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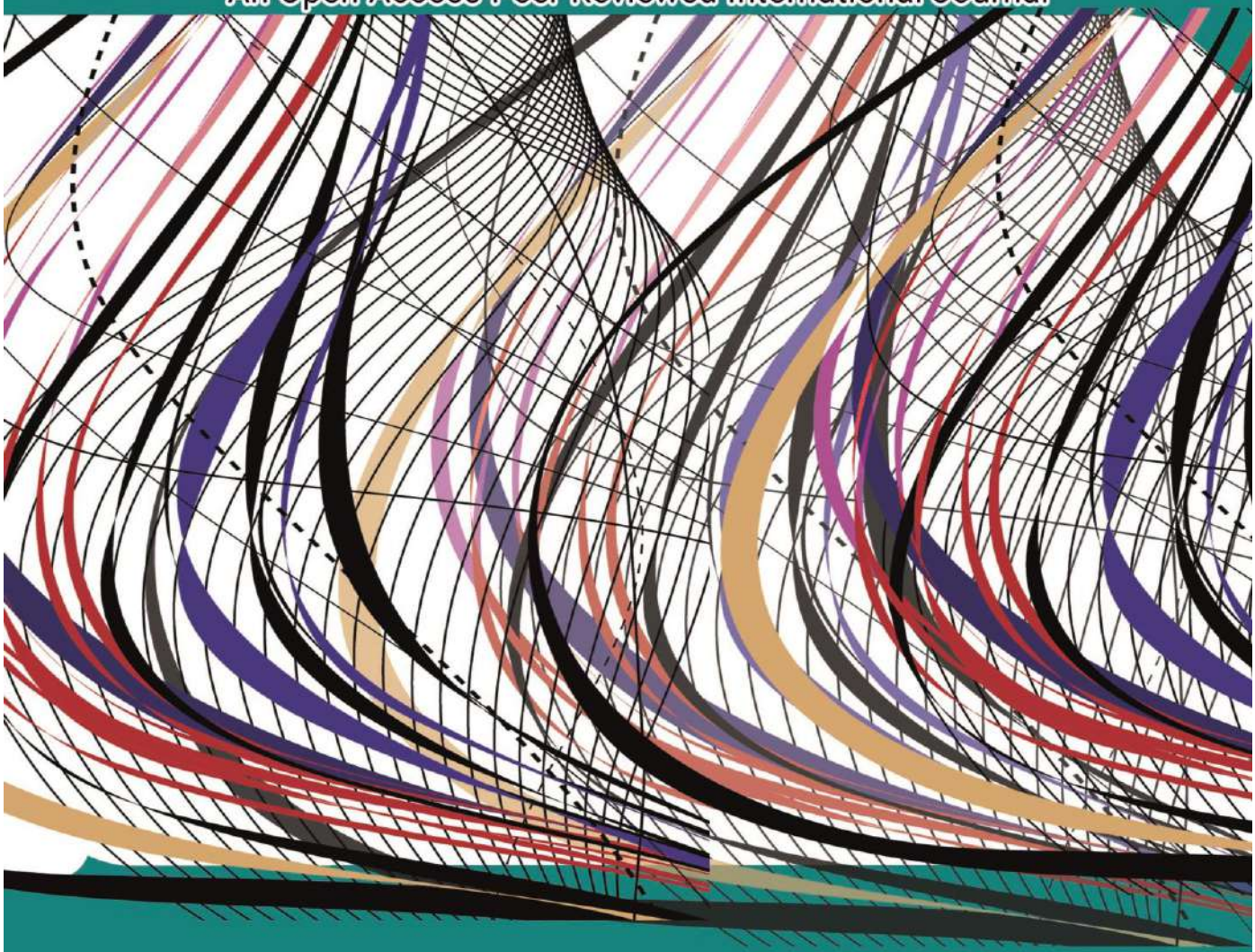

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*Editor in Chief*

Dr. Dinh Tran Ngoc Huy

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# FOREWORD

I am pleased to put into the hands of readers Volume-6; Issue-2: Feb, 2020 of **"International Journal of Advanced Engineering, Management and Science (IJAEMS) (ISSN: 2354-1311)" ,** an international journal which publishes peer reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

**Dr. Dinh Tran Ngoc Huy**
Editor-in-Chief
Date: March, 2020

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# Milk Tea Industry: An Exploratory Study

Fhrizz S. De Jesus, MBA, LPT

***Abstract*****—** *This study entitles "Milk Tea Industry: An exploratory study" aims to determine the increasing popularity of milk tea industry. Its main objective is to identify and assess the profile of the respondents, the 4Ps of marketing - product, price, promotion and place and the SWOT analysis strength, weaknesses, opportunity and threats.*

*This study made use of the descriptive normative research to determine the increasing popularity of milk tea industry in the areas of Bongabon, Nueva ecija. This method quantitatively describes specific details of specific groups. The descriptive survey and interview were used in gathering information on the increasing popularity of milk tea industry. It is descriptive in nature since it is limited in determining the current status of the problem at hand.*

*According to the gathered data most of the respondents are highly considering the quality of the products in their businesses. Based on the results of assessment on the SWOT analysis the respondents are highly considering the convenience and fast service, quality ingredients and creating of loyal customers in their business.*

*All milk tea shop owners in Bongabon regardless of their demographic and business profile are highly considered the marketing strategies when it comes to their businesses. Each of them have their own unique strategies.*

***Keywords*****— milk tea, product, price, promotion, place, strength, weaknesses, opportunity, threat.**

## I. INTRODUCTION

According to Weiner (2009), people are more adventurous and love to try new taste and experiment on new flavors. They love everything that is fresh, exciting and beneficial to them. It is evident that there a continuous demand for the milk tea industry since it was on trend and new in the market

This study will focus on the growing popularity of milk tea and its establishment within the municipality of Bongabon. This study will assess the milk tea industry base on the profile of the business, the 4P's of marketing and the SWOT analysis if it has a significant relationship with the increase of marketing popularity of milk tea.

The researcher aims to provide recommendations that will give solutions to the increasing demand of the milk tea industry.

## II. OBJECTIVES OF THE PROBLEM

This research based on the study of Ilusorio (2014) entitled "Increase of Popularity of Milk Tea in the vicinity of Mendiola" have found out the real reason why milk tea is to be seen in demand in Mendiola and discovered what is in milk tea that makes people crave for it given what they only know about the product.

This study aims to describe and assess the milk tea industry.

Specifically, the study sought answers to the following questions:

1.How may the profile of the respondents be described in terms of:

1.1 Sex

1.2 Age

1.3 Civil status

1.4 Years of operation

1.5 Types of ownership

1.6 Average monthly income

2.How may the popularity of milk tea industry be assessed in terms of:

2.1 Product

2.2 Price

2.3 Promotion

2.4 Place

3.How may the milk tea industry be assessed in terms of:

3.1 Strength

3.2 Weakness

3.3 Opportunity

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3.4 Threats

## III. METHODOLOGY

This study made use of the descriptive normative research to determine the increasing popularity of milk tea industry in the areas of Bongabon, Nueva Ecija. This method quantitatively describes specific details of specific groups.

The research instrument used in this study was survey method wherein the respondents answered questions administered through questionnaires and interviews.

The instrument was formulated in the modified 4-point likert-scale ranging from strongly agree (4), agree (3), disagree (2), strongly disagree (1). Respondents were then instructed to rate the statements and answer the questions.

The data collected from the locale were encoded, tallied and analyzed. The following statistical tools were used. Data presentation of the given scale was used to interpret the results of the information gathered:

To determine the respondents degree of perception the weighted mean was computed using the formula: Weighted mean (∑ WM) is equal to total weighted frequency (∑WF) divided by the total number of cases (F).

The percentage frequency distribution was computed using the formula: frequency (F) divided by the sample (N) and multiply by one hundred (100). The researcher used ranking to compare items to each other by placing them in order of preferences.

## IV. RESULTS AND DISCUSSION

According to the gathered data:

*Table.1: Demographic Profile According to Sex*

| PROFILE VARIABLE | F | % |
|---|---|---|
| **SEX** | | |
| MALE | 2 | 25% |
| FEMALE | 6 | 75% |

Table 1 shows the demographic profile of the respondents in terms of sex. Majority of the respondents who participated in the interview were females with a number of six (6) or seventy-five percent (75%) outsourcing the number of two (2) or twenty-five percent (25%) that males emerged on.

Generally, Municipality of Bongabon is dominated by males but females are more interested in managing the milk tea business.

*Table 2. Demographic Profile According to Age*

| PROFILE VARIABLE | F | % |
|---|---|---|
| **AGE** | | |
| 15 – 25 | 3 | 38% |
| 26 – 35 | 1 | 12% |
| 36 – 45 | 3 | 38% |
| 46 – 55 | 1 | 12% |
| 55 up | 0 | 0% |

For the age range of the respondents, Table 2 presents the age range of fifteen to twenty five (15-25) and thirty six to forty five (36-45) years of age comprised thirty eight percent (38%) of the respondents. They formed the majority group and were followed by the group that belonged to the age range of twenty six to thirty five (26-35) and forty six to fifty five (46-55) years of age who comprised the next highest percentage of twelve percent (12%).

The above findings indicated that majority of the respondents were in the age of 15-25 years old and 36-45 years old followed by 26-35 and 46-55 years old. These findings point to the fact that the respondents are more teenagers and middle-aged adults. During the interview conducted, the respondents who are teenagers said that their love for the milk tea was the reason why they put up milk tea business. On the other hand, middle-aged adults said that the trend of milk tea products was their reason to put up this kind of business. Local milk tea shops are emerging everywhere, taking advantage of the craze and catering to the taste of teenagers and young adults.

*Table 3. Demographic Profile According to Civil Status*

| PROFILE VARIABLE | F | % |
|---|---|---|
| **CIVIL STATUS** | | |
| Single | 5 | 63% |
| Married | 2 | 25% |
| Widow/Widower | 1 | 12% |
| Separated | 0 | 0% |

Table 3 visualizes the business profile of the respondents in terms of the civil status wherein the most number of respondents were

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single with five (5) individuals or sixty three percent (63%). And those who were widow or widower were least in number with one (1) person obtaining twelve percent (12%) of the respondents.

Majority of the respondents were single because of age reason, 15 years old and above. Single individuals are more likely to invest in a milk tea business. On the interview conducted, they said that the increasing popularity of milk tea was the reason why they put up this kind of business. They also said that massive number of students getting in on the trend, buying milk tea allowed milk tea shops to thrive.

*Table 4. Business Profile According to Years of Operation*

| PROFILE VARIABLE | F | % |
|---|---|---|
| **YEARS OF OPERATION** | | |
| **Less than 1 year** | 7 | 88% |
| **1-2 years** | 1 | 12% |
| **3-4 years** | 0 | 0% |
| **5-6 years** | 0 | 0% |
| **7-above** | 0 | 0% |

For the years of operation, Table 4 presents the years of business with less than one year with seven (7) or eighty eight percent (88%) of the respondents. They formed the majority group and were followed by the group that belonged to the one to two years of business operation with one (1) or twelve percent (12%) who comprised the next highest percentage.

The above findings indicated that majority of the respondents were less than one year of business operation followed by one to two years. These findings point to the fact that the large numbers of respondents are new with the milk tea business. During the interview conducted, the respondents said that they are new with milk tea business because milk tea is recently discovered and gaining popularity in the local market. Milk tea trend was officially back and local milk tea shops are emerging everywhere.

*Table 5. Business Profile According to Types of Ownership*

| PROFILE VARIABLE | F | % |
|---|---|---|
| **TYPES OF OWNERSHIP** | | |
| **Sole Proprietorship** | 4 | 50% |
| **Partnership** | 4 | 50% |
| **Corporation** | 0 | 0% |

Table 5 visualizes the business profile of the respondents in terms of types of ownership wherein sole proprietorship and partnership had the same number of respondents with four (4) individuals or fifty percent (50%) respectively.

The findings indicated that majority of the business owners were sole proprietorship and partnership. These findings point to the fact that commonly the owner of the milk tea business was sole proprietor or partnership.

*Table 6. Business Profile According to Average Monthly Income*

| PROFILE VARIABLE | F | % |
|---|---|---|
| **AVERAGE MONTHLY INCOME** | | |
| **₱5,000-10,000** | 0 | 0% |
| **₱15,000-20,000** | 2 | 25% |
| **₱25,000-30,000** | 2 | 25% |
| **₱35,000-40,000** | 1 | 12% |
| **₱45,000-90,000** | 3 | 38% |

Table 6 visualizes the business profile of the respondents in terms of average monthly income wherein forty-five thousand to ninety thousand pesos (₱45,000-90,000) or thirty eight percent (38%) of the respondents. They formed the majority group and were followed by the fifteen to twenty thousand pesos (₱15,000-20,000) and twenty five to thirty thousand pesos (₱25,000-30,000) or twenty five percent (25%) of the respondents. And thirty-five thousand to forty thousand pesos (₱35,000-40,000) were least in number with one (1) person obtaining twelve percent (12%) of the respondents.

The above findings indicated that the common average monthly income of the milk tea business range from forty five to ninety thousand pesos (₱45,000-90,000). These findings point to the fact that number of milk tea fans keep growing as milk tea shops keep popping up. Love for milk tea is at an all-time high.

*Table 7. 4Ps of Marketing: Product*

| INDICATORS | WM | RANK | DESCRIPTION |
|---|---|---|---|
| Materials and ingredients used in milk tea are important elements in production. | 4 | 1 | Strongly Agree |

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| | | | |
|---|---|---|---|
| Taste is a factor in selling milk tea. | 4 | 1 | Strongly Agree |
| Colorful features of packaging attract the customer to buy milk tea. | 3.62 | 3 | Strongly Agree |
| Incorporation of creativity and innovativeness in the product. | 3.87 | 2 | Strongly Agree |
| Use of brand name to sell the product. | 3.5 | 4 | Strongly Agree |
| Availability of numerous numbers of flavors. | 3.5 | 4 | Strongly Agree |
| Customizing the taste of product based on customer preference. | 3.87 | 2 | Strongly Agree |
| Standard procedures are used in the milk tea production. | 4 | 1 | Strongly Agree |
| General Weighted Mean | 3.80 | | Strongly Agree |

Table 7 below presents the effects of marketing strategy of the business in terms of product. The researcher found out that the materials and ingredients, taste and standard procedure of a milk tea are the factors to be considered in a milk tea product with a weighted mean of 4.

These findings pointed the fact that the milk tea shop owners are highly considered the materials and ingredients, taste and standard procedure of the milk tea they are selling. Taste of a milk tea often attracts consumers that are seeking new milk tea varieties to savor. Consumers are more likely to choose a milk tea that can satisfied their cravings.

*Table 8. 4Ps of Marketing: Price*

| INDICATORS | WM | RANK | DESCRIPTION |
|---|---|---|---|
| Customers buy milk tea because of its affordability. | 3.75 | 2 | Strongly Agree |
| Uses price discounts to increase sales. | 3.12 | 5 | Agree |
| Price lists are available and presented to the customers. | 4 | 1 | Strongly Agree |
| Provide PWD and senior citizen allowance/discount. | 3.5 | 3 | Strongly Agree |
| The price of the milk tea is value based from its taste. | 3.25 | 4 | Agree |
| Income is based on the percentage of the price mark-up. | 2.87 | 6 | Agree |
| General Weighted Mean | 3.41 | | Strongly Agree |

Table 8 presents the effects of marketing strategy of the business in terms of price. The researcher found out that the price lists that are presented to the customers, has an effect when they are buying a milk tea with a weighted mean of 4.

These findings pointed the fact that the price list of the milk tea that is presented to the consumers has a huge impact to them. The price list helped them to choose the milk tea they want and see the price of it.

*Table 9. 4Ps of Marketing: Promotion*

| INDICATORS | WM | RANK | DESCRIPTION |
|---|---|---|---|
| Direct selling provides information to the consumers. | 3.37 | 2 | Strongly Agree |
| Outdoor advertisement (such as tricycle tarpaulin, jeepney stickers etc.) encourages customer to buy a milk tea. | 2.75 | 6 | Agree |
| Radio advertisement helps the store in their sales. | 2.87 | 5 | Agree |
| Customers buy milk tea because of social media. | 3 | 4 | Agree |
| The store uses different promotional discounts (e.g loyalty card, discount coupon, unli promos). | 3.12 | 3 | Agree |
| The store has a signage that can be seen in morning and night. | 3.75 | 1 | Strongly Agree |
| General Weighted Mean | 3.14 | | Agree |

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Table 9 presents the effects of marketing strategy of the business in terms of promotion. The researcher found out that the store signage that can be seen in morning and night help the consumers to see where the shop is located with a weighted mean of 3.75.

These findings pointed the fact that the milk tea shop signage that can be seen in morning and night are one of the factors to be considered by the owners to help the customers to easily locate their shops. Signage help owners to promote their business because it draws attention to the consumers and it help them to differentiate the shops from the others.

Table 10 presents the effects of marketing strategy of the business in terms of place. The researcher found out that the location of the shop if it is located near the town and if it is safe and secured for the public is also one factor to be considered to gain more consumers with a weighted mean of 3.87.

