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Effects Of Rice Cultivation Input On Water Quality: Case Of Mmiri Ate Mele, Ifete-Ogwari Ayamelum, Anambra State, Nigeria

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ABSTRACT
Rice (*Oryza sativa L.*) is grown in all ecological zones globally, although different varieties, cultivation methods, processing adaptation traits for each of the ecological zones exist. Quest for increased rice productivity lead to agrochemicals input with deterimental environmental impact. Detrimental effects of agrochemicals on ecosystem and human health necessitated the need to conduct water quality assessment in the study area The study examines pollution indicators of *Mmiri Ate Mele* river as induced by agrochemical input in rice cultivation at *Ifite-Ogwari*. Survey design (random administration of 100 questionnaires), field observations and appropriate laboratory analyses were employed. It uncoverred major agricultural system practiced in the study area to be continuous farming, major crops grown is rice, irrigation farming system is practiced by the community, with major farm input to be fertilizer. Laboratory analyses revealed some pollution inicators range pH (6.7–7.24), Ec (6.7- 875.5), mercury (0.50 -1.60 mg/l), lead (0.006-0.014 mg/l), turbidity (1.2–4.5 ntu), all within WHO Standard limits. Other indicatos as DDT (0.031 - 0.125), Cadmium (0.015 - 0.157 mg/l), Arsenic (0.019 - 0.81 mg/l), Phosphate (1.53 - 2.30 mg/l) were above WHO standard limits. An indication that if agrochemical usage persists in rice cultivation without regulation and farmers attitudinal change at the area, it will increase the river toxicity and induce more harm to the environment and human health in coming years. Cultural methods of weed and pest control is advocated being one of the best eco-friendly methods of pest control. Farmers intermitent training and educational interventions.
Keywords: Rice (*Oryza* Sativa *L.*), Ecosystem degradation, Agrochemical input, Water quality, Sustainable Environment.

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1.
0 INTRODUCTION
Rice (*Oryza sativa L.*) is a primary food source for an estimated 3.5 billion people globally. The crop is grown in all the ecological zones in Nigeria, although different varieties, cultivation methods, processing and adaptation traits for each of the ecological zones exist. Agrochemicals are generally used worldwide to enhance crop production by using pesticide, to controls pest, disease, pathogens, and weeds and by using fertilizers that add nutrients to the soil (Futakuchi *et al.,* 2021). However, there is a large and growing volume of literature on the potential environmental and toxicological risks associated with unscientific use of agrochemicals (Udeigwe e*t al.,* 2015). In addition, water safety is a major concern worldwide. This is because pollution by nutrients from agricultural activities causes many problems in water bodies and the environment (Varma, *et al* 2017). The main sources of these problems are fertilizers and pesticides applications among other bad agricultural practices engaged by the farmers. Fertilizers input onto the soil might have had the requested affect, however, considerable amount of

