yield in Lafia, Nasarawa State, Nigeria

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Abstract- Analysis of rainfall and temperature patterns on yam yield in Lafia, Nasarawa State, Nigeria. Variability is one of the serious environmental challenges that has received a lot of complaints. This study therefore sought to examine the effects of climate variants on yam yield, data were collected for a period of 15years from the Nigerian Meteorological Agency (NIMET) and the Nasarawa Agricultural development Project (NADP) in Lafia, capital of Nasarawa State. The data were analyzed using the Pearson correlations and linear regression analysis and the trends in temperature, rainfall on yam yields. The result of the study shows an increase in maximum and minimum temperature at 0.168^{0}C and 0.413^{0}C respectively, coupled with unreliable rainfall of 0.079 over the investigated period (2001-2015), while the standardized coefficient Beta was 0.075. The study indentified poor yield as the major effect of rainfall and temperature variations on yam yield. Maximum temperature had a weak (0.168) positively significant relationship on yam yield for the investigated period, minimum temperature had a weak (0.413) positive significant relationship on yam yield which is more advisable and rainfall had the weakest (0.079) positive significant relationship and it cannot be held responsible for higher crop yield, except if joined with other factors like soil fertility, soil moisture, soil pH, and so on for the 15 years period. It was recommended that crops like yam should be planted in the month of February due to enough heat absorption so it could rapidly grow when the first or early months of rains start, and that Agricultural Extension Officers should be deployed to guide famers through routine visits, sensitization programmes on variability in rainfall and temperature characteristics, use of farm inputs and monitoring of crop-climate relationships in the area in order to achieve improved crop yield.

Keywords: rainfall, temperature, pattern, yam, yield.

I. Introduction

Rainfall continues to be the most important climatic parameter with the highest spatial and temporal variability over most part of the world. The distribution of precipitation over the earth is considerably more complex than of insolation or air temperature (Oguntoyinbo, et al., 2015).

Rainfall is an element of weather. Other elements of weather include temperature, humidity, wind, cloud and sunshine. It is the collective pattern of expression of these elements overtime that becomes described as the climate of a place. Climate is the synthesis of the weather in a given place over a period of at least 30 years. Thus climate is the "average weather" together with the variability from the average.

Apart from precipitation, temperature is probably the most talked about weather element. Temperature can be defined in terms of movement of molecules such that the more rapid the movement the higher the temperature. More usually, it is defined in relative terms on the basis of the degree of heat a body has. Temperature is the condition that determines the flow of heat from one substance to another. Heat moves from a body having higher temperature to a body lower temperature. The temperature of a body is therefore its' degree of hotness as measured by the thermometer. Various scales are used to express temperatures, these include the Fahrenheit, centigrade and Kelvin or absolute temperature scale is used. In most countries temperatures are now measured in centigrade or Celsius scale and in some applications the Kelvin or absolute temperature scale are used. Temperatures on Fahrenheit (F) scale can be converted to Celsius (C) using the simple equation of the form. C =5/9(F-32) (Ayoade, 2004, p.29).

Climate refers to the characteristics condition of the atmosphere deduced from repeated observation over a long period. It includes considerations of departures from average (i.e. variability's), extreme conditions and the probabilities of occurrences of a given weather condition (Ayoade, 2013).

Rainfall is an important aspect in both climatic and geomorphologic studies. Amount of rainfall in a given region is influenced by many factors; among them are relief, wind and direction (relative to coastal orientation) and distance from the ocean. For instance, where humid air masses moving across a region are forced to rise over highlands/plateau, it tend to bring about instability resulting in heavy rainfall (Ayoade, 2013). The geographical local of Nigeria, its topographical variations and latitudinal extent dictate the behaviour of the climatic types and its characteristics in the region.

Rainfall in Nigeria is the most variable climatic element both in its spatial and temporal distribution as areal-precipitations which is the average depth of precipitation over a specific area calculated on timescales on a storm, seasonal, or annual basis vary from place to place in the country.

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David (2010) observed in southern Nigeria that at the onset and end of rainy season, the rains are in the form of heavy showers of short duration, staring with maximum intensity of up to 75mm/hour and more, declining the intensity after about 30 minutes when the sun gives way to a steady downpour with a lower intensity of about 12.5mm/hour and less. The amount of rainfall has also been show to be at variance with intensity. For instance, David (2010) found that rainfall intensity is not associated with amount or number of raindrop size. The intensity and time period of the rainfall event determine the amount of rainfall in an area at a time and the average amount of rainfall in an area over years, sum up to the mean annual rainfall of the area. Also with the spread of rainfall characteristics, the productivity of the area may be determined. The nature of rainfall over northern Nigeria is highly variable and the variability includes rainfall amount, time and duration, intensities and spatial coverage.

According to the Nigeria Meteorological Agency (NIMET, 2012), Nigeria's climate is characterized by strong latitudinal zone with which becomes progressively drier as one moves northwards from the coast. Rainfall is the key climatic variable and there is a marked difference between the wet and dry seasons in most areas. Rainfall characteristics in Nigeria have been examined for dominant trend notably by (IPCC, 2014).

II. Materials and Methods

a) Types and Sources of Data

The types of data required and used were mostly secondary data. The annual rainfall and temperature data of Lafia station for the period of 2001 to 2015 covering a 15 years period. The data was obtained from Nigeria Meteorological Agency (NIMET, 2015) in Lafia. The data on crop yield were data collected from documented crop output by the Nasarawa Agricultural development Project (NADP) Lafia for the period of 2001 to 2015.

b) Method of Data Analysis

The study employed the annual rainfall variability and annual temperature patterns and annual yam yield were analyzed using Pearson correlation, linear regression, ANOVA, and coefficients Beta for the period of 15 years (2001-2015).

III. Results and Discussion

a) Mean Rainfall, Average Minimum And Maximum Temperature Trend In Nasarawa State

Table 1: Annual rainfall data, average minimum and maximum temperature data (2001-2015)

S/No.	Average Min. Temperature	Average Max. Temperature	Mean Rainfall (Mm)	Years	Total Rainfall (Mm)
1.	21.96	33.97	117.86	2001	1414.1
2.	22.16	34.34	99.39	2002	1192.7
3.	22.52	34.3	117.23	2003	1406.8
4.	22.24	33.93	108.75	2004	1305
5.	22.83	34.27	107.55	2005	1290.7
6.	23.03	34.58	109.99	2006	1319.9
7.	21.05	34.76	132.97	2007	1595.7
8.	20.93	35.06	94.83	2008	1138
9.	23.13	34.84	132.97	2009	1595.7
10.	24.09	34.67	110.16	2010	1322
11.	22.58	34.03	104.46	2011	1253.6
12.	22.58	33.63	110.39	2012	1324.7
13.	23.06	33.61	104.91	2013	1259
14.	22.73	37.13	111.00	2014	1332
15.	23.88	33.71	105.08	2015	1261

Culled: Nigerian Meteorological Agency, Lafia (NIMET, 2001-2015)

Table 1 give the detailed account of the rainfall variability trend in Nasarawa State. The annual rainfall amount portrays an increasing trend at the first year and a decreasing trend in the second year. There was an increase in annual rainfall from 2000 to 2010 followed by a slight decrease in 2002 of 1192.7mm. An increase in the amount of annual rainfall in Nasarawa state was then recorded in 2003. Then a decrease is recorded between 2004 and 2005 respectively. The amount of rainfall increase again in year 2006 and 2007 from 1319.9mm to 1595.7mm respectively. In the second decade, the amount of rainfall increase again in year 2009 while a fall occurred in 2010. The annual rainfall experience increase as from 2014-2015.

It is obvious from the graph, that rainfall indeed experienced a number of variations over the period under consideration (2001-2015) with the highest rainfall (1595.7mm) occurring in 2009. This means that even though rainfall seems to be increasing over the period, the trend of increase is generally, gradual. This gives an indication of an increase in rainfall in the stud area. The implication of the inter-annual rainfall analysis shows that the increase in rainfall in the district has the potential to affect crops which do not need abundant rainfall.

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The general increase in annual rainfall may be due to the fact that, some years recorded very high rainfall which might have generally influenced the overall trend. For instance, from the graph the annual rainfall recorded in the area showed the following figure; 2003 (1406.8mm), 2007 (1595.7mm), 2009 (1595.7mm). This means that even though annual rainfall increase over the period, the rate of increase was gradual. The high recordings of rainfall in some periods of the years may be detrimental to crop production especially those which do not need excessive rainfall. It is also important to note that the high amount of rainfall in the area as observe by the study is related to temperature which invariably increase evapo transpiration rates.

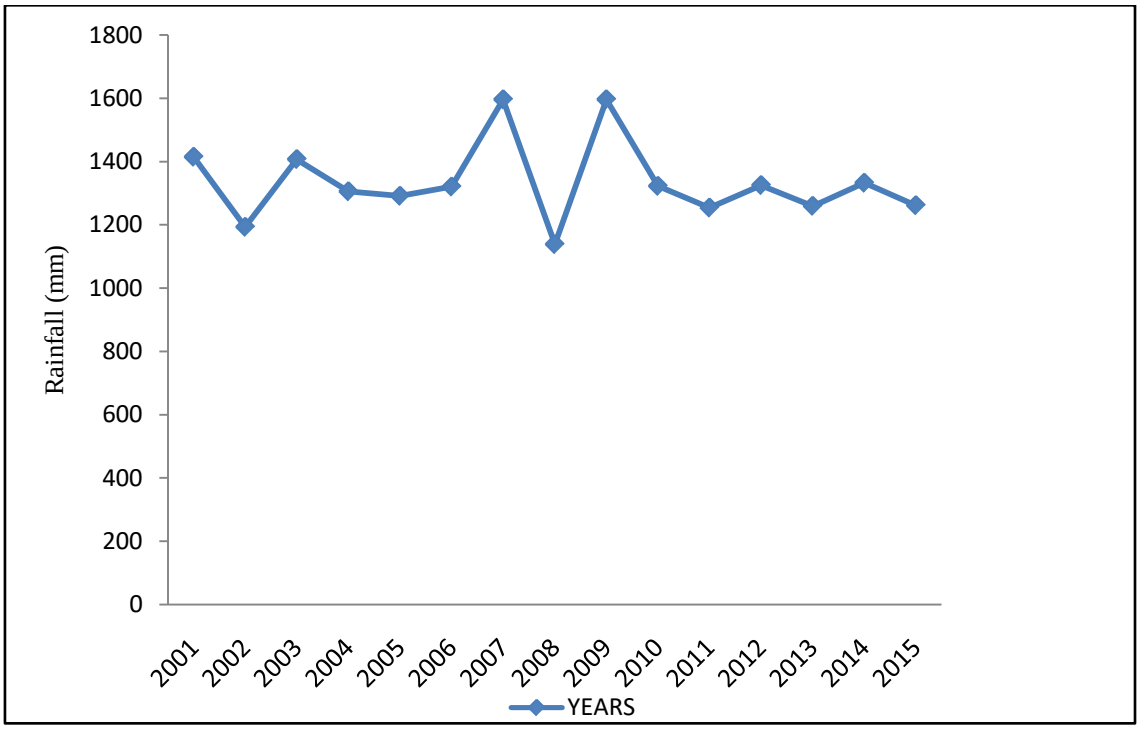


Figure 1: Annual rainfall trend in Nasarawa State

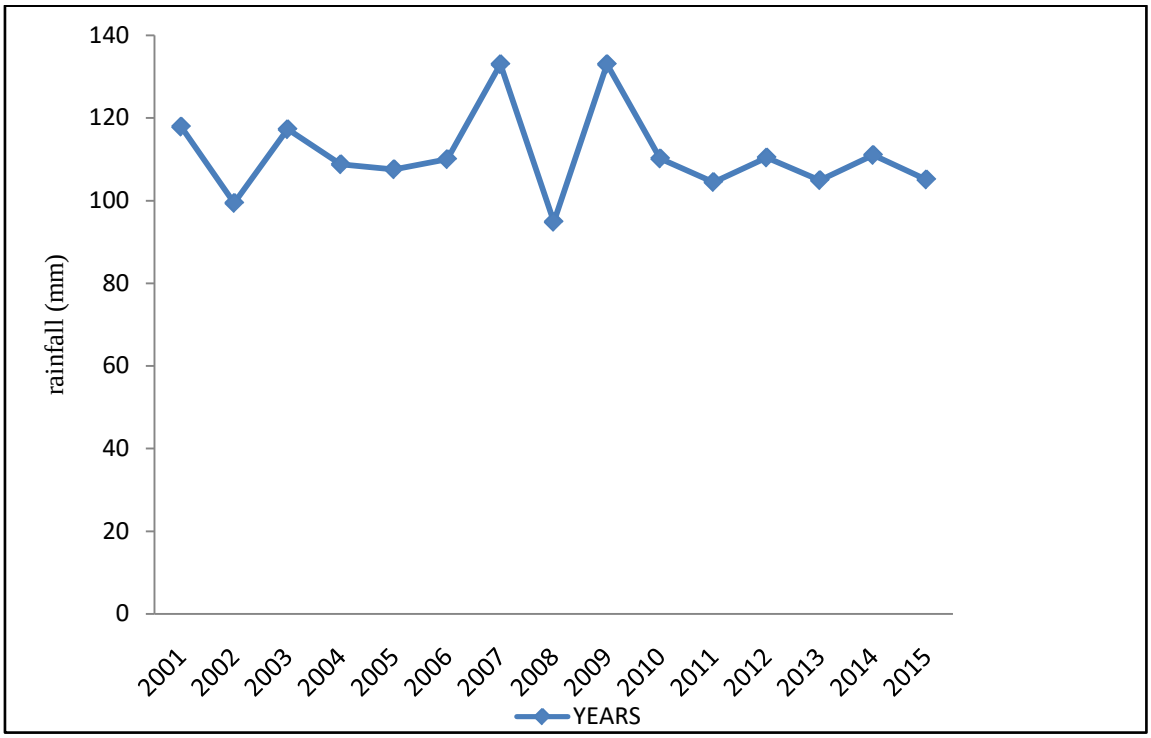


Figure 2: Mean rainfall of Nasarawa State (2001-2015)

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b) Trend in Yam Yield (Mt/Ha) in Nasarawa State

Figure 1 shows the yam yield (Mt/Ha) trend in the state. The yam yield shows increasing trend in production over the periods under consideration from (2001-2015). From the result, the yearly yam yield shows an increase yield in 2010 and 2009, 21.69 and 21.56 respectively a slight drop of yield was recorded in the year 2002 of 14.52 (Mt/Ha). There was an increase in annual yam yield again in 2012 of 2015 (Mt/Ha) follow by a decrease in 2013. An increase in the quantity of yam yield was recorded in 2008, 2009, and 2010 respectively; there was a drop in yield of yam in 2011. Increase was recorded in the annual yam yield in Nasarawa state in 2012 of 20.46 (Mt/Ha). In the second decade, the amount of yam yield increase in 2012, then a steady yield of 19.46-19.51 which increase 2014 to 2015 with a slight variation between them.

It is clear from the yam yield of Nasarawa state over the period (2001-2015), there was a steady increase, with 21.69 being the highest recorded trend of the annual yam yield, also shows a steady increase from 2007 (18.31), 2008 (20.21), 2009 (21.56) and 2010 (21.69). This means that the annual yam yield in Nasarawa state is gradual over the years in view.

It may also mean that the high and favourable rainfall recorded, might be a reason for the increase of the yam yield in the study area.

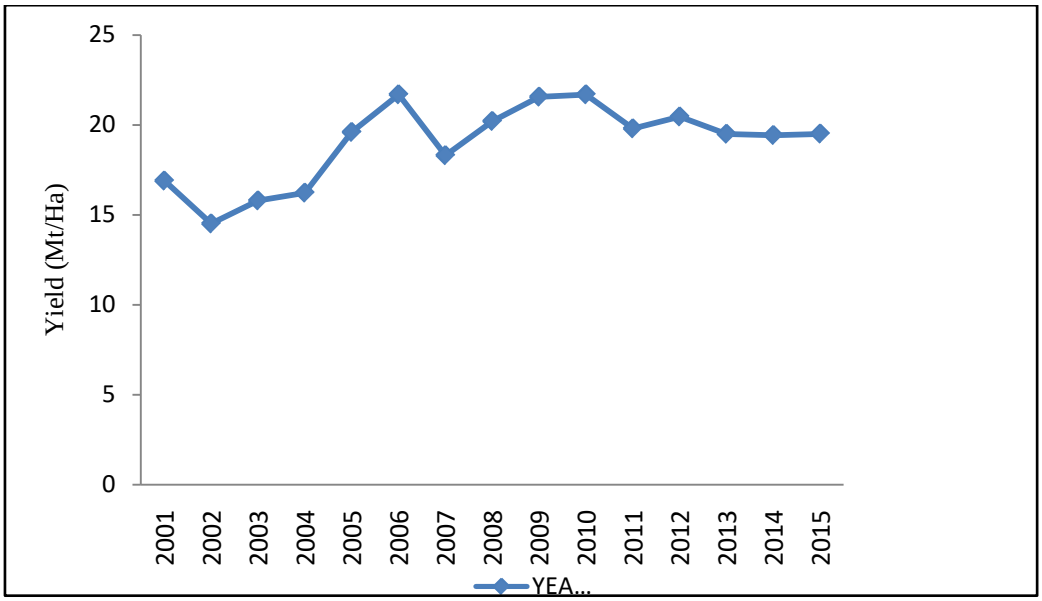


Figure 3: Yam Yield Mt/Ha

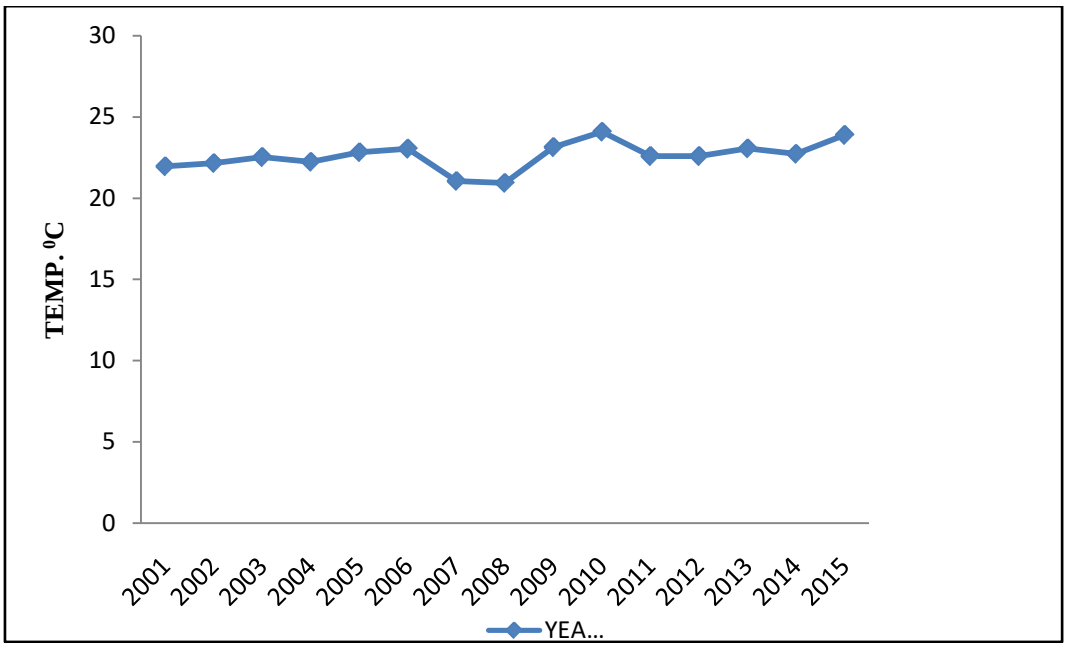


Figure 4: Annual Minimum Temperature

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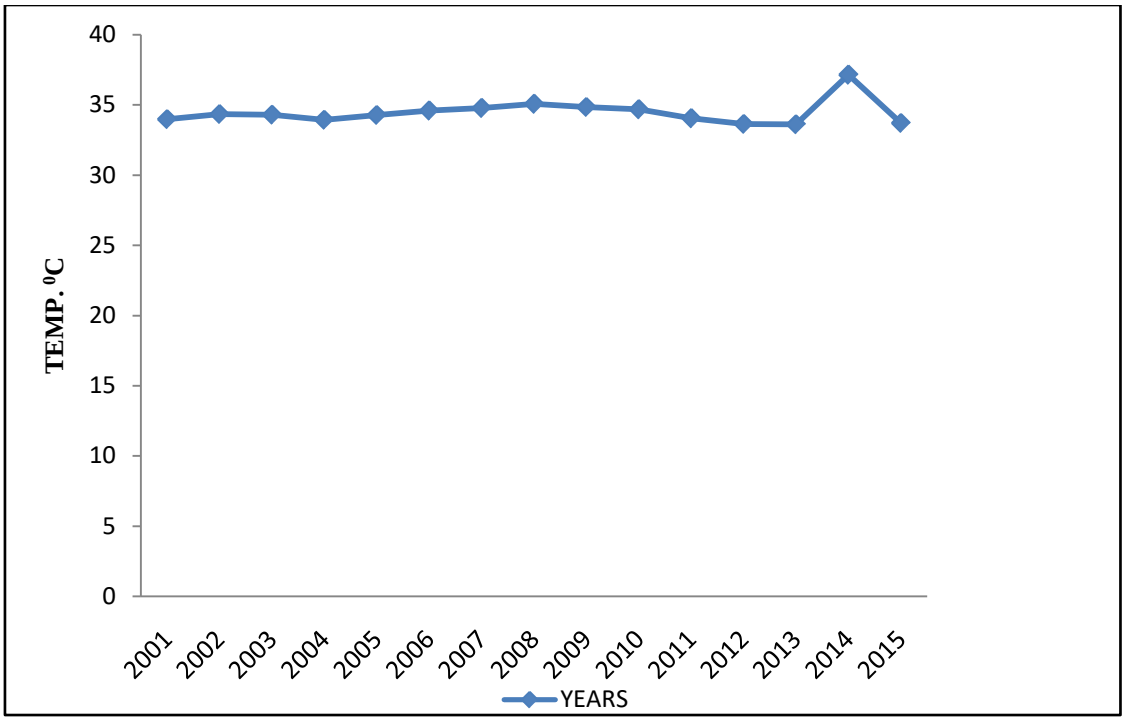


Figure 5: Annual Maximum Temperature

Table 2: Rainfall and Yam Yields

S/N	Year	Annual Rainfall	Yield (Mt/Ha)
1.	2001	1414.1	16.90
2.	2002	1192.7	14.52
3.	2003	1406.8	15.80
4.	2004	1305	16.23
5.	2005	1290.7	19.60
6.	2006	1319.9	21.69
7.	2007	1595.7	18.31
8.	2008	1138	20.21
9.	2009	1595.7	21.56
10.	2010	1322	21.69
11.	2011	1253.6	19.80
12.	2012	1324.7	20.46
13.	2013	1259	19.50
14.	2014	1332	19.43
15.	2015	1261	19.51
			Total = 285.21

Culled: NIMET (2001-2015), 2018

Table 3: Yam Yield, Production and Land Area (2001-2015)

S/N	Area (000ha)	Years	Yield (Mt/Ha)	Production (000mt)
16.	79.48	2001	16.90	1343.21
17.	62.00	2002	14.52	900.00
18.	61.75	2003	15.80	975.66
19.	67.79	2004	16.23	1235.74
20.	68.67	2005	19.60	1315.64
21.	76.49	2006	21.69	1657.23
22.	96.85	2007	18.31	1773.39
23.	79.77	2008	20.21	1612.15
24.	95.41	2009	21.56	2057.11
25.	118.46	2010	21.69	2568.99

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26.	203.96	2011	19.80	4039.06
27.	205.40	2012	20.46	4203.66
28.	219.70	2013	19.50	4283.98
29.	225.00	2014	19.43	4370.60
30.	223.70	2015	19.51	4365.20

Table 4: Data presentation of annual rainfall, maximum temperature, minimum temperature and yam yield

Year	Rainfall (mm)	Max. Temperature (°C)	Min. Temperature (°C)	Yam Yield (Mt/Ha)
2001	1414.1	407.7	263.5	16.90
2002	1192.7	412.1	265.9	14.52
2003	1406.8	411.6	270.2	15.80
2004	1305	407.1	266.9	16.23
2005	1290.7	411.2	273.9	19.60
2006	1319.9	414.9	276.3	21.69
2007	1595.7	417.1	252.6	1.31
2008	1138	420.7	251.1	20.21
2009	1595.7	417.1	252.6	18.31
2010	1322	416	289.1	21.69
2011	1253.6	408.3	270.9	19.80
2012	1324.7	403.5	270.9	20.46
2013	1259	403.5	276.7	19.50
2014	1332	445.6	272.7	19.43
2015	1261	404.5	286.6	19.51

Nigerian Meteorological Agency, Lafia (NIMET, 2001-2015)

Pearson Correlations Table 1

Table 5: Correlations

		Yam yield	Rainfall	Max temperature	Min temperature
Yam yield	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	15			
Rainfall	Pearson Correlation	.079	1		
	Sig. (2-tailed)	.779			
	N	15	15		
Max temperature	Pearson Correlation	.168	.131	1	
	Sig. (2-tailed)	.551	.642		
	N	15	15	15	
Min temperature	Pearson Correlation	.413	-.053	-.129	1
	Sig. (2-tailed)	.126	.851	.646	
	N	15	15	15	15

Note: 0, weak; 1, perfect; -, negative; + positive correlation

IV. Correlation Analysis

Table 4.5 shows a weak positive correlation between rainfall and yam yield in Nasarawa state, to examine these two variables, the Pearson correlation analysis was used. The result of the correlation was established to be 0.079 which connote a weak positive relationship between rainfall and yam yield in Nasarawa state this accounts for 10% to 20% of relationship between rainfall and yam yield, while that of maximum temperature was established to be 0.168 which connote a weak positive relationship between maximum temperature and yam yield but it's a bit higher than that of rainfall, this means that rainfall does not have a direct effect on yam yield but it could be considered with other factors as soil type, seed, soil pH etc, that of minimum temperature was established to be 0.413, which connote a weak positive relationship, but in this case the value is higher than that of both rainfall and maximum temperature. This is to say yam yield require little rainfall and minimum temperature to produce a bountiful harvest, or it could also require a high amount of rainfall

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and a high or maximum temperature in order to be balanced and produce high yield of crops (yam). Note that too much rainfall and minimum temperature can cause the decay of yams as well as seeds on the farm.

a) Test of Hypothesis

We reject the Null hypothesis and accept the alternative hypothesis from the above it was found that there was a weak positive relationship between rainfall, temperature and yam yield in Nasarawa state. Hence, the Null hypothesis was rejected and the alternative hypothesis accepted.