These findings pointed the fact that the milk tea shop location helps the business to have more consumers. A good location is important to the success of a business. It helps them to improved revenue and increased marketing exposure.

*Table 10. 4Ps of Marketing: Place*

| *INDICATORS* | *WM* | *DESCRIPTION* | *RANK* |
|---|---|---|---|
| ***Product*** | *3.80* | *Strongly Agree* | *1* |
| ***Price*** | *3.41* | *Strongly Agree* | *3* |
| ***Promotion*** | *3.14* | *Agree* | *4* |
| ***Place*** | *3.54* | *Strongly Agree* | *2* |

*Table 11. Summary of 4Ps of Marketing*

| INDICATORS | WM | RANK | DESCRIPTION |
|---|---|---|---|
| The store is located near the town. | 3.87 | 1 | Strongly Agree |
| The store is located in front of school. | 2.62 | 5 | Agree |
| The store is accessible. | 3.75 | 2 | Strongly Agree |
| The store atmosphere and decorations are appealing to the public. | 3.62 | 3 | Strongly Agree |
| Store hours cater the customers dining needs. | 3.62 | 3 | Strongly Agree |
| The place is safe and secure for the public. | 3.87 | 1 | Strongly Agree |
| The store underwent the zoning and other inspections of the LGUs. | 3.5 | 4 | Strongly Agree |
| The store uses feasibility study in the selection of the location. | 3.5 | 4 | Strongly Agree |
| General Weighted Mean | 3.54 | | Strongly Agree |

Table 11 shows the comparison of each items by placing them in order of preferences. Having the Product ranked as number one (1), Place ranked as number two (2), Price ranked as number three (3) and Promotion as number four (4). The milk tea shop owners are highly considered the quality of their product as one of the factors that helps them to gain more customers. The respondents were strongly agreed based on the product.

*Table 12. SWOT Analysis: Strength*

| INDICATORS | WM | WM | DESCRIPTION |
|---|---|---|---|
| Convenient and fast service | 4 | 1 | Strongly Agree |
| Cheaper than other milk tea shop | 3.37 | 4 | Strongly Agree |
| Long operating hours | 3.5 | 3 | Strongly Agree |
| Marketing strategy | 3.87 | 2 | Strongly Agree |
| Quality ingredients | 4 | 1 | Strongly Agree |
| Discount promos | 3.87 | 2 | Strongly Agree |
| Loyal customers | 4 | 1 | Strongly Agree |
| Innovation in the product | 3.87 | 2 | Strongly Agree |

Table 12 presents the effects of SWOT analysis of the business in terms of strength. The researcher found out that the convenient and fast service, quality ingredients, and loyal customers are the factors to be considered in a milk tea industry with a weighted mean of 4.

These findings pointed the fact that the milk tea owners are highly considered the convenient and fast service, quality ingredients, and loyal customers as the strength of their business. Quality ingredients are the most important factor

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in making a product. Also good services will help to promote a positive and friendly environment that will leave a great impression with the customer, and they will return often and likely to spend more and eventually become a loyal customers.

*Table 13. SWOT Analysis: Weaknesses*

| INDICATORS | WM | RANK | DESCRIPTION |
|---|---|---|---|
| **Many competitors within the area** | 3.5 | 3.5 | Strongly Agree |
| **Rental fees** | 3.12 | 3.12 | Agree |
| **Internet access** | 2.87 | 2.87 | Agree |
| **Store capacity** | 2.75 | 2.75 | Agree |
| **Marketing strategy** | 3 | 3 | Agree |
| **Rainy season** | 3.62 | 3.62 | Strongly Agree |

Table 13 presents the effects of SWOT analysis of the business in terms of weaknesses. The researcher found out that during rainy season the revenue of the milk tea business were decreasing, with a weighted mean of 3.62.

These findings pointed the fact that rainy season has a massive effects on the milk tea business in terms of their income.

*Table 14. SWOT Analysis: Opportunity*

| INDICATORS | WM | RANK | DESCRIPTION |
|---|---|---|---|
| New product to introduce | 3.87 | 2 | Strongly Agree |
| Open new branch | 3.37 | 4 | Strongly Agree |
| Introduce of brand name in bigger market | 3.37 | 4 | Strongly Agree |
| Create more loyal customers | 4 | 1 | Strongly Agree |
| Trendy product | 3.87 | 2 | Strongly Agree |
| Innovative technology | 3.5 | 3 | Strongly Agree |

Table 14 presents the effects of SWOT analysis of the business in terms of opportunity. The researcher found out that one of the opportunities that can help a milk tea business is to create more loyal customers with a weighted mean of 4.

These findings pointed the fact that creating more loyal customers can helps the business to grow. No matter the size of the business, customer loyalty is incredibly important. One of the best and the cheapest way to reward loyal customer is to give extra perks.

*Table 15. SWOT Analysis: Threats*

| INDICATORS | WM | RANK | DESCRIPTION |
|---|---|---|---|
| Many competitors | 3.25 | 2 | Agree |
| Seasonal demand: rainy season and summer are different | 3.62 | 1 | Strongly Agree |
| Nothing new to offer | 2.75 | 4 | Agree |
| Similar concept or service | 3.12 | 3 | Agree |
| Price war | 3.12 | 3 | Agree |

Table 15 presents the effects of SWOT analysis of the business in terms of threats. The researcher found out that the seasonal demand, the rainy season and summer season has an effect in a milk tea industry with a weighted mean of 3.62.

These findings pointed the fact that rainy season has a huge effects on the milk tea business in terms of their income.

*Table 16. Summary of SWOT Analysis*

| INDICATORS | WM | DESCRIPTION | RANK |
|---|---|---|---|
| Strength | | | |
| Loyal customers Quality ingredients Convenient and fast service | 4 | Strongly Agree | 1 |
| Weaknesses | | | |
| Rainy season | 3.62 | Strongly Agree | 1 |
| Opportunity | | | |
| Create more loyal customers | 4 | Strongly Agree | 1 |
| Threats | | | |
| Seasonal demand: rainy season and summer are different | 3.62 | Strongly Agree | 1 |

The researcher used ranking to compare items to each other by placing them in order of preferences. The first SWOT analysis of the business is strength. The researchers found out

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that the convenient and fast service, quality ingredients, and loyal customers are the top priority to be considered in a milk tea industry. The milk tea shop owners are highly considered the convenient and fast service, quality ingredients, and loyal customers as the strength of their business. Marketing strategy, discount promos, innovation in the product and long operating hours are among the top three strength of the milk tea business.

The second SWOT analysis of the business is weaknesses. The researchers found out that during rainy season the revenue of the milk tea business were decreasing. Many competitors within the area and rental fees are also their weaknesses. These findings pointed the fact that rainy season, many competitors and the rental fee has a huge effect on the milk tea business in terms of their income.

The third SWOT analysis of the business is opportunity. One of the opportunities that can help a milk tea business is to create more loyal customers. Trendy product, new product to introduce, innovative technology are also the factors that can help the business to grow.

And the last SWOT analysis of the business is threats. Seasonal demand, the rainy season and summer season, many competitors, similar concept or service and price war has an effect in a milk tea industry. These findings pointed the fact that the weakness of the milk tea business is also the threats that can affect their business in terms of their income.

Based from the findings and conclusions presented, the following are the recommendations:

1. For the SMEs, it is recommended to ensure high quality of products on top of good customer service or relation to achieve sustainability.

2. For the LGUs, security must be observed, since it is one of the best assets of a company.

3. For the DTI, the main economic catalyst that enables innovative, competitive, job generating inclusive business, and empowers consumers helps the business to be more effective and efficient.

4. For the marketing professionals, it is recommended to offer different promotional discounts (like offering loyalty cards, discount coupons, vouchers, etc.) as part of the marketing strategy to increase the demand for the product.

5. For the Milk tea industry, it is recommended to provide more varieties of milk tea to the customers (like twist of flavor, offering small cups of milk tea for affordable or cheapest price, etc.) for them to have a wider selection of choices. It should be done because of fast changing preference of the generations. Innovation is one of the strength of the milk tea business. Businesses should continue developing products according to consumers' preference. Hence, regular assessment should be done regularly.

6. The Milk tea industry should regularly get feedback from their customers and implement innovations to their products always to ensure continued patronage and can be used as SWOT Assessment.

7. For the Milk tea industry it is recommended to provide excellent services to gain positive purchasing experience to the consumers, by doing this it may lead in increase of consumers and create loyal customers.

8. The Milk tea industry should make the atmosphere and decorations of the shop appealing to the public and ensure the safety of the consumers, it is a way of creating loyal consumers.

9. The Milk tea industry should consider the location of the shop that are accessible and can be easily seen by the customers. Some customers who experience difficulty in parking will leave the shop and lead in sales decrease.

10. Seasonal demand is one of the threats of the milk tea business, it is recommended to produce hot tea products (like hot coffee, hot chocolate, etc.) for consumers to maintain high volume of customers even during rainy season.

11. A similar study should also be conducted for other business sectors to assess their marketing strategy and develop a feasibility plan.

12. This study could serve as a basis for further business researches.

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# Assessment on the allocation of Cash Grants of 4Ps beneficiaries to their daily Expenditures

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***Abstract*— *This study aims to determine where the 4Ps beneficiaries allocate the cash grants they receive from the government on their daily expenditures in terms of Education, Food, Transportation, Clothing, Entertainment, and Other bills. This study was conducted on seventeen barangays of Laur, Nueva Ecija with total number of 337 4Ps beneficiaries as respondents. Descriptive research was used through the survey questionnaire and interviews to answer the research problem. Based from the result, the education was highly prioritized. The researchers formulated a recommendation that may help 4Ps beneficiaries on spending their grants.***

***Keywords*— *Cash Grants, daily Expenditures, 4Ps beneficiaries.***

## I. INTRODUCTION

According to Casco, Lam, Lumantas, and Magno (2015), The Philippine government implemented the Pantawid Pamilyang Pilipino Program (4Ps) and patterned it after Latin American conditional cash transfer (CCT) programs, with the goals of poverty reduction and social development. Pantawid Pamilyang Pilipino Program, also known as 4Ps and formerly *Ahon Pamilyang Pilipino,* is a Conditional Cash Transfer program of the Philippine government under the Department of Social Welfare and Development.

Frufonga (2016), mentioned that one factor that is associated to the health status of an individual is poverty. According to the study of Institute of Family Life and Children's Studies - Philippine Women's University (October 26, 2016), it aims to eradicate extreme poverty in the Philippines by investing in health and education particularly in age 0-14.It is patterned on programs in other developing countries like Brazil (*Bolsa Familia*) and Mexico (*Oportunidades*).

As extracted from the official website of Pantawid Pamilyang Pilipino Program (Pantawid.dswd.gov.ph), the 4Ps program now operates in 17 regions, 79 provinces and 1,484 municipalities and 143 key cities covering 4,876,123 poor households nationwide as of December 31, 2018.

According to the study of Institute of Family Life and Children's Studies - Philippine Women's University (October 26, 2016), conditional cash transfers (CCT) are essentially providing financial incentives or resources to underprivileged families in exchange for their agreements to a set of conditions aimed at cultivating their capacities. More often than not, the conditionality is linked to education and health outcomes to address the chronic poverty of the household. As extracted from (Pantawid.dswd.gov.ph), The Philippines' version of the CCT is the Pantawid Pamilyang Pilipino Program (hereinafter referred as Pantawid). As mentioned in studylib.net, it has two goals: (1) alleviation of immediate income poverty (social assistance), and (2) break the intergenerational cycle of poverty through human capital investments and nutrition (social development). It targets the "poorest of the poor" in the country, and as beneficiaries, they receive a monthly cash grant of PhP 500 for health expenses, and PhP300 per school child member in elementary school or PhP 500 if the child is in high school (maximum of three children) (Pantawid.dswd.gov.ph). The program was formally launched in 2008 with 360,000 household recipients; by 2015, the number of beneficiaries was 4.4 million. The latest evaluations of the Pantawid show its positive impact on the concerns directly targeted by the conditionality i.e. in children's education (there is an increased enrolment rate in primary schools in the Pantawid communities) and health (more mothers are going to health centers for professional maternal health services and health guidance in general, more children are receiving vaccines and regular de-worming, the household has increased their food intake). Based from Flores, Espinoza, Enrico, and Casimiro (2015), it is therefore recommended that the scope of the program be extended especially that two years have been added to the secondary education. However, there is a need to assess changes beyond the compliance of households to the Pantawid conditionality and how the positive impact of the program be sustained after its beneficiaries have "graduated" from the program. It is noted that one of the goals of the conditional cash handover program is to break the intergenerational series of poverty. Thus it is even more vital that the positive changes resulting from the program

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should not be dependent on the cash grant currently being received, rather it is because the beneficiaries are already empowered to create environments, whether within their households or in their community, where their rights to education, health, and development are realized.

The purpose of this study is to find out where the 4Ps beneficiaries commonly used the cash grants they receive from the government on their daily and other expenditures. The researchers believe that the outcome of this study can be helpful for 4Ps beneficiaries and the government.

## II. OBJECTIVES OF THE PROBLEM

This study was based on the study of Arnold Q. Malaluan, Gleziel M. Malaluan, Regine T. Leyesa, Kathleen H. Malayba and Marissa H. Perez (2018) entitled "Financial Priorities of 4p's Beneficiaries: An Assessment Using First Bucket Theory".

This study attempted to describe and assess the allocation of cash grants of 4ps beneficiaries to their daily expenditures.

Specifically, the study sought to answers the following:

1. How may the demographic profile be described in terms of:
   - Sex
   - Age
   - Number of dependents
   - Amount of Grants Received
   - Number of Pantawid children in Household
   - Educational Attainment
2. How does the cash grant helped the daily expenditures of the family in terms of:
   - Education
   - Food
   - Transportation
   - Clothing
   - Entertainment
   - Other Bills

## III. METHODOLOGY

The study used descriptive method to determine how the allocation of cash grants of 4Ps beneficiaries of Laur, Nueva Ecija were affected by their personal profile.

The research instrument used was survey method and interview, wherein respondents answered questions administered through questionnaires and interviews.

The instrument was formulated in the modified 4-point likert scale ranging from always (4), sometimes (3), seldom (2), never (1). Respondents were then instructed to rate the statements and answer the questions.

The data collected from the locale were encoded, tallied and analyzed using the following statistical tools were used. Data presentation of the given scale was used to interpret the results of the information gathered:

To determine the respondents' degree of perception, the weighted mean was computed using the following formula: Weighted mean (ΣWM) is equal to total weighted frequency (ΣWF) divided by the total number of cases (F).

The percentage frequency distribution was computed using the formula: frequency (F) divided by the sample (N) and multiply by one hundred (100). The researchers used ranking to compare items to each other by placing them in order of preferences.

## IV. RESULTS AND DISCUSSION

According to the gathered data:

*Table 1. Demographic Profile according to Sex*

| PROFILE VARIABLE | F | % |
|---|---|---|
| **SEX** | | |
| MALE | 82 | 24% |
| FEMALE | 255 | 76% |

Table 1 shows Distribution of the respondents according to Sex. Most of the respondents were Female with a number of 255 or 76% compared to just 82 or 24% of the Male respondents.

Male were supposed to be the beneficiary of the cash grants because they were the head of the family. But since they spent more of their time on working, they were rarely present on attending the Family Development Session (FDS), an activity where all the beneficiaries must be present or else the cash grants to be received will be deducted. So they transferred the honors to female beneficiaries knowing that they were usually staying on their houses.

*Table 2.Demographic Profile according to Age*

| Age | Frequency | Percentage |
|---|---|---|
| 21 – 30 | 28 | 8% |
| 31 – 40 | 120 | 36% |
| 41 – 50 | 119 | 35% |
| 51 YEARS OLD ABOVE | 70 | 21% |

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Table 2 shows Distribution of the respondents according to Age. Most of the respondents were ages 31-40 years old with a number of 120 or 36% of the sample, not too far from the respondents aged 41-50 years old with a number of 119 or 35% of the samples.

31-40 and 41-50 years old were the common age of having a family wherein the children were all studying and must have a stable financial support in terms of education.

*Table 3. Demographic Profile according to Number of Dependents*

| Number of Dependents | Frequency | Percentage |
|---|---|---|
| 1 – 3 | 128 | 38% |
| 4 – 6 | 146 | 43% |
| 7 ABOVE | 63 | 19% |

Table 3 shows Distribution of the respondents according to Number of Dependents. Most of the respondents have 4-6 dependents with a number of 146 or 43% of the total sample.

Dependents were those aged under 16 years old living with at least one parent, or aged 16 to 18 in full-time education, excluding all children who have spouse, partner or child living in the household.

*Table 4. Demographic Profile according to Amount Received*

| Amounts Receive | Frequency | Percentage |
|---|---|---|
| Php1,000 – 2,500 | 77 | 23% |
| Php2,501 – 4,000 | 84 | 25% |
| Php4,001 ABOVE | 176 | 52% |

Table 4 shows distribution of the respondents according the Amounts Receive. When it comes to the amounts of grants received, 176 respondents or 52% of the total samples were receiving Php4,001 and above of cash grants.

Amount of grants received was based accordingly to how many benefited children studying there in 4Ps family. Another factor is the interval of date that the cash grants will be given (i.e. every 2 months, every 3 months.)