the applied fertilizers are carried to land-based and aquatic ecosystems by leaching, surface run-off and other processes (Madukasi, Igwe and Azaka, 2025; Kratz, Schick & Schnug , 2016). Agrochemical is a mixed blessing to farmers and has become an integral part of modern agriculture improving and protecting agro products as well as to eradicate pests transmitting infectious diseases to crops (Govinda, 2014). It has been estimated globally that nearly $38 billion are spent on pesticides each year (Patil-Shreya and Patil-Rahul, 2022). Millions of people use fertilizer in their farms and backyards to increase their crop yield or enhance plants growth. Ideally, the applied agrochemicals should only be toxic to the targeted organisms, should be biodegradable and eco-friendly to some extent (Rosell, Quero, Coll & Guerrero, 2018). However, improper use of fertilizer combined with runoff leads to contamination of both surface and groundwater thereby degrade water quality. Nutrients in fertilizer could cause nutrient buildups in streams, lakes, and rivers, stimulating unwanted growth of algae and other aquatic plants (Berg and Mary, 2017). Furthermore, nutrient enrichment could lead to reduced dissolved oxygen concentrations; without sufficient dissolved oxygen, fish and other aquatic species could suffocate (Berg and Mary, 2017). Fertilizer is primarily made up of two nutrients: nitrogen and phosphorus (Sara Davies, 2001: Chen, Erica and Eusden**,** 2021). Although phosphorus is mainly responsible for algal blooms in surface waters and can cause an excessive amount of nutrients, its low solubility renders the loss of phosphates in water insignificant, especially in comparison to quantities released by industrial wastes (Easton, et al 2004). On the other hand, nitrogen is highly soluble and can leach down through the soil and contaminate groundwater (Chen, Erica and Eusden, 2021**).** The deterimental effects of nitrogen to human health made the U.S. Public Health Service to set limit for nitrate level in domestic water supplies to be 10 ppm (Mc Dowell, 2018). High nitrate levels in drinking water causes babies to develop methemoglobinemia, a disorder which interferes with oxygen intake in the circulatory system (Berg & Mary, 2017: Van Metre 2016). The addition of fertilizer can also drastically change the pH of water, making it drop below the acceptable level of 6.5-8.5. Waters of low pH leaches toxic metals, including iron, manganese, copper, lead, and zinc etc., leading to corrossion and bitter taste (Hancock and Nicole, 2016). Many species of fish and aquatic life are also sensitive to changes in water temperature and composition and could be harmed due to acidification. Total dissolved solids (TDS) are also an important indicator of water quality, hence, the U.S. EP A guideline for TDS is 500 ppm. High levels of dissolved solids can stain household supplies, corrode pipes, and cause a metallic taste. Also similar to low pH, increased TDS levels could imply that harmful metals like bromide, sulfate, and iron are present in the water body (Hancock, Nicole, 2016). In many countries, such as America, China, France and United Kingdom, population pressure has resulted in expansion into marginal lands and is usually associated with subsistence farming. In Nigeria, food insufficiency has led to expansion and steadily increase in the use of fertilizers, herbicide and pesticides to achieve and sustain higher yields (Schreinemachers and Tipraqsa, 2012). Although agriculture is essential in sustaining human life, the practices associated with it have been known to have certain impacts on the environment (Kay, Edwards & Foulger, 2009). Fertilizer application is one of agricultural activities that have environmental impacts on land, water, and air; hence, the environmental impacts will differ based on the farm location, farm type, and the specific farming and land management practices used as well as the timing of these practices such as season of fertilizer application (Skytte & Armitage, 2010). The most notable of these effects includes climate change, deforestation, pollution, and general environmental degradation (Aluko, Oyeleye, Sulaiman & Ukpe, 2008). Fertilizer application as one of agricultural practices that have negative impacts on water quality through improper applications which may elevate concentrations of nutrients, fecal coliforms, and sediment loads (Carriger, Rand, Gardinal, Perry, Tompkins & Fernandez, 2006). In Malaysia, farmers are exposed to a variety of pollutants particularly heavy metals that are released into the environment as a consequence of agricultural activities such as use of pesticides and fertilizers (Ghazali, *et al.*, 2012).

The problem under investigation is the effects of agricultural practices on water. Water is beneficial to human and environment at large. Agricultural land use in *Ifete-Oqwari* includes land used for producing crops and raising livestock. *Ifite-Oqwari* community is located in Ayemelum council Area of Anambra State traversed *Mmiri Ate Mele* river is an agricultural community producing mainly food-stuffs (rice, corn, vegetable, cassava, plantain, potatoes and fruits), and rearing of animals (goat, pig, fowl, and fish farming). Application of pesticides and herbicide as the main Agricultural practices is done irrespective of where the farming operation is carried out which includes the bank of

Mmiri Ate mele river; agricultural wastes are discharged directly into the river or as runoff. This makes the river prone to harmful effects, not just the community but the ecosystem within the environment.

Farmers usually apply some hazardous agrochemicals like organochlorine and organophosphate more than the recommended quality or frequency per season (Madukasi, Igwe and Azaka, 2025). Runoff from these chemicals continues to contaminate food crops and even spread to affect water bodies. The problem is compounded by the fact that farmers usually wash knapsack sprayers and their clothes in the river water after spraying. Despite that the source water (*Mmiri Ate Mele*) is not free from residual pesticides, most rural folks depend on the river as source water for drinking and other domestic activities, hence, the communities that depend on the *Mmiri Ate mele* river as source of water is invariably exposure to chemical and other toxic contaminants. It has been demonstrated from previous studies that residues of both banned and currently used fertilizers and pesticides such as organochlorines and organophosphates, contributed to the accumulation of heavy metals found in both terrestrial and aquatic environments which have been found in terrestrial food and aquatic environments (Akintujoye, Anumudu &Awobode, 2013).

Apart from the fact that agricultural land use accounted for a much greater proportion of the total land area in the basin, cultivation has become more clearly concentrated in the vicinity of the river and its tributaries. Again, practically most bank of the river is now actively a farm settlement in Nigeria. These activities have greatly increased erosion in the basin causing the river to alter its hydraulic variables so that it can accommodate the sediment produced by erosion. In addition, no study has been conducted on this major water resource (*Mmiri Ate Mele* river) to establish the extent of agricultural activities on the quality of the river. This research seeks to assess empirically the Environmental effect of Agricultural practice on the multipurpose river named *Mmiri Ate mele* and report the results of study in order to establish the effects of agricultural wastes, agrochemical residues, other toxicants on the river and to provide a framework for environmental sustainability and food security.

