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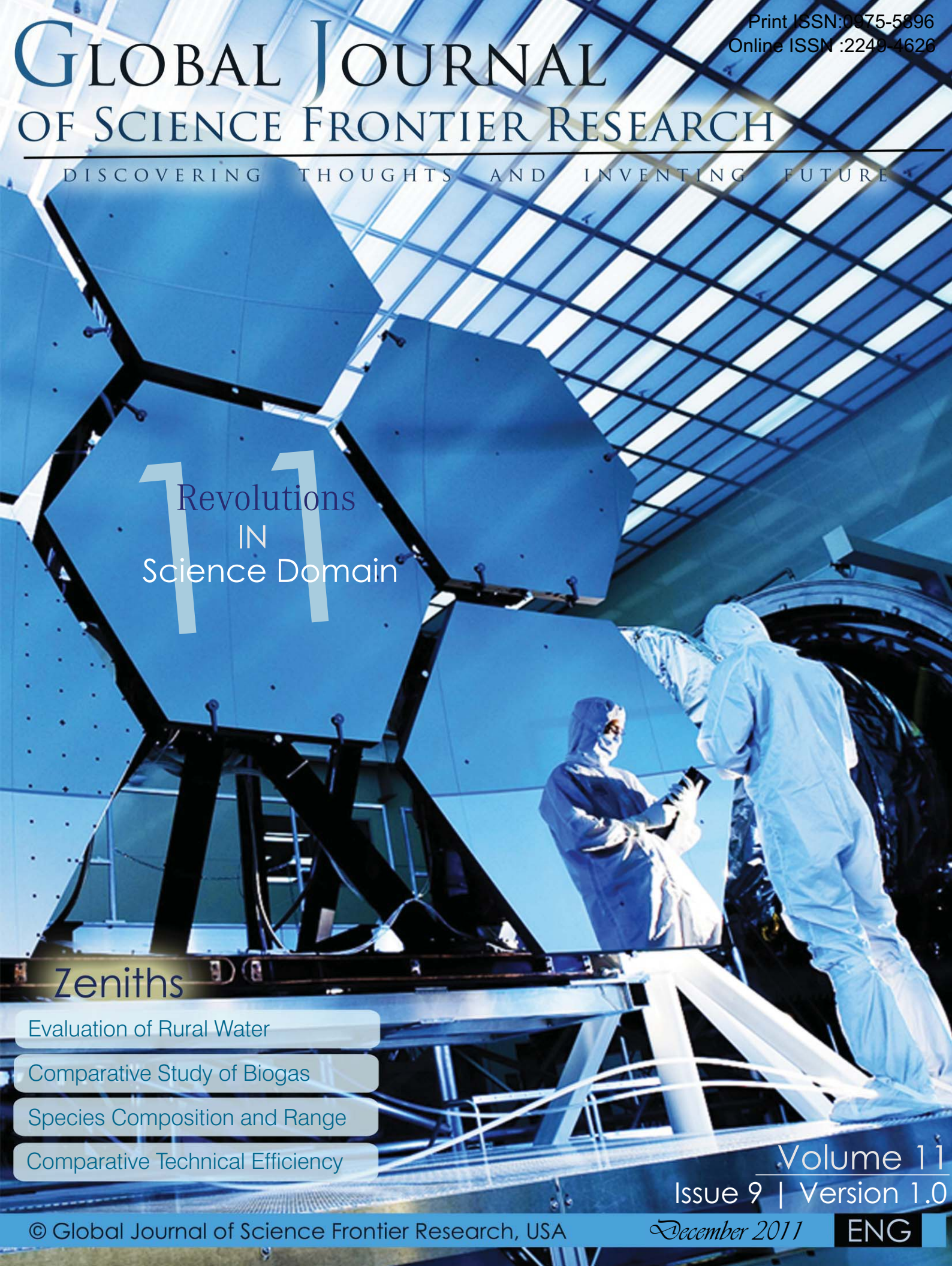

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Evaluation of Rural Water Supply Schemes in Selected Communities in Oke-Ogun Area, Oyo State, Nigeria

By Toyobo A.E.,Tanimowo N.B

Akintola University of Technology, Ogbomoso,Oyo State, Nigeria

Abstract - The study examine water supply schemes in selected communities in Oke-Ogun area. Data were collected through primary and secondary sources. A total of 450 structure questionnaire were administered through systematic random sampling to solid information from household heads in the area. The study reveals that female respondents were higher than males, and majority engaged in farming activities with low income. Hand-pump wells and boreholes were the major water facilities in the area. Majority of the water facilities were in the state of disrepairs. The study therefore recommended some management strategies in order to improve the sustainability of water schemes in the study area.