*Table 5. Demographic Profile according to the Number of Pantawid Children*

| Number of Pantawid Children | Frequency | Percentage |
|---|---|---|
| 1 | 95 | 28% |
| 2 | 105 | 31% |
| 3 | 137 | 41% |

Table 5 shows distribution of the respondents according to the Number of their Pantawid Children. 137 respondents or 41% of the total sample have three (3) benefited children or Pantawid children, followed by 105 respondents or 31% of the total sample having two (2) Pantawid children and 95 respondents or 28% of the total samples have only one (1) Pantawid child.

Three (3) children per 4Ps beneficiary only were eligible to receive additional Php300 educational assistance for elementary and Php 500 educational assistance for high school, in which it affected the amount of grants they received.

*Table 6. Demographic Profile according to Educational Attainment*

| Educational Attainment | Frequency | Percentage |
|---|---|---|
| ELEMENTARY UNDERGRADUATE | 52 | 15% |
| ELEMENTARY GRADUATE | 52 | 15% |
| HIGH SCHOOL UNDERGRADUATE | 107 | 32% |
| HIGH SCHOOL GRADUATE | 107 | 32% |
| COLLEGE UNDERGRADUATE | 11 | 4% |
| COLLEGE GRADUATE | 8 | 2% |

Table 6 show Distribution of the respondents according to their Educational Attainment. In terms of educational attainment, Elementary Undergraduate and Elementary Graduate respondents were with the same number of 52 or 15% of the total sample, as well as the High School Undergraduate and High School Graduate respondents having the same number of 107 respondents or 32% of the total sample. College Undergraduate respondents were only 11 or 4% of the total sample and College Graduate respondents having only 8 or 2% of the samples.

Some respondents were dropped out for higher education. These may be due to individual issues or a mix of problems like financial problems, poor life preparation, they were undecided, conflict with work and family commitments and lack of support.

TABLE 7 shows the allocation of cash grants for Education. The Students Daily Allowance ranked at number 1 with 3.67 weighted mean, followed by School Uniform at number 2 with 3.58 weighted mean, School Supplies at number 3 with 3.55 weighted mean, School Projects at number 4 with 3.40 weighted mean, PTA Contribution at number 5 with 3.40 weighted mean and School Donations at number 6 with 3.28 weighted mean.

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The 4Ps beneficiaries highly prioritized the education of the children because it was the main purpose of the cash grants from the government. It was found out that the cash grants they received is always allocated at the above mentioned items with a composite mean of 3.48.

*Table 7.Allocation of cash grants with regards to Education*

| INDICATORS | WM | DESCRIPTION | RANK |
|---|---|---|---|
| SCHOOL UNIFORM | 3.58 | ALWAYS | 2 |
| SCHOOL SUPPLIES | 3.55 | ALWAYS | 3 |
| SCHOOL DONATIONS | 3.28 | ALWAYS | 6 |
| STUDENT'S DAILY ALLOWANCE | 3.67 | ALWAYS | 1 |
| SCHOOL PROJECTS | 3.40 | ALWAYS | 4 |
| PTA CONTRIBUTION | 3.40 | ALWAYS | 5 |
| **COMPOSITE MEAN** | **3.48** | **ALWAYS** | |

*Table 8. Allocation of Cash Grants with regards to Food*

| INDICATORS | WM | DESCRIPTION | RANK |
|---|---|---|---|
| RICE | 3.02 | SOMETIMES | 1 |
| LEAN MEAT | 2.51 | SOMETIMES | 4 |
| POULTRY | 2.50 | SELDOM | 5 |
| SEA FOOD | 2.41 | SELDOM | 6 |
| CANNED GOODS | 2.72 | SOMETIMES | 3 |
| VEGETABLES | 2.84 | SOMETIMES | 2 |
| FRUITS | 2.38 | SOMETIMES | 7 |
| **COMPOSITE MEAN** | **2.63** | **SOMETIMES** | |

TABLE 8 shows the allocation of cash grants on Food. Rice was ranked number 1 with 3.02 weighted mean, followed by Vegetables at number 2 with 2.51 weighted mean, canned good at number 3 with 2.72 weighted mean, lean meat was ranked at number 4 with 2.51 weighted mean, poultry has a weighted mean of 2.50 and was ranked at number 5, sea food was ranked at number 6 with 2.41 weighted mean and fruits was ranked at number 7 with 2.38 weighted mean.

It was found out that most of the respondents sometimes allocated their cash grants on food with a composite mean of 2.63. Foods were the basic necessity of every family. The above mentioned items were the basic foods that some families were afford to purchase.

*Table 9.Allocation of cash grants with regards to Transportation*

| INDICATORS | WM | DESCRIPTION | RANK |
|---|---|---|---|
| TRICYCLE FARES | 2.55 | SOMETIMES | 1 |
| JEEPNEY FARES | 2.46 | SELDOM | 2 |
| BUS FARES | 2.35 | SELDOM | 3 |
| **COMPOSITE MEAN** | **2.45** | **SELDOM** | |

TABLE 9 shows the allocation of cash grants on Transportation. It was revealed that in general, respondents seldom spent their cash grants on transportation with a composite mean of 2.45.

Tricycle fares were ranked at number 1 with 2.55 weighted mean, Jeepney Fares gained a weighted mean of 2.46 and ranked at number 2 and Bus Fares were on the least as it ranked number 3 with 2.35 weighted mean.

Some Barangays of Laur, Nueva Ecija are not reachable by Jeepneys and buses and they sometimes allocated their cash grants on tricycle fares. Most of the respondents have their own transportation vehicle used for nearby places only.

*Table 10.Allocation of Cash Grants with regards to Clothing*

| INDICATORS | WM | DESCRIPTION | RANK |
|---|---|---|---|
| BUYING NEW CLOTHES | 2.27 | SELDOM | 1 |
| BUYING BRANDED CLOTHES | 1.70 | NEVER | 3 |
| BUYING CLOTHES FOR FAMILY | 2.14 | SELDOM | 2 |
| **COMPOSITE MEAN** | **2.04** | **SELDOM** | |

Table 10 shows the allocation of cash grants on clothing. Respondents were seldom allocating their cash grants on buying new clothes as it gains 2.27 weighted mean and ranked at number 1, seldom in buying clothes for their family with a weighted mean of 2.14 and ranked at number 2 and they never buy branded clothes as it gains a weighted mean of 1.70 and was ranked at number 3.

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Some respondents stated that they buy clothes if their children request for it. Occasionally, as long as their clothes were presentable and decent, there is no need for them to buy a new one.

*Table 11. Allocation of cash grants with regards to Entertainment*

| INDICATORS | WM | DESCRIPTION | RANK |
|---|---|---|---|
| SHOPPING | 2.00 | SELDOM | 2 |
| RECREATIONAL ACTIVITIES | 2.03 | SELDOM | 1 |
| FAMILY OUTING | 1.87 | SELDOM | 3 |
| FAMILY VACATION | 1.76 | SELDOM | 4 |
| VISITING THEME PARK | 1.76 | SELDOM | 5 |
| **COMPOSITE MEAN** | **1.87** | **SELDOM** | |

Table 11 shows the allocation of cash grants on entertainment.

Respondents were seldom allocating their cash grants on Recreational Activities ranked at number 1 with 2.03 weighted mean, Shopping ranked at number 2 with 2.00 weighted mean, Family Outing ranked at number 3 with 1.87 weighted mean, Family Vacation ranked at number 4 with 1.76 weighted mean and the least was Visiting Theme Park ranked at number 5 with 1.76 weighted mean.

In general, the respondents seldom allocated their cash grants on the above mentioned items with a composite mean of 1.87. This means that the respondents are seldom entertaining themselves using the cash grants.

*Table 12.Allocation of Cash Grants with regards to Bills*

| INDICATORS | WM | DESCRIPTION | RANK |
|---|---|---|---|
| WATER BILLS | 2.27 | SELDOM | 2 |
| ELECTRICITY BILLS | 1.98 | SELDOM | 3 |
| HOUSE RENTALS | 1.52 | NEVER | 4 |
| CELLULAR LOADS | 2.32 | SOMETIMES | 1 |
| **COMPOSITE MEAN** | **2.02** | **SELDOM** | |

Table 12 shows the allocation of cash grants on Bills. Cellular Loads were ranked at number 1 with 2.32 weighted mean, Water Bills ranked at number 2 with 2.27 weighted mean, Electricity Bills ranked at number 3 with 1.98 weighted mean and House Rentals ranked at number 4 with 1.52 weighted mean.

Some respondents were seldom allocating their cash grants on water bills because not all the barangays in Laur Nueva Ecija have potable water line. Most respondents were seldom allocating their cash grants on Bills because they were rarely using it every day.

*Table 13. Summary of Allocation of Cash Grants*

| INDICATORS | WM | DESCRIPTION | RANK |
|---|---|---|---|
| EDUCATION | 3.48 | ALWAYS | 1 |
| FOOD | 2.63 | SOMETIMES | 2 |
| TRANSPORTATION | 2.45 | SELDOM | 3 |
| CLOTHING | 2.32 | SELDOM | 4 |
| ENTERTAINMENG | 1.87 | SELDOM | 6 |
| OTHER BILLS | 2.02 | SELDOM | 5 |

The researchers concluded that the cash grants were always allocated as follows:

a) For Education with a composite mean of 3.48, in which Students Daily Allowance being highly prioritized with a weighted mean of 3.67.
b) Food gained a composite mean of 2.63, Rice was prioritized with a weighted mean of 3.02.
c) As to Transportation that gained a composite mean of 2.45, Tricycle fared were prioritized with a weighted mean of 2.55.
d) As to clothing that gained a composite mean of 2.04, Buying New Clothes were slightly prioritized with a weighted mean of 2.27.
e) As to entertainment that gained a composite mean of 1.87, Recreational Activities were slightly prioritized with a weighted mean of 2.03.
f) As to bills that gained a composite mean of 2.02, Water Bills were prioritized with a weighted mean of 2.27.

Based from the findings and conclusions presented, the following are the recommendations:

**Government/Local Government Unit (LGU)**

1. The Government should search for more poor qualified families to be their beneficiaries especially those family

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living in far places who has limited accessibility with other benefits from the government.

2. The government should provide financial education on the 4Ps beneficiaries for them to be more knowledgeable on how to budget their cash grants.

3. The national government should work hand-in-hand together with the barangay officials for monitoring and coaching of the 4Ps Beneficiaries.

**Brgy. Officials**

1. The Brgy. Officials should have a Livelihood Programs and Activities for 4Ps families to help them have an extra income and not just to be a dependent on the subsidy.

**4Ps Beneficiaries**

1. 1. The 4Ps beneficiaries must keep their children in school to continuously receive the cash grants from the government.
2. 2. The 4Ps beneficiaries should allocate their cash grants on important needs only such on education and food. Cash grant management should be thought to them so that proper allocation will be practiced, a financial education program might help them.
3. 3. The 4Ps beneficiaries should also find alternative source of income to continuously provide other needs of their family.

**Researchers**

1. For the future researchers, they should conduct a further study to have a wide knowledge and understanding about this topic.

2. The future researchers can use this study as guide in the establishments of other researchers related to the topic stated.

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# Physicochemical Assessment of Groundwater Quality from Hand Dug Wells and Boreholes of Part of Mokola-Eleyele, Ibadan Metropolis, Southwest Nigeria

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***Abstract***— *Water is the second most important basic need of man after oxygen which is the first. The quality of life in villages and cities depends on the regular supply of pure and unpolluted fresh water. The quality of water bodies depends on their physicochemical and microbial characteristics. The hand-dug wells and boreholes are charactacterised as groundwater under this study. Sampling was done on 21 points containing wells and bore holes within part of Mokola-Eleyele in order to assess their physiochemical contents. The sample was collected during September 2018 - February 2019. Laboratory analysis was carried out on them. The physical and chemical contents observed are; pH, total dissolved solids (TDS), Calcium ($Ca^{2+}$), magnesium ($Mg^{2+}$), Chloride ($Cl^{-}$), Sulphate ($SO_4^{+}$), Nitrate ($NO3^{+}$) and iron content ($Fe^{2+}$) were analyzed for each water sample collected. The values of physical and chemical contents were compared with the standard values set by the Standard Organization of Nigeria (SON) and the results were within their safe limits. The t-test analysis carried out showed the correlation between chemical contents at 90%, 95% and 99% confidence level, the results shows that the significant differences exist for the parameters. It can be concluded that the qualities of both hand dug wells and boreholes water samples were suitable for human consumption*

***Keywords***— ***Groundwater, Physicochemical, unpolluted, quality, parameters, Regulation standard***

## I. INTRODUCTION

Adequate water supply is an essential element in the list of infrastructures of any developing area. Ibadan being an urban area provides a good example of a region where industrial and social developments are being retarded by limited water supplies. With population of about 2.5 million ( long term water supply data, 1979) the average water need of a person in Ibadan is about 50 gallon/head/day (WHO 1983), but daily supply of water per person by Oyo state water corporation is 28.0 gallon/head/day, 1985). Therefore inability of the Oyo state water corporation (OSWC) to adequately supply water to the entire population in the study area calls for the need to accelerate planned for groundwater. People in urban areas especially in the North Western part of Ibadan city, which is the local government area in which the study area falls into, rely mostly on shallow dug wells for their domestic water needs.

Groundwater is being one of the earth's most widely distributed and most important natural resources and it exists wherever water penetrates the subsurface soil and where the formations beneath the surface are porous and permeable enough to transmit this water to the zone of saturation. Groundwater becomes useable natural resources when enough water can be tapped from this zone of saturation through wells or boreholes, springs or stream. Many investigations had been carried out on water quality in Nigeria, and these are limited to local scales and consider as few in number by chemical constituents (Ajibade et al., 2018). A survey was carried out on groundwater and tap water quality determined from different sources in southern Nigeria (Asubiojo et al, 1997). Nitrate-NO3 of up to 124 mg/l, nitrite-NO2 of up to 1.2 mg/l in concentration in weathered basement rocks of south-west Nigeria from sample of shallow groundwater from dug wells was reported by (Malomo et al., 1990). Scale formation may be caused by too much alkalinity values and the water may also have a clearly flat, and may cause irritating taste (Orewole et al., 2007). The essential elements required much by the human body are calcium (Ca) and magnesium (Mg) as calcium is used in teeth and bone formation and also plays a crucial role in nerves and

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muscles draw out, and good to make it become smaller and for blood clotting (Frantisek, 2003).

However, the major contributors to water hardness are calcium and magnesium while calcium is crucial for strong teeth and bones. Trace metals in groundwater are chemical elements that dissolved in water in quantity of minute, and in concentration of less than 1 mg of trace metal per one liter of water (United State Geological Survey, 1993). Drinking water that was contaminated by diseases making the microorganisms (i.e. pathogens) continues to exist and globally recognised and this become a severe threat to human health. (Hering, 2008). The primary standard parameter with no health implication is pH (Standards Organisation of Nigeria, 2007). Gastrointestinal disorder is the health implication of high concentration of copper (Cu) while cancer is that of chromium (Cr) (Standards Organisation of Nigeria, 2007).

Potassium (K) from 1-3mg/l has no health effect in drinking water standards (Nkono *et al*, 1998). The demand for water in the study area has been on the increase as a result of urban and industrial growth. Despite the fact that the quality of water being supply by the state Water Corporation is less compared to the WHO standard, it is also irregular, erratic and sometimes with a lot of impurities, thus groundwater now provides an alternative means of getting portable water in the area of study. These facts have therefore help to unveil the importance of this study as enormous and immeasurable. Therefore, this study assesses the physicochemical parameters of groundwater quality from hand-dug wells and boreholes of part of Mokola-Eleyele Axis and domestic uses and its suitability for domestic use.

## II. MATERIALS AND METHODS

### 2.1 The Study Area

Mokola-Eleyele is located in part of Ibadan North and North West Local Government of Oyo State. It is lying between latitude 7° 25′ 24″ to 7° 26′ 09″N and 4° 22′ 28″ to 4° 23′ 13″E. The area is accessible through major and minor roads. Collective amenities such as shops, markets, hospitals, schools, transport networks are readily available. The area of study was within the rock basement complex comprising; gneises, migmatite, quartzites and schists and older granites as well as quartzites southwesterns Nigeria within which Ibadan lies (Oyawoye, 1970; Rahman, 1976; Elueze, 1982). The rock in the study area serves as good aquifers because of the existence of secondary porosity and permeability which take place as a result of fractures and extreme degree of weathering in the study area.