H_0: Null hypothesis rejected

H_1: Alternative hypothesis accepted

b) Effect of Rainfall and Temperature on Yam Yield in Nasarawa State

To assess the effect of some of the climatic variables (rainfall and temperature) on crops (yam yield) linear regression analysis was used to investigate the ability of the two climatic variables (rainfall and temperature) to predict yam yield.

Table 6: Coefficients

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-27.411	30.049		-.912	.381
Rainfall	.001	.005	.075	.279	.785
Max temperature	.046	.057	.215	.799	.441
Min temperature	.095	.057	.445	.662	.125

Table 6 show the effects of rainfall and temperature variations on yam yields in Nasarawa state for the period of 2001 to 2015. The table revealed that rainfall variation has a weak positive effect of (0.075) on yam production within the period investigate.

The major variable responsible for huge variation in yam yield was minimum temperature, it had a highly positive significant relationship in the production of yam in the study area between 2001 and 2015. Table 6.6 shows the standardized coefficients Beta of 0.445 for minimum temperature as the highly weak positive significant relationship with a t' value of 1.662 which is approximately 2.062.

Coefficients: that of the coefficients, the standardized coefficient beta for mini temperature is o.445, while the t= 1.662 which is approximately 2.062 so as you can see it's a good one and it is very high. This means there is high production of yam (crops) with minimum temperature and rainfall.

c) Relationship between Rainfall and Yam Yield in Nasarawa State

The relationship between rainfall and yam yield in Nasarawa state were examined using correlation analysis shown in table 4.5 and 4.6 the result of the analysis revealed that rainfall has the weakest positive significant relationship with yam yield in the study area. The implication of this is that the higher the rainfall and temperature, the higher the yield of yam. The possible reason for the fairly correlation between rainfall and yam production may also be attributed to nature of soil, fertility rate some times.

d) Yam Yield

Figure 3 shows the yield over the period (2001-2015) of Lafia, Nasarawa state with a steady increase, and 21.69 being the highest recorded of the trend annually which shows an increase in the yam yield in the study area; it also portrays a combination of factors favourable, which may have positive effect on yam yield example (temperature, soil, fertility, soil, porosity level and moisture content amongst others) this means that these factors at equal and favourable condition have a positive effect on yam yield, in the state. Therefore this support the study of Kalibbala (2011) who asserts that favourable climatic and nutrient value have a positive effect on yam yield. However we observed a decrease in yam yield in the wake of high soil temperature and pH of the soil.

V. Conclusion

The study has established that, there is slight variability in rainfall which translates into variability in some year as indicated by the rainfall data in Lafia, Nasarawa state. Data were collected for a period of 15 years from the Nigeria Meteorological Agency (NIMET) and Nasarawa Agricultural Development Program (NADP), Lafia. The data also shows a steady increase in yam yield in the study area with an $R^2 = 0.226$ variance within the years under review (2001-2015). The results from the study showed a weak positive significant effect in rainfall with unreliable rainfall distribution over the investigated period (2001-2015). The study identified poor yield as a major negative effect of rainfall variability on yam yield, though a weak significant amount. The

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effect of rainfall on yam yield may also vary depending on types of yam species and seasonal properties and length of days in which the crop is permitted.

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Experimental Study on Effect of Plastic Waste as Coarse Aggregate on Concrete Properties

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Abstract- High demand for aggregate to meet day-to-day activities in construction industry has intensified mining of the natural aggregate resources, thereby resulting in depletion of the resources and which raised concerns on compromise of the future generation needs. Over time, the cost of construction kept increasing due to high cost of aggregates. Serious environmental concerns have been raised on the ineffective management of the plastic waste generated globally and which has caused environmental, ecological and economic sabotage. Interest in the environmentally friendly recycling of plastic waste as materials for concrete is being considered. This study investigates the performance of concrete with addition of plastic Poly ethylene terephthalate (PET) aggregate. The plastic PET aggregate was used as substitution for coarse aggregate at 10%, 20% and 30% replacement levels. Effects of the presence of plastic PET aggregate in concrete on workability, density, compressive strength, flexural strength and water absorption were determined.

Keywords: *alternative materials; compressive strength; environmental impact; coarse aggregate; flexural strength; and plastic pet aggregate.*

GJSFR-H Classification: *FOR Code: 700401*



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Experimental Study on Effect of Plastic Waste as Coarse Aggregate on Concrete Properties

Babatunde Olawale Yusuf [α], Adebayo, Halir Shola [σ] & Shuaib, Qudus Ajidagba [ρ]

Abstract- High demand for aggregate to meet day-to-day activities in construction industry has intensified mining of the natural aggregate resources, thereby resulting in depletion of the resources and which raised concerns on compromise of the future generation needs. Over time, the cost of construction kept increasing due to high cost of aggregates. Serious environmental concerns have been raised on the ineffective management of the plastic waste generated globally and which has caused environmental, ecological and economic sabotage. Interest in the environmentally friendly recycling of plastic waste as materials for concrete is being considered. This study investigates the performance of concrete with addition of plastic Poly ethylene terephthalate (PET) aggregate. The plastic PET aggregate was used as substitution for coarse aggregate at 10%, 20% and 30% replacement levels. Effects of the presence of plastic PET aggregate in concrete on workability, density, compressive strength, flexural strength and water absorption were determined. The results showed that the workability increases as the proportion of PET plastic waste increases in the concrete matrix. In comparison with the control concrete, the compressive and flexural strength of concrete reduces as the content of plastic PET aggregate increases. Compressive and flexural strength reduction trends of 25%, 47% and 53% and 38%, 43% and 51% for concrete containing 10%, 20% and 30% of plastic PET aggregate respectively. The loss of strength can be attributed to the ineffective bonding between plastic PET aggregate and mortar due to the smooth surface of the plastic PET aggregate. Also, plastic PET aggregate has relatively no water absorption and which makes excess water in the concrete. Upon hydration, the excess water gets evaporated and which creates voids in the concrete and weak region around the aggregates in the concrete. However, improvement in water absorption capacity were observed. As the content of plastic PET aggregate increases, the water absorption capacity reduces. However, significant reduction in strength properties was obtained for concrete with 20% and 30% of PET plastic waste. Meanwhile, the water absorption capacity of the concrete composite gets higher as the proportion of the PET plastic waste increases. From the study, it can be said that sand can be substituted with PET plastic waste up to 10% replacement levels in concrete matrix.

Keywords: alternative materials; compressive strength; environmental impact; coarse aggregate; flexural strength; and plastic pet aggregate.

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I. Introduction

There has been yearly rapid growth in the demand for construction materials, largely due to rise in population, urbanization and industrialization. Concrete is one of the major construction materials, and aggregates represents about 65 – 85 % by volume in concrete composite (Bahij et al., 2020). Currently, the yearly demand for concrete is estimated to be about 10 billion tons, and which has been projected to increase to 18 billion tons by the year 2050(Asadi et al., 2018). The high rate of usage of aggregates for day-to-day activities in construction has raised concern on the depletion and overexploitation of the natural resources, thereby, hindering the future needs of this resources by future generations. It becomes imperative to seek for alternative materials that could match up with the engineering properties of the conventional aggregates for structural and non-structural purposes.

Ecosystem and ecological systemsare becoming unsafe from generated plastic waste. Continuous increase in plastic usage and plastic waste generation growth have posed serious environmental concerns. In the year 2012, about 280 million tons of plastic waste was generated globally, and it rose to 335 million tons in the year 2016. It has been estimated to be around 1 billion tons by the year 2050 (Bahij et al., 2020).However, the global management of the large chunk of plastic generated is still low, as 22 % was recycled, 27 % incinerated and the majority ended up in landfills and dumpsites(Li et al., 2020). In Nigeria, about 32 million tons of plastic waste is generated annually, below 12% is recycled and about 80%finds their way to landfills and dumpsites (Kehinde et al. 2020). It has been reported that over 10 million tons of plastic waste ended up in ocean annually, and which contributed to the death of 100,000 marine animals and 1 million sea birds (Faraj et al., 2020). It has been forecasted that oceans will have more plastics than fishes by 2050 (Kehinde et al. 2020). It becomes necessary to improve the management of plastic waste generated. One of the effective ways is the recycling of plastic waste as aggregate for construction purposes. Being a new material, there is need to investigate the performance of concrete produced with plastic waste as aggregate. There are different types of plastics, but plastic Polyethylene Terephthalate (PET) is one of the larger percentages of plastic waste as it is commonly used

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daily by human. Efforts are geared towards the adoption of plastic waste as alternative materials in construction industry. Hence, the study focused on recycling plastic PET as partial replacement for fine aggregate in concrete matrix.

Boucedra et al. (2020) conducted an experimental study on concrete containing plastic wastes as aggregate. The plastic waste was substituted for fine aggregate at 25%, 50% and 75% replacement levels. Their findings showed reduction in density of concrete as the contents of plastic waste aggregate in the concrete increases. Nevertheless, replacement levels of up to 50% gave density that falls within the range of lightweight concrete. Similarly, behaviour of concrete with addition of plastic waste aggregate at 25%, 50% and 75% replacement levels were studied by Belmokaddem et al. (2020). Their study results indicated that the content of plastic aggregate is inversely proportional to the density of concrete. The higher the contents of plastic aggregate, the lower the density of concrete. Almeshal et al. (2020) incorporated plastic waste aggregate in concrete matrix in dosage of 10%, 20%, 30%, 40% and 50% replacement of fine aggregate. Results revealed slight reduction in compressive strength for 10% and 20% incorporation of plastic waste aggregate, compare to control mix. Beyond that, the reduction in strength became significant. Over 30% reduction in compressive strength when 40% plastic waste aggregate was incorporated in concrete mix. The decreasing trend was attributed to the reduction in composite bulk density. Effect of 5, 10 and 20% of plastic waste aggregate in concrete matrix was experimentally studied. The plastic aggregate was added as replacement for sand. Compare to the control concrete, it was observed that the compressive strength reduces by 7, 12 and 24% for concrete containing 5, 10 and 20% plastic aggregate respectively. The reduction trend was explained to be as a result of lower compressive strength of plastic aggregate compare to sand (Mustafa et al., 2019). Needhidasan et al. (2020) used plastics from electronic materials (E-plastic) as replacement for conventional coarse aggregate in concrete mix. It was found out that, up to 22% of E-plastic waste can be incorporated into concrete mix with minimal reduction in compressive strength. At 28 days, the target strength of 40MPa was achieved for concrete with 22% E-plastic waste. Experimental investigation of the properties of concrete with PP and LDPE plastic waste. The results revealed that the presence of plastic waste in concrete reduced the flexural strength of concrete mix of all replacement levels. Meanwhile, concrete with PP plastic waste showed better flexural strength performance than LDPE aggregate concrete. This can be explained to be due to the higher tensile strength of PP plastic aggregate over LDPE plastic aggregate. Concrete mix with 5% of PP as replacement for fine aggregates indicated 18% variation to the control concrete. However, concrete with incorporation of 5% and 10% PP plastic waste and 5% LDPE plastic waste gave considerable variation of 18%, 38% and 41% to conventional mix respectively. It was observed that there is decreasing trend of flexural strength as the contents of plastic waste increase and decrease in fine aggregate contents (v Visweswara Sastry Dhara&kumar, 2018).

II. Materials and Methods

All materials used for the study are sourced locally. The materials comprise of cement, fine aggregate (sand), coarse aggregate, plastic waste PET and water. The cement used for producing the concrete samples was Ordinary Portland Cement (O.P.C). Dangote cement brands of 42.3R grade and which conform to NIS 444-1:2003 based on the NIS trademark on the bag was procured. The cement was purchased from a retail shop at Oke-odo, Tanke, Ilorin. River sandwas used as fine aggregates and which can be regarded as sharp sand based on visual examination. Crushed aggregate or granite was used as coarse aggregate. Both fine and coarse aggregates were sourced from a construction site in the University. Precautions were taken that the aggregates did not have impurities such as grass, waste materials among others. Both fine and coarse aggregates conform to BS 822.Plastic waste of Polyethylene Terephthalate (PET) bottles was bought in packs from a local vendor at Tanke, Ilorin. After procurement, all materials were transported to the laboratory for further test before use in concrete. The water that conforms to WHO standards was sourced from the laboratory.

a) Preparation of Plastic Waste PET as Coarse Aggregate

The preparation of the PET coarse aggregates follows several steps. Firstly, the PET bottles were fragmented into small pieces or flakes, then it was washed thoroughly with detergent and water to remove any impurities. The PET bottles flakes were poured in a pan and heated at a temperature of 15°c/min up to 250°c using cooking gas. The PET flakes were continuously stirred to ensure uniform melting of the plastics. Then, it was transferred to the moulds and allowed to cool and solidify into a boulder form. The plastic waste PET in its boulder form was crushed to obtain desired plastic waste PET coarse aggregate with maximum size of 25 mm. The acquired plastic waste PET coarse aggregates were round in shape and had smooth surface texture. The physical properties of the materials such as particle size distribution, specific gravity and aggregate impact value were carried out in accordance with BS EN 933-1, 2012; BS EN 1097-2, 2020; BS EN 1097-3, 1998respectively.

b) Mix proportion

Conventional mix ratio of 1:2:4 (cement: fine aggregate: coarse aggregate) was employed for the

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proportions of constituent materials for the control concrete with a target strength of 20N/mm^2 at 28 days. The water-cement ratio was fixed at 0.5 for all the concrete mixes. The plastic PET aggregate was incorporated as substitute to the natural coarse aggregate at 10%, 20% and 30% levels. Table 1 shows the mix design of the relative proportion of each of the constituent materials in concrete production.

c) Test specimens

The batching method of the constituent materials employed was by weight. For the concrete workability, slump test was carried out on the fresh concrete in accordance to BS EN 12350-2: 2019. The total number of thirty-six (36) cubes of 150 mm x 150 mm and thirty-six (36) beams of 100 mm x 100 mm x 500 mm were casted. Nine (9) cubes and nine (9)beams were used for control (that is concrete of 0% of PET) while the remaining twenty-seven (27) cubes and (27) beams contain plastic PET aggregates at 10%, 20% and 30% respectively. The cubes and beams were cured in water for 7, 14 and 28 days. At the end of each curing ages, specimens were removed from the curing tank and surface dried. The bulk density, compressive strength and Flexural strength of concrete containing plastic PET aggregates and that of control (0% of PET) was determined. Universal Testing Machine (UTM) was employed for the compressive and flexural tests on the concrete specimens in compliance to BS EN 12390-3: 2019 and BS EN 12390-5: 2019. Concrete cubes were oven dried for 72 hours at 110°c. It was removed and allowed to cool for a day. Afterwards, the cubes were weighed and recorded. Then, it was immersed in water for 30 hours. The weight was measured and recorded after expiration of 30 hours. The water absorption was determined in accordance to BS 1881-122: 2011.

Table 1: Mix Proportion of Cement, Fine and Coarse aggregate and PET for Cubes

% Mix of PET	Cement (kg/m^3)	Fine Aggregate (Sand) (kg/m^3)	Coarse Aggregate (kg/m^3)	Plastic PET Aggregate (kg/m^3)	Water-cement ratio
0%	359.84	719.67	1439.01	0.00	0.50
10%	359.84	719.67	1295.11	143.90	0.50
20%	359.84	719.67	1151.21	287.80	0.50
30%	359.84	719.67	1007.31	431.70	0.50

III. Results and Discussion

Figure 1 and 2depicts the particle size distribution for fine and plastic PET aggregates respectively. The fine aggregate used for this experimental study was uniformly graded soil because the coefficient of uniformity, C_U is 3.33 and which is less than 6 as specified by BS 812-103-1. Also, the Plastic PET aggregate used for this research work was uniformly graded aggregate because the coefficient of uniformity, C_U is 3.15, and which is less than 4as specified by BS 812-103-1.As shown in Table 2, the physical properties of plastic PET aggregate indicates that it is a lightweight material. Plastic PET aggregate has lower specific gravity, aggregate impact value, aggregate crushing value and coefficient of gradation compared to natural coarse aggregate. Also, zero water absorption was obtained for plastic PET aggregate.

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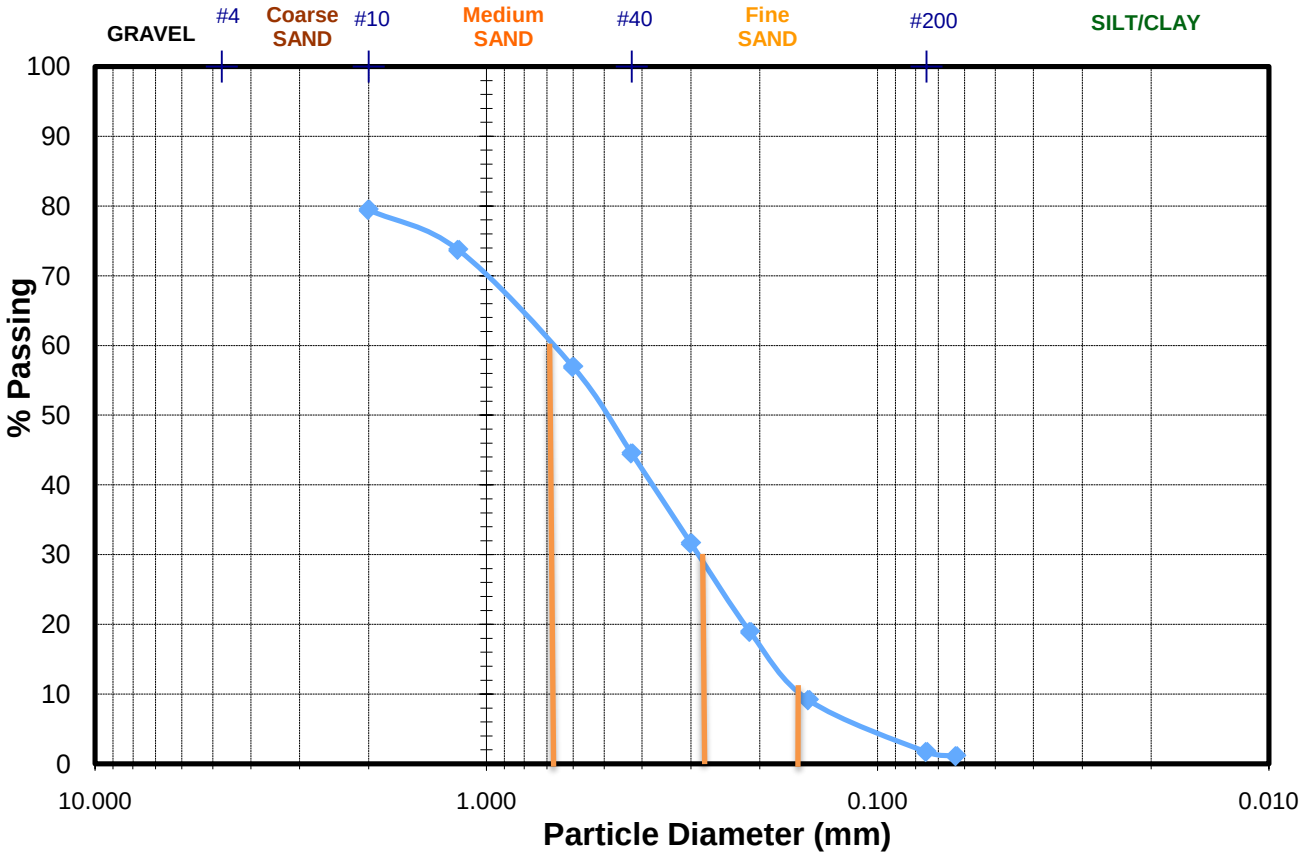


Figure 1: Sieve Analysis curve for Fine Aggregate

Grain Size Distribution Curve Results:

% Gravel:	0.0	D_{10}:	0.18	C_u:	3.33
% Sand:	97.2	D_{30}:	0.42	C_c:	1.63
% Fines:	2.8	D_{60}:	0.6		