Keywords : *Community, Management, Water-scheme, Sustainability.*

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Evaluation of Rural Water Supply Schemes in Selected Communities in Oke-Ogun Area, Oyo State, Nigeria

Toyobo A.E.[α] ,Tanimowo N.B[Ω]

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I. Introduction

Successful community management requires that clear ownership of the water systems be defined. Ownership issues lie at the heart of the seeming paradox that communities with long histories of internal water resource management for natural system such as irrigation systems are often not successful at managing water supply systems (Schouten and Moriarty, 2003; Renold,1992). Such is the case in Madagascar, where small streams used for irrigation of lowland rice fields have been sustainably shared amongst communities for food production but most improved water sources have fallen into a state of disrepair. Common to the management of all property resources should be tied to a sense of communal ownership are the inclusion of rules and regulation needed to regulate the behavior of water users and a guide for water committees. Enforcement of rules and regulations is usually the responsibility of the water committees, through the levying of some sort of social sanction of fine (Schouten and Moriarty, 2003; Parry Jones, Reed and Skinner 2001).

Operation and maintenance agreements ensures the longevity and proper running of rural water infrastructure and this could be attained with community. However, in order to ensure proper maintenance of community water supply schemes, there should be a trained local technicians who should have access to tools and spare parts needed to fix the water systems (Lockwood, 2004; UNICEF and WHO, 2000; Narayan 1994; Pretty 1995 and UNDP 2005).

The aim of the study is to assess water supply schemes in selected rural communities in oke-ogun area, Oyo State.The specific objectives of the study are to: (i). examine socio-economic characteristics of respondents in the study area, and (ii) assess the management of water supply schemes in Abare, Ogbooro, Igbope, Iwere-ile communities in the study area.

II. Materials and Methods

a) Brief of the study area

The study was conducted in ten local governments in Oke-Ogun area in Oyo state. Oyo state is located in the south western geo-political zone of Nigeria. It is bounded in the west by Republic of Benin, to the east by Osun State, to the north by Kwara State.

The study area is Oke-Ogun rural settlements in Oyo state. Oke-Ogun is located on latitude 6° 08[1] north of the equator and 3°00[1] east of Greenwich meridian. Oke-Ogun area consist often local government namely: Oorelope, Irepo, Olorunsogo, Saki East and West .Itesiwaju, Atisbo, Iwajowa, Kajola and Iseyin. The people in the study area are mostly Yorubas. The Yoruba who formed majority of the rural community were interviewed with some few ethnic groups such as Hausa, Igbo and Ibariba.

b) Methods of data collections

The study area was grouped into four contiguous zones. Within each zone, a random sampling technique was adopted to select one village The samples frame consist of the following rural settlement namely:, Igbope, Ogbooro, Abare, and Iwere-ile village. Respondents were household heads. A 2,5% sample size of the household heads were chosen for the purpose of questionnaire administration, and respondents were selected on systematic sampling. One household was selected from every five housing units. This was based on the reconnaissance survey. Where the respondent was not available at the first visit, a return visit was made to get in touch with him or her. In the process, a total of 450 respondents were interviewed for the study.

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Data on socio-economic characteristics were obtained in the first part of the questionnaire raising questions about gender, age, marital status, ethnicity, educational qualifications, occupation and income of respondents in the study area.

Information on the sources and characteristics of water supply in the study area was obtained from respondents and confirmed through direct observations and frequency counts of the water sources and schemes in the communities sampled. The sources were mainly the natural ones such as rivers, streams, and ponds and those provided by government, non-governmental organizations, community efforts and inter-aids. The latter focused upon are the ones regarded as schemes. Available water supply facilities in each community was exhaustively enumerated and recorded during the research survey.

c) Methods of data analysis

Data were collected from the field and analyzed using descriptive statistic such as frequency count, percentages and tables to affirm the level of operation and repairs of water facilities in the study area.

III. Results and Discussion

a) Socio-economic characteristics of the respondents

Table 1 reveals the socio-economic characteristics of respondents in the study area. Female respondents (52.9%) were higher than male respondent (47.1%). Literacy rate was average among the respondents with only 49.1% respondent having one form of formal education or the other.