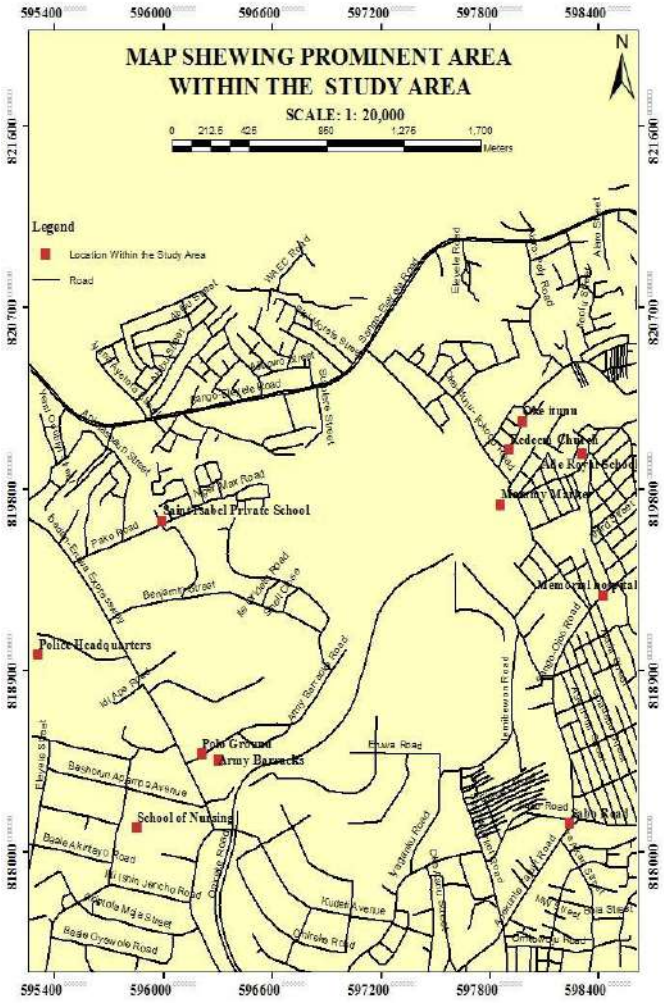


*Fig. 1: Study Area Map*

### 2.2 Sample Collection

The total of twenty-one water samples were collected in a random manner, 13 from hand-dug wells and 8 from boreholes within the study area and was collected into a screw capped polyethylene bottles of 75cl capacity. All the samples collected were labeled with their locations and source. Coordinates of sample points for the hand dug wells and boreholes were determined (table 1). Sampling was carried out without adding any preservatives in bottles

*Table 1: showing sample locations, groundwater types and their coordinate (x, y) for the study.*

| Sample Location | Groundwater Type | Easting | Northing |
|---|---|---|---|
| Police Headquarters | Hand-dug well | 595495.473 | 818993.115 |
| Army Barrack | Hand-dug well | 596324.814 | 818404.818 |
| Army Barrack | Hand-dug well | 596268.690 | 818292.570 |

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| | | | |
|---|---|---|---|
| Mummy Market | Hand-dug well | 597828.935 | 819605.870 |
| Mummy Market | Hand-dug well | 598014.144 | 819706.893 |
| Oke Itunu | Hand-dug well | 597823.323 | 820183.947 |
| Ade Royal | Hand-dug well | 598366.349 | 820004.914 |
| Redeemed Christian Church | Hand-dug well | 597823.323 | 819998.738 |
| Sabo Road | Hand-dug well | 598277.927 | 818112.974 |
| Saint Isabel Private School | Hand-dug well | 596044.195 | 819628.320 |
| Memorial Hospital | Hand-dug well | 598457.523 | 819229.840 |
| School of Nursing | Hand-dug well | 595915.110 | 818152.261 |
| Polo Ground | Hand-dug well | 596291.140 | 818606.864 |
| Police Headquarters | Borehole | 595372.083 | 818984.889 |
| Army Barrack | Borehole | 596235.016 | 818505.841 |
| Mummy Market | Borehole | 597761.587 | 819746.180 |
| Oke Itunu | Borehole | 598002.919 | 820094.148 |
| Ade Royal | Borehole | 598234.733 | 819996.688 |
| Saint Isabel Private School | Borehole | 595982.458 | 819695.668 |
| Memorial Hospital | Borehole | 598350.888 | 819302.801 |
| Polo Ground | Borehole | 596145.218 | 818533.903 |

### 2.3 Analytical Instruments

#### 2.3.1 Onsite Field Analysis

Site analysis was carried out on the field for pH, conductivity and turbidity as at when the sample was taken using American Public Health Organization (APHA) standard methods and protocols and American Society for Testing and materials (ASTMs) using different calibrated standard instruments. The pH of the water samples was measured by using a pH meter (model HI 98130 HANNA Mauritius, iramac sdn, Bhd.). However, before measurements were taken, three standard solutions (ph 4.0, 7.0, and 10.0) were used to calibrate the pH meter. After submerging the pH probe in the water sample and leave for some minutes to obtain accurate reading, then the value for each water sample was taken.

Conductivity meter (model HI 98130 HANNA Mauritius, iramac sdn, Bhd.) was used to determine the Conductivity of the water samples. Standard solution was used to calibrate the probe a known conductivity. Moreover, the probe was submerged into each of the water sample then, the reading was recorded after the stability indicator disappeared. At the end of each sample measurement, deionized water was used to rinse the probe so as to avoid cross contamination among different samples. Turbidity meter HANNA HI 93703) was used to measure the water samples and each of the water samples were poured into the sample holder and kept inside for a few minutes. Then, after determining the reading stability, the value for each water sample was recorded.

#### 2.3.2 Laboratory Analysis

The measurements of Total dissolve solid (TDS) in sample bottles were carried out in line with the standard methods used by (APHA, 1995) and filtration process by (Sawyer et al., 1994). Standard methods of water sampling was used for other trace metals such as calcium, Nitrate, magnesium, sulphate, phosphate, iron content, chloride, etc. to determine the amount of chemical contents present in them. Gravimertry method was used in which oven was used to heat the filtrate at more than 100c it was totally evaporated. The result showed that the left over residue represents the quantity of TDS in each of the sample. Determinations of Anions (Nitrate, chloride, sulphate, phosphate,) were done by spectrophotometer (JENWAY Aquanova spectrophotometer) while determination of Cations (potassium, magnesium and calcium) were done by flame photometry method. The standard solution for each tested element was prepared according to its concentration and used to calibrate the system before analyzing each water sample. AAS system was connected to a computer and was used to record the result automatically.

### 2.4 Statistical and Descriptive Analysis

Statistical and descriptive analysis was done using EVIEWS version 9 software to analyse the correlation between the chemical contents for the hand dug wells and boreholes. All elements were tested so as to know if there is any association among various elements determined and also analysis based on their measure of central tendency and dispersion was done in the study. The Pearson ‘r’ statistics for the t-test was done to show the

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coefficient of their correlation and their significance level (Table 5). Table 6 shows mean median, minimum and maximum values for the chemical elements.

## III. RESULTS AND DISCUSSION

Figure 2 shows the location of wells and bore holes as determined from the study. Table 3 below shows the results of the physicochemical analyses for the study. Table 4 shows the summary of the result in table 3 and their comparism with the Standard Organisation of Nigeria SON (2003) standards. Table 5 shows correlation coefficient matrix of all the chemical elements analyzed. Table 2 shows the safe limits by SON for determining water quality.

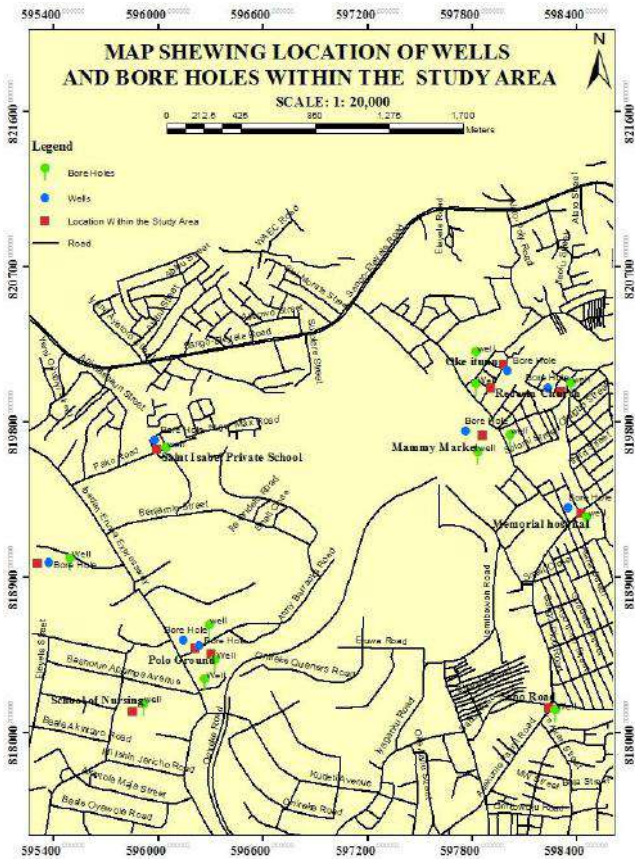


*Fig. 2: Composite Map of the Study*

*Table 2: showing the safe limits by SON for determining water quality*

| Parameters/Chemical Contents | SON Standards (mg/l) |
|---|---|
| Ph | 6.5 – 8.5 |
| Turbidity | 5 |
| Conductivity (us/cm) | 1000 |
| Total Dissolved Solid | 500 |
| Total Hardness | 150 |
| Chloride | 250 |
| Nitrate | 50 |
| Sulphate | 200 |
| Calcium | 100 |
| Iron | 0.3 |
| Carbonate | 500 |
| Magnesium | 150 |

*Source: Standard Organisation of Nigeria (2003)*

*Table 3. Concentration of Physicochemical Parameters in Groundwater Samples of the Study Area*

| Sample No | pH | Turbidity (ntu) | EC (ucm) | Hardness (mg/L) | TDS (mg/L) | HCO3- (mg/L) | Cl- (mg/L) | $NO_3$- (mg/L) | $SO_4^{2-}$ (mg/L) | $PO_4^{3-}$ (mg/L) | Mg (mg/L) | Fe (mg/L) | Ca (mg/L) | Na (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Police Headquarters, Eleyele along Ibadan-Eruwa Expressway, Ibadan | | | | | | | | | | | | | | |
| W | 7.4 | 4.06 | 412 | 98.2 | 140.1 | 125.0 | 50.0 | 20.2 | 0.3 | 0.02 | 9.72 | 0.5 | 26.3 | 11.4 |
| BH | 5.5 | 3.76 | 505 | 54.1 | 231.7 | 130.1 | 75.1 | 41.8 | 0.24 | 0.02 | 8.01 | 0.02 | 14.4 | 8.2 |
| Army Staff Quarters, Mokola Barrack, Ibadan | | | | | | | | | | | | | | |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 6.3 | 2.05 | 536 | 78.6 | 170.4 | 108.8 | 35.0 | 14.2 | 0.33 | 0.08 | 22.8 | 0.01 | 32.2 | 12.5 |
| W | 7.2 | 7.66 | 453 | 56.0 | 260.8 | 205.0 | 70.2 | 32.1 | 0.15 | 0.02 | 9.15 | 0.01 | 36.7 | 11.5 |
| BH | 7.3 | 1.67 | 628 | 50.9 | 290.4 | 160.3 | 65.4 | 28.8 | 0.17 | 0.01 | 20.5 | 0.02 | 33.6 | 11.0 |
| Mammy Market Mokola Ibadan | | | | | | | | | | | | | | |
| W | 6.1 | 1.95 | 464 | 101.7 | 300.7 | 163.7 | 75.6 | 28.0 | 0.24 | 0.02 | 12.8 | 0.02 | 36.8 | 9.9 |
| W | 5.9 | 2.07 | 577 | 79.4 | 265.8 | 156.0 | 62.8 | 22.2 | 0.3 | 0.01 | 26.3 | 0.02 | 20.4 | 7.5 |
| BH | 5.7 | 1.25 | 258 | 56.7 | 301.9 | 144.8 | 45.5 | 28.8 | 0.22 | 0.01 | 16.2 | 0.02 | 26.2 | 10.7 |
| Oke Itunu Mokola, Ibadan | | | | | | | | | | | | | | |
| W | 6.4 | 2.9 | 227 | 100.7 | 290.5 | 202.3 | 165.0 | 28.4 | 0.17 | 0.08 | 19.4 | 0.01 | 39.9 | 7.2 |
| BH | 6.9 | 3.25 | 361 | 88.1 | 300.2 | 215.0 | 75.8 | 16.2 | 0.02 | 0.08 | 28.4 | 0.01 | 57.9 | 9.4 |
| Ade Royal Mokola Ibadan | | | | | | | | | | | | | | |
| W | 5.6 | 4.48 | 282 | 67.4 | 109.9 | 122.1 | 70.0 | 18.6 | 0.02 | 0.2 | 35.4 | 0.03 | 46.3 | 10.5 |
| BH | 7.1 | 5.86 | 144 | 56.6 | 170.0 | 217.4 | 40.0 | 21.8 | 0.2 | 0.12 | 10.3 | 0.07 | 33.5 | 9.9 |
| Redeemed Christian Church of God Mokola, Sango Road, Ibadan | | | | | | | | | | | | | | |
| W | 6.0 | 4.02 | 124 | 86.2 | 236.3 | 146.0 | 52.4 | 13.6 | 0.15 | 0.03 | 14.8 | 0.02 | 20.7 | 6.8 |
| Sabo Road Mokola, Ibadan | | | | | | | | | | | | | | |
| W | 4.7 | 2.37 | 303 | 55.8 | 240.6 | 151.2 | 75.0 | 18.4 | 0.13 | 0.12 | 43.7 | 0.01 | 26.6 | 7.2 |
| Saint Isabel Private School Eleyele-Mokola Ibadan | | | | | | | | | | | | | | |
| W | 5.4 | 8.33 | 278 | 58.7 | 220.2 | 168.0 | 90.2 | 42.1 | 0.24 | 0.1 | 4.58 | 0.01 | 31.1 | 6.2 |
| BH | 5.9 | 5.03 | 377 | 61.1 | 230.3 | 152.4 | 95.0 | 45.0 | 0.09 | 0.14 | 6.87 | 0.03 | 26.1 | 6.1 |
| Memorial Hospital Mokola, Ibadan | | | | | | | | | | | | | | |
| W | 5.7 | 3.23 | 319 | 76.4 | 176.2 | 152.0 | 70.0 | 21.4 | 0.05 | 0.2 | 11.4 | 0.02 | 21.7 | 8.2 |
| BH | 6.9 | 4.01 | 402 | 59.2 | 163.7 | 118.2 | 35.6 | 13.2 | 0.2 | 0.08 | 2.3 | 0.02 | 29.4 | 9.4 |
| School of Nursing Eleyele | | | | | | | | | | | | | | |
| W | 5.6 | 6.68 | 274 | 54.4 | 142.6 | 148.0 | 52.2 | 18.6 | 0.3 | 0.1 | 3.43 | 0.03 | 23.4 | 6.0 |
| Polo Ground Mokola, Ibadan | | | | | | | | | | | | | | |
| W | 5.9 | 2.82 | 305 | 87.5 | 278.8 | 180.2 | 70.2 | 42.0 | 0.14 | 0.1 | 5.7 | 0.02 | 22.8 | 8.9 |
| BH | 6.1 | 3.96 | 351 | 57.0 | 167.1 | 172.6 | 50.0 | 42.8 | 0.2 | 0.1 | 7.2 | 0.02 | 31.3 | 9.5 |
| SON Std Safe Limit | 6.5-8.5 | 5 | 1000 | 150 | 500 | 500 | 250 | 50 | 100 | 0.5 | 0.2 | 0.3 | 100 | 200 |

W = Hand-dug Wells, BH = Bore Holes

*Table 4: Summary of the physicochemical Analyses Results in comparism with SON (2003) Standards for Drinking Water.*

| **Parameter mg/l** | **Range** | | **Mean** | **Maximum Permissible SON Standard** | **No of samples above permissible level** |
|---|---|---|---|---|---|
| | Lowest | Highest | | | |
| Ph | 4.7 | 7.4 | 6.2 | 6.5 – 8.5 | Nil |
| Turbidity | 1.25 | 8.33 | 3.88 | 5 | 3 |
| Conductivity | 124 | 628 | 361 | 1000 | Nil |
| Total Hardness | 50.9 | 101 | 70.7 | 150 | |
| Total Dissolve Solid (TDS) | 109 | 301.9 | 223.2 | 500 | Nil |
| Bicarbonate | 108.8 | 217.4 | 159 | 500 | Nil |
| Chloride | 35 | 95 | 67.7 | 250 | Nil |
| Nitrate | 13.2 | 45 | 26.6 | 50 | Nil |
| Sulphate | 0.02 | 0.3 | 0.18 | 200 | Nil |
| Phosphate | 0.01 | 0.2 | 0.07 | 0.5 | Nil |
| Magnesium | 2.3 | 43.7 | 15.2 | 150 | Nil |
| Iron | 0.01 | 0.5 | 0.05 | 0.3 | 1 |
| Calcium | 14.4 | 57.9 | 30.3 | 100 | Nil |
| Sodium | 6.0 | 12.5 | 8.9 | 200 | Nil |