Mmiri Ate Mele (river) in *Ifite-Oqwari* located in Ayemelum Council Area of Anambra State is no doubt a reference point for rural water supply in the area. The river supplies water to the people all year round and is been effectively utilized for different domestic and agricultural purposes within the community. While agriculture in the area is carried out along the bank of the river, agricultural wastes are discharged directly into the river or as runoff. From the foregoing therefore, there is the need to carry out in-depth analysis on the river water to detect, identify and quantify level of changes agricultural activities has caused on physiochemical parameters, toxicity, agrochemical residues, and biological indices of *Mmiri Ate Mele* river.

Theoretical Framework: Environmental Sustainability:

The study is based on the concept of Environmental Sustainability that leads to Sustainable Agriculture. Environmental sustainability as defined by Rebecca, (2003) is the responsible interaction with the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality. It integrates the concerns of socio-economic aspects while dealing with the natural environment (Ray, 2002). In this study, *Ifite-ogwari* farmers activities includes bush farming, fallow, tillage and irrigation among others. These activities has to be done sustainable as to reflect the three dimensions of Environmental Sustainability which includes environment, economic and social (Gimenez, Sierra & Rodon, 2012) that is sustainability based on the triple bottom line concept (Labuschagne, Brent, & Van Erck, 2005). Therefore, in the context of environmental sustainability, agricultural practices as in Ifite-ogwari should be carried out such that it do not degrade the environment or endanger public health. However, the residue of agro input use in the study area (*Ifite-oqwari*) such as pesticides, fertilizer and other chemicals used for cultivation should not affect other component of the environment as it is against the rule of sustainability. This is because environmental sustainability is meant to give quality assurance to soil, water and air also maintain quality socio-economic livelihood that sustains man. Although increased human population and high agricultural practices is the prompting factor for agrochemical use which has caused environmental degradation and public health dangers. This problem can alternatively be overcome by employing environmentally friendly means of agricultural practices such as using organic manure and adopting cultural/biological pest management strategies.

The study also dwells on the concept of Green Agriculture. The concept of green agriculture deals with organic farming which is the alternative agricultural system that originated early in the 20th century in reaction to rapidly changing farming practices. According to Paul and Benjamin (2016) organic farming is defined as the use of fertilizers of organic origin such as compost manure, green manure, and bone meal. It also places emphasis on techniques such as crop rotation and companion planting. Organic standards are designed to allow the use of naturally occurring substances while prohibiting synthetic substances.Green agriculture techniques relevance to this study lies in its holistic view of environmental impacts associated with farming practices in *Ifite-ogwari.* It identifies critical phases in farming practices adopted in the study area such as shifting cultivation, mixed cropping, and continuous farming system. This encourages agricultural practices that uses natural control system of pest populations by anticipating pest problems and preventing pests from reaching economical damaging levels via appropriate techniques that enhances natural enemies elimination, planting pest-resistant crops and using pesticides judiciously.

As green agricultural techniques emphasize minimal use of pesticides in controlling pests, its adoption by farmers could reduce the use of pesticides and their adverse impacts. In this study the *Ifite-ogwari* farmers will be availed with the most agricultural practice that will minimizes application of pesticides in their farms among crop production, livestock rearing and agro-based products.Sustainable Agriculture is defined as the ability of farmland to produce food and other agricultural products to satisfy human needs indefinitely as well as preventing any negative impacts on the broader environment (Adams, 2006). Therefore, in the context of environmental sustainability, agricultural practices should be carried out such that they do not degrade the environment or endanger public health. Most farm produce are cultivated in a waterlogged area or nearby water bodies (i.e.) wetlands. The residue of agrochemicals used for agricultural production affects water quality, which is against the rule of environmental sustainability that is meant to give quality assurance to soil, water and air also maintains quality socio-economic livelihood of man. *Ifite-ogwari Mmiri Ate mele* river among other recreational uses is source water for drinking/cooking, irrigation, cassava fermentation, bathing/swimming.