Majority of the respondents were Christians 59.0%, Muslims 36.7%, Traditional herbalist 4.7% and others 2.6%.most of the respondents engaged in farming and trading as their major and minor occupations respectively. For instance 53.4% were farmers, 12.9% Artisan, 18.7% civil servant, 13.9% traders and others (1.1%). The income level of respondents was very low for them to contribute in community development programme in the study area. For instance about 42.1% respondents income fell between 6,000 naira-10,000 naira with the highest being 21,000 naira and above (11.7%). A greater proportion of the population in the study area were Yoruba (79.6%) and are subsistence farmers cultivating maize, yams, cassava and millet. Production is low because most farmers used traditional tools of hand hoe. Hausa constituted about 14.8% and are businessmen and women, the Igbos 4.9% mostly businessmen and women and other tribes of 1.3% such as Ibariba, Idoma, Igala, Fulani and Ghanaians most of who are artisan, craft men and other informal jobs.

b) Assessment of sampled communities in the management of water supply schemes

One rural community was chosen from each of the sampled zones of the study area to assess the management strategies employed for borehole, hand-pump and dam in villages where they are available. Assessment was based on a random sampling of a community in each of the zones included in the study area.

i. *Abare Village*

Abare is located in Itesiwaju local government area in Oyo State with a population of six hundred and eighty people. The village is accessible by a good tarred road which is about fifteen (15) kilometers from Igbojaye. Hand-pump water supply in the village was constructed in 1994 by the local government in the area. At the time of field survey ,the hand -pump were not functioning because of the failure of the local government to repair the faulty hand-pump. The community however did not make any attempt to repair the same due to lack of fund. However, there was no any move by the community to contribute financially for the repair of the hand-pump water facility in Abare village. The villagers therefore depend on alternative sources of water supply in the area such as rivers, ponds and earth dam along streams/rivers course in the area.

ii. *Ogbooro Village*

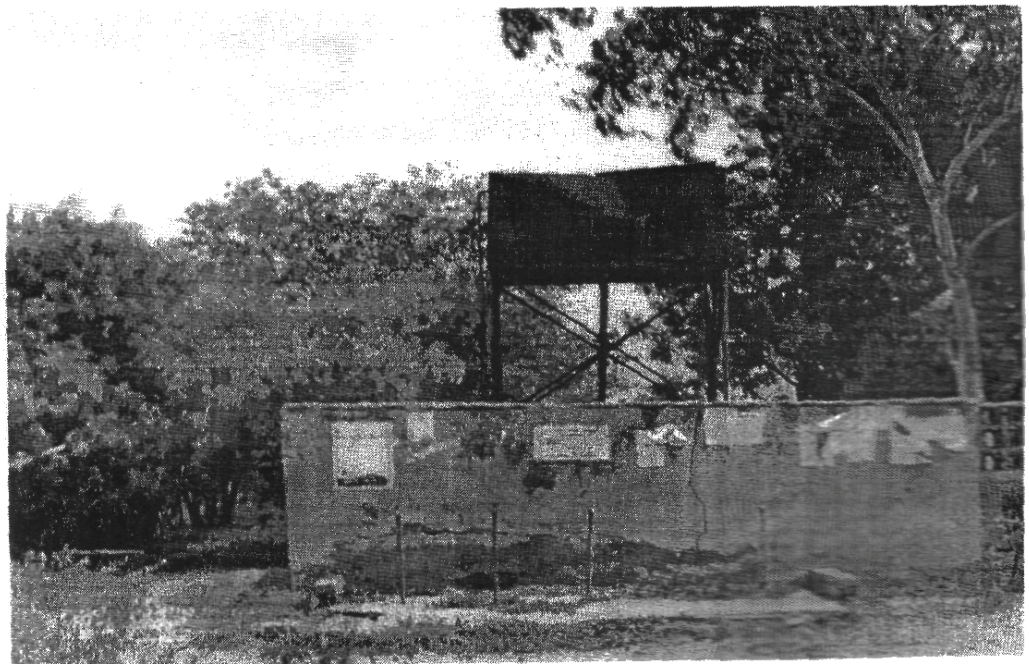
Ogbooro is located in Saki east local government area of Oyo state with a population of five thousand and ten people. Accessibility to the community is through tarred road which is fairly well maintained. There are two types of water facilities in the village - hand-pumps and boreholes. The hand-pumps wells were constructed by the local government while one of the boreholes were constructed by UNICEF-Assisted Water and Sanitation Project (WATSAN) by Oyo state government and two others by private individual for profit making. At the time of data collection, one borehole was functioning in the village and this is owned by an affluent family in the village. The two boreholes had broken down due to negligence by the donor agencies to repair them. There was no village caretaker committee to monitor the repair and maintenance of the boreholes and hand-pump water supply facilities donated by WATSAN. An interview with the opinion leaders in the area revealed that non involvement of rural community members in planning and implementation of water schemes had necessitated the negligence of non repairs.