*Source: Author compiled*

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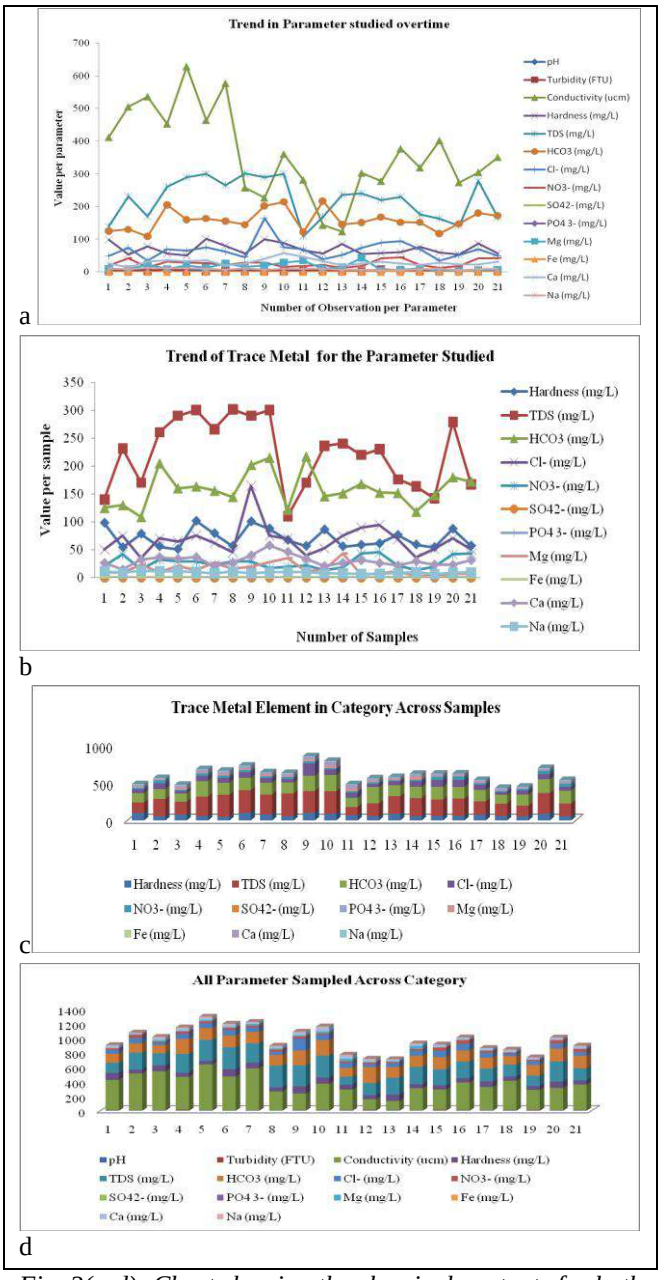


*Fig. 3(a-d): Chart showing the chemical contents for both Hand dug wells and Boreholes*

### 3.1 Result of chemical content analysis for both Hand dug wells and Boreholes

Measurements of pH are measured in relation to the acidity or alkalinity of the water. It is acidic if the pH value is below 7.0 while, alkaline if the pH value is higher than 7.0. Corrosion of metal pipes and plumbing system is to acidity while the disinfectant is to alkalinity in water. SON, (2003) has recommended maximum permissible limit of pH from 6.5 to 8.5 (Table 2). At all locations for hand dug wells, pH values ranged from (4.7 to 7.4) and that of boreholes ranged from (5.5 to 6.9). Therefore, the values for both the hand dug wells and borehole ranged from (4.7 to 7.4) and the values were within the limits set by (SON, 2003) (Table 4). The values of electrical conductivity (EC) of hand dug wells ranged from 124 to 577 microhoms/cm and borehole ranged from 144 to 628 microhoms/cm, then, the values for both wells and boreholes ranged from 124 microhoms/cm to 628 microhoms/cm which are within the permissible range of 1000 microhoms/cm by SON. The results of the turbidity results for hand dug wells ranged from 1.95 to 8.33 ntu and boreholes ranged from 1.25 to 5.86 ntu, then the values for both wells and boreholes ranged from ranges from 1.25 ntu to 8.33 ntu which are within the limit 5 nephelometric turbidity unit (ntu) prescribed by SON for drinking water.

The total dissolve solid (TDS) for hand dug wells ranged from 109.9 to 300.7 mg/L and boreholes ranged from 163.7 to 301.9 mg/L, then the values for both hand dug wells and boreholes ranged from 109mg/L to 301.9 mg/L which are lower than the allowable limits of 500 mg/L by (SON, 2003) standard of 500 mg/L. Water with more than 500 mg/L of TDS is not good for drinking water. Several factors may accounts for the presence of total dissolve solid obtained from the water samples collected. Most of the locations are within residential areas where septic tanks are indiscriminately site around the wells.

The result of the total hardness in this study for the hand dug wells ranged 54.4 to 101.7 mg/L and boreholes ranged from 50.9 to 88.1 mg/L, then, both the hand dug wells and boreholes ranged from 50.9 mg/L and 101 mg/L and are within the limit set by (SON, 2003). According to the classification of groundwater based on hardness by (Sawyer and McCarthy, 1987), total samples of 88.3% assessed were soft and 3.3% are hard, thereby making the groundwater suitable for drinking. Water with total hardness value greater than 150mg/L is designated as being hard; soft water have values less than 60ml/L (Freeze, and Cherry, 1979). Sulphate content in water in the study area for the hand dug wells ranged from 0.02 to 0.33 mg/L and boreholes ranged from 0.02 to 0.24 mg/L, then both the hand dug wells and boreholes range between 0.02 mg/L to 0.33 mg/L and considered generally low compared with the safe limits of 200mg/L minimum prescribed by (SON, 2003). With recommended limit of 250 mg/L for $CaSO_4$, $NaSO_4$, and $ZnSO_4$, sulphate could lead to problem of sense of taste if associated with some cations. More of $SO4^{2-}$ in groundwater could be associated to the geology of soil, interaction between clay and sandy soil could encourage sulphide such as pyrite from stratified matter reacting with water to produce $SO4^{2-}$ (Olobaniyi and Owoyemi, 2006). There is no health impacts recorded for high sulphate intake (SON, 2007). Excess concentrations of

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sulphate in groundwater not an indication to health hazard but can cause scale formation and may lead to a bitter taste in water which can result in laxative effect of humans and young livestock (Orewole et al., 2007).

According to the Department of National Health and Welfare, Canada, it was reported that, the chloride comes from natural and man-made sources are the main sources of chloride in groundwater. The sources are agricultural runoff, inorganic fertilizers, industrial and septic tank effluents, animal feed stocks. Chloride is not harmful to human at low concentration but could alter the taste of water at concentrations above 250 mg/L. The values of chloride for hand dug wells ranged from 35 to 165 mg/L and boreholes ranged from 35.6 to 95 mg/L, the both hand dug wells and boreholes ranged 35.0 and 95 mg/L and the result are within the safe limit set by (SON, 2003). The Hardness is directly related to Calcium and Magnesium content in water is related to hardness. Moreover, in this study, the Calcium contents from hand dug wells ranged from 20.4 to 46.3 mg/L and boreholes ranged from 14.4 to 57.9 mg/L, then both the hand dug wells and boreholes ranged between 14.4 mg/L to 57.9mg/L which are below the permissible of 100 mg/L limit set by (SON, 2003). The magnesium content for hand dug wells ranged from 3.43 to 43.7 mg/L and boreholes ranged from 2.3 to 28.4 mg/L, then both the hand dug wells and boreholes ranged from 2.3 mg/L to 43.7 mg/L which are below the permissible limit of 150 mg/L by WHO. Magnesium ($Mg^{2+}$) does not show any side effect since it is an essential element required by the human body (Frantisek, 2003).

Nitrates for hand dug wells ranged from 13.6 to 42.1 mg/L and boreholes ranged from 13.2 to 45 mg/L, the both the hand dug wells and boreholes ranged between 13.2 mg/l to 45 mg/l and are very low compared to the standard limit of 50 mg/L set by SON. Phosphate for hand dug wells ranged from 0.01 to 0.2 mg/L and boreholes ranged from 0.01 to 0.14 mg/L then both the hand dug wells and boreholes ranged between 0.01 mg/L to 0.2 mg/L and was very low compared to the permissible limit of 0.5 mg/L by (SON, 2003) (Table 2).

High nitrate values observed in some locations were due to poultry rearing and cassava processing wastes dump in the area. The concentration of bicarbonate $HCO_3$ for hand dug wells ranged from 108 to 205 mg/L and boreholes ranged from 118.2 to 217.4 mg/L, the both the hand dug wells and boreholes ranged from 108 mg/l to 217 mg/L and are within 100-500mg/L permissible limit set by (SON, 2003) for bicarbonate contents in water. HCO3- has no effect as both the wet and the dry season showed no correlation effects and no health-based guidelines were indicated for HCO3- by (SON, 2003). Sodium is an important component of most groundwater.

The concentration of sodium from hand dug wells present ranged from 6 to 12.5 and boreholes ranged from 6.1 to 11 mg/L, then both the hand dug wells and boreholes ranged between 6.0 mg/L and 12.5 mg/L are considerably not exceeds the permissible limit of 200 mg/L set by (SON, 2003). Iron ranged between (0.01 - 0.5) mg/L. Only in Police headquarters is found having iron content of 0.5 mg/L higher than the (SON, 2003)maximum permissible of 0.3 mg/L. pH, basin hydrological conditions; local geological structure are some of the crucial factors that could influence the ability of being able to dissolve and resulting in iron content as pointed out by (Amadi et al., 1989). However, geology of the area could be related to the other source of the iron content (Edet, 2003). Iron is one of important element useful in the body system; moreover, iron toxicity could lead to liver malfunctioning and diabetes mellitus (Klaassen et al, 1986).

### *3.2 Result of Statistical Analysis*

Number of observations (N) = 21

Pearson's correlation (r)

Degree of freedom (df) for a two tailed = N – 2

Degree of freedom (df) = 21 – 2= 19

From the Pearson's critical table at two tailed, the degree of freedom df (19) at 99% (0.01) confidence interval = 0.549, at 95% (0.05) confidence interval = 0.433 and at 90% (0.1) confidence interval = 0.369.

This values were compared with the

*Table 5: Correlation Coefficient Matrix for hand dug wells*

| | CA_mg_l | CL_ mg_l | EC_ µS/ cm | FE_m g_l | Hardnes S_ mg_l | HCO 3_mg _l | Mg_mg _l | NA_m g_l | NO3_mg_l | PH | PO43_mg _l | SO42_m g_l | TDS_ mg_l | Turb._ntu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CA_mg_l | 1 | | | | | | | | | | | | | |
| CL_mg_l | 0.431*** | 1 | | | | | | | | | | | | |
| EC_ µS/ cm | 0.032 | -0.346 | 1 | | | | | | | | | | | |
| FE_mg_l | -0.125 | -0.232 | 0.133 | 1 | | | | | | | | | | |
| Hardness_ | 0.030 | 0.253 | 0.076 | 0.364 | 1 | | | | | | | | | |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mg_l | | | | | | | | | | | | | | |
| HCO3_ mg_l _ | 0.116 | 0.675* | -0.155 | -0.344 | 0.013 | 1 | | | | | | | | |
| MG_mg_l _ | 0.266 | 0.053 | 0.092 | -0.179 | -0.136 | -0.325 | 1 | | | | | | | |
| NA_mg_l _ | 0.422*** | -0.355 | 0.583* | 0.355 | 0.222 | -0.295 | 0.081 | 1 | | | | | | |
| NO3_mg_l | 0.120 | 0.418** | -0.025 | -0.155 | -0.006 | 0.688* | -0.490 | -0.130 | 1 | | | | | |
| PH | 0.172 | -0.041 | 0.344 | 0.571* | 0.449** | 0.143 | -0.423 | 0.630* | 0.042 | 1 | | | | |
| PO43_mg_l | 0.177 | 0.099 | -0.390 | -0.278 | -0.356 | -0.236 | 0.262 | -0.135 | -0.061 | -0.568 | 1 | | | |
| SO42_ mg_l | -0.263 | -0.273 | 0.517** | 0.311 | 0.149 | -0.204 | -0.294 | 0.065 | -0.070 | 0.295 | -0.656 | 1 | | |
| TDS_mg_l | -0.049 | 0.481** | 0.085 | -0.394 | 0.324 | 0.751* | -0.070 | -0.222 | 0.501** | 0.018 | -0.500 | 0.025 | 1 | |
| Turb._ntu | 0.134 | -0.006 | -0.271 | 0.002 | -0.617 | 0.265 | -0.496 | -0.177 | 0.363 | 0.109 | 0.029 | -0.006 | -0.251 | 1 |

The Correlation coefficient matrix from table 5 above shows the relationship that exists between chemical contents for the hand dug wells. The results shows that $Cl^-$ depends on Ca with r = 0.431 at 90% confidence level. $HCO_3$ depends on $Cl^-$ with r = 0.675 at 99% confidence level. Na depend on Ca and EC with r = (0.422, 0.584) at 90% and 95% confidence level. $NO_3$ depend on $Cl^-$ and $HCO_3$ with r = (0.418, 0.688) at 90% and 99% confidence level. pH depends on Fe, hardness and Na with r = (0.571, 0.449, 0.630) at 90% and 95% confidence level. $SO4^2$ depends on EC with r = (0.517) at 95% confidence level. TDS depends $Cl^-$, HCO3 and $NO_3$ with r = (0.481, 0.751, 0.501) at 95% and 99% confidence level.

*Table 6: Correlation Coefficient Matrix for the Boreholes*

| | **CA_mg_l _** | **CL_ mg_l** | **EC_µS/ cm** | **FE__ mg_l** | **Hardness_ mg_l** | **HCO3_ mg_l** | **MG_mg_l** | **NA_ mg_l** | **NO3_ mg_l** | **PH** | **PO43 _mg_l** | **SO42_ mg_l** | **TDS_ mg_l** | **TURB._ntu** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ca_ mg_l | 1 | | | | | | | | | | | | | |
| Cl_ mg_l | 0.040 | 1 | | | | | | | | | | | | |
| EC_ µS/ cm | -0.156 | 0.426** | 1 | | | | | | | | | | | |
| Fe_ mg_l | -0.139 | -0.306 | -0.612 | 1 | | | | | | | | | | |
| Hardness_ mg_l | 0.833* | 0.301 | -0.190 | -0.309 | 1 | | | | | | | | | |
| HCO3_ mg_l | 0.728* | 0.021 | -0.473 | 0.436* | 0.524** | 1 | | | | | | | | |
| Mg_ mg_l | 0.731* | 0.256 | 0.129 | -0.291 | 0.593* | 0.561* | 1 | | | | | | | |
| Na__MG_L_ | 0.269 | -0.686 | -0.016 | -0.009 | -0.135 | 0.192 | 0.428** | 1 | | | | | | |
| NO3_ mg_l | -0.589 | 0.523* | 0.216 | -0.070 | -0.421 | -0.257 | -0.334 | -0.524 | 1 | | | | | |
| PH | 0.618* | -0.308 | 0.060 | 0.262 | 0.193 | 0.469** | 0.340 | 0.476** | -0.712 | 1 | | | | |
| PO43_ mg_l | 0.229 | 0.115 | -0.511 | 0.470* | 0.273 | 0.403*** | -0.352 | -0.575 | 0.062 | 0.136 | 1 | | | |
| SO42___MG_L | -0.778 | -0.594 | -0.021 | 0.241 | -0.841 | -0.503 | -0.577 | 0.323 | 0.196 | -0.288 | -0.409 | 1 | | |
| TDS_ mg_l | 0.307 | 0.438* | 0.317 | -0.485 | 0.329 | 0.078 | 0.821* | 0.233 | -0.057 | -0.065 | -0.594 | -0.395 | 1 | |
| TURB_ntu | -0.058 | 0.052 | -0.444 | 0.653* | 0.056 | 0.297 | -0.530 | -0.589 | 0.093 | 0.073 | 0.855* | -0.095 | -0.752 | 1 |

The Correlation coefficient matrix from table 6 above shows the relationship that exists between chemical contents for the boreholes. The results shows that EC depends on $Cl^-$ with r = 0.426 at 90% confidence level. Water hardness depends on Ca with r = 0.833 at 99% confidence level. $HCO_3$ depends on Ca, Fe and water

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hardness with r = (0.728, 0.436, 0.524) at 95% and 99% confidence level. Mg depends on Ca, water hardness and $HCO_3$ with r = (0.731, 0.593, 0.561) at 99% confidence level. Na depends on Mg with r = (0.428) at 90% confidence level. $NO_3$ depends on $Cl^-$ with r = (0.523) at 95% confidence level. pH depends on Ca, HCO3 and Nawith r = (0.618, 0.469, 0.476) at 99% and 95% confidence level. $PO4^3$ depends on Fe and $HCO_3$ with r = (0.470, 0.403) at 95% and 90% confidence level. TDS depends on $Cl^-$ and Mg with r = (0.438, 0.821) at 95% and 90% confidence level. Lastly, Turbidity depends on Fe and $PO_4$ with r = (0.653, 0.885) at 99% confidence level.