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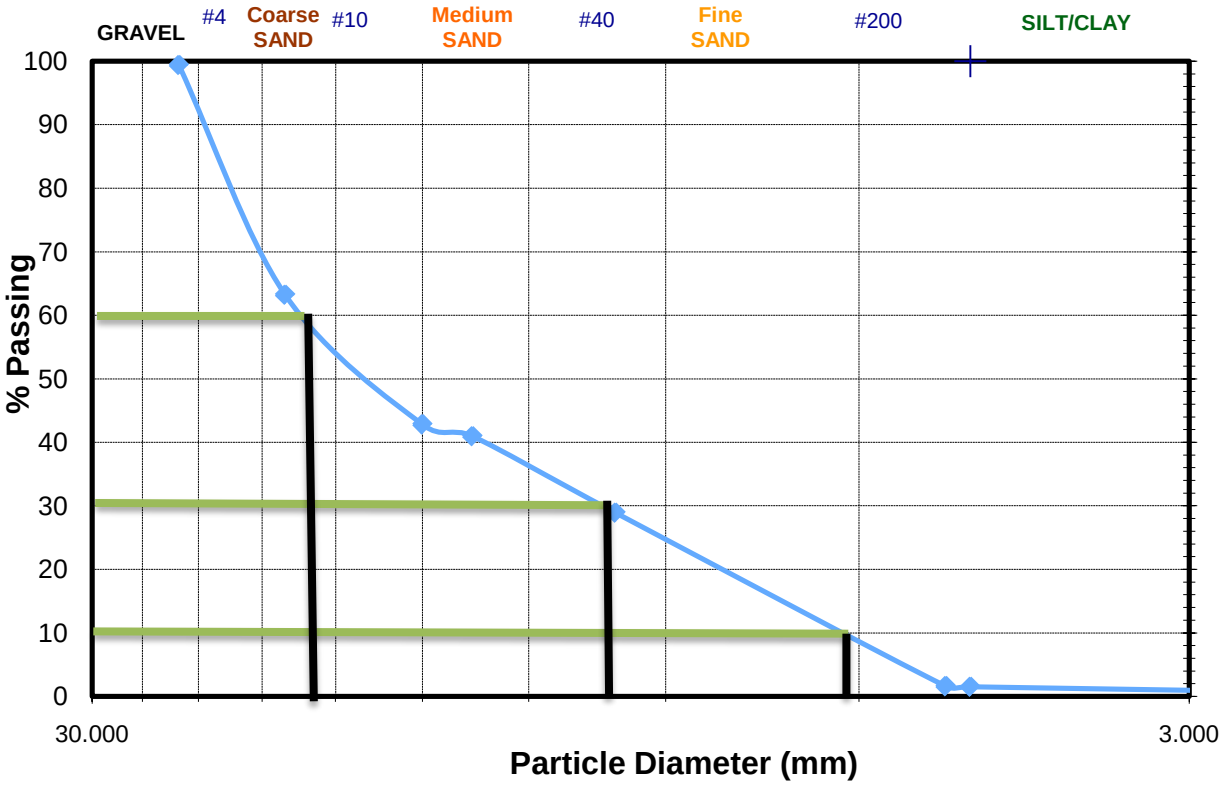


Figure 2: Sieve analysis curve of plastic PET coarse aggregate

Grain Size Distribution Curve Results:

% Gravel:	50.0	D_{10}:	6.20	C_u:	3.15
% Sand:	30	D_{30}:	10.4	C_c:	0.89
% Fines:	20	D_{60}:	19.5		

Table 2: Physical Properties of Constituent Materials

Materials	Specific Gravity	Aggregate Impact Value (%)	Aggregate Crushing Value (%)	Water Absorption (%)	Density (g/cm^3)	Maximum Aggregate Size (mm)	Coefficient of Gradation (Cc)
Coarse Aggregate	2.65	18.5	45.76	0.7	-	25	1.17
Sand	2.43	-		2.2	1.81	4.75	1.63
Plastic PET Aggregate	1.53	5.1	10.08	0	1.02	25	0.89

a) *Effect of plastic waste aggregate on concrete slump value*

The result for the slump test is presented in Figure 3. From the results, the workability of concrete with partial addition of plastic PET aggregate increases as the percentage of plastic PET aggregate increases. This can be explained to be as a result of the hydrophobic property of the plastic PET aggregates because it repels mix water to provide excess water in the concrete. The availability of excess water increases the flowability of the concrete matrix.

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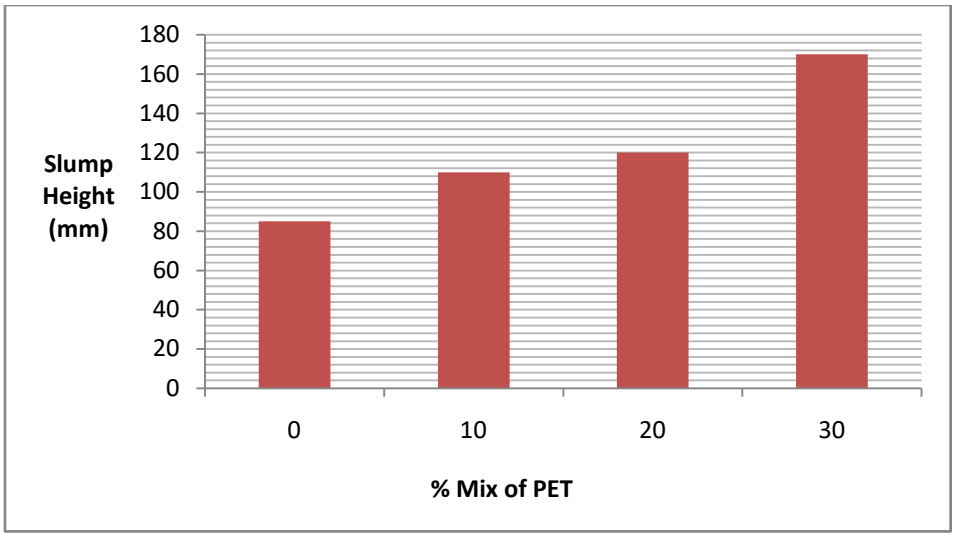


Figure 3: Slump at various percentage content of plastic as fine aggregate

b) Effect of plastic PET aggregate on concrete bulk density

Figure 4 presents the results of bulk density against percentage of plastic PET aggregate. From the results, it can be seen that the bulk density of concrete decreases as the percentage of plastic PET aggregates increases. Concrete with 0% of plastic PET aggregate has the highest bulk density with a value of 2785kg/m^3. When 10% plastic PET aggregate was added to concrete matrix, there was 4% reduction in density and the decrement increased to about 22% when 30% of natural coarse aggregate was substituted with plastic PET aggregate.

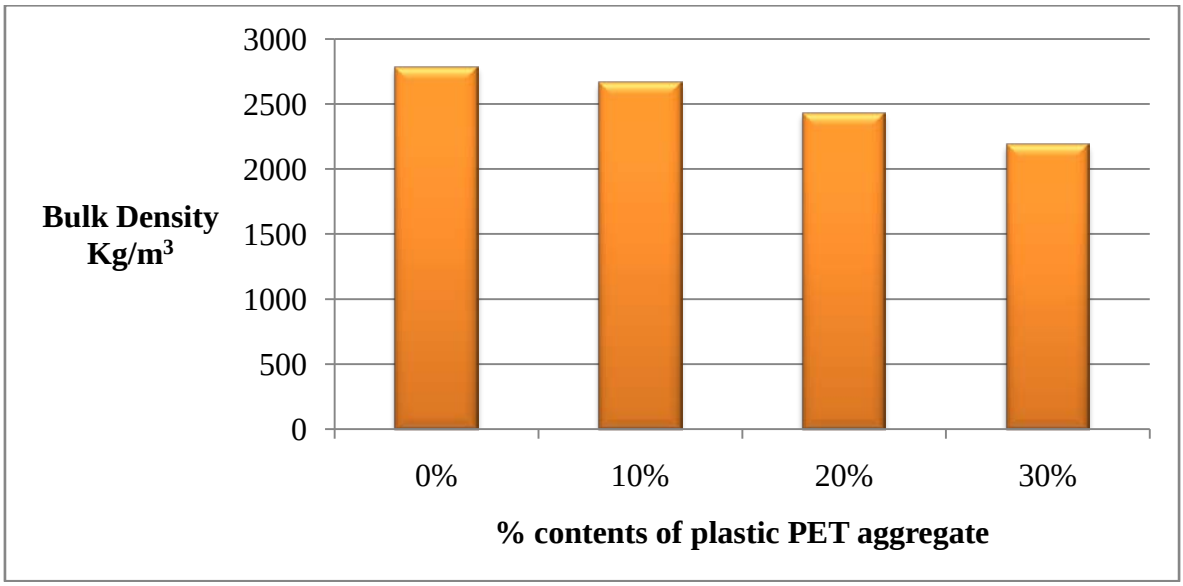


Figure 4: Bulk Density of Plastic PET Aggregate Concrete

c) Effect of plastic PET aggregate on concrete compressive strength

Figure 5 depicts the compressive strength result of the Plastic PET aggregate concrete. The result shows that the concrete strength increases as the curing ages increases and decrease with the incorporation of plastic PET aggregate in concrete matrix. Reduction in compressive strength associated with concrete containing plastic PET aggregate increases as the content of plastic PET aggregate increases. At 28 days, the compressive strength values trends decreased by 25%, 47% and 53% for concrete containing 10%, 20% and 30% of plastic PET aggregate respectively. The decrement of the compressive strength values as the plastic PET aggregates increases is as a result of the deficient bonding of the plastic PET aggregates and the cement paste, due to the smooth surface of the plastic PET aggregate. Also, plastic PET aggregate has low water absorption and which makes excess water in the concrete. After hydration, the excess water gets evaporated and which creates voids in the concrete and weak region around the aggregates in the concrete.

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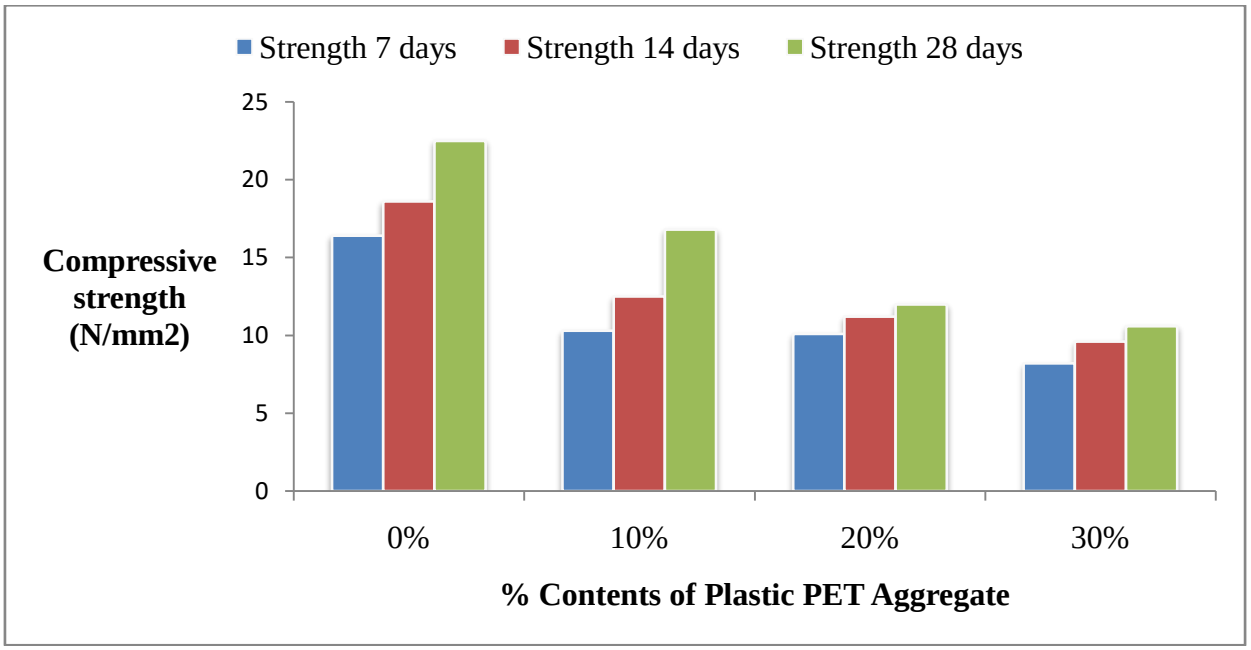


Figure 5: Compressive strength of Plastic PET Aggregate Concrete

d) *Effect of plastic PET aggregate on concrete flexural strength*

Figure 6 presents the result of flexural strength of the Plastic PET aggregate concrete. It can be observed that the flexural strength increases as the curing ages increases. From the results, there was reduction in flexural strength of concrete with plastic PET aggregate compare to the control concrete. The strength trends declined as the percentage of plastic PET aggregate increases in the concrete mixture. In comparison with the control concrete, significant drop in flexural strength of 38%, 43% and 51% were obtained for concrete matrix containing 10%, 20% and 30% plastic PET aggregate respectively. Similar to compressive strength, the reduction in strength can be adjudged to be as a result of ineffective cohesion between the plastic PET aggregate and the cement paste due to the smooth surface of the plastic PET aggregate. Also, excess water in the concrete due to hydrophobic characteristic of plastic PET aggregate, and upon evaporation of the excess water, voids were created. The voids magnified as the content of plastic PET aggregate increase. The decrement of the flexural strength values as the PET aggregate increases is as a result of the weakness property inherent in the PET.

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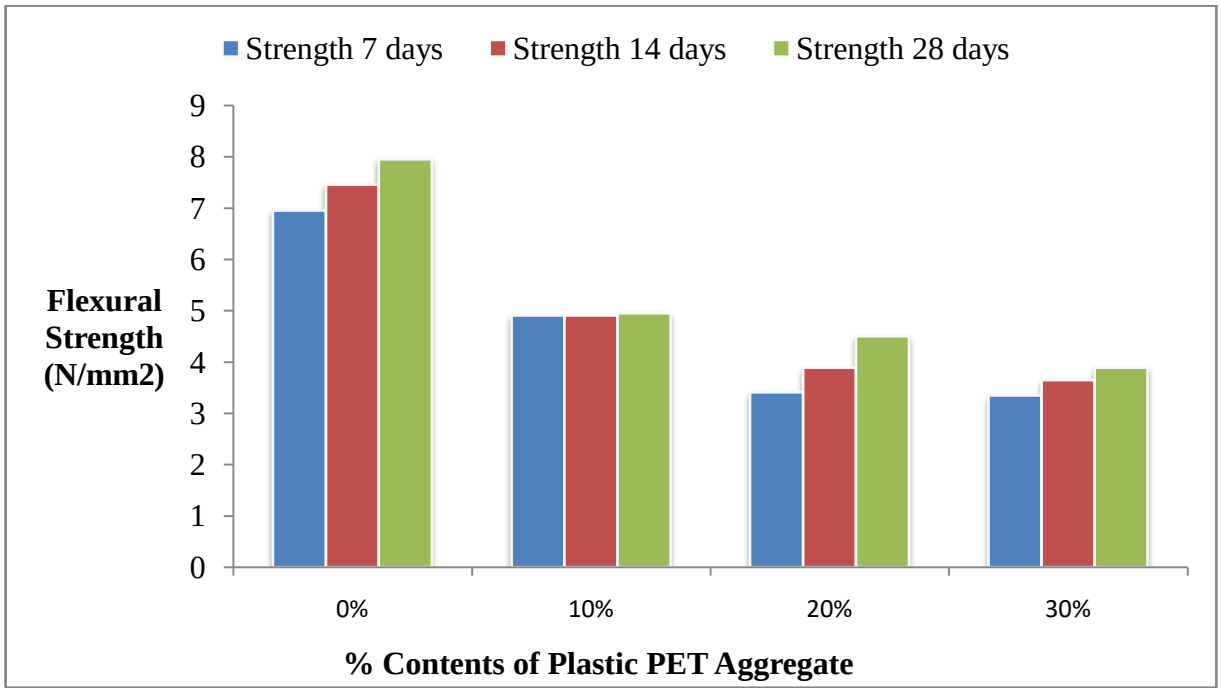


Figure 6: Flexural Strength of Plastic PET Aggregate Concrete

e) Effect of plastic PET aggregate on concrete Water absorption

Water absorption is measure of concrete durability against percolation of water into the concrete and which can result into concrete volume expansion to crack formation and disintegration. The water absorption capacity results of the plastic PET aggregate concrete are shown in Figure 7. As indicated, the water absorption property of concrete decreases with increase in plastic PET aggregate content in concrete mix. The water insulation of concrete appreciates by 44.7%, 57.3% and 85.7% as the percentage content of plastic PET aggregate rose up to 10%, 20% and 30% respectively. This can be attributed to the impermeability of plastic PET aggregate.

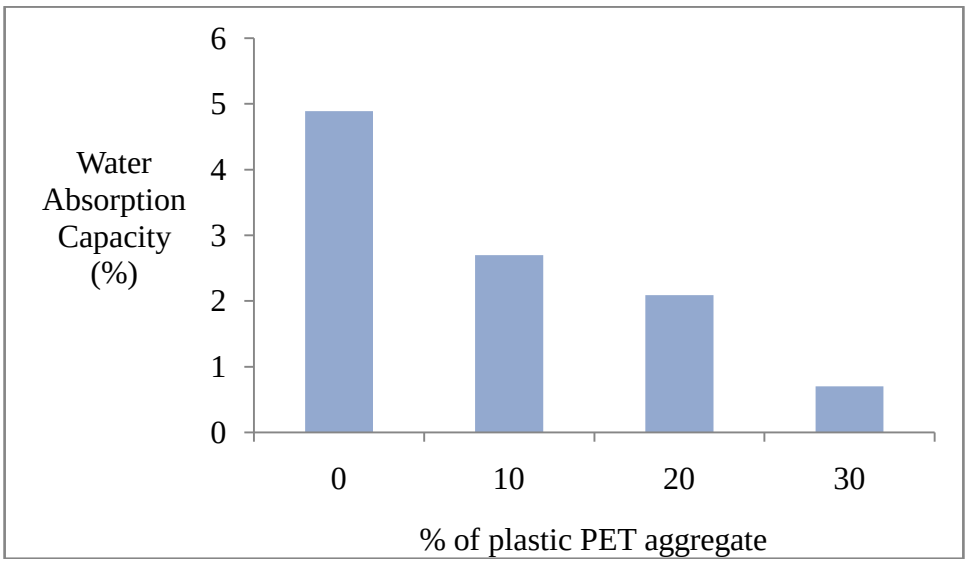


Figure 7: Water Absorption of Plastic PET Aggregate Concrete

IV. Conclusions

The following conclusions were drawn from this study:

i. The PET coarse aggregate is weak and light because its impact and crushing values are 5.10% and 10.08% and which are lower than the values specified by BS 812-112.

ii. As the percentage replacement of coarse aggregate with recycled PET plastic aggregate

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increases, so does the workability. This can be attributed to the smooth surface and low absorption characteristics of Plastic aggregate.

iii. The higher the percentage replacement of the coarse aggregate with recycled PET plastic aggregate, the lesser the compressive and flexural strength. Concrete mix with addition of plastic PET aggregate has lower water absorption property compare to the control concrete, and which is a function of the proportion of the plastic PET aggregate in the matrix.

iv. It is recommended that PET concrete should not be used as reinforced concrete due to the fact that the values gotten at 28days for 10%, 20% and 30% of PET aggregate replacement were lower than the strength recommended by standards. However, it can be used where light weight concrete coupled with water proof or resistance is required.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Relationship between Climatic Variables and Incidence of Malaria and Asthma in Keffi Local Government Area of Nasarawa State, Nigeria

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Abstract- There has been a significant upsurge in global warming phenomenon in the recent times than ever. This resulted from the alteration of global climatic variables i.e., temperature, rainfall, relative humidity e.t.c. This study assess the trends of climatic variables in Keffi from 2003-2018. (Temperature, rainfall and relative humidity). The method was used to source data from mega and reputable institution for the purpose of this research. Where malaria data was sourced from the PHC unit, Keffi Local Government Council. Asthmatic data was retrieved from federal medical center (FMC) Keffi. Whereas, those climatic variables were obtained from the Nigerian Meteorological Agency (NIMET), FCT Abuja. The study finds out the trends and impacts of climatic variables on climatic sensitive diseases. Which are principally in the aspect of an existing relationship and impacts of climatic parameters on malaria/asthma. As explained by U.S Center for Disease Control (CDC). Climate is the key and basic determinant of the distribution of malaria in the world.

Keywords: *relationship, variables, incidence, climatic, asthma, malaria.*

GJSFR-H Classification: *FOR Code: 040105*



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Relationship between Climatic Variables and Incidence of Malaria and Asthma in Keffi Local Government Area of Nasarawa State, Nigeria

Ayuba Hassan [α], Iliyasu M. Anzaku [σ], Anyaku. D. Ovye [ρ] & Nasir Umar [ω]

Abstract- There has been a significant upsurge in global warming phenomenon in the recent times than ever. This resulted from the alteration of global climatic variables i.e., temperature, rainfall, relative humidity e.t.c. This study assess the trends of climatic variables in Keffi from 2003-2018. (Temperature, rainfall and relative humidity). The method was used to source data from mega and reputable institution for the purpose of this research. Where malaria data was sourced from the PHC unit, Keffi Local Government Council. Asthmatic data was retrieved from federal medical center (FMC) Keffi. Whereas, those climatic variables were obtained from the Nigerian Meteorological Agency (NIMET), FCT Abuja. The study finds out the trends and impacts of climatic variables on climatic sensitive diseases. Which are principally in the aspect of an existing relationship and impacts of climatic parameters on malaria/asthma. As explained by U.S Center for Disease Control (CDC). Climate is the key and basic determinant of the distribution of malaria in the world. Explains "climate can influence all three components of the life cycle. It is thus, a key determinant in a geographic distribution and seasonality of malaria (U.S Center for Disease Control 2017). It added that, "even if malaria has been eliminated from an area, if rainfall, humidity and temperature persist, there is danger that the disease can be reintroduced (U.S CDC 2017). The work also reviews that, "climate change are altering patterns of temperature and precipitation, potentially affecting the regions of malaria" (Olson et' al 2009). Findings has also revealed that, logging of trees from massive agricultural practices and timber traders contribute to rising of temperature over the years. Findings analyzed from the retrieved data revealed that, rising temperature, relative humidity and declination in rainfall poses impacts on malaria and asthma in Keffi and the world-over, over the years. Marking a clear relationship between the two. The research wholesomely concluded by reiterating some abative measures to ravaging impacts of climatic variables on malaria/asthma and also on human health and comfort has been in the heart of the people. But unfortunately this has been the ultimate focus on government and people living in Keffi over the years. Thus, this calls for concerted effort and more commitment from both government and individual. Not putting down a lend of helping hand from NGOs, elites and stake-holders to win the fight.

Keywords: relationship, variables, incidence, climatic, asthma, malaria.

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I. Introduction

Human health vulnerability at the expense of climatic variables (temperature, rainfall and relative humidity) has continues to be of intense concern in all the countries of the world. Clear indications has therefore proven that the negative effects incurred from the increasing Temperature, rainfall and relative humidity etc has been on the high side. These can be clearly perceived via the rapid increase of infection i.e malaria/asthma resulting from the influence of these climatic elements, which both could be direct and indirect effects resulted from the depletion of the ozone to climatic variation. For example, increasing global warming. Whereby, increasing temperature becomes an added advantage to mosquito operation and also increasing malaria cases. Breeding grounds from precipitation and an aggravation of asthmatic cases from relative humidity and temperature modification. While the indirect could be gotten from the polluted air, water and food quality and quantity. i.e warm temperature can increase air and water (H_2O) pollution which in turn harm human health.

Human beings are exposed to climatic effects through changing weather patterns (for example, via frequent and intense events and also indirectly through changes in water, air, food quality and quantity (being a man's life dependence) ecosystem, agriculture, and economy. At these early stages the effects are small but are projected to progressively increase in all countries and regions of the world (IPCC, 2007). Simple example of this are rampant malaria cases today which are both contribution of vast effect of Temperature, Insolation and Rainfall. One may ask how, seasonal extension this days which results from the modification of climate variation is an added advantage to the periodic operation and proliferation of mosquitoes thereby, resulting to high malaria/relative humidity infections.