iii. *Igbope Mllage*

Igbope village is in Oorelope local government with a population of seven thousand, six hundred and forty-eight people. The village is about one kilometers to Igboho town. Hand-pumps and boreholes water supply facilities were found in the village. The hand-pumps were constructed by the local government in the area but the boreholes were donated by WATSAN to the community in order to assist the primary health care centre which is in operation in the village. At the time of field survey, a borehole was not in use due to non repair

of the damaged parts by both the community and the donor agency.

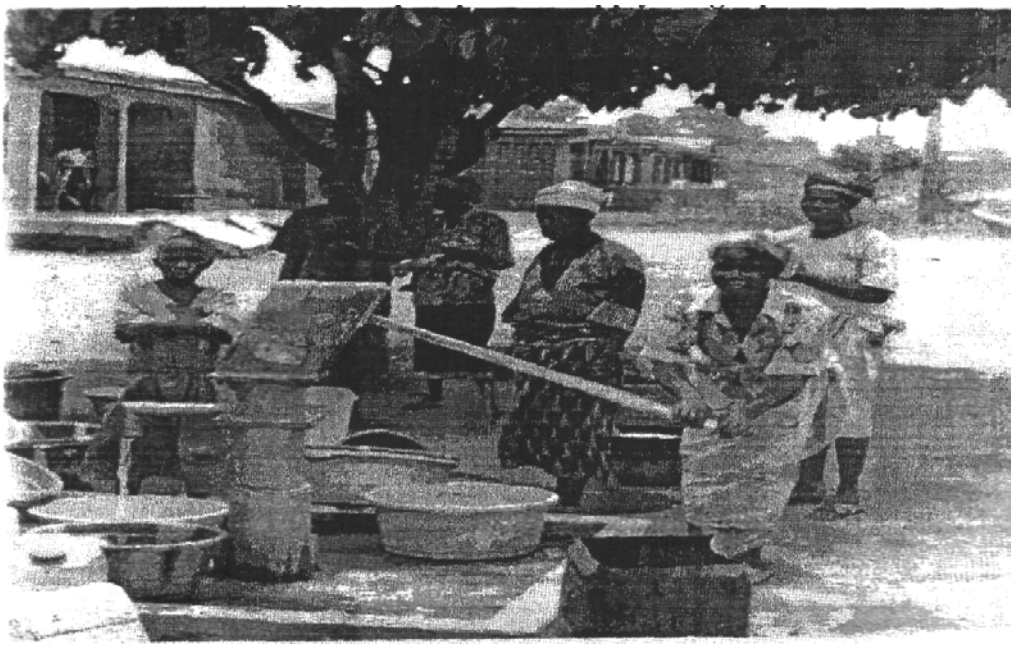
Plate 1: Borehole at Igbope in Oorelope Local Government, Oyo State.



Source : Authors' field survey, (2010).

Three of the hand-pump wells were out of use due to the failure of the local government authority to put all the necessary machinery to repair the water supply systems. The villagers in the area depended on Igboho dam which is about half a kilometer to the village. There were no caretaker committee at the village level to oversee the management of water supply facilities in the village. There was therefore, high demand for water supply on the only hand-pump available in Igbope. **(See plate 2).**

Plate 2 : Functioning Hand pump water supply at Igbope



Source : Authors' field survey, 2010.