*Table 7: Correlation coefficient matrix for the Chemical Contents for both hand dug wells and Boreholes*

| | CA (mg/L) | CL (mg/L) | EC.(µcm) | FE (mg/L) | Hardness (mg_l) | $HCO_3$ (mg/L) | MG (mg/L) | NA (mg/L) | $NO_3$ (mg/L) | PH | $PO4^{-3}$ (mg/L) | $SO_4^2$(mg/L) | TDS (mg/L) | Turb_ntu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CA (mg/L) | 1 | | | | | | | | | | | | | |
| CL (mg/L) | 0.239 | 1 | | | | | | | | | | | | |
| EC. (µcm) | -0.050 | -0.127 | 1 | | | | | | | | | | | |
| FE (mg/L) | -0.105 | -0.184 | 0.044 | 1 | | | | | | | | | | |
| Hardness (mg_l) | 0.215 | 0.327 | -0.054 | 0.332 | 1 | | | | | | | | | |
| $HCO_3$(mg/L) | 0.442** | 0.398*** | -0.282 | -0.227 | 0.092 | 1 | | | | | | | | |
| MG (mg/L) | 0.384 | 0.134 | 0.078 | -0.140 | 0.112 | -0.046 | 1 | | | | | | | |
| NA (mg/L) | 0.350 | -0.441 | 0.392*** | 0.287 | 0.063 | -0.104 | 0.128 | 1 | | | | | | |
| $NO_3$ (mg/L) | -0.223 | 0.357 | 0.109 | -0.142 | -0.234 | 0.244 | -0.445 | -0.215 | 1 | | | | | |
| PH | 0.380*** | -0.166 | 0.251 | 0.410*** | 0.179 | 0.300 | -0.246 | 0.589* | -0.190 | 1 | | | | |
| $PO_4^3$ (mg/L) | 0.176 | 0.123 | -0.432 | -0.193 | -0.129 | -0.0134 | 0.130 | -0.254 | -0.041 | -0.362 | 1 | | | |
| $SO_4^2$ (mg/L) | -0.448 | -0.302 | 0.313 | 0.295 | 0.006 | -0.314 | -0.320 | 0.104 | -0.010 | 0.072 | -0.567 | 1 | | |
| TDS (mg/L) | 0.119 | 0.425*** | 0.184 | -0.356 | 0.226 | 0.475** | 0.151 | -0.076 | 0.280 | 0.021 | -0.533 | -0.113 | 1 | |
| TBD_ntu_ | 0.045 | 0.031 | -0.327 | 0.049 | -0.356 | 0.248 | -0.468 | -0.282 | 0.219 | 0.060 | 0.243 | -0.010 | -0.398 | 1 |

*, ** and *** denotes 1% (0.01), 5% (0.05) and 10% (0.1) significance level respectively for a 2 tailed Test (Significant level at 0.01 *, 0.05** and 0.1***)

The Correlation coefficient matrix from table 7 above shows the relationship that exists between chemical contents both from the hand dug wells and boreholes. The results shows that $HCO_3$ depends on increase in Ca at 95% confidence level with (r = 0.442) which shows positive and week relationship/correlation and higher than the Pearson's critical value (r) of 0.433 and Cl at 90% confidence level (r = 0.398) which shows positive and week relationship/correlation and higher than the Pearson's critical value (r) of 0. 369. Increase in $Na^+$ depends on increase in EC at 90% confidence level with (r = 0.392) which shows week relationship/correlation and higher than the Pearson's critical value (r) of 0. 369. The result also shows that increase in pH depends on Ca and Fe at 90% confidence level with (r = 0.380, 0.410) which shows positive and week relationship/correlation between pH (Ca, Fe) and higher than the Pearson's critical value (r) of 0. 369 and $Na^+$ which also shows strong relationship/correlation between (pH and $Na^+$). Therefore, high correlations that exist between pH and $Na^+$ showed that the two chemical contents are from the same source (Edet et al., 2011). The result of TDS results in increase in $Cl^-$ at 90% confidence level with (r = 0.425) which is higher than the Pearson's critical value (r = 0.369) and $HCO_3$ at 95% confidence level with (r = 0.475) which showed positive relationship between TDS and Cl, $HC0_3$ and higher than the Pearson's critical value (r = 0.433).

*Table 8: Descriptive statistics for the parameter study*

| | **CA (mg/l)** | **CL (mg/l)** | **COND (µcm)** | **FE (mg/l)** | **Hardness (mg/L)** | **$HCO_3$ (mg/L)** | **MG (mg/l)** | **NA (mg/l)** | **$NO_3$ (mg/l)** | **PH** | **$PO_4^3$ (mg/l)** | **$SO_4^2$ (mg/l)** | **TDS (mg/l)** | **TURB_ftu** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 30.348 | 67.667 | 360.952 | 0.044 | 70.700 | 159.005 | 15.19 | 8.952 | 26.581 | 6.171 | 0.078 | 0.184 | 223.3 | 3.877 |
| Median | 29.40 | 70.000 | 351 | 0.020 | 61.10 | 152.4 | 11.4 | 9.40 | 22.2 | 6.00 | 0.08 | 0.20 | 231.7 | 3.76 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | 0 | 00 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| Max. | 57.900 | 165.000 | 628 | 0.500 | 101.700 | 217.400 | 43.70 | 12.50 | 45.00 | 7.400 | 0.200 | 0.330 | 301.9 | 8.330 |
| Min. | 14.400 | 35.000 | 124 | 0.010 | 50.900 | 108.800 | 2.300 | 6.000 | 13.200 | 4.700 | 0.010 | 0.020 | 109.9 | 1.250 |
| Std. Dev. | 9.760 | 27.810 | 133.004 | 0.105 | 17.243 | 31.200 | 11.01 | 1.945 | 10.655 | 0.721 | 0.059 | 0.090 | 61.18 | 1.936 |
| Skewness | 1.037 | 1.995 | 0.226 | 4.147 | 0.572 | 0.422 | 1.071 | 0.008 | 0.503 | 0.187 | 0.561 | -0.28 | -0.23 | 0.847 |
| Kurtosis | 4.329 | 8.243 | 2.483 | 18.477 | 1.842 | 2.371 | 3.424 | 1.893 | 1.893 | 2.310 | 2.574 | 2.331 | 1.737 | 2.960 |
| Jarque-Bera | 5.314 | 37.984 | 0.413 | 269.767 | 2.318 | 0.970 | 4.174 | 1.073 | 1.958 | 0.540 | 1.262 | 0.659 | 1.579 | 2.515 |
| Prob. | 0.070 | 0.000 | 0.813 | 0.000 | 0.314 | 0.616 | 0.124 | 0.585 | 0.376 | 0.764 | 0.532 | 0.719 | 0.454 | 0.284 |
| Sum | 637.300 | 1421.00 | 7580 | 0.920 | 1484.70 | 3339.10 | 319 | 188. | 558.2 | 129.6 | 1.640 | 3.860 | 4688 | 81.41 |
| Sum Sq. Dev. | 1905.21 | 15468. | 353803 | 0.222 | 5946.28 | 19468.2 | 2426 | 75.65 | 2271 | 10.40 | 0.069 | 0.161 | 74853 | 74.96 |
| Obs. | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |

The major chemical parameters that are mostly with high concentrate in the water sample are; electrical conductivity (EC) with (360.952, 351.000, 628.000, 124.000), Hydrogen carbonate ($HCO_3$) with (159.005, 152.400, 217.400, 108.800) with high value in average mean, median, maximum and minimum, total dissolve solid (TDS) while other are total hardness with (70.700, 61.100, 101.700, 50.900), Chloride (CL) with (67.667, 70.000, 165.000, 35.000), calcium (Ca) with (30.348, 29.4, 57.900, 14.40), $NO_3$ with (26.581, 22.200, 45.000, 13.200) and those with low content are magnesium (Mg) with (15.189, 11.400, 43.7, 2.300), sodium (Na) with (8.952, 9.400, 12.500, 6.000), pH with (6.171, 6.000, 7.400, 4.700) which all falls with the WHO limit 0f 6.5-7.5 and turbidity with (3.877, 3.760, 8.330, 1.250). Those with lowest content intake are iron (Fe) with 0.044, $PO_4^3$ with 0.078, $SO_4^2$ with 0.184. Though. The descriptive analysis shows that all the parameters are within the WHO limits.

## IV. CONCLUSION

The physicochemical assessment of groundwater in Mokola-Eleyele, Ibadan, Nigeria was assessed. From the findings of the study, it showed that the chemical contents investigated were found below the SON limits. Therefore, the groundwater samples from the hand dug wells and borehole could generally be classified as of good quality, portable for drinking and fit for other domestic purposes. Generally, correlation analysis carried out helps in understanding the nature of extent of relationship between the chemical contents present in both the hand dug wells and boreholes in the study area. The result from the study will help in knowing the type of treatment to be carried out on the hand dug well and the boreholes that are presently in use and the one to use in the future so as to prevent people from contacting diseases

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# Challenges encountered by women Entrepreneurs in managing Food Businesses

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***Abstract*— *The primary purpose of this study is to identify the challenges of women entrepreneurs in running a food business. The researchers used a questionnaire checklist for collecting the data. It consisted of different variables such as the nature of the business, marketing knowledge, capital of the business and challenges encountered which are all related to running a business. The findings revealed that most of the respondents were engaged in eatery business, they have their own business stall and their start-up capital was low. Moreover, the respondents' used their own ideas to conceptualize the business. They utilized a distribution channel that is product direct to the consumer (end-user).To promote their product they prefer personal selling. Lack of resources was the most difficult challengethat the women entrepreneurs have encountered in starting a business.***

***Keywords*— *Challenges, food industry, start-up capital, strategy, women entrepreneur.***

## I. INTRODUCTION

Entrepreneurs are important players in any economy. "Entrepreneurs who prove to be successful in taking on the risks of a startup are rewarded with profits, fame, and continued growth opportunities and those who fail to suffer losses and become less prevalent in the markets"[1].

The researchers observed that there are different factors affecting the business making including Climate Condition. Climate conditions may affect your business in a number of ways. Unpredictable weather can impact directly on your business, for example by increasing the risk of water shortages or flooding. This can cause significant disruption to your business and make it more difficult to get insurance [2].

The researchers also observed that business owners handling meat processing products have encountered African Swine Fever or ASF, which brought a scare to a lot of customers in Cabanatuan City causing a low market on Meat Products specially Longganisa which is very popular in Cabanatuan City. According to Rappler-Ralf Rivas, "the National Meat Inspection Service (NMIS), ASF is a highly contagious viral disease that affects pigs, warthogs, and boars. It causes pigs to have a high fever and lose their appetite. It also causes hemorrhages in the skin and internal organs. Death is certain. Pigs die in a span of 2 to 10 days upon affliction. There is no known vaccine against ASF yet. Agriculture Secretary William Dar said 7 areas in two provinces in Luzon have been affected by ASF. These are Rizal - San Jose, Macabud, San Isidro, San Rafael, Mascap, and Cupang in Antipolo, Bulacan – Guiguinto. According to the Food and Agriculture Organization, ASF has severely affected China, Mongolia, Vietnam, Cambodia, some areas in South Korea, Laos, and Myanmar. ASF outbreaks have been detected in 32 provinces in China. Almost 1.2 million pigs there have been culled in an effort to halt the further spread of the disease"[3].

There are many misconceptions about entrepreneurs and businessmen. The entrepreneur is the market leader; it creates a new market and starts a new idea or concept. On the other hand, businessman plays as the market player who sets up the business with existing idea offering product or service.

"Women entrepreneurship is the process in which women initiate a business, gather all resources, undertake risks, face challenges, provides employment to others and manages the business independently. There has been a change in the role of women due to growth in education, urbanization, industrialization, and awareness of democratic values"[4].

Women often have skills and abilities that are useful in business and tend to be great at networking, and they possess inherent skills for negotiating to have the ability to multitask. Single mothers are often good at delegating and budgeting, skills that they rely on to manage their families [5].

One of the situations in Cabanatuan Cityis the noticeable growth of a business, and some of them are managed by women entrepreneurs. The aim of the research is to determine the challenges of starting a business in Cabanatuan City. The findings of this study will be useful to the citizens of Cabanatuan City and for the women entrepreneurs of the business or for the future women entrepreneurs in the City. With this study, the institution can determine the

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effectiveness of women entrepreneurs in the field of business. Likewise, this study can help women entrepreneurs to improve their marketing strategy, selling techniques and to bring emphasis on women entrepreneurs making it in the field of business.

## II. METHODOLOGY

This study utilized a descriptive research design with a questionnaire as the main data gathering tool. According to Dr. Y.P. Aggarwal (2008) as cited by [6] and [7] "descriptive research is devoted to the gathering of information about prevailing conditions or situations for the purpose of description and interpretation. This type of research design is not simply amassing and tabulating facts but includes proper analyses, interpretation, comparisons, identification of trends and relationships."

The respondents of the study who were chosen purposively based on the researchers' criteria [8] were 30 women entrepreneurs involved in food industries.

## III. RESULTS AND DISCUSSIONS

*Table 1. Business Profile*

| | **f** | **%** |
|---|---|---|
| Kind of Business | | |
| Food Processing | 6 | 20.00 |
| Eatery | 10 | 33.33 |
| Delicacies | 5 | 16.67 |
| Bakery | 4 | 13.33 |
| Others | 5 | 16.67 |
| Starting Capital | | |
| Below 20,000 | 16 | 53.33 |
| 20,001 – 30,000 | 6 | 20.00 |
| 30,001 – 40,000 | 4 | 13.33 |
| 40,001 – 50,000 | 2 | 6.67 |
| 50,001 and above | 2 | 6.67 |
| Source of Capital | | |
| Own Savings | 21 | 70.00 |
| Family Members | 7 | 23.33 |
| **Loans** | **2** | **6.67** |

The women entrepreneurs were mostly engaged in an eaterywith 33.33percent the highest among the other kind of businesses. It is one of the most common and simple kinds of businesses in the Philippines. Filipinos are known to eat a lot, a great source of idea for entrepreneurs that open opportunity. Filipinos are constantly eating. Three meals a day just isn't enough, so they've added two meryendas [9]. Eatery the most rewarding right types of businesses to invest in the Philippines as you serve hungry customers while turning a neat profit when managed properly[10].

In terms of the starting capital of the respondents, 53.33 percent were those who are on the bracket of below 20,000. This merely implies that with a lower capital aspiring entrepreneurs can start their own food business. The capital need is about P15,000 to open a small carinderia (eatery) or food kiosk. The money will go to two weeks' worth of inventory of food and ingredients, equipment and utensils, space rentals, and barangay permit fees. An entrepreneur may need a lower amount if he/she will do business in his/her own backyard or front yard (deduct P1,500 to P2,000 from the original estimate if this is the case) and if he/she will use his/her own existing kitchen utensils (deduct their brand-new cost). Assuming an income of P600 daily six days a week, an entrepreneur can expect to recover his/her investment by the second month [11].

The highest source of capital of the women entrepreneurs is from their own savings with 70 percent. The majority of the respondents are capable of starting their business using their own money. Twenty-three point thirty-three percent of the respondents were supported by family members while 6.67 percent availed loan.

*Table 2. Conceptualization, Distribution, and Promotion of the Food Business*

| Conceptualization | | |
|---|---|---|
| Personal Idea | 18 | 60.00 |
| Influence by family and friends | 11 | 36.67 |
| Attending trade fairs | 0 | 00.00 |
| Through | 0 | 00.00 |
| agencies/institutions | | |
| Others | 1 | 3.33 |
| Distribution | | |
| To retailers | 1 | 3.33 |
| To consumer | 19 | 63.34 |
| To distributors | 9 | 30.00 |
| Others | 1 | 3.33 |
| Promotion | | |
| Personal Selling | 18 | 60.00 |
| Social Media | 7 | 23.33 |
| Signage, streamer, etc. | 3 | 10.00 |
| Others | 2 | 6.67 |

Table 2 shows that 60 percent of the respondents inspired by their personal idea to start their business. They have the traits to be successful entrepreneurs. They think big and they are bold. They are not deterred by the big boys in the industry, they are not afraid to take a risk and they deal with day-to-

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day battles [12]. The entrepreneur to consumers (end-user) is the highest with 63.34 percent among the distribution channel that the respondents used. Women entrepreneurs have their own business stalls.

As to the promotion, 60 percent of the respondents used personal selling to promote their product. This is a very effective way to use in business since it requires face to face encounter with the customer.

*Table 3. Challenges in Running a Business*

| Challenges Encountered | f | % |
|---|---|---|
| Lack of financial fund | 3 | 10.00 |
| Competition | 7 | 23.33 |
| Lack of resources | 13 | 43.34 |
| Accessibility | 2 | 6.67 |
| Indebtedness | 1 | 3.33 |
| Others | 4 | 13.33 |

The data shows the problems encountered by the women entrepreneurs in running their businesses. First in rank (43.34%) is a lack of resources. Since entrepreneurs create new products to market some require ingredients that are imported, uncommon and seasonal. Availability of the resources like meat, chicken, and seafood affected when diseases arise (African Swine flu, bird flu, red tide,etc.). Competition in business comes second (23.33%) as the problem encountered by the entrepreneurs. The food industry is a popular and open opportunity for an aspiring entrepreneur. The growth also raised competition in the industry. The foodservice industry in the Philippines is growing at a phenomenal rate and everyone wants a part of it [12].

Other factor ranked 3rd (13.33%) was also encountered by the respondents. It includes weather condition such as the rainy season. From a business perspective, weather can have a significant impact on the bottom line [13].Lack of Financial Fund was ranked 4th (23.33%) by the respondents. Debt is common to all especially to a business owner for additional capital. Starting your own business often means getting into debt. You might have a little equity of your own for the setup, but chances are you'll also be using a loan, a credit card, or even a few investors [14].