The effects of climatic elements i.e temperature, Insolation and Rainfall, relative humidity on human health are essentially the consequences of natural trend (processes) taking place on our social milieu (habitats) whose effects remain unsurpassed in recent years. While on the other hand, are exacerbated by humanitarian actions and inactions and the generality of the impact of man on the environments.

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Climate variation as a matter of reality, does not affect not only malaria/asthma (though being the primary target of this research) but also regulates man's social life e.g day-to- day activities such as economic activities, commercial transaction, agriculture, industrial and education etc, to some extent, both fauna and flora activities (lives).

Therefore, positive aspect of climates important (Temperature, Insolation and Rainfall) etc cannot be completely forgotten, though may just be meager compare to its negative side. Ayoade (1998) said and I quote "the impacts of climate variation on society may be positive (benevolent or desirable) and negative (malevolent or undesirable). Yet climate is both a hazard and a resource depending on time, and the values and types of climatic parameters involved". Despite its capacity to serve as a resources to man, unfortunately man ignorantly and deliberately augments the gaseous contents in the atmosphere (Green House Gasses). The drastic effects of human health vulnerability of climate (as mentioned earlier) includes infectious diseases such as; malaria, pneumonia, asthma, heat stroke, eczema, cardiovascular attack, influenza, bronchitis, diarrhea, as well as skin cancer and cataract of the eyes (eye blurred vision) among others.

For a long time, much of the efforts utilized, in the management and limiting the eminence (future) impacts of climate variation on malaria/asthma has being more of adaptation and mitigation, has been referred to as emergency relief assistance or disaster management, humanitarian aids, and disaster prevention such as the efforts of Intergovernmental Panel on Climate Change (IPCC), Environmental Protection Agency (EPA). Each of these elements and many others had, in their own respect, has a certain reactive focus of emergency/climatic infectious issues and vast amounts of money are still spent annually on response to situations of disaster/climatic related cases (ISDR, 2002).

Like most countries of the world, Nigeria has not been thoroughly left behind in issues related to these, appropriately putting mechanism such as national disaster plan at alert. Strongly affiliating and adhering to the IPCC's objectives, putting in place the National Emergency Management Agency (NEMA) has not been found wanting to or in handling these issues. Consequently, when affected persons in around our locality are acknowledged, they both rush relief and assistance to such people, i.e distributions of mosquitoes nets (treated insecticides net) to hospitals and private parastatals and also governments of all levels, free distribution of drugs and treatments of some climatic infected cases i.e pneumonia skin cancer etc. Unfortunately, these attempts decreased and the victims are left on their own. Often, these may not be able to continue forever. Therefore, the lasting and best dimension of remedying these problem is by at first, scrutinizing the causes, creating awareness so as to establish individual precaution and limiting the climatic future vulnerability on our health, environments etc.

Because the damage caused so far by this trend (Human Health vulnerability from climatic elements and his environments are of unimaginable proportions as the inhabitants in the habitats remain powerless even when there shall be no means of them refusing inhabiting their habitats (since climate is influential to both inhabitants above and beneath the earth surface).

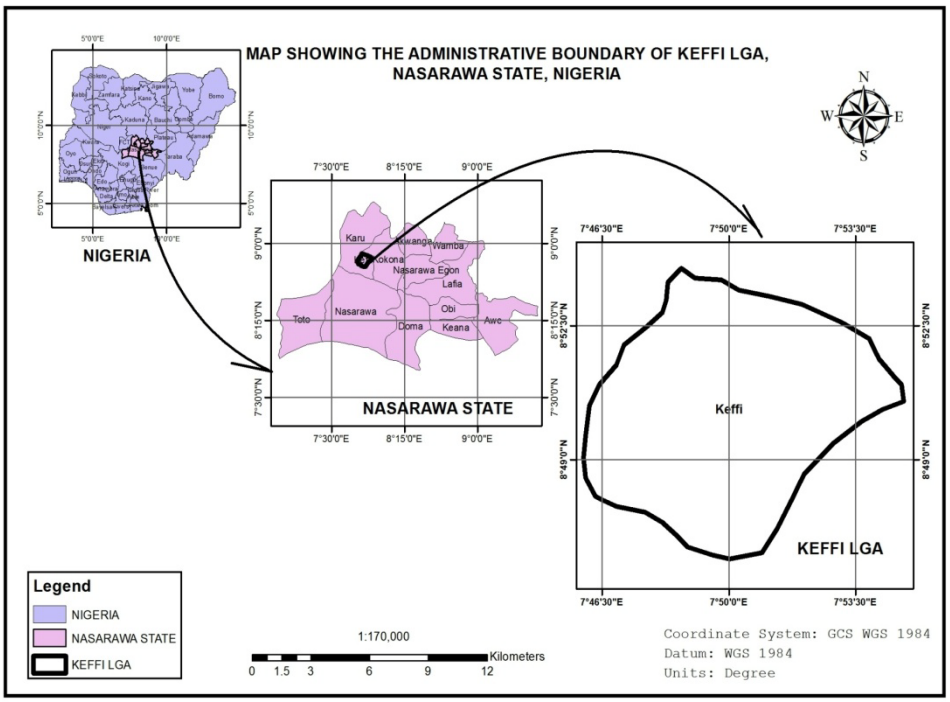
Therefore, the aforementioned alternative pointed out needs/ attention to over-rid these trends of climatic variation (rainfall, temperature and relative humidity) and its substantial influence on malaria/asthma whereby human health and comfort is impacted.

II. Materials and Methods

a) Location

The geographical entity known as Keffi local government area of Nasarawa state, Nigeria, was existing since 1802, located west ward of the state. It lies at the intersection of latitude 6°50′N and longitude 7°50′E. It is bounded to the north by Panda Development Area and to the East Kokona Local Government Area. While to the West Karu Local Government Area and Nasarawa Local Government Area at the South. (fig.1). It has a total land area of about 140.47km^2. The town has a substantial parcel of land area reserved for developmental (residential) purposes by the state government. Some of these parcel of land extended to the southern hemisphere of the area use largely for farmland. With its hinterland extended and networked all around it. According to National Population Commission 2006 census, reported Keffi has a population of 92.664. That encompasses of 47.801 male, and female 44.862 with total of 10,674 households. (NPC, 2006).

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Source: NAGIS, 2020

Fig. 1: Map of Keffi Local Government (Study area)

b) Methods of Data Collection

The research used secondary type of data. The method was used to source data from mega and reputable institutions, e.g., Federal Medical Centre (FMC) Keffi, PHC Unit, Keffi Local Government Council, Nigeria Meteorological Agency (NIMET). The method was adopted as a major tool to source the required documented data for the research.

In addition, the secondary data was also generated from the review of enormous relevant literatures in journals, textbooks, web pages and many other relevant published and unpublished materials as well. Where malaria data was retrieved or obtained from the health care unit (department) at the Keffi Local Government Council. As asthmatic data was retrieved from FMC and the climatic variables (data) was retrieved from the Nigeria Meteorological Agency (NIMET) FCT, Abuja.

This method was adopted and used in order to obtain or retrieve full data on climatic variables and malaria/asthmatic documented record. Hence, this may not be effectively and efficiently gathered or generated from the population via oral confrontation (interview).

c) Techniques of Data Analysis

Cooper and Schindler (2014), defined data preparation or analysis as the processes that ensure the accuracy of data and their conversion from raw form into classified forms appropriate for analysis. The analysis and interpretation of data used in this study was based on the research questions and objectives of the study. As earlier pointed out, the study elicits both quantitative and qualitative data. Hence, these data were processed and analysed both quantitatively and qualitatively. In analysing the quantitative data used in the study, the researcher employed the use of Microsoft Excel, IBM SPSS Statistical package version 26, and E-Views 10, to organize the data collected into manageable information that was understood. These data were edited by inspecting the data pieces. The data were then coded to facilitate data entry into the computer to allow for statistical analysis.

The analytical methods used in analysing the data was the univariate and bivariate methods. The univariate method of analysis used was the descriptive statistics. Explicitly, the descriptive statistics that was used, was the time series trend analysis. The bivariant method of analysis that was adopted was correlation and regression analysis.

III. Results and Discussion

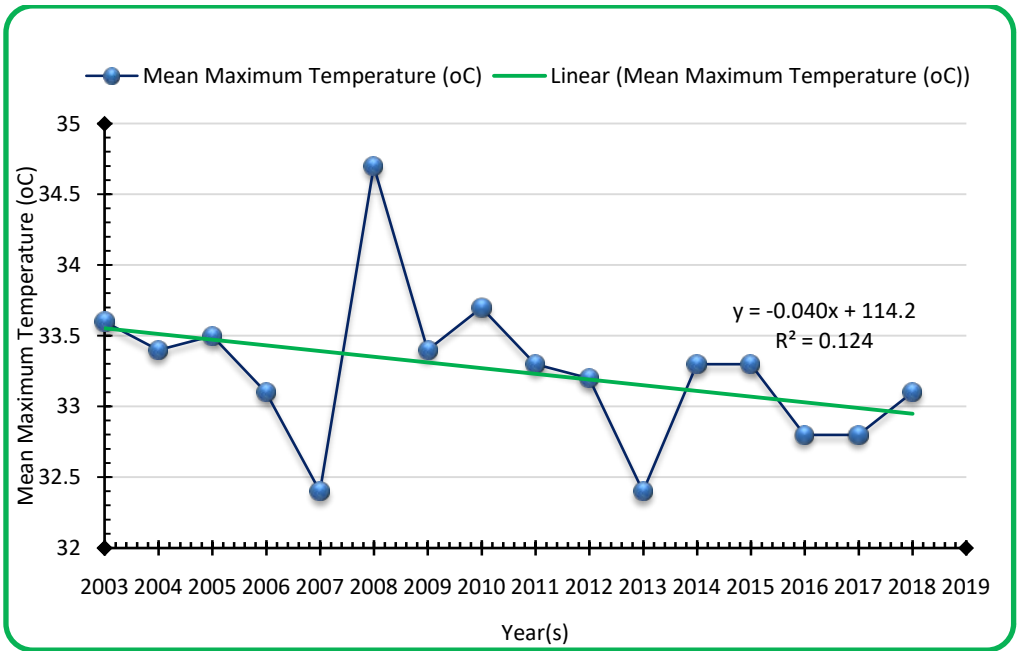
a) Climatic Variables Trends

i. *Maximum Temperature*

Figure 1 depict the trend of mean maximum temperature in the study area between 2003 and 2018. From the trend chart, it can be observed that the study area over the course of 16 years (2003-2018) has been experiencing a decreasing trend in average (mean) maximum temperature. From the cyclical nature of the trend plot, it can be observed that the year 2008 recorded the highest mean maximum temperature in the study area at 37.7°C, while the lowest mean maximum temperature was recorded in the year 2007 and 2013.

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The average (mean) maximum temperature recorded during years (2007 and 2013) was 32.4°C respectively. The trend equation depicted in the trend chart indicated a goodness of fit of the trend plot, and thus implies a 12% variability in the mean maximum temperature in the study area as indicated by the value of r^2 (0.1243). The results here conform with the work of Okoroha (2018).



Source: Author's computation, 2021.

Fig. 2: Trend Chart of mean maximum temperature (°C) in the study area

All the annual temperature was reading high with just little variations from 2003.-2018 respectively (fig. 1). This probably could be because of the fact that, it's a natural phenomenon with natural occurrences (Ayoade, 2004). And the increased temperature could further be traced to agricultural practices as well which resulted to the upsurge of temperature this high in the area. i.e logging down of trees, setting of bushes on fire in search for games could probably be a cause or factors to this high range of temperature witnessed within this period in the study area (J.O Ayoade, 2004).

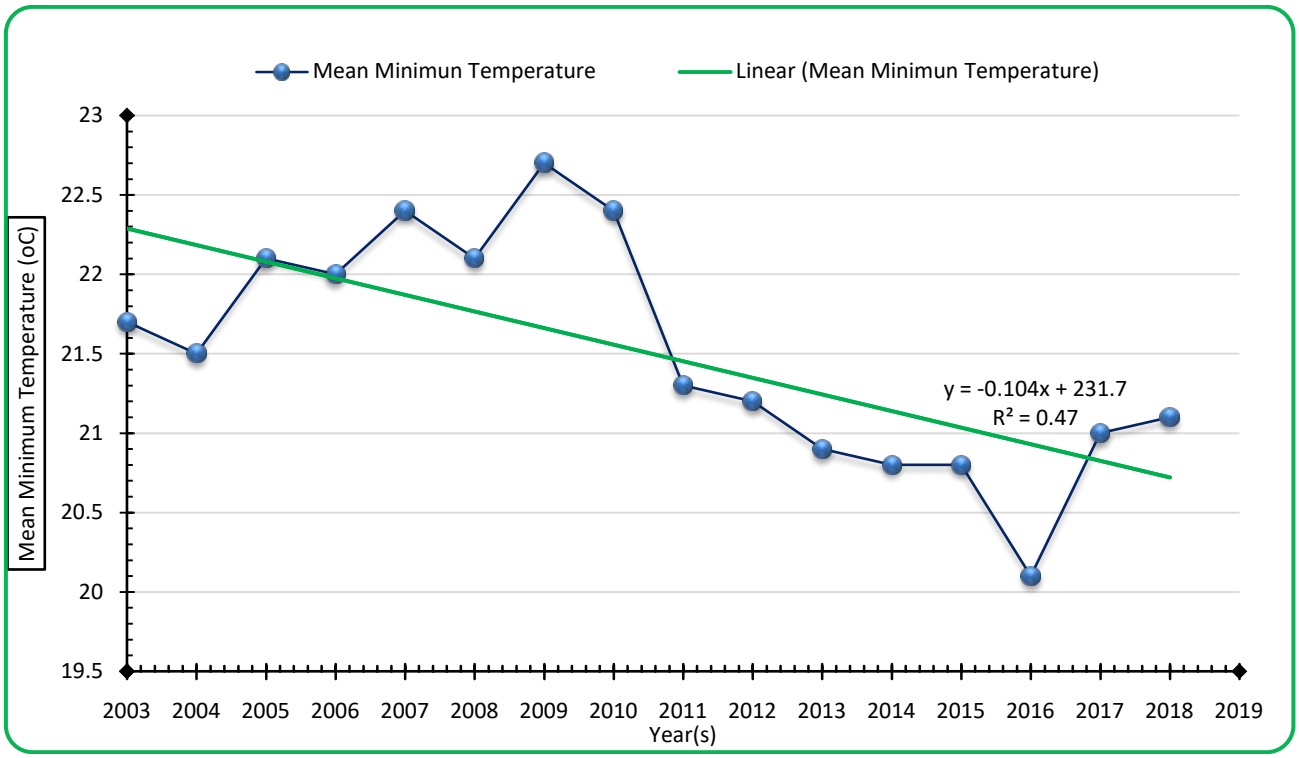
ii. *Minimum Temperature*

Figure2 depicts the nature of the trend of mean minimum temperature in the study area across the time frame under consideration by the researcher. The step downward sloping nature of the trend line indicates a sharp decreasing trend in the mean minimum temperature in the study area. It is however important to note take prior to the decreasing nature of the trend plot, there was a gradual increasing trend in the average (mean) minimum temperature in the study area. This increasing trend was recorded between 2003 and 2010. Explicitly, the year 2003 recorded a mean minimum temperature of 21.7°C, while the year 2004 recorded a slight decrease, with a mean minimum temperature of 21.5°C recorded. Compared to the year 2003 and 2004, the year 2005 recorded an increase in the mean minimum temperature in the study area at 22.1°C, while the year 2006 recorded a slight decline in the mean minimum temperature in the study area. This decline can be regarded as rather less significant and stood at 22°C. The year 2007 however recorded a slight increase in the average (mean) temperature in the study area. Temperature (mean minimum) recorded this year (2007) was 22.4°C, while the year 2008 experienced a slight decline (22.1°C). The fluctuating nature of increase and decline in the mean minimum temperature in the study area was also experienced in the year 2009 and 2010. During these periods, the mean minimum temperature recorded in the study area in 2009 was 22.7°C, while the year 2010 recorded a decline at 22.4°C.

What is most notable in the trend plot depicted in Figure 4.2 is the rapid and continuous decline in the mean minimum temperature in the study area. This decline began in the year 2011 to 2016. During these periods the mean minimum temperature recorded in the study area were; 21.3°C in 2011, 21.2°C in 2012, 20.9°C in 2013, 20.8°C in 2014 and 2015, and 20.1°C in the year 2016. Unlike previous years (2011-2016), the year 2017 and 2018 recorded gradual increase in the mean minimum temperature in the study area. Minimum temperature recorded during these periods were 21.0°C and 21.1°C respectively. It is important to state here that the year 2009 recorded the highest mean minimum temperature in the study area (22.7°C), while the year 2016 recorded the lowest mean minimum temperature in the study area (20.1°C). The trend equation indicates suggest a goodness of fit of the trend plot, while the

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value of r^2 (0.47) indicates a 47% variability in the mean minimum temperature in the study area. This results conform with the findings of Okoroha, (2018).



Source: Author's computation, 2021.

Fig. 2: Trend chart mean minimum temperature (°C) in the study area

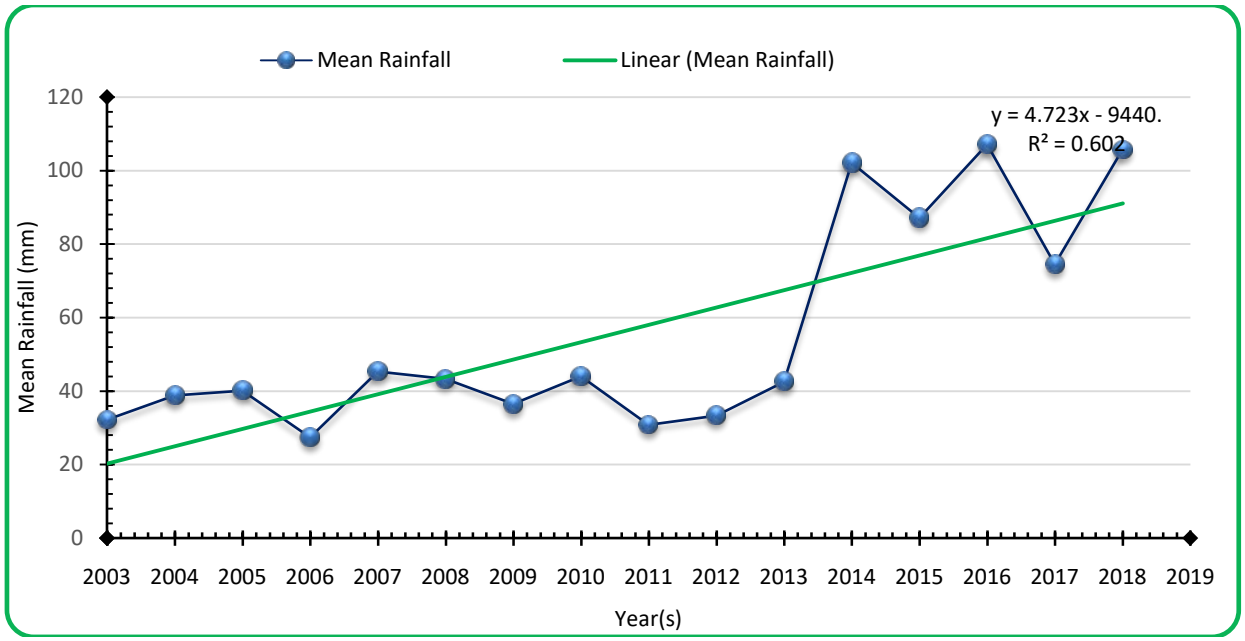
All the annual temperature was reading high with just little variations from 2003.-2018 respectively (Fig. 1). This probably could be because of the fact that, it's a natural phenomenon with natural occurrences (Ayoade, 2004). And the increased temperature could further be traced to agricultural practices as well which resulted to the upsurge of temperature this in the area. i.e logging down of trees, setting of bushes on fire in search for games could be probably be a cause or factors to this high range of temperature witnessed within this period in the study area (Ayoade, 2004).

iii. *Rainfall*

The trend of rainfall was also taken into consideration in assessing the variability trend of climatic variables in the study area. The trend chart depicted in Figure 4.3 shows the nature of the trend of mean rainfall in the study area between 2003 and 2018. From the trend chart, it can be observed that the trend line is upward in nature, signifying an increasing trend in the average (mean) rate of rainfall in the study area. Although some years like 2006, 2009, 2011, 2015, and 2017 recorded slight decline in rainfall, this decline was not significant to warrant step fall in the trend plot. During these periods mean rainfall data recorded were 27.4mm, 36.5mm, 30.8mm, 87.1mm, and 74.5mm respectively. More so, the significant increase in rainfall (average) in the study area was experienced in the year 2014. During this period, the mean rainfall recorded was 102.1mm.

The highest mean rainfall recorded in the study area was in the year 2016. Mean rainfall during this period was recorded at 107.1mm, while the lowest rainfall experienced, and was in the year 2006, which was recorded at 27.4mm. The trend equation suggests a goodness of fit of the trend plot, while the value of r^2 (0.629) indicates a 63% variation in the mean rainfall recorded in the study area between 2003 and 2018. This result conforms with the studies of Bulus (2018).

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Source: Author's computation, 2021.

Fig. 3: Trend chart of mean rainfall in the study area

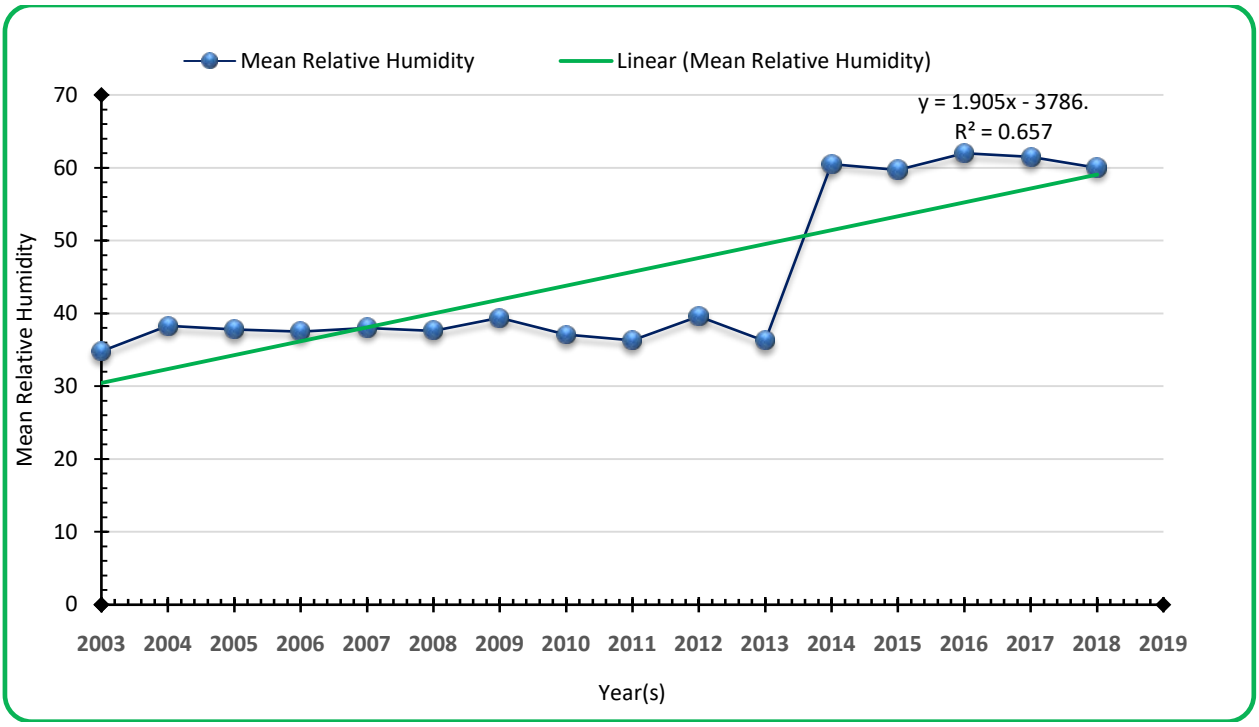
The town always experience this trend of downpour following probably its location at the tropics. Where is usually relatively unstable and high. Influenced by its tropical temperature (Akwa *et' al* 2007). And lastly, its unstableness and variations could be traced to the phenomenon of climate change experienced over the years (Ayoade, 2004). Logging of trees increases the effect of drought thereby, impacting patterns of precipitation.

iv. *Relative Humidity*

Figure 4 depicts the trend of relative humidity in the study area. From the trend plot it can be observed that the trend line is upward sloping in nature, indicating an increasing trend in the mean value of relative humidity in the study area between 2003 and 2018. From the trend chart, it can be observed that there is a steady and gradual increasing trend between 2003 and 2009. During these periods the relative humidity recorded in the study area were 34.8% in 2003, 38.3% in 2004, 37.8% in 2005, 37.5% in 2006, 38% in 2007, 37.6% in 2008, and 39.4% in 2009. In the year 2010 and 2011, a slight decline of mean relative humidity was recorded in the study area. During these periods, relative humidity recorded were 37.1% and 36.3% respectively; while a slight increase was recorded in the 2012, which was 39.6%. A noticeable decline in relative humidity in the study area was recorded in the year 2013 as depicted by the downward movement of the trend plot. During this period, the mean relative humidity recorded in the study area was 36.2%.