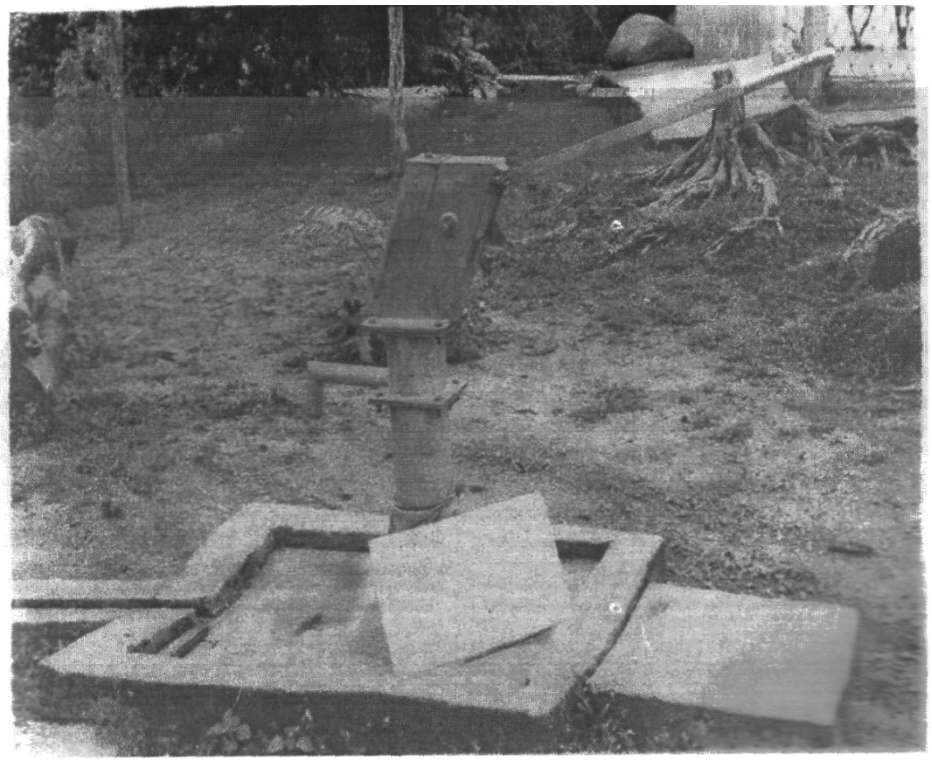
Nevertheless, community members were satisfied with the quality of water supplied from hand-pump since water from the pump look pure, free from insects, debris, animal waste, sticks or leaves and does not smell or taste bad. This corroborates UNDP (2005) findings on community water supply that people are thirsty of clean water. Water obtained from the hand-pump is free from rubbish and does not smell or taste

bad. Water obtain from dam by the rural community of Igbope was used for domestic purpose without any treatment. However, WHO (2000). States that water must undergo some processes of chlorination, purification, sedimentation and other stages of treatment before it is acceptable for usage by community members. Lack of treatment of dam water of this nature can cause ill-health to people.

iv. *Iwere-Ile Village*

Iwere-Ile is located in Iwajowa local government area of Oyo State with population of nine thousand and twenty-four people. There were three boreholes in the settlement and only one was functioning. One of the boreholes was out of use due to non repairs. Also about seven hand pumps were constructed in the area, three of them were functioning at the time of field survey was conducted in the area. (see Plate 3).

Plate 3 : Non-functioning hand pump water supply system at Iwere-ile.



Source : Authors' field survey, (2010).

At the village level, there was no caretaker committee to take care of proper repairs and maintenance of the hand-pumps provided by the local government authority. This has hindered regular supply of water consumption by the community members.

IV. Recommendations

The following recommendations are made towards the sustainability of water supply schemes in the study area.

a) Daily maintenance :

i. Pump operation of water scheme
ii. Pump and base cleanness of the scheme
iii. Waste water drainage of the scheme
iv. Comments of users

b) Weekly maintenance

i. Lubricate moving parts of water scheme
ii. Check tightness of nuts and bolts
iii. Check security of pump on base

c) Monthly maintenance

i. Check output rate of water scheme
ii. Check for condition of concrete base.

No matter what system of management is adopted users must be involved in the planning and management of water schemes so as to prolong the long-term effectiveness of the hand-pump and borehole water facility. The best way to achieve this is by the appointment of a pump caretaker who, after proper training and the supply of a tool kit will carry out the following duties:

d) The pump caretaker duties

i. To carry out inspections daily, weekly and monthly;
ii. To keep records of all checks and work;
iii. To monitor pump output rate;
iv. To keep pump and base clean and clear of refuse;
v. To train people how to use the pump properly;
vi. To make simple repairs and replacements;
vii. To request help for major problems;
viii. To keep a supply of spare parts;
ix. To ensure surplus water is drained away; and
x. To give guidance in health care.

e) The pump caretaker should

i. Be female if culturally or socially acceptable;
ii. Be age 18-35;
iii. Live close to the pump;
iv. Be physically fit and active;
v. Be acceptable to the community;
vi. Be a pump user;
vii. Have own means of support as the pump caretaker job is only part time and
viii. Be self-motivated.