Lastly, accessibility (6.67%) and Indebtedness (3.33%) were the lasts in rankand are the least challenges for women entrepreneurs.

## IV. CONCLUSIONS

Most of the respondents were engaged in the Eatery business. In terms of Start-up Capital, the lower fund is involved. Many of the respondents used their personal savings to open their businesses and used their own ideas to conceptualize the businesses.

The distribution channel that commonly used is product direct to the consumer (end-user).To promote the product respondents prefer personal selling. Lastly, the lack of resources is the problem that was most encountered by the respondents.

The results of this study may aid the researchers' ways of improving [15] their business and entrepreneurial skills. Lastly, a project feasibility study is recommended to identify [16] the potential market of the women entrepreneurs' in different industries in the country.

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# Improving Transient Stability of the Nigerian 330kv Transmission System on Ajaokuta - Benin Transmission Line with the help of artificial Neural Network (ANN) based VSC high Voltage direct current method

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***Abstract*****—** *Enhancement of the dynamic response of generators, within a power system, when subjected to various disturbances, has been a major challenge to power system researchers and engineers for the past decades. This work presents the application of intelligent Voltage Source Converter – High Voltage Direct Current (VSC-HVDC) for improvement of the transient stability of the Nigeria 330kV transmission system which is used as the case study network in this work. First, the current transient stability situation of the grid was established by observing the dynamic response of the generators in the Nigeria 330-kV grid/network when a balanced three-phase fault was applied to some critical buses and lines of the transmission network. These critical buses were determined through the eigenvalue analysis of the system buses. The result obtained clearly show that there exist critical buses such as Ajaokuta and critical transmission line such Ajaokuta - Benin Transmission line within the network. The results also revealed that the system losses synchronism when a balanced three-phase fault was applied to these identified critical buses and lines. The results further indicated that the Nigeria 330-kV transmission network is on a red-alert, which requires urgent control measures with the aim of enhancing the stability margin of the network to avoid system collapse. To this effect, VSC-HVDC was installed in addition to those critical lines. The inverter and the converter parameters of the HVDC were controlled by the artificial neural network. The results obtained showed that 42.86% transient stability improvement was achieved when the HVDC was controlled with the artificial neural network when compared to the PI controllers in the Nigeria 330-kV grid/network.*

***Keywords*****— buses, converter, stability, transient, transmission.**

## I. INTRODUCTION

### 1.1 BACKGROUND OF THE STUDY

Nowadays, the demand of electricity has radically increased and a modern power system becomes a difficult network of transmission lines interconnecting the generating stations to the major loads centers in the overall power system in order to support the high demand of consumers. Transmission networks being overloaded, are pushed closer to their stability limits. This is as a result of increasing demand for electricity due to growing population. This could have negative effect on the power system security. The complicated network causes the stability problem. Stability is determined by the observation of voltage frequency and rotor angle. One of the indices in assessing the state of security of a power system is the transient stability. This also involves the ability of power system to remain in equilibrium or return to acceptable equilibrium when subjected to large disturbances (Ayodele, Jimoh, Munda and Agee, 2012). Transient stability examines the impact of disturbance of power systems considering the operating conditions. The analysis of the dynamic behavior of power systems for the transient stability give information about the ability of power system to sustain synchronism during and after the disturbances.

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## II. LITERATURE REVIEW

### 2.1 POWER FLOW ANALYSIS NIGERIA 330KV TRANSMISSION POWER SYSTEM

The Nigeria 330-kV transmission network is used as the case study in this work. It consists of eleven (11) generators, twenty-nine (29) loads, comprising of forty (40) buses and fifty-two (52) transmission lines, which cut across the six (6) Geopolitical zone (South-West, South-South, South-East, North- Central, North-West and North-East Region) of the country with long radial interconnected transmission lines. The line diagram and data of the Nigerian transmission system were sourced from the National Control Centre of Power Holding Company of Nigeria, Osogbo. Nigeria. Power flow analysis of the Nigerian transmission system was performed in Matlab/PSAT environment

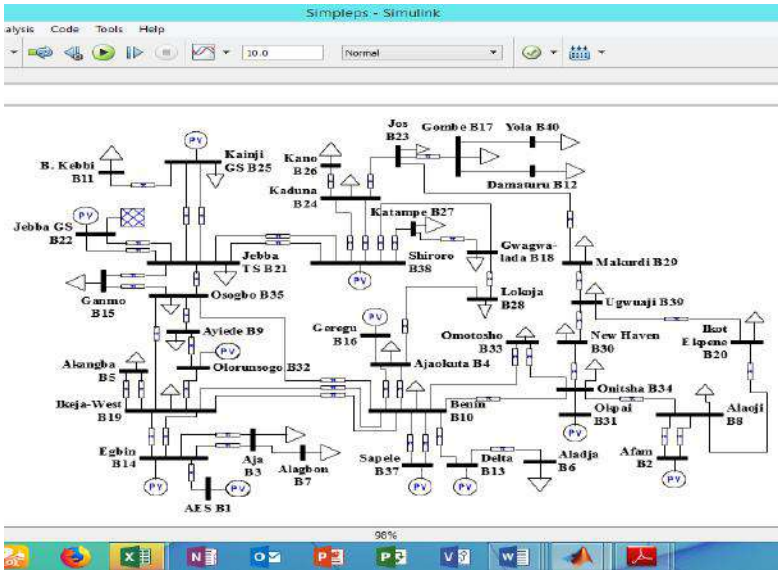


*Fig.1.0: PSAT Model of the Nigeria 330kV transmission power system without VSC-HVDC*

## III. METHODOLOGY

### 3.1 EIGENVALUE ANALYSIS

The Eigenvalue analysis investigates the dynamic behavior of a power system under different characteristic frequencies (''modes''). In a power system, it is required that all modes are stable. Moreover, it is desired that all electromechanical oscillations are damped out as quickly as possible. The Eigen value ($\gamma$) gives information about the proximity of the system to instability. The participation factor measures the participation of a state variable in a certain mode oscillation. The damping ratio ($\tau$) is an indication of the ability of the system to return to stable state in the event of disturbance. The output from the eigenvalue analysis on the Psat model of the Nigeria 330kV transmission grid is extracted and tabulated in Table 1.0 To ensure that the buses to be used are marginally unstable, the buses selected are buses having eigenvalue that lie on the right side of the S-plane and having lowest value of damping ratio.

*Table 1.0 Extracted output from eigenvalue analysis*

| Bus Number | Bus Name | Eigen Value ($\gamma$) | Damping Ratio ($\tau$) | Participation Factor (%) |
|---|---|---|---|---|
| 1 | AES | $2.7653 \pm j8.4192$ | 0.6442 | 1.0520 |
| 2 | Afam | $-1.9404 \pm j4.2813$ | 0.4723 | 0.6197 |
| 3 | Aja | $-2.1746 \pm j6.7011$ | 0.2632 | 0.7139 |
| 4 | Ajaokuta | $1.9640 \pm j3.1032$ | 0.0476 | 2.6122 |
| 5 | Akangba | $2.0367 \pm j8.2287$ | 0.5941 | 0.6122 |
| 6 | Aladja | $-3.4083 \pm j6.0053$ | 0.7456 | 2.4165 |
| 7 | Alagbon | $0.2562 \pm j5.7324$ | 0.6745 | 0.4165 |
| 8 | Alaoji | $-0.4528 \pm j4.2183$ | 0.6259 | 1.0817 |

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| | | | | |
|---|---|---|---|---|
| 9 | Ayiede | $-2.7653 \pm j11.2419$ | 0.4933 | 0.3021 |
| 10 | Benin | $2.8730 \pm j6.1437$ | 0.0219 | 3.3021 |
| 11 | BreninKebbi | $-2.1674 \pm j5.1101$ | 1.3511 | 0.3228 |
| 12 | Damaturu | $1.6064 \pm j6.8320$ | 0.8232 | 3.1297 |
| 13 | Delta | $-2.0367 \pm j8.2287$ | 0.7624 | 1.1096 |
| 14 | Egbin | $3.4083 \pm j7.1537$ | 0.8320 | 0.3176 |
| 15 | Ganmo | $-0.2562 \pm j5.7324$ | 0.8031 | 0.2113 |
| 16 | Geregui | $-0.4528 \pm j4.2183$ | 0.2803 | 0.2113 |
| 17 | Gombe | $-4.6097 \pm j7.5635$ | 2.3893 | 0.3260 |
| 18 | Gwagwa | $2.3576 \pm j8.1273$ | 0.3048 | 1.0640 |
| 19 | Ikeja-West | $-0.5284 \pm j3.3182$ | 1.1601 | 0.2639 |
| 20 | IkotEkpene | $4.6097 \pm j7.3637$ | 0.5060 | 0.2680 |
| 21 | Jebba TS | $-1.7356 \pm j4.9214$ | 0.0931 | 4.6422 |
| 22 | Jebba GS | $-1.7653 \pm j10.4192$ | 0.1311 | 0.1422 |
| 23 | Jos | $1.4011 \pm j3.1375$ | 0.6534 | 0.3252 |
| 24 | Kaduna | $-2.1746 \pm j6.7011$ | 0.7324 | 1.9180 |
| 25 | Kainji GS | $-1.9640 \pm j5.3208$ | 0.6612 | 1.2912 |
| 26 | Kano | $2.5376 \pm j10.9419$ | 0.3342 | 1.0768 |
| 27 | Katampe | $-1.7011 \pm j3.1375$ | 0.3442 | 0.0768 |
| 28 | Lokoja | $-2.1746 \pm j6.7011$ | 0.2632 | 0.7139 |
| 29 | Makurdi | $3.0640 \pm j5.3208$ | 0.0564 | 2.6122 |
| 30 | New Haven | $2.0367 \pm j8.2287$ | 0.5941 | 0.6122 |
| 31 | Okpai | $-3.4083 \pm j7.5374$ | 0.7456 | 5.4165 |
| 32 | Olorunsogo | $-0.2562 \pm j4.7324$ | 0.2674 | 3.4165 |
| 33 | Omotosho | $2.7297 \pm j5.5635$ | 0.3284 | 4.2720 |
| 34 | Onitsha | $0.4528 \pm j4.2183$ | 0.6259 | 0.1817 |
| 35 | Osogbo | $-3.8372 \pm j6.3756$ | 0.1842 | 4.3366 |
| 36 | Papalanto | $-2.7653 \pm j11.2419$ | 0.4933 | 0.3021 |
| 37 | Sapele | $1.7301 \pm j3.1375$ | 0.2193 | 3.3021 |
| 38 | Shiroro | $0.1674 \pm j4.1170$ | 0.0925 | 6.3228 |
| 39 | Ugwuaji | $-1.6064 \pm j6.8320$ | 0.8232 | 3.1297 |
| 40 | Yola | $-2.0367 \pm j8.2287$ | 1.7624 | 1.1096 |

### 3.2: INSTALLATION OF VSC-HVDC TO THE NIGERIA 40 BUS 330KV TRANSMISSION NETWORK FOR TRANSIENT STABILITY IMPROVEMENT DURING OCCURRENCE OF A THREE-PHASE FAULT

Figures 2.0 show the PSAT Model of the Nigeria 330kV transmission power system with VSC-HVDC installed along side with Ajaokuta – Benin Transmission Line. The position for the location of the VSC-HVDC was determined through eigenvalue analysis as aforementioned. The demonstration for the transient stability improvement on the Nigeria 330-kV grid network, in this work, considered Ajaokuta – Benin Transmission Line.

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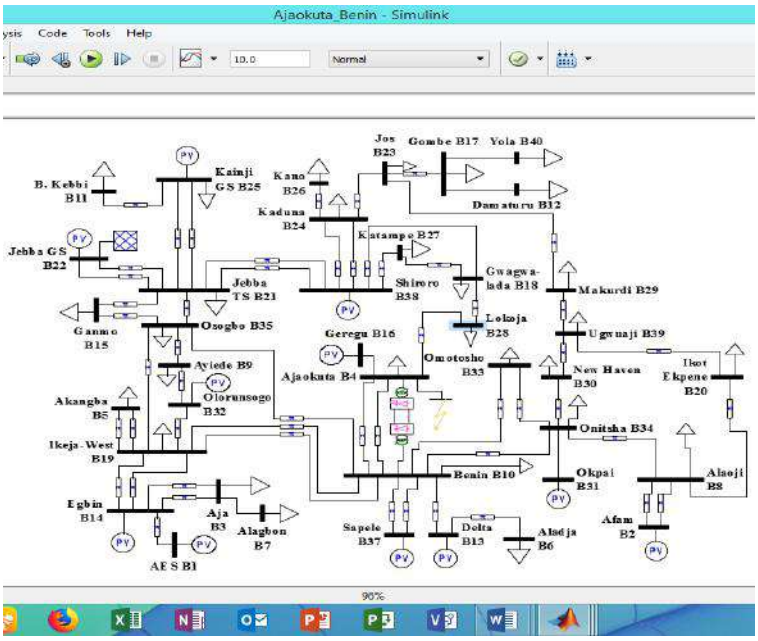


*Fig.2.0: PSAT Model of the Nigeria 330kV transmission power system with VSC-HVDC installed along side with Ajaokuta – Benin Transmission Line*

### 3.3 RESPONSE OF THE NIGERIA 330KV TRANSMISSION GRID TO OCCURRENCE OF A THREE-PHASE FAULT WITHOUT ANN CONTROLLED VSC-HVDC INSTALLED IN THE UNSTABLE BUSES

In this scenario, a three-phase fault was created on Ajaokuta bus (Bus 4) with line Benin – Benin (4-10) removed. Figures 3 and 4 shows the dynamics response of the generators for CCT of 300ms.Figures 3 and 4 shows the plot of the power angle curves and the frequency response of the eleven generators in the system during a transient three-phase fault on Ajaokuta to Benin transmission line. It can be observed that generators at Geregu, Sapele, Delta, Okpai and Afam buses were most critically disturbed and failed to recover after the fault was cleared at 0.35 seconds. These five generators in the system lost synchronism and became unstable as shown in Figures 3.0 and 4.0

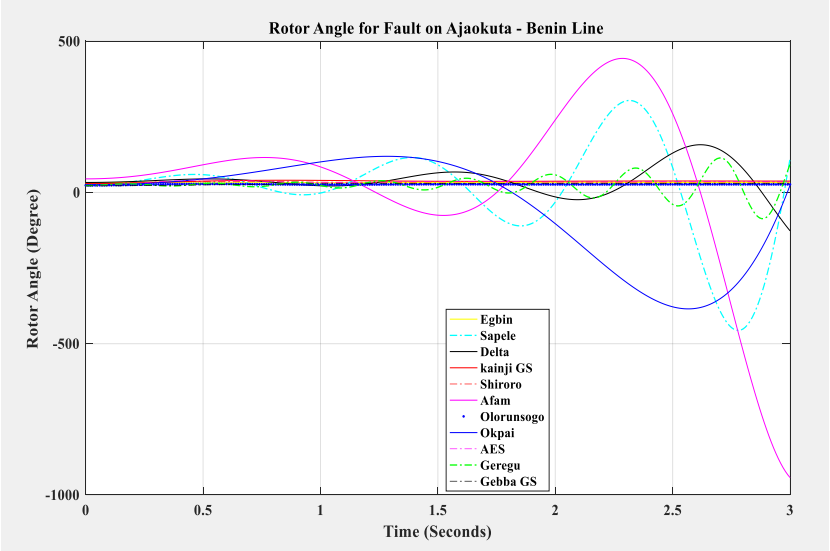


*Fig.3.0: Rotor Angle response of the generators for fault clearing time of 0.35 sec without any VSC-HVDC*

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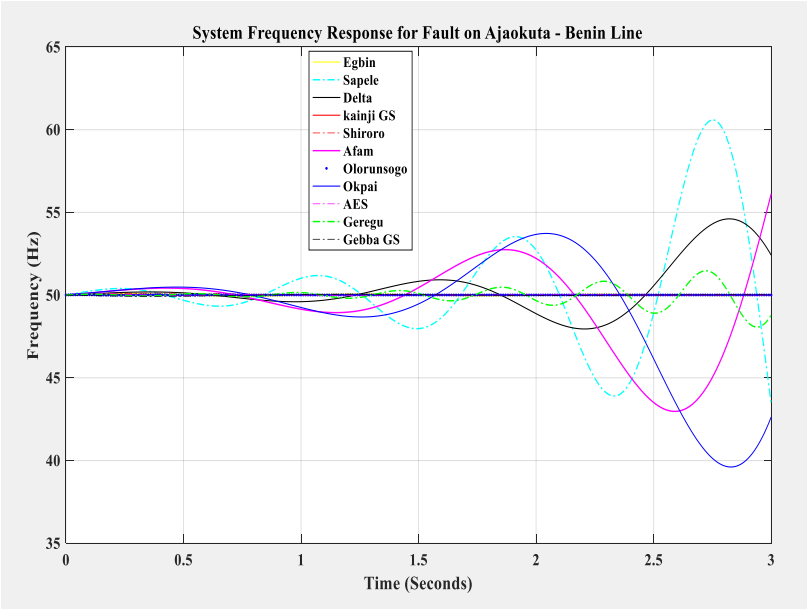


*Fig.4.0: Frequency response of the system generators for fault clearing time of 0.35 sec without any VSC-HVDC*

The voltage profile results of the Nigerian 40-bus 330kV transmission system after the occurrence of the fault are shown in Table 4.4 as obtained from the power flow analysis of the network in PSAT environment. It can be observed that there are serious voltage violations at buses 1 (AES), 2 (Afam), 13 (Delta), 16 (Geregu), 31 (Okpai), 32 (Olorunsogbo) and 37 (Sapele). The voltage magnitudes at these buses are lower than the acceptable voltage limit of ±10% for the Nigerian 330kV transmission system.