Most vivid from the trend chart as depicted in Figure 4.4 is the sharp upward movement of the trend line. This movement signifies a significant increase in the relative humidity in the study area. This increase was recorded in the year 2014. In this year (2014) relative humidity recorded in the study area was 60.5%. However, a slight decline in relative humidity was recorded in the year 2015, which was 59.7%. Besides the decline recorded in the year 2015, the year 2016 to 2018 recorded a much higher percentage in relative humidity in the study area. During these periods (2016 to 2018) relative humidity recorded were; 62% in 2016, 61.5% in 2017, and 60% in 2018. The trend equation indicates a goodness of fit in the trend plot, while the value of r^2 (0.6573) suggest a 66% variation in relative humidity in the study area between 2003 and 2018. This work conform with the studies of Ahmad (2020).

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Source: Author's computation, 2021.

Fig. 4: Trend chart of mean relative humidity in the study area

The variations and increased relative humidity over the years could reflect the climate change phenomenon (Cooney C.M, 2011). Hence, it's a natural phenomenon itself. Also, declination of rainfall reduces moisture content in the air aggravating asthmatic condition.

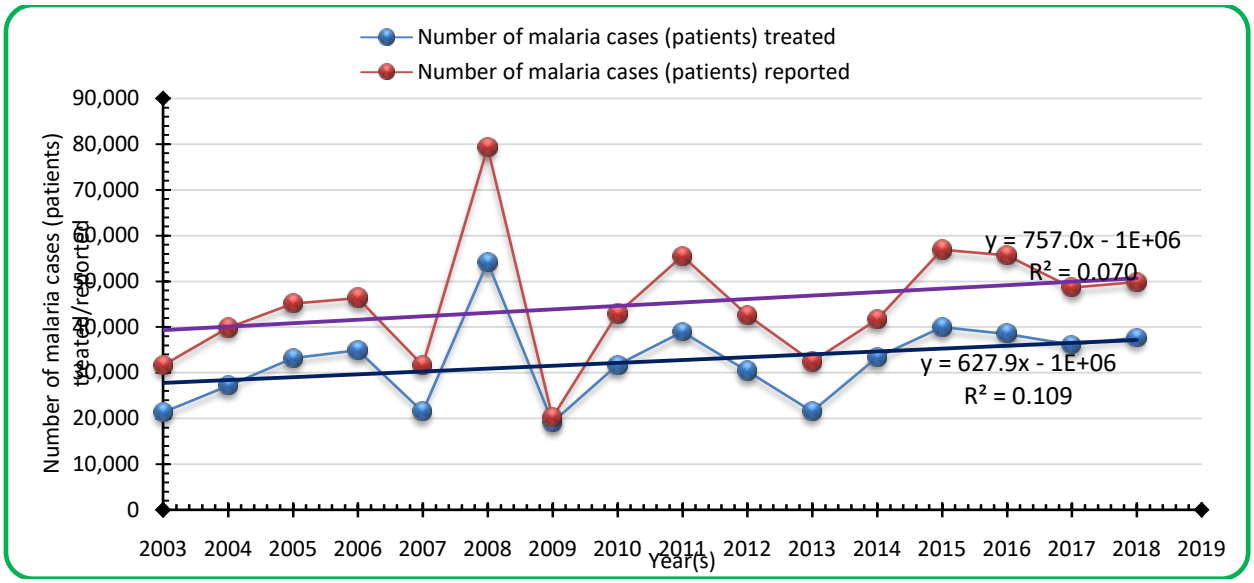
b) Incidence of Malaria and Asthma

i. *Malaria Treated and Reported Cases*

The trend chart depicted in Figure 5 revealed the trend of reported cases of malaria in the study area, as well as treated cases between the year 2003 and 2018 vis-à-vis the variation between reported cases and treated cases. From the trend chart, it can be observed that there is an upward movement in the trend plot between the year 2003 and 2006, implying and increasing trend in malaria cases reported and treated. Specifically, the cases of malaria reported were; 31,605 in 2003, 39,802 in 2004, 45,101 in 2005, and 46,307 in 2006. Similarly, the cases of malaria treated during this period were; 21,034 cases in 2003, 27,103 cases in 2004, 33,171 cases in 2005, and 34,908 cases in the year 2006. The year 2007 recorded a decline the cases of malaria reported as well as treated cases of malaria in the study area. In this year malaria cases reported was 31,604, while patients (cases) treated of malaria was 21,444.

The sharp movement of the trend plot of malaria cases reported in the year 2008 indicates a significant increase in the cases of malaria in the year. Reported cases consisted of 79,240 patients. Similarly, the sharp upward movement of the trend plot for treated cases of malaria in the study area signifies a significant increase in treated cases of malaria in the study area during the same year (2008). Treated cases of malaria during this year consisted of 54,147 patients. Though the trend plot of treated cases of malaria in the study area was upward significantly, it important to not that the movement no way near that of the upward movement of the trend plot of reported cases, thus implying a significant difference (25,093 cases) between reported cases of malaria and actual treated cases in the study area during the said year. More so, it is important to state that this period recorded the highest cases of malaria reported as well as treated cases of malaria in the study area.

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Source: Author's computation, 2021.

Fig. 5: Trend chart of the number of treated and reported cases of malaria in the study area

The year 2009 recorded a significant decline in the cases of malarial reported and treated in the study area as depicted by the sharp downward slope of the trend plot. During this period reported cases of malaria consisted of 20,209 patients, while treated cases consisted of 19,157 patients. What is most peculiar is that there was no significant difference between the number of treated cases of malaria and reported cases of malaria in the study area. The difference between treated and reported cases was 1,052 cases (patients). More so, this year recorded lowest cases of reported and treated cases of malaria across the entire timeframe (2003 to 2018) under consideration in the study.

From the trend chart in Figure 5, it can be observed that is an upward movement in the trend plot between the year 2010 and 2011, signifying and increasing trend in reported cases of malaria, as well as treated cases of malaria in the study area. During this period, reported cases of malaria were 42,890 cases in 2010 and 55,505 cases in 2011, while treated cases consisted 31,700 cases (patients) in 2010 and 38,922 cases in 2011. From this data, it can be observed that there is a significant variation between reported cases of malaria and treated cases of malaria in the study area. Explicitly, 11,190 cases in the year 2010 were not treated, while 16,583 cases were not treated in the year 2011. Contrast to the year 2010 and 2011, the 2012 and 2013 carried downward sloping trend plot; signifying a decreasing trend in reported and treated cases of malaria. During this period reported cases of malaria were 42,619 cases in 2012 and 32,406 cases in 2013, while treated cases were 30,362 cases in 2012, and 21,505 cases in 2013. During these periods a cumulative case of 23,158 were left untreated.

Looking at the trend chart (Figure.5), it can be observed that there is steady upward movement in the trend plot between 2014 and 2018, signifying and increasing trend in the reported and treated cases of malaria in the study area. During this period, a cumulative 252,595 cases of malaria was reported, while a cumulative 185,444 cases of malaria were treated. More so, a cumulative malaria cases of 67,151 were not treated. Overall, the upward nature of the trend lines in Figure.5 indicates an increasing trend in both reported and treated cases of malaria in the study area between 2003 and 2018. More so, the trend equation signifies a goodness of fit of the trend plot. The value of r^2 (0.0707) signifies a 71% variation in reported cases of malaria in the study area between 2003 and 2018. Similarly, the r^2 value of 0.1091, signifies an 11% variation in the number of treated cases of malaria in the study area between 2003 and 2018. In the discussion carried out between the researcher and the authorities of PHC unit, LGC, it was revealed that some of the factors attributed to the variation between reported cases of malaria and treated cases were; cost of treatment/drugs, inability to finance treatment by patients after diagnose, delay/shortage of supply malaria drug by WHO, especially in the year 2008. This work conform with the studies of Nyasa (2021).

The cases of malaria witnessed in the area could be attributed to both physical and human induced factors (Sarah Moore, 2021), i e, precipitation creates mosquito breeding grounds, which promotes mosquito operations leading to high incidence of malaria in the study area (US. CDC, 2017).

It could further be probably due to increased temperature experienced in the region (Fig. 1), i.e hence, high temperature leads to heat-upsurge,

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compelling people to keep outdoor (US. CDC, 2017). This becomes an added advantage to mosquitoes operation given rise to such high cases of treated malaria incidence in the area over the years. Whereas, those human induced factors are; lack of adequate hygiene in the environment, also open up rooms for mosquitoes breading.

And also, we witnessed high range of temperature (Temperature maximum. and Temperature minimum.) in 2003, 2007 and 2013 respectively (Fig. 1) (which poses a great impact on malaria). But yet, low treated malaria cases in those years was recorded. This probably could be connected to economic factors, i.e lack of money to go for treatment resulted to low treated cases or records in those years.

And lack of sensitization and awareness to go for the treatment may also be a factor why treated cases are low.

c) Evidence of Climatic Sensitive Diseases in Keffi Local Government Area of Nasarawa State



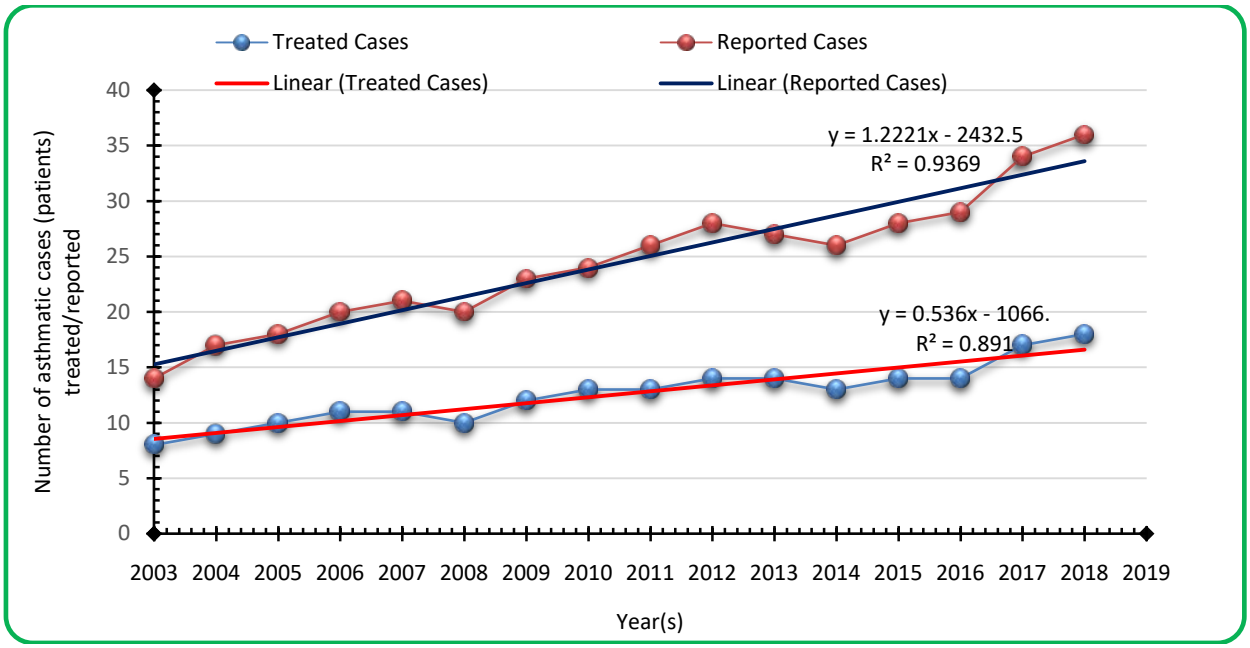
Source: Author field survey (2021)

Plate 1: Malaria patient receiving treatment at the Federal Medical Centre Keffi, Nasarawa State

d) Asthmatic Treated and Reported Cases

Figure 6 depict the trend of treated and reported cases of asthma in the study area between the year 2003 and 2018. From the upward nature of the trend line, it can be deduced that there is a steady increasing trend of treated and reported cases of asthma in the study area across the timeframe considered in the study. The most significant movement in the trend plot was in the year 2018. During this period, a total of 18 cases of asthma was treated, while 36 cases were reported. The value of r^2 (0.9369) signifies a 94% variation in reported cases of asthma in the study area between 2003 and 2018, and an 89% (r^2 = 0.891) variation in treated cases of asthma in the study area, across the time series under study. This was conform with the work of Asher (2020).

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Source: Author's computation, 2021.

Fig. 6: Trend chart of the number of treated and reported cases of Asthma in the study area

Generally, the plotted graph depicts a consistence increase of asthmatic treated and reported cases throughout the period up to the last year. This could probably be attributed to an increased relative humidity in the area (fig. 3) and the high temperature (fig .1 & 2) as well. Hence, relative humidity and temperature has a vast impact on Asthmatic condition (Cooney C.M, 2011). While, other factors that could be responsible to this increasing cases of asthma in the area could be; lack of efficient awareness of the disease to the people to reduce its effect or increasing cases shown on the graph, (fig..3)

e) Evidence of Climatic Sensitive Diseases in Keffi Local Government Area of Nasarawa State



Source: Author field survey

Plate 2: Asthmatic patient receiving treatment at the Federal Medical Centre Keffi, Nasarawa State

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f) Relationship between Climatic Variables and Incidence of Malaria/Asthma

The relation between climatic variables and incidence of malaria/asthma in the study area was examined through the Pearson Product Moment Correlation and a one-tail test employed.

g) Relationship between Maximum Temperature and Malaria

The result extract presented in Table 1 depicts the relationship between mean maximum temperature and reported cases of malaria in the study area. For the result extract, the Pearson Product Moment correlation coefficient was arrived at 0.500. The value of the correlation coefficient by interpretation implies that there is a moderate positive relationship between mean maximum temperature and reported cases of malaria in the study area. More so, this moderate positive relationship was statistically significant, as indicated by the *p*-value (significant value) 0.024 < 0.05. This positive significant relation conforms with the study of Minoo *et al.* (2019).

Table 1: Correlation between Max. Temperature and Reported Cases of Malaria

Variables		Mean Max. Temperature	Reported Cases of Malaria
Mean Max. Temperature (T°C)	Pearson Correlation	1	0.500*
	Sig. (1-tailed)		0.024
	N	16	16
Reported Cases of Malaria	Pearson Correlation	0.500*	1
	Sig. (1-tailed)	0.024	
	N	16	16

*. Correlation is significant at the 0.05 level (1-tailed).

Source: Author's computation, 2021.

This result shows that maximum temperature affect malaria. Though, study showed that, high temperature disturb mosquitoes life cycle. The inconsistency can be related to mosquito habits and their adaptations to the region's climate (Nkurunziza *et' al*, 2011).

h) Relationship between Minimum Temperature and Malaria

Table 2 depicts the relationship between mean minimum temperature and reported cases of malaria in the study area. For the result extract, the Pearson Product Moment correlation coefficient was arrived at -0.295. The value of the correlation coefficient by interpretation implies that there is a weak negative relationship between mean minimum temperature and reported cases of malaria in the study area. More so, this weak negative relationship was not statistically significant, as indicated by the *p*-value (significant value) 0.134 > 0.05.

Unlike the study of Minoo *et al.* (2019) which established a positive significant relationship between mean minimum temperature and malaria, the current study was of an opposite result.

Table 2: Correlation between Minimum Temperature and Reported Cases of Malaria

Variables		Mean Minimum Temperature	Reported Cases of Malaria
Mean Minimum Temperature (T °C)	Pearson Correlation	1	-0.295
	Sig. (1-tailed)		0.134
	N	16	16
Reported Cases of Malaria	Pearson Correlation	-0.295	1
	Sig. (1-tailed)	0.134	
	N	16	16

Source: Author's computation, 2021.

The relation between minimum temperature and incidence of malaria may be due to low temperature at night. Though, some studies reveal that, minimum temperature has been known as an effective factor in the incidence of malaria. These differences may be further attributed to mosquitoes response to habitats and climatic condition of a certain location.

i) Relationship between Relative Humidity and Malaria

The result extract presented in Table 4.3 depicts the relationship between mean relative humidity and reported cases of malaria in the study area. For the result extract, the Pearson Product Moment correlation coefficient was arrived at 0.274. This by interpretation, implies a weak positive relationship between the mean relative humidity, and reported cases of malaria in the study area. More so, this weak positive relationship was statistically not significant, as indicated by the *p*-value (significant value) 0.152 > 0.05. This positive relationship agrees with the study of Minoo *et al.* (2019). However, while the current study established a non-

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statistically significant positive relationship, the study of Minoo *et al.* (2019) established a statistically significant positive relationship.

Table 3: Correlation between Relative Humidity and Reported Cases of Malaria

Variables		Mean Relative Humidity	Reported Cases of Malaria
Mean Relative Humidity	Pearson Correlation	1	0.274
	Sig. (1-tailed)		0.152
	N	16	16
Reported Cases of Malaria	Pearson Correlation	0.274	1
	Sig. (1-tailed)	0.152	
	N	16	16

Source: Author's computation, 2021.

Increase in relative humidity is related to increase in malaria. The result is probably the fact that, humidity in this area is high enough to influence malaria all year round. Because, high humidity will increase the mosquito's life-span and help the parasite complete its life cycle and transmit the infection. (Akinbobola & Omotosho, 2013).

j) Relationship between Rainfall and Malaria

Table 4 depicts the relationship between mean rainfall and reported cases of malaria in the study area. For the result extract, the Pearson Product Moment correlation coefficient was arrived at 0.274. The value of the correlation coefficient by interpretation implies that there is a weak positive relationship between mean rainfall and reported cases of malaria in the study area. More so, this weak positive relationship was not statistically significant, as indicated by the *p*-value (significant value) 0.153 > 0.05.

This positive relationship agrees with the study of Minoo *et al.* (2019). However, while the current study established a non-statistically significant positive relationship, the study of Minoo *et al.* (2019) established a statistically significant positive relationship.

Table 4: Correlation between rainfall Temperature and Reported Cases of Malaria

Variables		Mean Relative Humidity	Reported Cases of Malaria
Mean Rainfall	Pearson Correlation	1	0.274
	Sig. (1-tailed)		0.153
	N	16	16
Reported Cases of Malaria	Pearson Correlation	0.274	1
	Sig. (1-tailed)	0.153	
	N	16	16

Source: Author's computation, 2021.

This study showed an unexpected and complex relation between rainfall and malaria incidence, probably connected to understated reason; studies revealed that, the time and location of precipitation plays an important role in disease (malaria) transmission. Such that, if precipitation occurs before the anopheles' reproductive season, rivers and water streams can become places for mosquito breeding, but if rainfall occurs during the reproductive season of mosquito, it will wash the breeding sites and reduce malaria transmission (Juri, Zaidenberg, Claps, Santana, & Almiron, 2009). Probably resulted to this outcome.

k) Relationship between Maximum Temperature and Asthma

Table 5 depicts the relationship between mean maximum temperature and reported cases of asthma in the study area.

For the result extract, the Pearson Product Moment correlation coefficient was arrived at -0.403. The value of the correlation coefficient by interpretation implies that there is a weak negative relationship between mean maximum temperature and reported cases of asthma in the study area. More so, this weak positive relationship was not statistically significant, as indicated by the *p*-value (significant value) 0.061 > 0.05.

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Table 5: Correlation between Max. Temperature and Reported Cases of Asthma

Variables		Mean Max. Temperature	Reported Cases of Asthma
Mean Max. Temperature (T°C)	Pearson Correlation	1	-0.403
	Sig. (1-tailed)		0.061
	N	16	16
Reported Cases of Asthma	Pearson Correlation	-0.403	1
	Sig. (1-tailed)	0.061	
	N	16	16

Source: Author's computation, 2021.

This study indicates a weak negative relation between maximum temperature and asthma. Whereas, some study showed positive relation. This complex result could be traced to the fact that it's a natural phenomenon with natural occurrence. And latitudinal response to temperature and the disease.

l) Relationship between Minimum Temperature and Asthma

The results depicted in Table 4.6 depicts the relationship between mean minimum temperature and reported cases of asthma in the study area. For the result extract, the Pearson Product Moment correlation coefficient was arrived at -0.586. The value of the correlation coefficient by interpretation implies that there is a moderate negative relationship between minimum temperature and reported cases of asthma in the study area. More so, this moderate negative relationship was statistically significant, as indicated by the *p*-value (significant value) 0.009 < 0.05. This result agrees with the study of Campbell (2016).

Table 6: Correlation between minimum Temperature and Reported Cases of Asthma

Variables		Mean Minimum Temperature	Reported Cases of Asthma
Mean Minimum Temperature (T°C)	Pearson Correlation	1	-0.586**
	Sig. (1-tailed)		0.009
	N	16	16
Reported Cases of Asthma	Pearson Correlation	-0.586**	1
	Sig. (1-tailed)	0.009	
	N	16	16

**. Correlation is significant at the 0.05 level (1-tailed).*

Source: Author's computation, 2021.

This also indicates a weak negative relation between minimum temperature and asthma. Whereas, some study showed positive relation. These inconsistence result could be traced to the fact that it's a natural phenomenon with natural occurrence. And also latitudinal response to temperature and the disease.

m) Relationship between Relative Humidity and Asthma

Table 7 depicts the relationship between mean relative humidity and asthma in the study area. For the result extract, the Pearson Product Moment correlation coefficient was arrived at 0.728. The value of the correlation coefficient by interpretation implies that there is a strong positive relationship between relative humidity and asthma in the study area. This strong positive relationship was statistically significant, as indicated by the *p*-value (significant value) 0.001< 0.05.

Table 7: Correlation between Relative Humidity and Reported Cases of Asthma

Variables		Mean Relative Humidity	Reported Cases of Asthma
Mean Relative Humidity	Pearson Correlation	1	0.728**
	Sig. (1-tailed)		0.001
	N	16	16
Reported Cases of Asthma	Pearson Correlation	0.728**	1
	Sig. (1-tailed)	0.001	
	N	16	16

**. Correlation is significant at the 0.05 level (1-tailed).*

Source: Author's computation, 2021.