In order to emphasize their responsibility, pump caretakers should receive payment. With respect to the management of dam water schemes in the study area, the following management approaches are important:

i. Keeping spillways clear of debris;
ii. Watching for underling of the spillway outlet or uncontrolled flow beneath or around the spillway;
iii. Preventing trees and bush from growing on earth dams;
iv. Watching for uncontrolled seepage on the dam face around all metal and concrete structures;
v. Eliminating burrowing animals and ant hills and taking measures to prevent their habitation;
vi. Maintaining a healthy stand of grass on earth dams and vegetated spillways to prevent erosion;
vii. Making sure that gates, valves and all water control mechanisms are always operationable and
viii. Watching for any sign of settlement cracking unstable slopes or other slope movement.

1. Local community members should be encouraged to see the rural water supply facilities as their own projects, so as to ensure adequate maintenance and repairs, and to guaranteed the sustainability of the rural water - supply schemes in the study area.
2. Performances of community members in contributing labour and materials for maintenance, constant repairs of water schemes, borehole, and hand- pump wells in particular should be encouraged.
3. The local government councils and other donor agencies in the area should train selected community members to improve their skills and technical know-how to provide local expertise for repairs and maintenance of rural water supply facilities in the study area.
4. Adequate water facilities should be provided by the state, and local government and other donor agencies in view of high population density in the rural community of the study area.
5. The types of rural water supply schemes such as boreholes and hand - pumps should be determined for local community in the study area with active participation of all the stakeholders in the process of planning, and execution of the water projects.

There is a clear need for the communities to rethink their approaches. Good hand-pumps exist and technical solutions are available. Management of hand pumps and boreholes are the real issue for village level operation and management to work.

The capacity building of those responsible for operation and maintenance is essential. They need training in proper management of supplies, spare parts and finances. Community planning and support need to match local people willingness to contribute.

References Références Referencias

1. **Kumar, S. (**2002): Methods for community participation: a complete guide for ITDG*,* London, U.K.
2. **Lockwood** (2004): Operations and Maintenance Strategies for Community Managed Rural Water Supply Systems in the Dominican Republic, Environmental Health project. Activity report no. 105, contract HRN – 1-00-99-00011-00.
3. **Maranz, D.E.** (2001): African friends and money matters: Observations from Africa International *Academic Bookstore.*
4. **Narayan. D** (1994): Contribution of people's participation: evidence from 121 rural *water* supply projects. *Environmentally sustainable development occasional paper series,* -Vol. World Bank, Washington, D.C.
5. **Parry- Jones. S., Reed, R. and Skinner, B. H.** (2001): Sustainable hand-pump projects in Africa: A literature review. *WEDC,* Loughborough University, UK.
6. **Pretty, J. N.** (1995): Participatory learning for sustainable agriculture. *World Development* Vol 23 No 8: 1247-1263.
7. **Reynolds, J.** (1992): Handpumps: towards a sustainable technology. *UNDP-World Bank Water and Sanitation Program, Water and Sanitation Report 5,* World Bank, Washington DC, USA.
8. **Schouten and Moriarty** (2003): Background Paper "Beyond the Community" Community Water Supply Management. Delft IWSC. Pp 10-21.
9. **UN1CEF and WHO** (2000) Joint Monitoring Programme Definitions of Indicators http;.//www .unicef.org we&Tndgrepori'definition.php (accessed: 1st September 2006).
10. **UNDP** (2005): Human Development Report Interactive World Map http://hdr .undp.org statistics'datahdi_tank_map.cfm (accessed: 28th August 2006).
11. **Webster, J., Dejachew. G., Tsekm, B., Mehari, M., Tesfaye, G.** (1999): Sustainability of rural water and sanitation projects. *Proceedings from the 25th WEDC Conference, Integrated Development for Water Supply and Sanitation* Addis Ababa. Ethiopia.
12. **WELL** (1998) DHD guidance manual on water supply and sanitation programmes. *WELL. WEDC.* Loughborough University, UK.