*Table.2.0: The Simulated Bus Voltage Profile during Occurrence of a Three Phase Fault on Ajaokuta Bus*

| Bus No | Bus Name | Voltage [p.u.] | Phase Angle [rad] |
|---|---|---|---|
| 1 | AES | 0.773990 | 0.02390 |
| 2 | Afam | 0.822780 | -0.00125 |
| 3 | Aja | 0.998480 | 0.006284 |
| 4 | Ajaokuta | 0.989621 | -0.00676 |
| 5 | Akangba | 0.805418 | -0.10014 |
| 6 | Aladja | 0.996952 | -0.00231 |
| 7 | Alagbon | 0.842001 | -0.03763 |
| 8 | Alaoji | 1.000000 | -0.00962 |
| 9 | Ayiede | 0.996654 | 0.001761 |
| 10 | Benin | 0.995594 | -0.00382 |
| 11 | B. Kebbi | 0.955445 | -0.04433 |
| 12 | Damaturu | 0.996001 | 0.001354 |
| 13 | Delta | 0.821045 | 0.000607 |
| 14 | Egbin | 1.000000 | 0.007773 |
| 15 | Ganmo | 0.995887 | -0.00372 |
| 16 | Geregu | 0.798931 | -0.00382 |
| 17 | Gombe | 0.766327 | -0.04365 |

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| | | | |
|---|---|---|---|
| 18 | Gwagwa-lada | 0.853375 | -0.03592 |
| 19 | Ikeja-West | 0.996943 | 0.001354 |
| 20 | IkotEkpene | 0.988973 | -0.01895 |
| 21 | Jebba TS | 1.000000 | 0 |
| 22 | Jebba GS | 1.000000 | 0.00215 |
| 23 | Jos | 0.966434 | -0.04046 |
| 24 | Kaduna | 0.971423 | -0.03687 |
| 25 | Kainji GS | 1.000000 | 0.007816 |
| 26 | Kano | 0.825577 | -0.20071 |
| 27 | Katampe | 0.973536 | -0.03586 |
| 28 | Lokoja | 0.970445 | -0.03763 |
| 29 | Makurdi | 0.972167 | -0.03443 |
| 30 | New Haven | 0.985259 | -0.01984 |
| 31 | Okpai | 0.816998 | -0.00953 |
| 32 | Olorunsogo | 0.783557 | 0.04615 |
| 33 | Omotosho | 0.772546 | -0.72907 |
| 34 | Onitsha | 0.992507 | -0.01132 |
| 35 | Osogbo | 0.994828 | -0.00446 |
| 36 | Papalanto | 0.963277 | -0.04365 |
| 37 | Sapele | 0.873953 | -0.00113 |
| 38 | Shiroro | 0.818990 | -0.90286 |
| 39 | Ugwuaji | 0.981078 | -0.02538 |
| 40 | Yola | 0.995245 | -0.04763 |

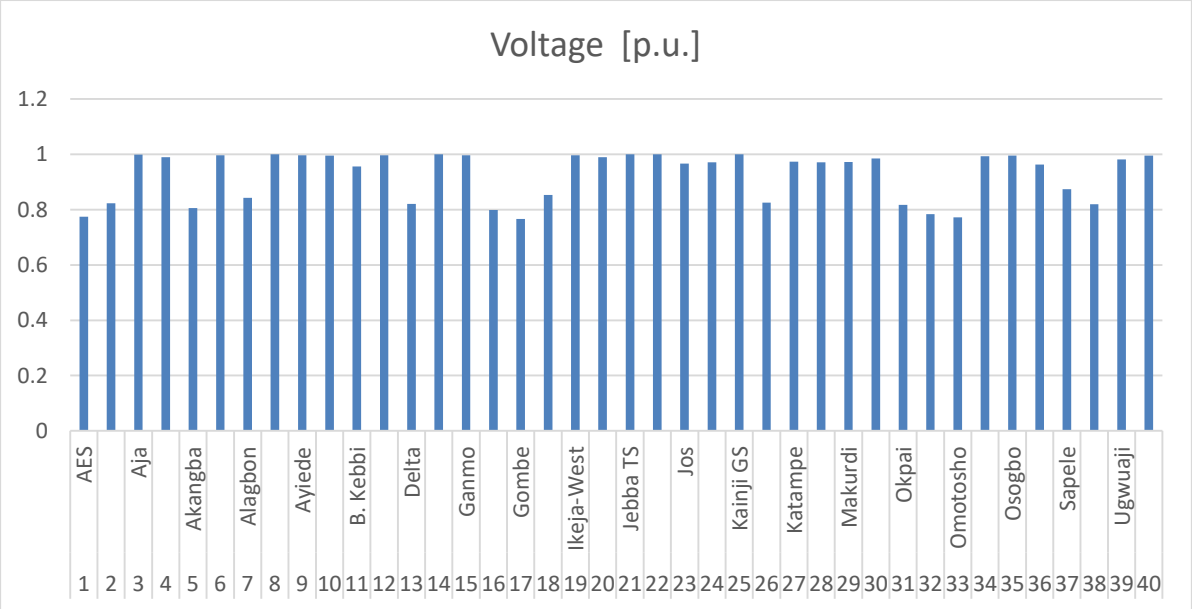


*Fig.5.0 Nigeria 330kV Transmission Line Bus Voltage Profile During Occurrence of a Three Phase Fault on Ajaokuta Bus*

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### 3.4 RESPONSE OF THE NIGERIA 330KV TRANSMISSION GRID TO OCCURRENCE OF A THREE-PHASE FAULT WITH ANN CONTROLLED VSC-HVDC INSTALLED IN THE UNSTABLE BUSES

Here, artificial neural network was used to regulate and control the parameters of the rectifier and the inverter of the VSC-HVDC instead of the convectional PI method. The idea is to see the effect of the HVDC, whose parameters are being controlled by neural network, on the transient stability of the system during occurrence of a three-phase transient fault and also on the bus voltage violations.The numerical solver, ode45, which is a built-in MATLAB function, is employed in solving the *m*-number of swing equations within the system. The CCT for the phase fault has been improved from 350ms to 500ms resulting to a 42.86% increment.When the position of the ANN controlled VSC-HDVC was atAjaokuta – Benin transmission line, a three-phase fault was created on Ajaokuta bus (Bus 4) with line Ajaokuta – Benin (4-10) removed by the CBs at both ends opening to remove the faulted line from the system. Figures 6.0 and 7.0show the plot of the power angle curves and the frequency responses of the eleven generators in the system during a transient three-phase fault on Ajaokuta to Benin transmission line. It can be observed that the oscillation of those five generators at Geregu, Sapele, Delta, Okpai and Afam buses which were most critically disturbed during a fault occurrence without VSC-HVDC, along with other generators, have achieved faster damping. It can also be noted that the CCT has been increased from 350 milli-seconds to 500 milli-seconds and also the oscillations were quickly damped.This can be attributed to the intelligent response of the neural network in controlling the parameters of the VSC-HVDC, which enabled to inject the needed power in the two buses (Bus 4 – 10) in time and most appropriately. Hence, from Figures 6.0 and 7.0, the transient stability of the system has been further improved with the intelligent HVDC in the system.

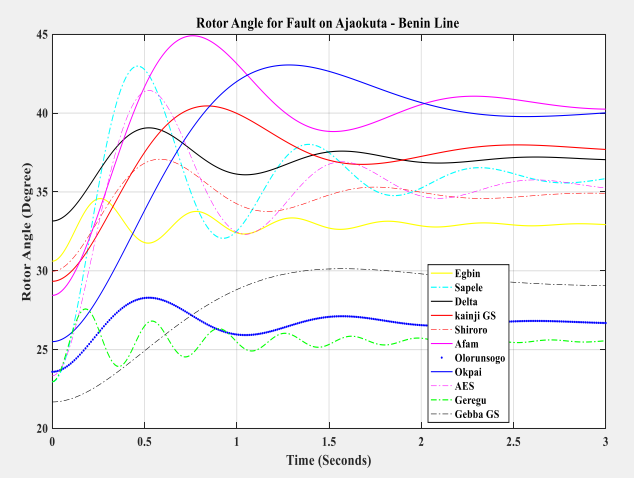


*Fig.6.0: Rotor Angle response of the generators for fault clearing time of 0.5 sec with ANN Controlled VSC-HVDC*

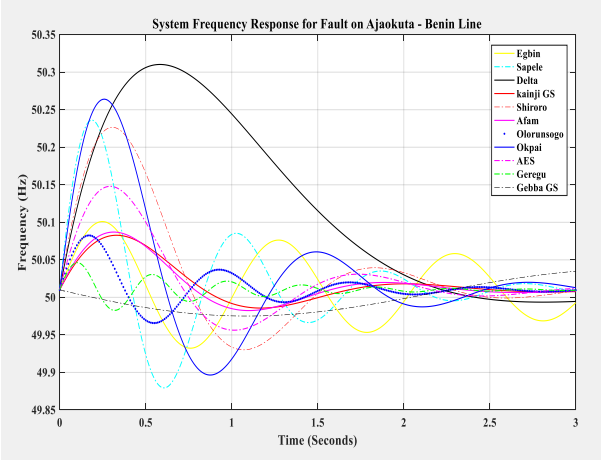


*Fig.7.0: Frequency response of the system generators for fault clearing time of 0.5 sec with ANN Controlled VSC-HVDC*

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The voltage profile results of the Nigerian 40-bus 330kV transmission system with ANN Controlled VSC-HVDC installed between Ajaokuta to Benin bus after the occurrence of the fault are shown in Table 2.0 as obtained from the power flow analysis of the network in PSAT environment. It can be observed from Table 2.0 and Figure 5.0 that the voltage violations at buses 1, 2, 13, 16, 31, 32 and 37 which were 0.905738, 0.909903, 0.922923, 0.919679, 0.941849, 0.919188 and 0.960770 as obtained previously when the VSC-HVDC was being controlled by the conventional PI method are now improved to 0.998421,1.000000, 0.999275, 0.979914, 0.997805, 0.998835 and 1.000000 respectively. This is as result of the intelligent response of the VSC-HVDC in injecting adequate reactive power timely.

*Table.3.0: The Simulated Bus Voltage Profile during Occurrence of a Three Phase Fault on Ajaokuta Bus with ANN Controlled VSC-HVDC Installed*

| Bus No | Bus Name | Voltage [p.u.] | Phase Angle [rad] |
|---|---|---|---|
| 1 | AES | 0.998421 | 0.02336 |
| 2 | Afam | 1.000000 | -0.01134 |
| 3 | Aja | 0.998480 | 0.006284 |
| 4 | Ajaokuta | 0.989621 | -0.00676 |
| 5 | Akangba | 0.805418 | -0.10014 |
| 6 | Aladja | 0.996952 | -0.00231 |
| 7 | Alagbon | 0.842001 | -0.03763 |
| 8 | Alaoji | 1 | -0.00962 |
| 9 | Ayiede | 0.996654 | 0.001761 |
| 10 | Benin | 0.995594 | -0.00382 |
| 11 | B. Kebbi | 0.955445 | -0.04433 |
| 12 | Damaturu | 0.996001 | 0.001354 |
| 13 | Delta | 0.999275 | 0.00146 |
| 14 | Egbin | 1.000000 | 0.007773 |
| 15 | Ganmo | 0.995887 | -0.00372 |
| 16 | Geregu | 0.979914 | -0.00953 |
| 17 | Gombe | 0.766327 | -0.04365 |
| 18 | Gwagwa-lada | 0.853375 | -0.03592 |
| 19 | Ikeja-West | 0.996943 | 0.001354 |
| 20 | IkotEkpene | 0.988973 | -0.01895 |
| 21 | Jebba TS | 1.000000 | 0 |
| 22 | Jebba GS | 1.000000 | 0.00215 |
| 23 | Jos | 0.966434 | -0.04046 |
| 24 | Kaduna | 0.971423 | -0.03687 |
| 25 | Kainji GS | 1.000000 | 0.007816 |
| 26 | Kano | 0.825577 | -0.20071 |
| 27 | Katampe | 0.973536 | -0.03586 |
| 28 | Lokoja | 0.970445 | -0.03763 |
| 29 | Makurdi | 0.972167 | -0.03443 |
| 30 | New Haven | 0.985259 | -0.01984 |

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| | | | |
|---|---|---|---|
| 31 | Okpai | 0.997805 | -0.05617 |
| 32 | Olorunsogo | 0.998835 | 0.05615 |
| 33 | Omotosho | 0.772546 | -0.72907 |
| 34 | Onitsha | 0.992507 | -0.01132 |
| 35 | Osogbo | 0.994828 | -0.00446 |
| 36 | Papalanto | 0.963277 | -0.04365 |
| 37 | Sapele | 1.000000 | -0.00380 |
| 38 | Shiroro | 0.818990 | -0.90286 |
| 39 | Ugwuaji | 0.981078 | -0.02538 |
| 40 | Yola | 0.995245 | -0.04763 |

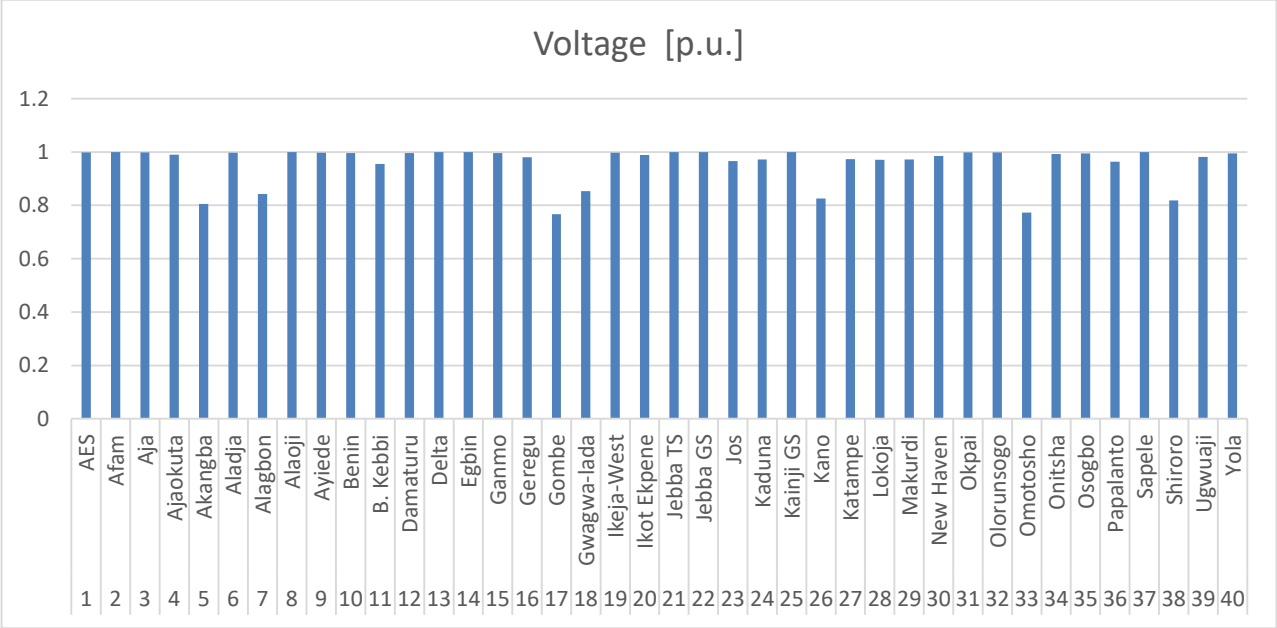


*Fig.8.0: Nigeria 330kV Transmission Line Bus Voltage Profile during Occurrence of a Three Phase Fault on Ajaokuta Bus with ANN Controlled VSC-HVDC Installed*

## IV. CONCLUSION

In this work, transient stability improvement of the Nigeria 330-kV grid system using intelligent VSC-HVDC has been carried out. The location of a balanced 3-phase fault, at various nodes, was determined based on the most critical buses within the network which was determined through eigenvalue analysis. The dynamic responses for various fault locations are obtained. The results obtained show that the Nigeria 330-kV transmission network is presently operating on a time-bomb alert state which could lead to total blackout if a 3-phase fault occurs on some strategic buses. The result obtained shows that when a 3-phase fault of any duration occurs on Ajaokuta bus, the system losses synchronism immediately. The Ajaokuta – Benin transmission lines have been identified as a critical line that can excite instability in the power network if removed to clear a 3-phase fault. The results obtained showed that greater transient stability was achieved when the HVDC was controlled with the artificial neural network as can be seen by observing the dynamic response of the generators in the Nigeria 330-kV grid network. The entire simulation of the Nigeria 330kV transmission network was done in MATLAB/PSAT environment.

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