Although increased human population and high food demand is the prompting factor of intensive agriculture and agrochemical use which have caused environmental degradation and public health dangers. This problem can alternatively be overcome by employing environmental friendly on green means of agricultural production (i.e.) conservative tillage, avoiding bush burning, using organic manure and adopting cultural and biological pest management strategies (Pannell, Marshall, Barr, Curtis, Vanclay and Wilkinson, 2006). however, the ecological and social price of unsustainable agriculture has been steep erosion due to soil tillage; depleted and contaminated soil and water resources due to residues and runoff of agrochemicals; loss of biodiversity, due to rapid deforestation. In the context of environmental management, green approach must be built into the cultivation of food process, or else man continues to destroy those environmental assets (soil water and air) upon which his livelihood and survival depend on.

2.0 MATERIALS AND METHODS

2,1 Study Area:

The study area *Ifite-Ogwari* is a town located in Ayamelum local government area of Anambra state Nigeria. It is 45 km from Awka, the capital of Anambra State which is located between latitude 06° 60’41” N and longitude 06° 95’07” E, at an elevation of 91 m above sea level ((Ewuim e*t al.,* 2018). Geologically, *Ifite-Ogwari* is located within the Anambra Basin which is deposited and filled in two sedimentary phases, transgression and sea regression. The study area, *Ifite-Ogwari* is underlain by the Palaeocene Imo Formation which is the basal unit of the Niger Delta Basin. The Formation is essentially a mudrock unit consisting of dark gray to bluish gray shale, with occasional admixtures of clay, ironstone, thin sandstone bands, and limestone intercalations (Nwajide, 2013; Anakwuba *et al.,* 2021).

2,2 Research Design:

In this study, a questionnaire survey, personal observation and experimental design were adopted in other to achieve the research stated aim and objectives. The field survey design was done via personal observation which enabled information collection on types of farm input and application method. The experimental design focused on *Mmiri Ate Mele* Water sampling and sample analyses to determine the amount of pesticide residues (Organochlorine and Organophosphate) and some toxic heavy metals (Mercury, cadimum, lead and arsenic),on the water sample to infer the effects of the contaminants on humans and the environment.

2.3 Field Observation and Survey:

Field observation was conducted as part of the data collection exercise. A hand-held Global Positioning System (GPS) was used to determine coordinates where water samples were taken in the study area. While for the field survey, questionnaire was administered to the rice farmers to ascertain awareness level of the farmers on the effects of pesticide residues on human health and the environment. In terms of field survey design, a personal observation was applied in collecting information on type of agrochemicals most popular among the rice farmers of *Ifite-ogwari* .

2.4 Sample Collection and Prepration:

Discrete composite sampling method was used to collect water from the river's four (4) cardinal points and labelled North (N), East (E), South (S) and West (W), these points captured all the input from every part of the community using the river for agricultural, recreational and domestic activities. Two samples per cardinal point was taken from the river, a total of eight (8) samples were collected morning and evening (from 6am-7am) and (from 6pm–7pm) when the agrochemical application and other activities would have been concluded and the potential pollutants could be mobile while remnants could be washed off by either wind or storm to nearby settlements including the rivers. The physico-chemicals and heavy metals samples were stored in clean plastic bottles. All samples were stored using ice cube cooler and transported to an analytical laboratory.

2.5 Analytical Procedure for Heavy Metals and Pesticide Residues Determination

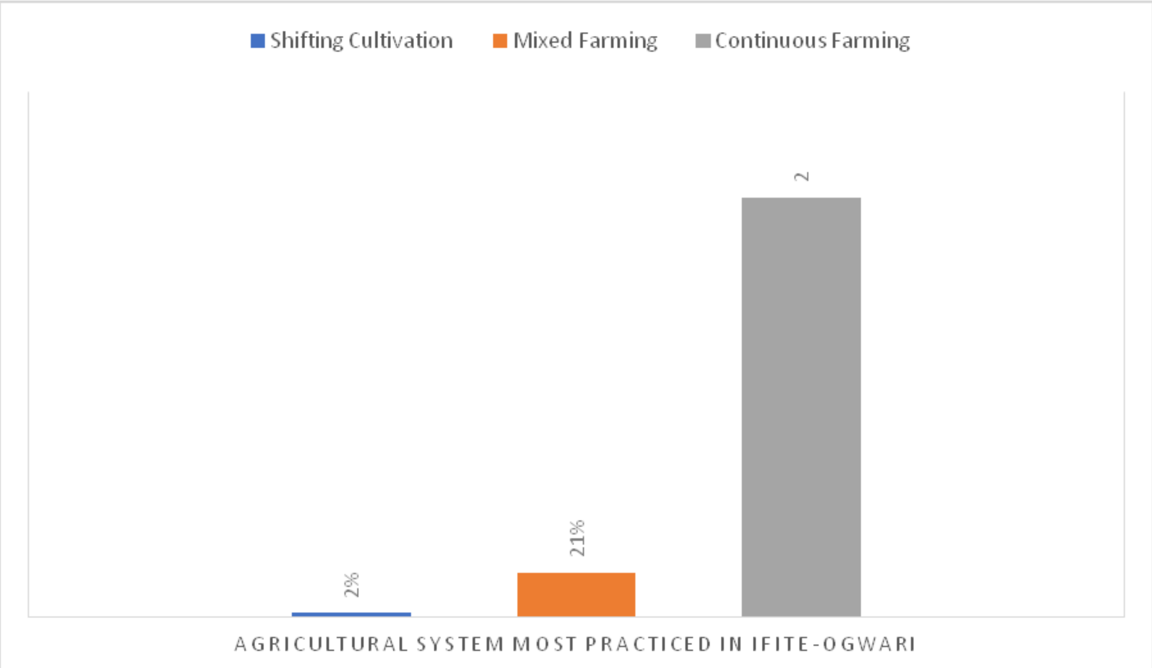
Heavy metals were analysed with the aid of Atomic Absorption Spectrophotometer (AAS), (Umeoguaju, et al., 2022; USEPA, 2008). While physicochemical parameters were analysed according to American Public Health Association (APHA), 2005 methods of analyses and USEPA, 2008). The pH was determined immediately after collection using portable digital pH meter (HI98108 pHep®, Hanna Instruments, Rhode Island).