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Ameliorate the Effects of Poultry Manure and NPK Fertilizer on the Performance of Pepper Relay Cropped With Two Cassava Varieties

By Adeola, R. G. , Tijani-Eniola, H, Makinde, E. A
University of Ibadan, Ibadan, Nigeria

Abstract - Farmers in Nigeria practice intercropping by relaying cassava (Manihot esculenta Crantz) into pepper (Capsicum annum L.). However, high cost of inorganic fertilizer had discouraged most farmers from applying fertilizer to their crops. The objective of this work was to evaluate the effects of NPK fertilizer and poultry manure on the performance of pepper relay cropped. A split-plot layout was adopted using four fertilizer levels: no fertilizer, 120N + 80P + 50K kg/ha, poultry manure (PM) 6,250 kg/ha and 50 % to 50 % mixture of NPK and PM. The cropping pattern, sole pepper, and two cassava cultivars relayed into pepper at 1 MAT were main plots while the fertilizer levels were the subplots. The experiments were replicated three times. Descriptive statistics and ANOVA were used to analyze the data of growth and yield parameters. Fertilizer application significantly ($P < 0.05$) affected all the characters investigated. The highest fruit yield of pepper (13.6 t/ha.) was obtained from the plots treated with 120N + 80P + 50K kg/ha. The highest cassava tuber yield (24.1 t/ha) was obtained from the plots treated with 6,250 kg PM/ha. The yield of pepper under different fertilizer application was in the order NPK > NPK + PM > PM. The yield (10.1 t/ha) of pepper obtained under 'Oko Iyawo' across the fertilizer treatments was 14.4 % greater than the yield (8.7 t/ha) obtained with TMS 30572. All the fertilizer treatments yielded more than the control in the following order: PM > ½ NPK + ½ PM >NPK alone respectively.

Keywords : *Manihot esculenta, cropping pattern, Capsicum annuum, relay intercrop, fertilizer application.*

AMELIORATE THE EFFECTS OF POULTRY MANURE AND NPK FERTILIZER ON THE PERFORMANCE OF PEPPER RELAY CROPPED WITH TWO CASSAVA VARIETIES

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Ameliorate the Effects of Poultry Manure and NPK Fertilizer on the Performance of Pepper Relay Cropped With Two Cassava Varieties

Adeola, R. G.[α], Tijani-Eniola, H[Ω], Makinde, E. A[β]

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I. Introduction

Pepper (*Capsicum annuum*) is a popular crop that is grown in most countries of the world and its production for spice and vegetables has increased by more than 21 % since 1994. According to FAO (1997), world production of peppers for 1996 was put at 14,068,000 metric tones. However, Asia is the largest producer, with China leading world with a production of 12,531,000 Mt. in 2005 (FAOSTAT, 2005). In pepper production, Nigeria was rated second in the world in 1979 (Yamaguchi, 1983).

However, production later declined and since the early 1980's, export has been minimal (Aliyu *et al.*, 1996). In 2005 Nigeria produced 720,000 Mt of pepper making her the largest producer of peppers in Africa and ranked 7th in the world (FAOSTAT, 2005). It is cultivated principally in southwestern and northern Nigeria between latitudes 10°N and 12°3N in the northern guinea savannah and Sudan savannah ecological zones (Erinle, 1988). *C. annuum* is one of the most popular cultivars grown by local farmers and the yield obtained ranges from 2.5 to 10.5 t/ha which is very low compared to 18 to 36 t/ha obtained in developed countries (Ado and Gupta, 1990).

Management of soil fertility in an intercropping system has a major influence on crop production. Several studies have revealed that intercropped mixtures extracted more nutrients from the soil than did single stands per unit area (Kassam and Stockinger, 1973; Dalal, 1974; Oelsligle *et al.*, 1976). High cost of nitrogen fertilizer has led to several research studies on the benefit of intercropping with legumes.