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Probably, damped and warm air reduces inhalation oxygen quality, causing respiration deficiency and influencing the complication.

n) Relationship between Rainfall and Asthma

The results depicted in Table 8 reveals the relationship between mean rainfall and asthma in the study area. For the result extract, the Pearson Product Moment correlation coefficient was arrived at 0.668. The value of the correlation coefficient by interpretation implies that there is a strong positive relationship between rainfall and asthma in the study area. This strong positive relationship was statistically significant, as indicated by the *p*-value (significant value) 0.002 < 0.05.

Table 8: Correlation between Rainfall and Reported Cases of Asthma

Variables		Mean Rainfall	Reported Cases of Asthma
Mean Rainfall (mm)	Pearson Correlation	1	0.668**
	Sig. (1-tailed)		0.002
	N	16	16
Reported Cases of Asthma	Pearson Correlation	0.668**	1
	Sig. (1-tailed)	0.002	
	N	16	16

**. Correlation is significant at the 0.05 level (1-tailed).*

Source: Author's computation, 2021.

This relation may be probably because of the heats emitted from the surface (ground) after some hours of down pour associates in impacting the disease condition via respiration.

o) The Ranking Effect of Climatic Variables on Malaria/Asthma

i. *The Ranking Effect of Climatic Variables on Malaria*

Juxtaposing the result extract (see appendix iV) of the coefficients of the explanatory variables into the linear regression model postulated in chapter three of the study, we have;

$$IM = \beta_0 + \beta_1 Mmax\ Temp + \beta_2 Mmin\ Temp + \beta_3 R\ Humidiy + \beta_4 Mrainfall + \mu$$

$IM = \beta_0 = (-359776.1)\ \beta_1 = (17644.23)\ \beta_2 = (-8862.783)\ \beta_3 = (244.3905) + \beta_4 = (-40.19738)$

T-Statistic $= \beta_0 = (-1.810367)\ \beta_1 = (3.157584)\ \beta_2 = (-1.561924)\ \beta_3 = (0.299275)\ \beta_4 = (-0.130316)$

Prob.$= \beta_0 = (0.0976)\ \beta_1 = (0.0091)\ \beta_2 = (0.1466)\ \beta_3 = (0.7703)\ \beta_4 = (0.8987)$

R-squared (r^2) = 0.526362

Adjusted R-squared ($\bar{R}^2$) = 0.354130

F-statistic = 3.056118

Durbin-Watson stat. = 1.595989

Prob(F-statistic) = 0.063895

The theoretical aprior expectation of the parameters coefficients is: $\beta_1, \beta_2, \beta_3, \beta_4 > 0$

The result summary depicts the ranking effect of climatic variables on malaria across the time frame under study with value of the coefficient of determination (also known as the R-squared [r^2]) as well as the coefficient of the adjusted coefficient of determination (also known as the Adjusted r-square [$\bar{R}^2$]). The coefficient of determination (r-square: r^2) which by definition, is the proportion of the variance in the dependent variable (incidence of malaria in this case), that is predictable from the independent variable(s) (mean maximum temperature, mean minimum temperature, mean relative humidity, and mean rainfall), was arrived at 0.526362. This thus implies that 53% of the variation in incidence of malaria in the study area, is explained by the variation in mean maximum temperature, mean minimum temperature, mean relative humidity, and mean rainfall in the study area across 2003 and 2018.

From the summary of the results, the adjusted $\bar{R}^2$ was arrived at 0.354130. This by implication implies that over 35 percent of the total variation in the incidence of malaria is explained by the variation in the explanatory variable (mean maximum temperature, mean minimum temperature, mean relative humidity, and mean rainfall)

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after taking into consideration the degree of freedom (12) which is indeed strong.

The F-statistic value of 3.056118 was low and shows the overall estimated regression model was not at the conventional significance level of 0.05 level of significance, and thus not statistically significant. This was as a result of the F-statistics (3.056118) found to be greater than the critical F-statistics probability (0.063895 > 0.05).

The Durbin-Watson statistic of 1.595989, indicate the presence of positive autocorrelation in the regression.

The regression results also reveals the coefficient of the constant parameter, as well as the coefficients of the explanatory variables of the regression model of the study. From the regression result, it can be observed that the constant parameter (β_0) is negatively related to the incidence of malaria in the study area over the period under study with a coefficient of β_0 = -1.810367. The value of t-statistic of the constant parameter shows the statistical significance of the relationship between the constant parameter and the dependent variable of the regression model. Given that the t-statistic was arrived at -1.810367, with a probability value of 0.0976, the negative relationship between incidence of malaria and β_0 was not statistically significant, since the *p*-value = 0.0976 > 0.05.

The results revealed a positive relationship between mean maximum temperature and the incidence of malaria in the study area, with a coefficient value of *MmaxTemp* = 17644.23. The t-statistic value of *MmaxTemp* shows the statistical significance of the relationship between *MmaxTemp* and the dependent variable of the regression model (incidence of malaria [*IM*]). The t-statistic of *MmaxTemp* was arrived at 3.157584, with a probability value of 0.0091. At 0.05% level of significance, *p*-value = 0.0091< 0.05. It thus implies that the positive relationship between *IM* and *MmaxTemp* is statistically significant. This result conforms to the aprior expectation of a positive relationship between *IM* and *MmaxTemp* ($\beta_1 > 0$). The implication here is that a unit increase in *MmaxTemp* resulted in a unit increase in *IM* in the study area between 2003 and 2018.

The coefficient of *MminTemp* shows a negative relationship between *MminTemp and IM* in the study area, with a coefficient value of -8862.783. The t-statistics of the coefficient of *MminTemp* was arrived at -1.561924, with a probability value of 0.1466 at 0.05% level of significance. This result is against our aprior expectation of a positive relationship between *MminTemp* and *IM* ($\beta_2 > 0$), and not statistically significant since *p*-value = 0.1466 > 0.05. The implication here is that an increase in *MminTemp* across the time series under consideration has disproportionally been met with *IM*, but not at a significant level.

The coefficient of *R Humidiy* from the results was arrived at 244.3905, indicating a positive relationship between the *IM* and *R Humidiy*. The t-statistics of this explanatory variable was arrived at 0.299275, with a probability value of 0.7703 at 0.05% level of significance. This result conforms with our aprior expectation of a positive relationship between *IM* and *RHumidiy* ($\beta_3 > 0$), but however, not statistically significant since *p*-value = 0.7703 > 0.05. The implication here is that an increase in *RHumidiy* across the time series under consideration resulted in an increase in *IM*, but not at a significant level.

More so, the coefficient of *Mrainfall* as depicted in the results above was -40.19738, implying an inverse (negative) relationship between *IM* and *Mrainfall* across the time series under study. The t-statistics of the coefficient of *Mrainfall* was arrived at -0.130316, with a probability value of 0.8987 at 0.05% level of significance. This result does not conform to our aprior expectation of a positive relationship between *IM* and *Mrainfall* ($\beta_4 > 0$), and was not statistically significant since p = 0.8987 > 0.05. The implication here is that and increase in the *Mrainfal* resulted into a decrease in the *IM* but not at a significant level.

p) The Ranking Effect of Climatic Variables on Asthma

Juxtaposing the result extract (see appendix V) of the coefficients of the explanatory variables into the linear regression model postulated in chapter three of the study, we have;

$IAsthm = \beta_0 + \beta_1 MmaxTemp + \beta_2 MminTemp + \beta_3 Mrainfall + \beta_4 RHumidiy + \mu$

$IAsthm = \beta_0 = (99.78362)\ \beta_1 = (-2.377939)\ \beta_2 = (-0.621961)\ \beta_3 = (0.431406) + \beta_4 = (-0.039827)$

t-Statistic $= \beta_0 = (1.212641)\ \beta_1 = (-1.027759)\ \beta_2 = (-0.264723)\ \beta_3 = (1.275884)\ \beta_4 = (-0.311828)$

Prob. $= \beta_0 = (0.2507)\ \beta_1 = (0.3261)\ \beta_2 = (0.7961)\ \beta_3 = (0.2283)\ \beta_4 = (0.7610)$

R-squared (r^2) = 0.586996

Adjusted R-squared ($\bar{R}^2$) = 0.436813

F-statistic = 3.908536

Durbin-Watson stat. = 0.579206

Prob(F-statistic) = 0.032654

The theoretical aprior expectation of the parameters coefficients is: $\beta_1, \beta_2, \beta_3, \beta_4 > 0$

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The result summary depicts the ranking effect of climatic variables on asthma across the time frame under study with value of the coefficient of determination as well as the coefficient of the adjusted coefficient of determination. The value of coefficient of r^2 was arrived at 0.586996. This thus implies that 59% of the variation in incidence of asthma in the study area, is explained by the variation in mean maximum temperature, mean minimum temperature, mean relative humidity, and mean rainfall in the study area across the time series under consideration.

From the summary of the results, the adjusted $\bar{R}^2$ was arrived at 0.436813. This by implication implies that over 44 percent of the total variation in the incidence of asthma is explained by the variation in the explanatory variable after taking into consideration the degree of freedom (12) which is indeed strong.

The F-statistic value of 3.908536 was low and shows the overall estimated regression model was at the conventional significance level of 0.05 level of significance, and thus statistically significant. This was as a result of the F-statistics (3.908536) found to be less than the critical F-statistics probability (0.032654 < 0.05).

The Durbin-Watson statistic of 0.579206, indicate the presence of positive autocorrelation in the regression.

The regression results also reveals the coefficient of the constant parameter, as well as the coefficients of the explanatory variables of the regression model of the study. From the regression result, it can be observed that the constant parameter (β_0) is positively related to *IAsthm* in the study area across the time series under study with a coefficient of $\beta_0 = 99.78362$. The t-statistic was arrived at -1.810367, with a probability value of 1.212641, the positive relationship between *IAsthm* and β_0 was not statistically significant, since the *p*-value = 0.2507 > 0.05.

The results revealed a negative relationship between *MmaxTemp* and *IAsthm* in the study area, with a coefficient value of -2.377939. The t-statistic of *MmaxTemp* was arrived at -1.027759, with a probability value of 0.3261. At 0.05% level of significance, *p*-value = 0.3261 > 0.05. It thus implies that the negative relationship between *MmaxTemp* and *IAsthm* was not statistically significant. This result does not conform to the aprior expectation of a positive relationship between *IAsthm* and *MmaxTemp* ($\beta_1 > 0$).

The coefficient of *MminTemp* shows a negative relationship between *MminTemp and IAsthm* in the study area, with a coefficient value of -0.621961. The t-statistics of the coefficient of *MminTemp* was arrived at -0.264723, with a probability value of 0.7961 at 0.05% level of significance. This result is against our aprior expectation of a positive relationship between *IAsthm* and *MminTemp* ($\beta_2 > 0$), and not statistically significant since *p*-value = 0.7961 > 0.05.

The coefficient of *RHumidiy* from the results was arrived at 0.431406, indicating a positive relationship between the *RHumidiy and IAsthm*. The t-statistics of this explanatory variable was arrived at 1.275884, with a probability value of 0.2283 at 0.05% level of significance. This result conforms with our aprior expectation of a positive relationship between *IAsthm* and *RHumidiy* ($\beta_3 > 0$), however, this positive relationship was not statistically significant since *p*-value = 0.2283 > 0.05. The implication here is that an increase in *RHumidiy* across the time series under consideration resulted in an increase in *IAsthm*, but not at a significant level.

The coefficient of *Mrainfall* was -0.039827, implying an inverse relationship between *IAsthm* and *Mrainfall* across the time series under study. The t-statistics of the coefficient of *Mrainfall* was arrived at -0.311828, with a probability value of 0.7610 at 0.05% level of significance. This result does not conform to our aprior expectation of a positive relationship between *IAsthm* and *Mrainfall* ($\beta_4 > 0$), and was not statistically significant since $p = 0.7610 > 0.05$. The implication here is that and increase in the *IAsthm* resulted into a decrease in the *IM* but not at a significant level.

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Determination of Heavy Metal Pollution in Soil Samples from Angwan Kawo Gold Mining Sites, Niger State, Nigeria

By S. O. Esiole, M. A. Onoja, N. N. Garba & R. A. Onoja

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Abstract- This present study involves the determination of heavy metal composition and its pollution levels in Angwan Maigero gold mining sites, Niger State Nigeria using Contamination Factor (CF), Pollution load Index (PLI), and Degree of Contamination (DC) Index. Samples were analyzed using Atomic Absorption Spectroscopy (AAS) to obtain their concentrations and composition. The study area was observed to be contaminated with Pb, Fe, Mn, Cu, Zn, As, Cr, Co, Ni, and Cd. The mean concentrations (ppm) of the heavy metals in the mine site was found to be 429.765, 1707.631, 181.614, 90.945, 37.412, 17.992, 93.187, 47.940, 22.282 and 3.232 respectively, Also the mean concentrations (ppm) of heavy metals in the mill tailing site was found to be 846.867, 1914.993, 177.703, 739.333, 100.405, 43.519, 163.284, 53.476, 45.591, 5.828. The highest concentration corresponds to Fe and the lowest corresponds to Cd. The increasing trend was in the order: Cd <As <Ni <Zn <Co <Cu <Cr <Mn<Pb<Fe. The concentrations of all the elements in the mill tailing sites were found to be higher than that obtained in the mine site with greater variation in relative abundance of most of the metals. These variations can be attributed to the variable dumping of tailings.

Keywords: heavy metals; pollution; PLI; DC; CF; FAAS.

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S. O. Esiole [α], M. A. Onoja [σ], N. N. Garba [ρ] & R. A. Onoja [ω]

Abstract- This present study involves the determination of heavy metal composition and its pollution levels in Angwan Maigero gold mining sites, Niger State Nigeria using Contamination Factor (CF), Pollution load Index (PLI), and Degree of Contamination (DC) Index. Samples were analyzed using Atomic Absorption Spectroscopy (AAS) to obtain their concentrations and composition. The study area was observed to be contaminated with Pb, Fe, Mn, Cu, Zn, As, Cr, Co, Ni, and Cd. The mean concentrations (ppm) of the heavy metals in the mine site was found to be 429.765, 1707.631, 181.614, 90.945, 37.412, 17.992, 93.187, 47.940, 22.282 and 3.232 respectively, Also the mean concentrations (ppm) of heavy metals in the mill tailing site was found to be 846.867, 1914.993, 177.703, 739.333, 100.405, 43.519, 163.284, 53.476, 45.591, 5.828. The highest concentration corresponds to Fe and the lowest corresponds to Cd. The increasing trend was in the order: Cd <As <Ni <Zn <Co <Cu <Cr <Mn<Pb<Fe. The concentrations of all the elements in the mill tailing sites were found to be higher than that obtained in the mine site with greater variation in relative abundance of most of the metals. These variations can be attributed to the variable dumping of tailings.

Keywords: heavy metals; pollution; PLI; DC; CF; FAAS.

I. Introduction

Mining activities has been observed to be one of the major contributors of heavy metals in the environment. The effect of heavy metals on gold mining areas is of serious concern, as such threatens life in all forms (Esiole, *et al.*, 2016). Following the recent illegal mining in the country, that reared its ugly head once again in rural Rafi Local Government Area in Niger state with reports of numerous deaths of children and women from lead poisoning. The outbreak is traced as a result of the new illegal mining sites from where high leaded ores were brought home for crushing and processing by illegal miners (The sun, 15th May, 2015). Mining activities in AngwanMaigero has generated a lot of survival related activities such as petty trading, hard and conventional drug peddling and prostitution. These developments expose people in these groups to radiation from exposed radioactive rock surface, milling processes, mine tailings, and raised indoor radon level. All of these cumulatively are of grave danger to their health (Esiole, 2016). The pathway of the seasonal stream, where panning and sedimentation takes place is a potential source of radiation hazards. All users of the stream for agricultural and domestic purposes have a possibility of exposure by contamination from radionuclides in tailings and toxic elements or in dissolved stream water as well as ones taken up by plants (Esiole, 2016).

The seemingly non-existence of government impact in terms of provision of social services to the area, education of communal people on risks to health of the mining operation as well as other related matters that require government participation has serious integrating effects on possibilities of radiation absorption and impacts of toxic elements on these communal people (Esiole, 2016).Several analytical techniques have been extensively employed for the assessment of heavy metal pollution such as; Instrumental Neutron activation analysis (INAA) (Coskun, et al., 2006). X-ray Fluorescence analysis (XRF) (Ene, et al., 2009), Particle-induced x-ray emission (PIXE) (Ene, et al., 2010), Atomic Absorption spectrometry (AAS) (Al-Khashiman, 2009) and inductively coupled plasma spectrometry-Atomic Emission Spectroscopy (ICP-AES) (Popescu, et al., 2009). For the purpose of this present study, the analytical technique chosen to be used will be the Atomic Absorption Spectrophotometry (AAS).

The Knowledge of metal composition present in soil in a particular region would enable one to assess any possible health hazard to man and his environment, hence the present study is therefore aimed at establishing a base line data on the composition and concentration of the studied heavy metals and the possible health risk associated with the gold mining and ore processing activities in the area. Results of this study are important for assessment of the risk for human health, planning process and policy making in Nigeria.

II. Materials and Methods

a) Study Area

The study area is located between latitude 1001‘29‘‘N and 1001‘30‘‘N and longitude 60 28’ 30‘‘E to 6028‘31‘‘Ein Niger State of Nigeria. Two sites were selected to carry out the present study. The field

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measurement and sampling were made at the artisan mines. For the purpose of accuracy the positions were marked with a portable hand held global positioning system (GPS). The horizontal profile soil sampling strategy was chosen for the present study, since the mine site is a virgin site. A total of 49 samples were collected all together. After removal of stones and vegetable matter, each soil sample were packed into its own secure water-tight polythene bag in order to prevent cross contamination and was taken to the laboratory for analysis.

b) Sample Preparation and Analysis

Samples were each dried at ambient laboratory temperature. For one week, ground, sieved 2.0mm with the aid of spatula and weighing bottle. 0.5g of each soil/mill tailing sample was obtained. The digestion was carried out using concentrated nitric (10ml) and concentrated perchloric acids in the ratio of 2:1 and the oven was maintained at 200oC. After one hour, the mixture was allowed to cool before leaching the residue with 5cm3 to 20% HNO3. Digested samples were then filtered and made up to 100ml with de-ionized water. A blank determination was treated in the atomic Absorption spectrometer, but without sample. Solution of samples were taken and aspirated into Unicom 969 Atomic Absorption spectrometer for analyzing metals. At least one reagent blank and one duplicate sample were run as described above for background correction and to verify the precision of the method.

A calibration graph was plotted for each element using measured absorbance and the corresponding concentration. The calibration curve was used to determine the concentration of the metal.

Accuracy was however assessed by analyzing two replicates of certified reference materials, Recoveries were satisfactory, average value being in excess of 90% for Pb, Cu, Zn, As, Mn, Fe, Cd, Cr, Co, Mn and Ni analyzed.

c) Assessment of Heavy Metal Contamination

i. *The contamination factor (CF)*

The level of contamination of soil in metal is expressed in term of a contamination factor calculated as follows (Harikumar, *et al.*, 2009):

$$CF = \frac{C_m\, sample}{C_m\, Background} \quad (1)$$

Where C_m represent the metal concentration in sample and $C_m\, Background$ represent metal concentration. If the contamination factor (CF) < 1 refers to low contamination; $1 \leq CF < 3$ means moderate contamination; $3 \leq CF \leq 6$ indicates considerable contamination and $CF > 6$ indicates very high contamination.

ii. *The Pollution Load Index (PLI)*

The pollution Load Index (PLI) is obtained as contamination factors (CF), the CF is the quotient obtained by dividing the concentration of the metal related to the target area by reference area. The PLI also provide comprehensive information about the metal toxicity in the respective samples. This method was developed by Tomlison (Tomlison, *et al.,* 1980). The PLI of the site are calculated by obtaining the n-root from the n-CFs that was obtained for all the metals as follows (Tomlison, *et al.,* 1980):

$$PLI = (CF_1 \times CF_2 \times CF_3 \times \ldots \times CF_n)^{1/n} \quad (2)$$

Where n represent number of metals studied, CF represent contamination factor and PLI represent pollution load index.

The PLI value of >1 is polluted, where as <1 indicates no pollution (Harikumar, *et al.,* 2009).

iii. *Degree of contamination (DC)*

The degree of concentration (DC) of one determined area is the sum of all contamination factors.

$$DC = \sum CF \quad (3)$$

If $DC < 1$: indicates low concentration

$1 \leq DC < 3$: Indicates moderates contamination

$3 \leq DC < 6$: Indicates considerable contamination

$DC \geq 6$: Indicates Very high contamination (Hakanson, 1980)

III. Results And Discussion

a) Heavy Metal Concentrations

The mean concentrations in (ppm) of the heavy metals (Pb, Fe, Mn, Cu, Zn, As, Cr, Co, Ni, Cd) were analyzed for the mine, mill tailing and control samples respectively. Heavy metals were detected at varying concentrations in the samples. Table 1 presents the mean concentrations of the heavy metals in the mine, mill tailing and control sites with the WHO limit and its toxic response factor. The mean concentrations (ppm) of the studied heavy metals in mine site were calculated to be 429.76±26.202 1707.63±237.78, 181.61±82.38, 90.95±59.42, 37.41±33.30, 17.99±4.53, 93.19±47.39, 47.94±5.71 22.28±6.17, and 3.23±2.07 respectively. For the mill tailing site, the mean concentrations (ppm) of the heavy metals were calculated to be 846.87±100.27, 1914.99±89.06, 177.70±50.51, 739.33 ±337.57, 100.41±41.37, 43.52±7.97, 163.28±39.48, 53.48±2.79, 45.59±18.54, 5.83±0.48 respectively and for the control area, the mean and standard deviations of the concentrations of heavy metals were calculated to be21.40±6.11, 1331.00±142.75, 68.10±23.99, 35.72 ±16.45, 11.91±8.91, 5.73±2.71, 47.85±4.78, 18.17 ±5.65, 14.26±3.26, and 0.23±0.29 respectively.

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Table 1: Mean concentrations of the heavy metals in the mine, mill tailing and control sites with WHO recommended limits and its toxic response factor

Element	Control site	Mine site	Mill tailing site	Toxic response factor	WHO recommended limits
Pb	21.40	429.76	846.87	5.00	100.00
Fe	1331.45	1707.63	1914.99	N/A	N/A
Mn	68.10	181.61	177.70	N/A	N/A
Cu	35.72	90.95	739.33	5.00	30.00
Zn	11.91	37.41	100.41	1.00	300.00
As	5.73	17.99	43.52	10.00	N/A
Cr	47.85	93.19	163.28	2.00	100.00
Co	18.17	47.94	53.48	N/A	N/A
Ni	14.26	22.28	45.59	5.00	80.00
Cd	0.23	3.23	5.83	30.00	3.00

It can be observed from the mean concentrations calculated that the mean concentrations in the mill tailing site were higher than that in the mine site and control area for all of the observed heavy metals in the study area. The Highest concentration corresponds to Fe and the lowest corresponds to Cd. The increasing trend was in the order: Cd <As <Ni <Zn <Co <Cu <Cr <Mn<Pb<Fe. The concentrations of all the observed heavy metals in the mill tailing site were found to be higher than that obtained in the mine site and control area with greater variation in relative abundance of most of the heavy metals. These variations can be attributed to the variable dumping of the mill tailing deposits.