Pesticide Residues analyese, a Shimadzu GCMS (GC - 17A) QP 2010 installed with a 35% diphenyl, 65% dimethylpolysiloxane column was used for the chromatographic separation adapted in Onuguh, Ikhuoria and Obibuzo (2022). The oven was programmed as follows: initial temperature 40˚C, 1.5 minutes, to 150˚C, 15 minutes, 5˚C/minute to 200˚C, 7.5 minutes, 25˚C/minute to 290˚C with a final holding time of 12 minutes and a constant column flow rate of 1 ml/minute. The detection of the organophosphorus pesticides was performed using the GC-MS and GC coupled with Electron Capture Detector (ECD) for organochlorine pesticides. Detection of pesticides was performed using the GC-ion trap MS with optional MSn mode. The scanning mode offer enhances selectivity over either full scan or selected ion monitoring (SIM).The retention time, peak area and peak height of the sample were compared with those of the standards for quantification.

2.6 Statistical Data Analyses: Data obtained were evaluated using Microsoft excel software and IBM SPSS Statistical software.

3.0 RESULTS AND DISCUSSION

Various types of agricultural practices identification at the study area was one of the objectivees of the research. Figure 1, shows the agricultural system practiced by the respondents 2% respondents practice shifting cultivation, 21% respondents practice mixed cropping, while 77% practice continuous farming system. This implies that the majority of the agricultural system is continuous farming. The data is presented in (Figure



1).

Fig. 1 The agricultural systems practiced by the respondents
Source: Researchers field work (2024)

Agricultural inputs used in the study area were also identified. Figure 2 shows the various farm inputs used for crop improvement by respondents in study the area. It indicates that 52% of the respondents use fertilizers to improve soil nutrients, 39% use herbicides to control weed, while 9% use pesticides to control pest infestation. The figure shows majority of the farm input applied for crop improvement in the study area is fertilizer. The data is presented (Figure 2).

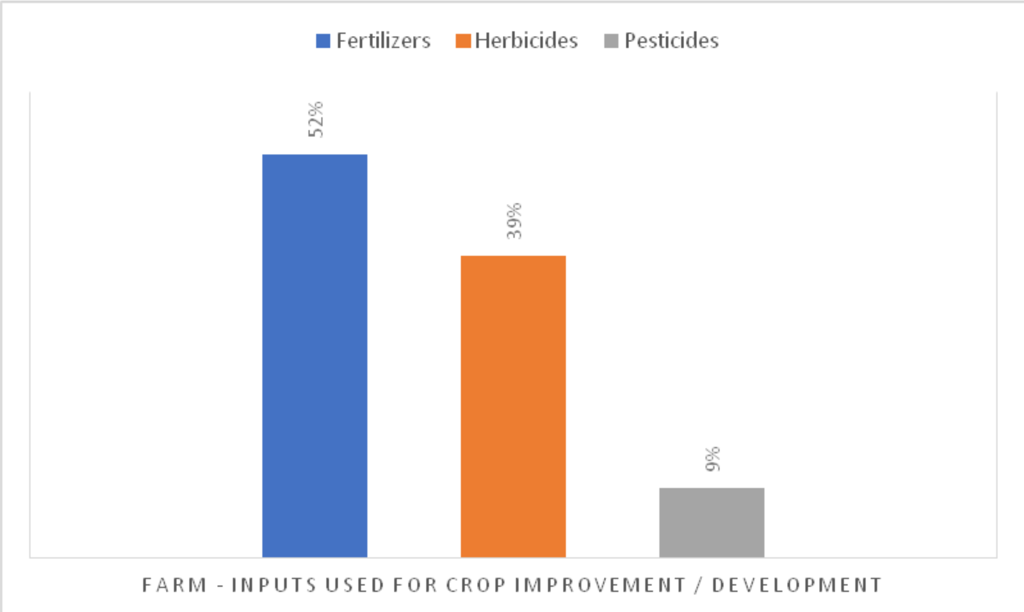


Fig. 2 The farm inputs for crop improvement applied by respondents
Source**:** Researcher's field work (2024)

Further analysis of the survey shows the recreational uses of *Mmiri Ate-mele* by the community, 25% of the respondents asserted drinking/cooking, 19% irrigation, 14% swimming/bathing, 19% soaking of cassava and 23% washing (Table 1), also view plate 1.

Table 1 Recreational uses of *Mmiri Ate-mele*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Drinking / Cooking	25	25.0	25.0	25.0
	Irrigation	19	19.0	19.0	44.0
	Swimming/ Bathing	14	14.0	14.0	58.0
	Soaking of cassava	19	19.0	19.0	77.0
	Washing	23	23.0	23.0	100.0
	Total	100	100.0	100.0	

Researcher's field work (2024)

Plate 1: Showing the community fetching *Mmiri Ate-mele* for varied uses
Source: Researcher's field work (2024)

The quantum dependency of the community on *Mmiri Ate Mele* river is shown on Table 2. From Table 2, it revealed that 33% of the respondents opined dependency about 50% - 75% while 67% opined about 75% - 100% dependency. This implies that the respondents valued and put the river on high usage.

Table 2 Importance and dependency on the river to the community (percentage).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	50 - 75%	33	33.0	33.0	33.0
	75 – 100%	67	67.0	67.0	100.0
	Total	100	100.0	100.0	

Researcher's field work (2024).

Agrochemical residues concentration in *Mmiri Ate Mele* river (water samples) were also opined key objectives of the study. The physio-chemical, heavy metal and pesticides residues of both organhlorine and phosphate origins assayed on *Mmiri Ate Mele* River water samples are shown on Tabless 3-6 respectively. The data was obtained through laboratory assay of varied river water saamples.

Table 3: Physico-chemical characteristics of *Mmiri Ate-mele* River

Parameters	Mean value Sample N	Mean value Sample E	Mean value Sample S	Mean value Sample W
pH	7.47	6.69	6.7	7.25
TDS mg/l	7.5	19	5.52	3.38
BOD mg/l	202	254	420	325
Sulphate mg/l	129	99.31	87.75	78
Chloride mg/l	150	114	146	163
Nitrate mg/l	8	7.75	3.75	4.5
Nitrite mg/l	0.72	0.77	1.4	0.97
Phosphate mg/l	1.54	2.3	1.53	1.56
Turbidity Ntu	2.9	4.5	1.2	1.2
E.C	727	875.5	1054.75	702

Table 4: Heavy Metal Analysis of Water Samples from *Mmiri Ate Mele* River

Heavy Metals	Mean value Sample N	Mean value Sample E	Mean value Sample S	Mean value Sample W
Lead ppm	0.006	0.01	0.003	0.014
Mercury µg/l	0.5	1.05	1.6	1.55
Arsenic mg/l	0.79	0.908	0.019	0.81
Magnesuim µg/l	33.25	23	22.75	14.75
Nickel µg/l	18.5	17.25	14.5	14.5
Cadmium µg/l	0.015	0.02	0.157	0.05

Copper mg/l	0.186	0.178	0.03	0.036
Chromium mg/l	3.02	2.98	2.99	3.035
Zinc ppm	0.323	0.307	1.191	0.176
Iron ppm	0.016	0.02	0.1	0.025

Table 5: Organochlorine residues Characteristics of Sampled *Mmiri Ate-Mele* River

Parameters	Mean value Sample N	Mean value Sample E	Mean value Sample S	Mean value Sample W
DDT	0.116	0.045	0.031	0.125
Aldrin	0.018	0.015	0.029	0.006
Lindane	0.002	0.002	0.004	0.000
Dieldrine	0.033	0.028	0.03	0.149