Comparing the results obtained from this study with the World Health Organization guideline on the maximum limits of toxic metals in the soils. Most of the observed heavy metals in the mine site and mill tailing site were observed to have concentrations above the WHO limit, while in the control area the concentrations were below the WHO limit. In the mine site, Pb was observed to have concentration 4 times higher than the recommended WHO limit, Co, was observed to have concentration 2 times higher than the recommended WHO limit, and Cd, was observed to have concentration 1.1 times higher than the recommended WHO limit while in the mill tailing site, Pb was observed to have concentration 8 times higher than the recommended WHO limit, Co, Cd, Ni and Cr were found to have concentrations about 2 times higher than the recommended WHO limit.

b) Contamination Factor (CF)

The contamination factor was used to assess the level of contamination of each element in the studied soils, based on the categories discussed in section 2.3.1, the elemental concentrations could be categorized as follows: in the mine site (i) Pb (14.94) and Cd (13.96) in the very high contamination category (ii) As (3.14) and Zn (3.14) in the considerable contamination category (iii) Mn (2.67), Cu (2.55), Co (2.64), Ni (1.56), Fe (1.28) and Cr (1.95) in the moderate contamination category and for the mill tailing site (i) Pb (39.58), Cu (20.70), Zn (8.43), As (7.61), and Cd (25.17) in the very high contamination category (ii) Cr (3.41) and Ni (3.20) in the considerable contamination category (iii) Fe (1.44), Mn (2.61), and Co (2.94) in the moderate contamination category.

c) Degree of Contamination (DC) and Pollution Load Index (PLI)

The degree of contamination and pollution index was used to assess the overall pollution level of the site resulting from the observed heavy metals. The pollution load index results indicate that the mine site was contaminated with all the observed heavy metals (mean PLI=2.71) and also the pollution load index results indicate that the mill tailing site was contaminated with all the observed heavy metals (mean PLI=5.78). The results of the degree of contamination index indicated that the mine site is in a very high degree of contamination (Mean DC=47.84) and also (Mean DC=115.088) for the mill tailing site respectively as described in sections 2.3.2 and 2.3.3.

IV. Conclusion

Determination of heavy metal pollution of soil and mill tailing samples from the AngwanKawo has been carried out using contamination factor, pollution load index and degree of contamination index. Flame Atomic Absorption Spectrometry (FAAS) were used to obtain their concentrations. The study area was observed to be contaminated with Pb, Fe, Mn, Cu, Zn, As, Cr, Co, Ni, and Cd. These heavy metals have been proved to be toxic to human health. Owing to their possible bioaccumulation, it is advisable that these sites should be subject to mandatory monitoring. Based on the findings of this study, the obtained result showed that the mine and mill tailing sites are seriously accumulated with heavy toxic metals, some of which were found to have high concentration above the WHO worldwide threshold limit. These heavy metals are thus terribly alarming and can cause serious environmental

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problems in the ecosystem of the area. Hence, it is suggested that these sites should be monitored for health related problems so as to minimize the extent of the accumulated pollution level in the area.

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Traditional Approaches on Morbidity and Case Management of Urinary Schistosoma Infection in Rural Communities of Ogun State, Nigeria

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Abstract- Schistosomiasis is considered to be one of the most prevalent neglected tropical disease (NTDs). It is estimated over 240 million people are infected and with about 700 million people are at risk of infection. The sample size of 152 was used to carry out the study. Ten milliliters of urine was centrifuged and the sediments were examined for *Schistosomahaematobium* ova. Data obtained were subjected to analysis using SPSS and chi-square at P< 0.05. Total Sample of 152 urine collected the result shows 33(47.8%) male and 36(52.2%) female at Ibaro and 41(49.4%) male and 42(50.6%) female at Apojula, 69 and 83 respectively for the two communities with no significant difference (p> 0.05). Treatment using traditional approaches (herbs) of which 148(97.4%) has been treated using drugs, herbs and other methods. In the two study communities, the studies shows that people where using *Trichilia emetic* and *Stylosantheserectain Ibaro and Apojula* for treatment of urinary schistosomiasis. The result also shows that roots of*Trichilia emetic* is the most used in the community with32(46.4%), stems 27(39.1%) has an impact on the treatment of urinary schistosomiasis. Traditional method as a case management plays a vital role in the treatment of urinary schistosomiasis in the study area.

Keywords: traditional approaches, morbidity, case management, urinary, schistosomiasis, infection, ogun state, nigeria.

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Traditional Approaches on Morbidity and Case Management of Urinary Schistosoma Infection in Rural Communities of Ogun State, Nigeria

Jonathan, Joseph [α], Andrawus, James [σ] & Akinjobi Rukayat, Omotayo [ρ]

Abstract- Schistosomiasis is considered to be one of the most prevalent neglected tropical disease (NTDs). It is estimated over 240 million people are infected and with about 700 million people are at risk of infection. The sample size of 152 was used to carry out the study. Ten milliliters of urine was centrifuged and the sediments were examined for *Schistosomahaematobium* ova. Data obtained were subjected to analysis using SPSS and chi-square at P< 0.05. Total Sample of 152 urine collected the result shows 33(47.8%) male and 36(52.2%) female at Ibaro and 41(49.4%) male and 42(50.6%) female at Apojula, 69 and 83 respectively for the two communities with no significant difference (p> 0.05). Treatment using traditional approaches (herbs) of which 148(97.4%) has been treated using drugs, herbs and other methods. In the two study communities, the studies shows that people where using *Trichilia emetic* and *Stylosantheserectain Ibaro and Apojula* for treatment of urinary schistosomiasis. The result also shows that roots of *Trichilia emetic* is the most used in the community with32(46.4%), stems 27(39.1%) has an impact on the treatment of urinary schistosomiasis. Traditional method as a case management plays a vital role in the treatment of urinary schistosomiasis in the study area.

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I. Introduction

Schistosomiasis is a parasitic infection caused by digenetic blood trematode worms of the family *Schistosomatidae*, is one of the most prevalent neglected tropical diseases (NTDs) and still considered as a major public health ravaging 77 developing countries in the tropics and subtropics [22]. Nigeria has a higher number of cases of schistosomiasis worldwide [9], with about 29 million infected people, among which 16 million are children, and about 101 million people are at risk of schistosomiasis [20, 8, 1, 22]. Water related activities such as harvesting hippo grass, fishing, washing clothes, washing utensils, bathing and fetching water from rivers or streams and open air defecations were observed to be risky behavior practices that enhanced disease transmission [4, 21,15,11,23, 13, 6, 2, 5,14, 16, 10, 12]. Looking a way forward towards justifying the menace of Schistosoma infections among rural endemic communities, traditional method were employed such as the use of herbs in treating Schistomiasis. Ethnobotany and ethno-medical studies are today recognized as the most viable methods of identifying new medicinal plants or refocusing on those earlier reported for bioactive constituents [7]. Plants have been of immense value to human health and roughly eighty percent (80%) of the world's populations rely on them for cure of various ailments [17]. The continual search for natural plant products used as medicines has acted as a catalyst leading to the widespread use of traditional medicinal practices today, are an important part of the primary health care delivery system in most of the developing world [3]. A study on South African medicinal plants revealed the efficiency of 21 plant species against schistosomula worms [18]. *Ricinus com-munis* leaf in association with *Capparistomentosa* leaf; *Trichiliaemetica* root in association with Afromomumlatifolium fruit and Zyziphusmucronata root bark in association with *Stylosantheserecta* whole plant were also reported to be used against urinary schistosomiasis [24]. This study highlighted on the knowledge and prevalence of Schistosoma infection and traditional approaches on morbidity and case management of urinary schistosoma infection in rural communities of Ogun State, Nigeria.

a) Research Method

i. Description of the study location

This study was carried out at Ibaro Oyan and Apojola community area of Abeokuta, located at the Ogun State, South-Western Nigeria. It is within longitude 7° 7′ 34.5″ North and 3°8′ 99.8″ east. Major occupation of people of these communities is fishing and farming, trading activities.

ii. Ethical Approval

Ethical approval was gotten from the Ogun State Ministry of Health, and from College of Biological Sciences, Federal University of Agriculture, Abeokuta.

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iii. *Informed Consent*

Before the study began, the village heads together with the people of the communities were fully briefed on the objectives of the study.

iv. *Data Collection*

A structured questionnaire was used in collection of data required for the study. This contains questions on knowledge, attitude and practice which includes traditional in treatment of the infection.

v. *Urine Collection*

Dark (black), sterile, plastic universal containers (labeled) were given to the people both Children and Adult to collect urine samples. This was done between the hours of 10.00 am to 2.00 pm. The urine collected was taken to the laboratory for analysis. Each sample collected was visually examined for the presence of visible blood in urine.

vi. *Examination of Urine for Haematuria*

A reagent strip Medi-test Combi 9 was carefully dipped into the dark sterile bottle containing the urine for 5 seconds. The strip was drawn across the rim of the container to remove excess urine. After 30 to 60 seconds, the resulting change in color of the strip was compared with the manufacturers colour chart to estimate amount of blood in the urine. Each sample collected was visually examined for the presence of haematuria.

vii. *Examination for Schistosoma Haematobium Egg*

Ten (10) millitres of the urine sample was centrifuged at 2500 rpm for 10 minutes to separate the *Schistosomahaematobium* ova from the urine. The supernatant was discarded to leave sediment which was transferred to the centre of a clean grease-free glass slide. This was mounted on a light microscope and examined at x 10 and x 40 objectives to identify *a Schistosomahaematobium ovum which is* characterized with a terminal spine.

viii. *Statistical analysis of data*

The data was entered and analysed using SPSS version 20.0 for Windows. The questionnaire was analysed on Microsoft word excel using chi square.

II. Result

A total of 152 people from the two communities were enrolled for the study (69 people from Ibaro and 83 people from Apojola) submitted their urine samples for analysis. The age range of the participants was from 1-22 years above from both communities (Table 1). The prevalence in demographic information in respondents showing more female participated in the study than male in both communities with female 13(41.9%) and 31(63.3%) and male 18(58.1%) and 18(36.7%) were tested positive at Ibaro and Apojula communities respectively. The school aged children of 5-13 years had high number of population that participated in the study with 22(71.0%) and 20(40.8%) were tested positive. The major occupation of both communities are into fishing and farming, in the study high number of people are into fishing and 23(74.2%) and 39(79.6%) were tested positive in Ibaro and Apojula communities with no significant difference ($p>0.05$).

Table 1: Demographic information of respondents and the prevalence of infection

Location	Ibaro			Apojula		
	Positive	Negative	Total	Positive	Negative	Total
Sex						
M	18(58.1)	15(39.5)	33(47.8)	18(36.7)	23(67.6)	41(49.4)
F	13(41.9)	23(60.5)	36(52.2)	31(63.3)	11(32.4)	42(50.6)
		P-value 0.151			P-value 0.007	
Age						
1-4	3(9.7)	8(21.1)	11(15.9)	10(20.4)	10(29.4)	20(24.1)
5-13	22(71.0)	22(57.9)	44(63.8)	20(40.8)	10(29.4)	30(36.1)
14-22	1(3.2)	4(10.5)	5(7.2)	8(16.3)	6(17.6)	14(16.9)
<22	5(16.1)	4(10.5)	9(13.0)	11(22.4)	8(23.5)	19(22.9)
		P-value 0.319			P-value 0.699	
Occupation						
Fishing	23(74.2)	26(68.4)	49(71.0)	39(79.6)	27(79.4)	66(79.5)
Farming	2(6.5)	1(2.6)	3(4.3)	8(16.3)	5(14.7)	13(15.7)
Others	6(19.4)	11(28.9)	17(24.6)	2(4.1)	2(5.9)	4(4.8)
		P-value 0.524			P-value 0.621	

(n=152)

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a) *Knowledge and Prevalence of Schistosomiasis and the Exposure to Source of Infection*

Table 2: Shows the knowledge and prevalence of schistosomiasis and the exposure to source of infection. At Ibaro and Apojula 51(73.9%) and 80(96.4%) visit the stream, 18(26.1%) and 3(3.6%) do not visit the stream, 20(64.5%) and 48(98.0) were tested positive in both communities. This table shows that some visit the stream daily, weekly and occasionally. At Ibaro high percentage visit rivers daily with 54(78.3%) and 26(83.9%) were tested positive while at Apojula high percentage visit rivers weekly of which 26(53.1%) tested positive with no significant difference ($p>0.05$). At Ibaro and Apojula community 60(87.0%) and 65(78.3%) have seen blood in their urine, 7(10.1%) and 32(38.6%) experience painful urination, 2(2.9%) and 18(21.7%) have not experience blood in their urine. Information on schistosoma infection in the communities shows that Ibaro and Apojula83(100%), 68(81.9) heard about the disease and 15(18.1%) have no idea of the infection.

Table 2: Prevalence of *Schistosomiasis* and the exposure to source of infections

Location	Ibaro			Apojula		
Positive		Negative	Total	Positive	Negative	Total
Do you visit stream?						
Yes	20(64.5)	31(81.6)	51(73.9)	48(98.0)	32(94.1)	80(96.4)
No	11(35.5)	7(18.4)	18(26.1)	1(2.0)	2(5.9)	3(3.6)
		P-value	**0.048**		**P-value**	**0.631**
How often do you visit river?						
Daily	26(83.9)	28(73.7)	54(78.3)	22(44.9)	11(32.4)	33(39.8)
Weekly	0(0.0)	3(7.9)	3(4.3)	26(53.1)	23(67.6)	49(59.0)
Occasionally	5(16.1)	7(18.4)	12(17.4)	1(2.0)	0(0.0)	1(1.2)
		P-value	**0.331**		**P-value**	**0.563**
Do you heard of Scistosomiasis?						
Yes	30(96.8)	37(97.4)	67(97.1)	26(76.5)	42(85.7)	68(81.9)
No	1(3.2)	1(2.6)	2(2.9)	8(23.5)	7(14.5)	15(18.1)
		P-value	**0.707**		**P-value**	**0.542**
Have you seen blood in your urine?						
Yes	31(100.0)	38(100.0)	69(100.0)	38(77.6)	27(79.4)	65(78.3)
No	0(0.0)	0(0.0)	0(0.0)	11(22.4)	7(20.6)	18(21.7)
		P-value	**0.707**		**P-value**	**0.542**

(n=152)

b) *Mean Intensity of Schistosoma Haemato-biumInfection*

Table 3 Showing intensity rates of the infections among population in both communities which seen in both male and female which is more in the age group of 5-13 years which are the school aged children. The female has more light infection than male 35(52.2%) and 32(46.4%) and 1(50.0%) and 10(71.4%) with heavy infection from Ibaro and Apojula with no significant difference ($p>0.05$).

Table 3: Mean Intensity of *Schistosomahaematobium* Infection

Location		Ibaro			Apojula		
		Light	Heavy	**Total**	Light	Heavy	**Total**
Sex	Male	32 (47.8)	1 (50.0)	33 (47.8)	37 (53.6)	4 (28.6)	41 (49.4)
	Female	35 (52.2)	1 (50.0)	36 (52.2)	32 (46.4)	10 (71.4)	42 (50.6)
			P-value	**1.000**		**P-value**	**0.141**
Age	1-4	11 (16.4)	0 (0.0)	11 (15.9)	18 (26.1)	2 (14.3)	20 (24.1)
	5-13	42 (62.7)	2 (100.0)	44 (63.8)	25 (36.2)	5 (35.7)	30 (36.1)
	14-22	5 (7.5)	0 (0.0)	5 (7.2)	11 (15.9)	3 (21.4)	14 (16.9)
	<22	9 (13.4)	0 (0.0)	9 (13.0)	15 (21.7)	4 (28.6)	19 (22.9)
			P-value	**0.760**		**P-value**	**0.773**

(n=152)

P-value < 0.05 means there is significant difference while p-value > 0.05 means there is no significant difference. Light infection is egg count less than 50 per 10ml (1-49 eggs/10ml) while heavy infection is greater than/equal to 50 eggs per 10 ml of urine (>=50 eggs/10 ml)

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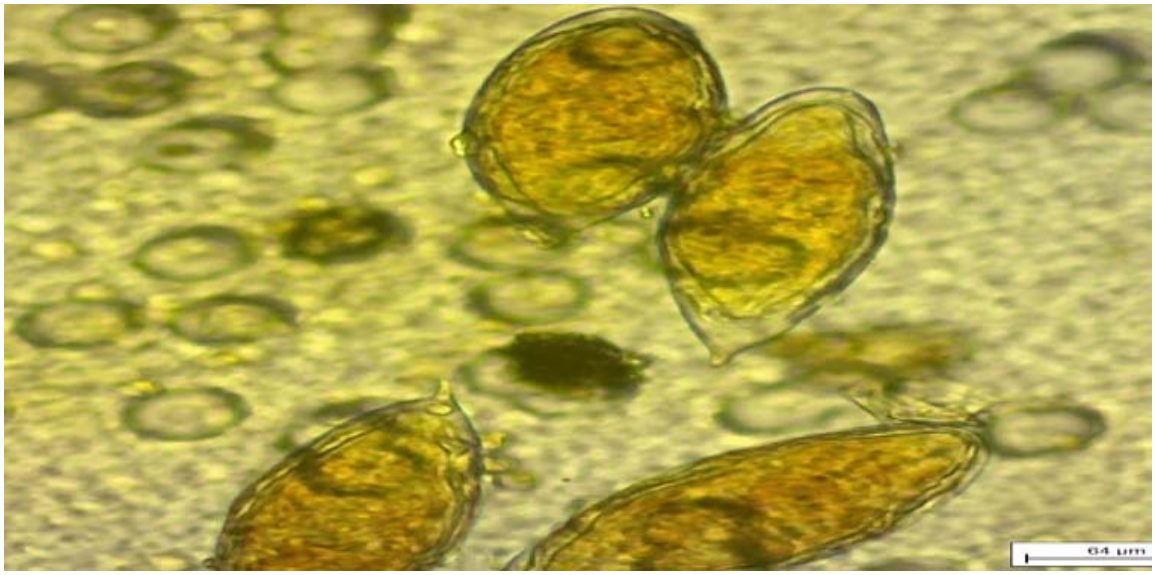


Plate 1: A *Schistosomahaematobium* ova observed from an infected person Magnification: x40

c) Knowledge of Respondents on Treatment Methods

Table 4 below shows the knowledge of respondents from both communities which indicates that 123(80.9%) people is not totally ignorance of schistosomiasis as a serious disease and 26(17.1%) agreed that it is not a serious disease of which 148(97.4%) has been treated using drugs, herbs and other methods. In the two study communities, the studies shows that people where using *Trichilia emetic*and *Stylosantheserectain Ibaro and Apojula* for treatment of the schistosomiasis. The result also shows that roots of *Trichilia emetic*is the most used in the community with 32(46.4%) and stems 27(39.1%), Whiles *Stylosantheserecta* and Hospital/MDAs are the most promised with 12 (14.5%) and 57 (68.7%) in Apojula. Effective medication period is 15 days by sucking in water as majorly practice traditionally in Apojula with 27 (32.5%) and raw consumption of with 26 (31.3%).

Table 4: Knowledge of respondents on types of herbs use and methods of treatment

Location		Ibaro	Apojula	Total
Schistosomiasis is a serious disease	Yes	61 (88.4)	62 (74.7)	123 (80.9)
	No	8 (11.6)	18 (21.7)	26 (17.1)
	I don't know	0 (0.0)	3 (3.6)	3 (2.0)
What herbs do you use for treatment?	*(Herbs)*	*Trichiliaemetic*	*Stylosantheserecta*	
	(L)	0(0.0)	6 (7.2)	6(3.9)
	(R)	32 (46.4)	12 (14.5)	44 (28.9)
	(S)	27 (39.1)	3 (3.6)	30 (19.7)
	(Se)	0(0.0)	5(6.0)	5(3.3)
	Hospital/MDAs	10 (14.75)	57 (68.7)	67 (44.1)
Effective medication period	(T)	(1/4L, 15 days)	(1/4L, 15 days)	
	Leaves	0 (0.0)	5 (6.0)	5 (3.3)
	Dry root/suck in water	15 (21.7)	27 (32.5)	42 (27.6)
	Raw consumption	1 (1.4)	26 (31.3)	27 (17.8)
	Others	0 (0.0)	10 (12.0)	10 (6.6)
Experience infection after use of herbs	Yes	67 (97.1)	67 (80.7)	134 (88.2)
	No	2 (2.9)	16 (19.3)	18 (11.8)
	Total	69 (100.0)	83 (100.0)	152 (100.0)

(n=152)
L: Leaves, R: Roots, S: Stems, Se: Seeds, T: TimeA

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III. Discussion

The result shows that the highest prevalence rate was found among the female of both communities. There was no significant difference in the sex in both communities to the infection ($p>0.05$).However, this study agrees with some findings carry out in the southern parts of Nigeria which showed that females have a higher prevalence of urinary schistosomiasis than males [25] and [26]. The reason for this is that women are mostly involved in activities known to favour infection due to their gender-assigned responsibilities which include fetching, bathing, religious act, washing these activities are done majorly by the females which probably makes the female has higher chance of infection.

The prevalence of the disease did not increase significantly with the age ($p>0.05$). This implies that the infection among population in both communities is not age specific. It confirms that the infection could be acquired through water contact activities. The knowledge, attitude and practices are high in both communities in which high population.

The result of this study show that population of both communities has the knowledge of traditional approaches in managing the disease due to no constant of mass administration of medicines (MAMs) in the communities. Findings shows that population in Ibaro communities uses *Trichiliaemetic and Stylosantheserecta* as a traditional approach in treatment of the infection and Arshe, a local name called by the Udoma people of Benue state. These traditional methods can be done using different methods in preparation of the herbs examples, boiling, drying, raw consumption etc. The result of the study on plant herbs shows that the root and stem of *Trichilia emetic* has great effect on the treatment of urinary schistosomiasis and whole plant of *Stylosantheserecta* this research work agreed with [24] where he confirms that extracts of *Trichiliaemetica* root in association with *Stylosantheserecta* whole plant has great effects against urinary schistosomiasis.

After treatment using herbs high number of population experience the infection again due to probably re-infection or constant exposure to source of infection. Since both communities are aware of the infection, there is need for the communities to be enlightened more on the dangers of re-infection. Lack of proper water supply was observed in both communities and lack of understanding of mode of transmission of the disease.

IV. Conclusion

This study concluded that traditional methods as case management play a vital role in the treatment of infection in the study area. Looking a way forward towards extenuating the menace of Schistosoma infections, traditional method and Ethnobotany and ethno-medical studies should be acknowledged as the most viable methods of identifying new medicinal plants or refocusing on those earlier reported for bioactive constituents. Plants have been of immense value to human health and roughly eighty percent (80%) of the world's populations rely on them for cure of various ailments. The continual search for natural plant products used as medicines, has acted as a catalyst leading to the widespread use of traditional medicinal practices today in most of the developing world.

Recommendations

Collaborative effort between the government and the community are required to reduce water contact behaviors that results in the transmission of urinary schistosomiasis. To make this feasible, health education should repairs all damages boreholes and provides availability of alternative sources of clean and safe water are recommended to complement ongoing efforts to control schistosomiasis and traditional method should be acknowledged as the most viable methods of identifying new medicinal plants in the study communities and other endemic communities of Sub-Saharan Africa.