Table 6: Organophosphate Characteristics of Sampled *Mmiri Ate-Mele* River

Parameters	Mean value Sample N	Mean value Sample E	Mean value Sample S	Mean value Sample W
Chlorpyrifos	0.599	0.280	0.522	0.288
Diazinon	0.213	0.255	0.190	0.123
Parathion	3.134	0.833	2.472	0.858
Terbufos	0.26	0.216	0.186	0.216
Carbaryl	0.872	0.697	0.587	0.607

The physicochemical laboratory results of the commonly utilized river water *Mmiri Ate-Mele* River (Table 3) showed that most of the parameters were within the WHO standard limits. However, some parameters such as phosphate, some heavy metals Table 4 (Cd ,Are & Cr) and some agrochemical residues Tables 5 and 6 (DDT, Chlorpyrifos and Parathion) were above the permissible limit, and the implication is that if agrochemical usage persists in the area for rice cultivation without regulation, it will increase the level of these pollutants and cause more harm to the environment and human as well (Li, 2022).

The compliance with regulatory standard was performed on the river water samples of the *Mmiri Ate-mele* using WHO Standrds, (2017). The compliance level of the physio-chemical parameters and heavy metals is shown on Table 7 It showed that some parameters were within acceptable limits, while others such as phosphate, arsenic, cadmium and chromium were above WHO acceptable limit. Phosphate indicates high plant nutrients enrichment in the river, also high increase of some toxic heavy metals (arsenic, cadmium and chromium) in the water samples of *Mmiri Ate Mele* is an indication of toxicity of the river.

Additionally, compliance level of organochlorine parameters is shown on Table 8. It showed that some organochlorine parameters were within acceptable limits. However, DDT was above WHO standard limits an indication that DDT is still in use within agricultural activities in the study area despite its global ban, carcinogenic effects on humans also its mutagenic effects on non-tagged organisms and crops (Saravi & Shokrzadeh, 2021; Li, 2022).

The compliance level of the organophosphate parameters is shown on Table 9. It showed that some parameters were within acceptable limits. While some (chlorpyrifos and parathion) were above WHO standard limit. The environmental effect of high agrochemical residual concentration in water bodies is that of bioaccumulation. Chlorpyrifos accumulates in fishes which biomagnifies when in contact with higher organism’s fatty tissues. Its is a known inducer of cancerous effects on both humans and animals (Hossain *et al*., 2022). Similarly, Anakwuba *et al.*, (2021) asserted that excess parathion causes pathological alteration in the testicle of male organs and decrease number of sperms produced daily. Apart from reproductive effect, Sasakova *et al.,* (2018) further stated that parathion can lead to neurological problems, muscle weakening, short period loss of memory and depression.

Table 7: Physico-chemical Parameters and some Heavy Metals Compliance with WHO Standard Limit

Parameters	Sample N	Sample E	Sample S	Sample W	WHO	Remark
pH	7.47	6.69	6.7	7.25	6.5-8.5	**A**

TDS mg/l	7.5	19	5.52	3.38	500	**A**
BOD mg/l	202	254	420	325	500	**A**
Sulphate mg/l	129	99.31	87.75	78	500	**A**
Chloride mg/l	150	114	146	163	250	**A**
Nitrates mg/l	8	7.75	3.75	4.5	50	**A**
Nitrite mg/l	0.72	0.77	1.4	0.97	3	**A**
Turbidity NTU	2.9	2.5	1.2	1.2	5	**A**
E.C	727	875.5	1054.75	702	2500	**A**
Phosphate mg/l	1.54	2.3	1.53	1.56	0.5	**N/A**
Lead ppm	0.006	0.01	0.003	0.004	0.01	**A**
Mercury µg/l	0.5	1.05	1.6	1.55	6	**A**
Arsenic mg/l	0.79	0.908	0.019	0.81	0.01	**N/A**
Magnesuim µg/l	33.25	23	22.75	14.75	80	**A**
Nickel µg/l	18.5	17.25	14.5	14.5	70	**A**
Cadmium µg/l	0.015	0.02	0.157	0.05	0.003	**N/A**
Copper mg/l	0.186	0.178	0.03	0.036	1.2	**A**
Chromium mg/l	3.02	2.98	2.99	3.035	0.05	**N/A**
Zinc ppm	0.323	0.307	1.191	0.176	3.0	**A**
Iron ppm	0.016	0.02	0.1	0.025	1.2	**A**

Source: Researchers laboratory work (2024)

A = Acceptable ; N/A = Not Acceptable

Table 8: Organochlorine Compliance with WHO Standard

Parameters	**Sample N**	**Sample E**	**Sample S**	**Sample W**	**WHO**	**Remark**
DDT	0.116	0.045	0.031	0.125	0.100	**N/A**
Aldrin	0.018	0.015	0.029	0.006	0.020	**A**
Lindane	0.002	0.002	0.004	0.000	0.100	**A**
Dieldrine	0.033	0.028	0.03	0.149	0.500	**A**
Heptachlor	0.004	0.002	0.006	0.000	0.200	**A**

Source: Researcher's Laboratory work (2024)

A = Acceptable ; N/A = Not Acceptable

Table 9: Organophosphate Compliance with WHO Standard

Parameters	**Sample N**	**Sample E**	**Sample S**	**Sample W**	**WHO**	**Remark**
Chlorpyrifos	0.599	0.280	0.522	0.288	0.500	**N/A**
Diazinon	0.213	0.255	0.190	0.123	0.500	**A**
Parathion	3.134	0.833	2.472	0.858	2.000	**N/A**
Terbufos	0.26	0.216	0.186	0.216	0.500	**A**
Carbaryl	0.872	0.697	0.587	0.607	1.000	A

Source: Researcher's laboratory work (2024)

Note: A = Acceptable ; N/A = Not Acceptable

Using the Wilk's Lambda at significant level of 0.05 in multivariate analysis, the hypothesis was tested to determine significant between the concentration of parameters in *Mmili Ate-mele* and acceptable WHO standard water quality (Table 9). From table 9, the P-value (0.054) is above significance level 0.05 (P>0.05) an indication that there is no significant difference between the concentration of parameters in *Mmili Ate-mele* and acceptable water quality standard. Thus, accept $\mathbf{H_o}$ if P>0.05. From the result of the Wilk's Lambda the null hypotheses is accepted due to P was greater than 0.05,

4.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

4.1 *Summary*

The research focused on assessment of environmental effects of agrochemical usage on rice growing in *Ifite-Ogwari*, Anyamelum Local Government Area, Anambra State Nigeria.

The objectives of the study were achievied by identifying that the majority of the agricultural system practiced in the study area is continuous farming. The study also revealed that the major crop grown in *Ifite-Ogwari* is rice and it was discovered that the community practices irrigation farming system. In addition, it was discovered that majority of the farm input applied for crop improvement in the farm was fertilizer. The level of agrochemical residues concentrations in river water samples were assayed in analytical laboratory using appropriate procedure. Lastly, the compliance level of the agrochemical residues detected in the river water samples with WHO standard limits revealed that large proportions of the parameters tested were within the WHO standard limit for water quality. Infering no sgnificnce difference

4.2 *Conclusion*

The activities of rice farming in the study area brought about an improvement in standard of living of the people, providing employment and means of livelihood. However, the study showed that recacitrants agrochemicals are still in use at the study area, it lead to environmental degradation through agricultural practice with resultnt surfce water pollution. Detection of phosphate and heavy metals (Cd ,As & Cr) in the river water above WHO standard was an indication of nutrient enrichment that could lead to eutrophication. While agrochemical residues such as DDT, Chlorpyrifos and Parathion detection above WHO standard limit, implies danger to higher animals and man due to its bioaccumulation that leads to cancerous and mutagenic effects on animals and plants alike. Hence, persistant application of agrochemical in rice growing in the study area without regulation and attitudinal change on the part of the farmers, will increase the level of these contaminants and cause more harm to the environment and human health in the coming years. Hnce, there is need to intermittently assay Mmiri Ate mele river which the residence of Ifite- Ogwari harnesses for varied usages.

4.3 *Recommendations*

1. Cultural methods of weed and pest control should be advocated since it is one of the eco-friendly methods of pest control in agriculture. If the herbs to be eliminated can easily be uprooted, then it is more advisable to do manual elimination.
2. Government of Anambra State Nigeria should develop good mechanism for enforcing regulations on the use of agrochemicals, adopting FAO and WHO guild lines with adequate educational and training interventions to the farmers.
3. The use of agrochemicals on farm land should not exceed recommended application dosage stipulated by the manufacturers and farmers should be made to understand that LD_{50} agrochemical kills only 50% of the population even when a whole container is applied. Therefore, there is no need for farmers to apply agrochemical at the rate against its recommended quantity
4. Regular monitoring team from the state Ministry of Environment and Ministry Agriculture is advised to checkmate the activities of rice farmers to make sure that rice cultivation is done in an eco-friendly manner free from environmental and health hazards.
5. Finally, further research should be carried out in the study area, especially as it relates to water pollution from agrochemical residues, as it is evident that the community depends on the river for other uses.

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