Abbreviations

L: Leaves, R: Roots, S: Stems, Se: Seeds, T: Time

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Water Quality Control of the Southern River Water in the Territory Town of Vranja

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Academy of Technical Studies

Abstract- The South Morava River is very important for the City of Vranje because it serves for irrigation of agricultural land, so its water quality is of great importance. Water quality control in the South Morava is done on a monthly basis by chemical and physical methods. Controlling is done at two measuring points from which the samples are taken, namely the village of Mezgraje, near the Railway Bridge, and the site of Marble Novo Selo. Tests of water samples from the South Morava River included determination of: general parameters, nutrients, salinity, organic substances and microbiological parameters. Measured values of the investigated physicochemical parameters at the sampling location at Mezgraja village level, with the Railway Bridge, dominantly correspond to class I except for BOD5 corresponding to class V, HPC corresponding to class IV, TOC, phenolic compounds and total nitrogen corresponding to class II, nitrites, ortho-phosphates, ammonium ion, Class III copper and iron content. At the same location, the measured values of microbiological parameters correspond to Class IV. The South Morava from the physico-chemical aspect has a mixed excellent to poor ecological status, while from a microbiological point of view it has a moderate ecological status at Mramor (Novo Selo) or poor ecological status at the level of the village of Mezgraja, at the Railway Bridge. The results of the water quality control tests show that the water is nutrient-poor and has microbiological parameters present in MPN / 100 ml.

Keywords: *quality control, south morava, testing.*

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Water Quality Control of the Southern River Water in the Territory Town of Vranja

Jelena Markovic

Abstract- The South Morava River is very important for the City of Vranje because it serves for irrigation of agricultural land, so its water quality is of great importance. Water quality control in the South Morava is done on a monthly basis by chemical and physical methods. Controlling is done at two measuring points from which the samples are taken, namely the village of Mezgraje, near the Railway Bridge, and the site of Marble Novo Selo. Tests of water samples from the South Morava River included determination of: general parameters, nutrients, salinity, organic substances and microbiological parameters. Measured values of the investigated physicochemical parameters at the sampling location at Mezgraja village level, with the Railway Bridge, dominantly correspond to class I except for BOD5 corresponding to class V, HPC corresponding to class IV, TOC, phenolic compounds and total nitrogen corresponding to class II, nitrites, ortho-phosphates, ammonium ion, Class III copper and iron content. At the same location, the measured values of microbiological parameters correspond to Class IV. The South Morava from the physico-chemical aspect has a mixed excellent to poor ecological status, while from a microbiological point of view it has a moderate ecological status at Mramor (Novo Selo) or poor ecological status at the level of the village of Mezgraja, at the Railway Bridge. The results of the water quality control tests show that the water is nutrient-poor and has microbiological parameters present in MPN / 100 ml.

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Izvod- Reka Južna Morava je veoma važna za Grad Vranje zato što služi za navodnjavanje poljoprivrednih površina, pa je od velikog značaja njen kvalitet vode. Kontrolisanje kvaliteta vode u Južnoj Moravi radi se na mesečnom nivou hemijskim i fizičkim metodama. Kontolisanje se radi na dva merna mesta sa kojih se uzimaju uzorci, to su selo Mezgraje, kod Železničkog mosta, i mesto Mramora Novo Selo. Ispitivanja uzoraka vode iz reke Južne Morave obuhvatala su određivanje: opštih parametara, nutritijenata, salinitet, organske supstance i mikrobiološke parametre. Izmerene vrednosti ispitivanih fizčko -hemijskih parametara na lokaciji uzorkovanja u nivou sela Mezgraja, kod Železničkog mosta dominatno odgovoraju I klasi osim za BPK5 koji odgovara V klasi, HPK, koji odgovara IV klasi, TOC, fenolna jedinjenja i ukupan azot koji odgovaraju II klasi, nitriti, ortofosfati, amonijum jon, sadržaj bakra i gvožđa koji odgovaraju III klasi. Na istoj lokaciji izmerene vrednosti mikrobioloških parametara odgovaraju IV klasi. Južna morava sa fizičko-hemijsko apspekta ima mešovit odličan do loš ekološki status dok sa mikrobiološkog aspekta ima umeren ekološki status kod Mramora (Novo Selo) odnosno slab ekološki status u nivou sela Mezgraja, kod Železničkog mosta. Rezultati ispitivanja kontrole kvaliteta vode pokazuju da je voda siromašna nutrijentima, a da ima mikrobioloških parametara koji su prisutni u MPN/100 ml.

Ključne reči: kontrola, kvalitet, južna morava, ispitivanje.

I. Introduction

South Morava is a river in Serbia that is the shorter of the two rivers that make up the Big Morava, 295 km long and flows mainly south-north, from the Macedonian border to central Serbia, where it meets the West Morava near Stalac and creates the Great Morava Much of this river flows through Pcinja district nd is of great importance for agricultural land in the territory of the City of Vranje. Due to the great erosion in its basin, the South Morava is rich in huge amount of material deposited in the river bed. [14]Enough clean water with the conservation of aquatic life is the basis of human survival on Earth. Therefore, constant monitoring of water quality is one of the prerequisites for initiating adequate protection actions. All water protection measures can be divided into three groups: elimination of causes of pollution; reducing the amount of harmful substances; special water purification measures. Surface water pollution is a direct consequence of the following elements: insufficient coverage of the sewage system in the area of the City of Vranje, suburban settlements and in the territory of rural settlements, discharge of untreated municipal, industrial and agricultural wastewater by concentrated and scattered pollutants, free flow of water through the terrain into ditches, water wells and their removal into technically and sanitary improperly constructed septic tanks. [2]Large surface water pollution occurs after the discharge of industrial wastewater containing high concentrations of ammonia, nitrite, nitrate and other organic matter into the watercourses, leading to an immediate reduction of oxygen concentration in the water and the risk of aquatic organisms. A particular problem is the so-called wild landfills on the banks of the South Morava. [1]Such landfills are mostly stationed near rural settlements and their number is not negligible. In addition to wild landfills near South Morava, it is also common to dump solid waste and empty rural pits, which greatly affects water quality. Although garbage disposal sites are designated in some villages, locals still dump large amounts of waste into the river. Because of all this, it can be said that the environmental awareness of the locals is still at a very low level [15]. In

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order to use water from rivers for agricultural land, water should be as low as possible. [13]. In his paper, Spuler states that the importance of crop production. Neither the banks of the Vranjska and Sobinska rivers in the city center of Vranje were spared trash. A particular problem is municipal wastewater. Measurement of water quality of the South Morava River in the territory of the Municipality of Vranje is carried out at 8 measuring points in four quarterly periods. Monitoring of surface water quality that determines quality is in accordance with the Law on Waters (Official Gazette of the RS, Nos. 30/10 and 93/12) and the relevant by-law or Decree on limit values of pollutants in surface and groundwater and sediment and deadlines to reach them (Official Gazette RS 50/12). Surface water control is very important, because of its sustainability [12] and thherefore their control is important. This paper presents the results of measuring the quality of water from the South Morava River at two measuring points.

Saprobiological analyzes of the phytobenthos community, at all profiles and at all study periods, show that the watercourse is loaded with moderate organic pollution. The obtained values of the saprobability index according to ZelinkaMarvan, on the profiles Ristovac and Vladicin Han, corresponded to the III class of water quality.

II. Materials and Methods

Water purification is done in two ways: precipitation and filtration. If the turbid water is allowed to stand for some time, the particles contained therein will fall slightly to the bottom. Larger and heavier particles will fall faster than smaller particles. It's a deposition. The filtration is carried out in such a way that the water is poured through a filter paper on which the impurity particles are retained as the pure water passes. In nature, water passes through layers of sand and gravel that are natural filters. All the dirty particles are left behind, which makes the spring water clear.[7] In cities, water is usually taken from rivers, so it must be treated before use. This is done in plumbing where precipitation is first done, then filtered, and then chlorine is added to the water to destroy contagious germs. Thus purified water can be used for drinking.

Water containing some solutes is purified by distillation (seawater - salt). Distilling water involves heating it to boiling, collecting water vapor and cooling it. Condensation of water vapor produces distilled water. In situations where we are not sure that the water we use to drink is of satisfactory quality, or where there is a possibility of contamination with something, the most appropriate method for purification is cooking. Boiling for a few minutes destroys pathogenic organisms so that after cooling such water can be used for drinking. To improve its taste, aeration of boiled water should be carried out - pouring from one vessel to another several times. Bacteriological purification of water can be done by leaving the water tank to stand in the sun for some time, so that the ultraviolet rays will destroy the biological pollutants.

In addition to active forms of protection, waterways are protected by appropriate legal means. National and international laws today restrict the discharge of waste into the sea and inland waters. However, they can hardly force people not to. [3]Therefore, raising the level of general awareness of the importance of water for the survival of man is of paramount importance. The wastewater treatment process is divided into: primary, secondary and tertiary treatment.

The primary phases involve the use of certain mechanical agents (grates, sedimentation, flotation) whereby most suspended solids are removed from the water. Secondary phases include the removal of solid particles from inorganic salts. In the tertiary phase, dissolved inorganic compounds (nitrates, phosphates) and biodegradable compounds are removed.

As the water pollution process itself is difficult to prevent, the protection of water is primarily aimed at reducing the impact of wastewater, at best, completely eliminating any impact. This is done through general environmental measures (work actions, environmental activism) as well as through water-specific measures (educating individuals on the importance of water to planet Earth) [9].

a) Purification and conditioning of drinking water

By improving the quality, water must be brought to the level of hygiene. For water to be used for drinking, it must fit the first or second class at the grasp. Mechanical, physical, chemical and biological methods are used for quality repair. [6]Reasons for improving water quality are organoleptic, health and technological. There are a number of processes used for quality repair, the most common being: oxidation, reduction, deferrization, demanganization, removal of phenol, sedimentation, aeration, filtration, coagulation, flocculation, flotation, adsorption, biological flocculation and precipitation, removal of water hardness, disinfection and fluoridation. These methods are combined as needed. Grates and sieves with meshes of 5 to 50 mm are used to remove large objects from the water.

Water disinfection is a process by which mechanical, physical or chemical processes significantly reduce the total number of microorganisms and destroy pathogenic microorganisms in drinking water. Mechanical procedures for water disinfection are filtration through: semi permeable membrane, unglazed porcelain filters, silver filters and biological membranes.

Physical procedures are the application of high temperature (cooking), the application of UV rays and ozone. Chemical methods of disinfection are the

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application of halogen elements (chlorine and chlorine preparations and iodine).

Cooking is the simplest method to disinfect small amounts of water. It is enough for the water to boil for 10 to 60 minutes. The disadvantage of this method is that when it is boiled, water loses oxygen, bicarbonates precipitate and water changes flavor - it becomes vomit. UV Disinfection - UV rays from 215 to 280 nm in wavelength are very effective in destroying pathogenic bacteria and their sporogenic forms. For successful disinfection in this way, the water must be clear, in a thin layer (up to 10 cm) and at a maximum distance of 20 cm from the UV lamp. This process is used in mineral water production.

Ozone disinfection is based on its strong oxidizing properties. Due to the way ozone is produced (air leakage through the high voltage field), this process is very expensive. The effect of ozone disinfection is very good - it oxidizes organic matter, iron, manganese phenols, etc. Its disadvantage is that it has no residual effect.

Chlorine Water Disinfection - In order to successfully monitor the effect of chlorine in the process of disinfection of drinking water and swimming pools, it is necessary to know its physical and chemical properties as well as its pathophysiological and microbiological action

Mechanical procedures are used for the disinfection of small amounts of water and in cases where the addition of chlorine or other disinfectants is not possible (mineral waters which retain the original composition).

Under normal conditions chlorine is a yellowish-greenish gas. One liter weighs 3,220 grams. Its critical temperature is 144 degrees. Below this temperature chlorine can go into a liquid state at a pressure of 4 at. at 0 degrees, and at 6 at. at 20 degrees. The boiling point is 34 degrees and the specific gravity is 1.45. The solubility of chlorine at 20 degrees is 7.4 grams, at 0 degrees 14.0 grams, at 10 degrees 9.5 grams and at 40 degrees 4.5 grams. Chlorine is a very reactive element and its reactivity is particularly high in the presence of water. When added to water, it first binds to organic matter and is consumed by the oxidation of iron and manganese. Residual chlorine forms residual chlorine in water. The amount of chlorine required to oxidize organic matter in water is called water requirement for chlorine or chlorine number. After a contact time of 30 minutes, residual chlorine is determined and the amount of chlorine met by the water requirements for chlorine. and types of microorganisms). The most important methods are: normal chlorination, pre-chlorination, fractional chlorination, hyperchlorination, chlorination at the breaking point, chlorination.

Normal chlorination is applied to clean, pre-treated (precipitation, filtration, etc.) waters. Most often it is done with an amount of 1 mg / l chlorine. Pre-chlorination is the process of adding chlorine to the water before the required treatment (precipitation, coagulation, filtration). This, by oxidizing organic matter and destroying microorganisms and algae, prepares the water for further treatment. This eliminates the unpleasant odor and taste from drinking water.

Fractional chlorination (double chlorination) is the addition of chlorine before and after filtration.

Hyperchlorination is carried out in highly polluted waters which cannot be disinfected by any other method. 2 to 5 mg / l of chlorine or more is added and contact time is extended (longer than one hour).[4]

Chlorination is a method of disinfecting water with chloramines that have a good effect but due to the slow action, a longer contact time is required. This method is used to disinfect the water that is stored and stored for long periods in large tanks. Chlorinators and hypochlorinators are used for the permanent chlorination of drinking water.[4]

III. Result

Water quality testing of the South Morava River is carried out on several profiles, of which Ristovac and Vladicin Han are located in the territory of the Pcinja District. During sampling on the Ristovac profile, the change of organoleptic properties of water was occasionally noted, that is, the water had a slightly noticeable color. The values of dissolved oxygen and the percentage of water saturation with oxygen O_2 occasionally in the Ristovac profile corresponded to the III class of water quality (deficit-supersaturation). For the water qualitz of the Ristovac profile it can be said that the climate conditions are not so good, because the relief and geographical location depend on the slope of the inlet of industrial waters that will enter the river and affect its pollution. [11] In mz work, Mcintzre attaches great importance to linking river and river pollution with climatic conditions. By monitoring the quality of surface water for 2017/2018, a sample of water from the South Morava River flowing in the territory of the City of Vranje was sampled in two places: at the level of the village of Mezgraja, at the Railway Bridge, near Mramor (Novo Selo). The measurement results are presented in tables in Tables 1.

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Table 1: Measured values with measurement uncertainty in samples from the South Morava River and limit values

Sampling Location		By The Marmole	Mezgraja-Code Railway Bridge	Limit Values, By Class				
Sample Identification Number	Unit	- 2202/17 249	2202/17-248	I	Ii	Iii	Iv	V
PARAMETER		Rez ±MN	Rez ±MN					
Water temperature	°C	6,6 ±0,3	7,1 ±0,4	/	/	/	/	/
A noticeable color		bez	bez	/	/	/	/	/
GENERAL PARAMETERS								
pH		7,39 ±0,44	7,86 ±0,47	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	<6.5 ili>8.5
Suspended mat.	mg/L	22 ±5	24 ±5	25	25	-	-	-
Dissolved oxygen	mgO_2/L	8,01 ±1,84	8,06 ±1,85	8,5	7	5	4	<4
Oxygen saturation	%	83 ±0,83	82 ±0,82	70-90	50-70	30-50	10-30	<10
BPK5	mgO_2/L	66 ±17	24 ±6	1,8	4,5	7	25	>25
HPK	mgO_2/L	103 ±26	37 ±9	10	15	30	125	>125
Total organic carbon (TOC)	mg/L	5,9 ±1,3	3,9 ±0,9	2	5	15	50	>50
NUTRIJENTI								
Total nitrogen	mgN/L	1,60 ±0,40	1,77 ±0,44	1	2	8	15	>15
Nitrates	mgN/L	<0,4 ±/	<0,4 ±/	1,5	3,0	6	15	>15
Nitrites	mgN/L	0,07 ±0,01	0,07 ±0,01	0,01	0,03	0,12	0,3	>0.3
Ammonium ion	mgN/L	0,195 ±0,030	0,320 ±0,050	0,05	0,1	0,6	1,5	>1.5
Total phosphorus	mgP/L	0,072 ±0,012	0,047 ±0,008	0,05	0,20	0,4	1	>1
Orthophosphates	mgP/L	0,221 ±0,035	0,144 ±0,023	0,02	0,1	0,2	0,5	>0,5
SALINITY								
Chlorides	mg/L	15,6 ±4,1	14,9 ±3,9	50	150	200	250	>250
Total chlorine residual	mg/L HOCl	<0,005 ±/	<0,005 ±/	0,005	0,005	-	-	-
Sulphates	mg/L	6 ±1	8 ±1	50	100	200	300	>300
Total mineralization	mg/L	150 ±17	245 ±67	<1000	1000	1300	1500	>1500
Electroconductivity at 20°C	µS/cm	274 ±37	270 ±36	$<1{\cdot}10^6$	$1{\cdot}10^6$	$1{,}5{\cdot}10^6$	$3{\cdot}10^6$	$>3{\cdot}10^6$
Total hardness (as $CaCO_3$)	mg/L	166 ±33	198 ±40	/	/	/	/	/
ORGANIC SUBSTANCE								
Phenolic compounds	µg/L	<2 ±/	<2 ±/	<1	1	20	50	>50
Total hydrocarbons	µg/L	280 ±110	700 ±300	/	/	/	/	/
PAM	µg/L	<30 ±/	<30 ±/	100	200	300	500	>500
METALS								
Arsenic	µg/L	< 0,05 ±/	< 0,05 ±/	<5	10	50	100	>100
Bor	µg/L	< 50 ±/	< 50 ±/	300	1000	1000	2500	>2500
Copper	µg/L	37 ±11	45 ±14	40	40	500	1000	>1000
Zinc	µg/L	149 ±49	137 ±45	300	1000	2000	5000	>5000
Chrome	µg/L	< 8 ±/	< 8 ±/	25	50	100	250	>250
Iron	µg/L	670 ±170	610 ±160	200	500	1000	2000	>2000
Manganese	µg/L	28 ±7	< 3 ±/	50	100	300	1000	>1000
Lead	µg/L	< 6 ±/	< 6 ±/	/	/	/	/	/
Cadmium	µg/	< 5 ±/	< 5 ±/	/	/	/	/	/
Nickel	µg/	< 3 ±/	< 3 ±/	/	/	/	/	/
MICROBIOLOGICAL PARAMETERS								
Total coliform	MPN/100	400	200	500	10 000	100	1 000	>1000 000

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bacteria	ml					000	000	
Fecal coliform bacteria	MPN/100 ml	400	200	100	1 000	10 000	100 000	>100 000
Fecal streptococci	MPN/100 ml	670	24 000	200	400	4 000	40 000	>40 000
Aerobic heterotrophic bacteria	cfu/ml	18 300	20 000	500	10 000	100 000	750 000	>750 000

IV. Discussion

The conclusions reached were as follows: The measured values of the tested physicochemical parameters at the sampling site at Marble (Novo Selo) dominantly correspond to class I except for BOD5 corresponding to V class, HPK, orthophosphates corresponding to IV class, TOC, ammonium ion and content iron corresponds to class III, total nitrogen, total phosphorus, phenolic compounds correspond to class II. At the same location, the measured values of microbiological parameters correspond to class III. Measured values of the investigated physicochemical parameters at the sampling location at Mezgraja village level, with the Railway Bridge, dominantly correspond to class I except for BOD5 corresponding to class V, HPC corresponding to class IV, TOC, phenolic compounds and total nitrogen corresponding to class II, nitrites , orthophosphates, ammonium ion, Class III copper and iron content. At the same location, the measured values of microbiological parameters correspond to Class IV. Based on the above, in accordance with the Decree on Limit Values of Pollutants in Surface and Groundwater and Sediment and Deadlines for their Reach (Official Gazette RS 50/12), it is concluded that the South Morava from the physico-chemical aspect has a mixed excellent to poor ecological status, while from a microbiological point of view, it has a moderate ecological status at Mramor (Novo Selo), ie poor ecological status at the level of the village of Mezgraja, at the Railway Bridge.

The requirements for water quality are different and depend on the purpose for which the water is to be served. If the water in the rivers is polluted, then many plant and animal species may disappear and biodiversity will be destroyed. In their work, [10] Campbell is committed to preserving biodiversity, different practices. One of the procedures he mentions is the restoration of water by special pollination methods. Drinking water must be drinkable and hygienic in order to protect human and animal health. Drinking water is water that is colorless, clear, odorless, fresh in taste, with temperatures between 7 and 12°C above zero. The turbid water, with its unpleasant smell and taste, is polluted and causes disgust when drinking. Hot water is vomiting and not refreshing, and excessively cold can cause serious illness in humans and livestock. For other household needs, water should have the same characteristics as drinking water. For industrial purposes, water must not, above all, be hard, because it causes unnecessary consumption of soap, and in the textile production and processing of leather and the reduction of quality of goods. The degree of hardness of water is of particular importance for steam engines, due to the deposition and the formation of scale in boilers and pipes.

a) Water protection measures - technological procedures, lines and systems for water treatment

Reducing the amount of pollutants that reach the watercourses is a very important form of pollution control. It involves the installation of appropriate filters and special sedimentation systems at the places where the waste water is spilled. It also includes the mandatory cooling of warm water prior to discharge into the river. A very important form of water pollution prevention is special protection of springs, planning and placement of fertilizers and landfills away from water courses, reduction of fertilizer and pesticide use in agriculture, as well as mass afforestation and protection of soil from erosion.[5]

Higher water pollution can be purified by chemical and biological agents. Chemicals are various chemicals that are introduced into water and neutralize dangerous substances. Biological measures are most effective because they are based on the natural laws and activities of living things. Due to the activities of members of the biocenosis, and especially the work of plants and micro-organisms, aquatic ecosystems have a strong power of natural self-purification. [8]This power is reflected in the fact that plants and other organisms eliminate pollutants relatively quickly and restore chemical relationships in water to their natural level. Of course, aquatic organisms are not almighty, so the effects of heavy pollution, especially heavy metals deposited at the bottom, can be felt for decades. In addition to active forms of protection, waterways are protected by appropriate legal means. National and international laws today restrict the discharge of waste into the sea and inland waters. However, they can hardly force people not to. Therefore, raising the level of general awareness of the importance of water for the survival of man is of paramount importance.

V. Conclusion

How to live in a world of increased industrialization, increased numbers of cars on the streets and increased amounts of waste and how they

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affect the quality of water, land, flora and fauna. Proper waste management has the effect of reducing the amount of environmental pollution. For this reason, it is very important for people's awareness to be as high as possible. The control of the parameters affecting the pollution must be regular. The South Morava River, located on the territory of the City of Vranje, is the largest and most significant river in the area, which is of great importance for agriculture. Water testing is carried out in two places. Samples are taken from the village of Mezgai and the village of Mramara. Analyzes of the results obtained after testing the water samples from the South Morava River showed that the water contains certain parameters some in larger quantities and some in smaller quantities. Based on the amount of nutrients present below the limit of detection, it can be said that the water quality is satisfactory and that according to these parameters the water is classified in Class II. The measured values of the investigated physicochemical parameters at the sampling site at Marble (Novo Selo) dominantly correspond to class I except for BOD5 corresponding to V class, HPK, orthophosphates corresponding to IV class, TOC, ammonium ion and iron content corresponding to III class, total nitrogen. total phosphorus, phenolic compounds correspond to class II. At the same location, the measured values of microbiological parameters correspond to class III. Measured values of the investigated physicochemical parameters at the sampling location at Mezgraja village level, with the Railway Bridge, dominantly correspond to class I except for BOD5 corresponding to class V, HPC corresponding to class IV, TOC, phenolic compounds and total nitrogen corresponding to class II, nitrites, orthophosphates, ammonium ion, Class III copper and iron content. At the same location, the measured values of microbiological parameters correspond to Class IV. Based on this, it can be concluded that the water from the South Morava River is of medium quality.

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17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. 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.

20. 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.

21. 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.

22. 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.

23. 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.

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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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

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