Cassava requires adequate fertilizer especially (K and N) for optimum growth and root yield (Amon and Adetunji, 1973; Obigbesan and Fayemi, 1976 and Sitti-busaya and Kurmarohita, 1978). The cultivation of cassava in traditional agriculture is without the use of any form of fertilizer. The use of adequate levels of nutrients by any crop is essential in order to increase its production and yield. Bosland and Votava (2000) reported that pepper required adequate amounts of major and minor nutrients to produce well. May *et al.* (1982) recorded the highest yield of 12.3t/ha from N and P application rates of 150 and 100 kg/ha respectively. Alabi (2006) found that P levels significantly increased pepper plant height, number of leaves and branches per plant and leaf area up to 125 kg P/ha level and concluded that poultry droppings increased the yield components of pepper more significantly than the phosphorous. The importance of integrated nutrient use in crop production in recent years cannot be over-emphasized in view of the high cost of chemical fertilizer to meet crop nutrient requirement. Complimentary use of organic manure and mineral fertilizers has proved to be a sound strategy to maintain soil fertility in many parts of the world (Lombin*et al.*, 1991*)*.Mello *et al.* (2000) recorded higher fruit weight and yield of pepper with 100 g poultry manure/hole + 100% NPK (130: 458: 262: kg N: $P_2 0_5$:$K_2 0$/ha) compared with treatments of 150 g peat compost/hole + 70 or 100% NPK; 100g wood chip

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compost (pine) per hole + 70 or 100 % NPK. Similarly, plant height and pepper fruit yield/ha increased with increasing levels of N with maximum yield recorded at 160 kg N/ha. Aliyu (2000) reported good establishment of pepper plants and superior yield with the application of various rates of organic manures supplemented with 50 kg N /ha.

II. Materials and Methods

Field trial on the ameliorate effects of NPK fertilizer and poultry manure on the performance of pepper relay cropped with two cassava varieties were conducted in Ogbomoso during 2001/2002 and 2002/2003 cropping seasons. Ogbomoso on Latitude 8° 01 N, Longitude 4° 06 E, about 310 m above sea level in the derived savanna belt of south-western Nigeria. The mean annual rainfall of the Experimental station was 1,062.18mm with high intensity over a period of seven months (April to October) (Table 1). The land used for the experiments had been previously cropped to staple food crops such as cassava, maize, yam guinea corn and grain. The soil is a ferric luvisol, locally classified under Iwo series (Murdoch *et al.*, 1970). Composite samples of the topsoil (0 – 15 cm depth) were taken from the site and analyzed for their physical and chemical properties before the commencement of the experiment in each year.

The experimental design for the trial was a split-plot fitted into a randomized complete block design with three replicates. The main plot was cropping pattern (i.e. sole pepper, *Oko Iyawo* + Pepper and TMS 30572 + Pepper. Both cassava varieties were relayed into pepper at one month after transplanting (MAT). The sub-plot was fertilizer at four levels namely:

i. No fertilizer,
ii. Inorganic fertilizer (alone), which was supplied in the form of urea, single super-phosphate and muriate of potash at 120 N + 80 P + 50 K kg/ha.
iii. Poultry manure (PM) at the rate of 6.3 t/ha.
iv. ½ NPK fertilizer (60 N + 40 P + 25 K kg/ha.) + ½ Poultry manure (3.15 t/ha.).

Each plot was 5 m x 4 m planted with cassava at 1 m x 1 m and pepper at 1 m x 0.5 m spacing. Plant population density was thus 10,000 per hectare for cassava and 20,000 plants per hectare for pepper. Two cassava clones the profusely-branching TMS 30572 from IITA, the local late-branching cultivar *Oko iyawo* and Pepper cultivar NHVI-B, released by the National Horticultural Research Institute (NIHORT) were used in the study.

Poultry manure was applied two weeks before transplanting. The rate of application was 6,250 kg. /ha in plots that received poultry manure alone and 3,125 kg/ha in plots that received poultry manure plus mineral fertilizers. The manure was spread uniformly on the respective plots and worked into the soil by light hoeing N, P and K were applied at the rate of 120 kg N. /ha, 80 kg P /ha and 50 kg K /ha respectively for inorganic fertilizer treatment and 60 kg N /ha, 40 kg P /ha and 25 kg K /ha in treatment with ½ poultry manure + ½ inorganic fertilizer treatment The fertilizers were applied in two equal split doses: two weeks after transplanting (WAT) of pepper and at fruit set (10 WAT).

Fifteen plants of each of the cassava varieties and pepper were randomly sampled from the net plot to record observations adopting the partial replacement procedure by Gomez and Gomez (1984). Days to 50 % flowering were also recorded. Number of days to first harvest was noted from sowing date to the time of picking the first fully ripe fruits of pepper. Ripe fruits of pepper were harvested at weekly intervals. Number of fruits per plant was obtained from randomly selected plants while the cumulative fresh weight of the total fruits picked from the net plot was recorded. Fruit length was obtained from 30 randomly picked fruits using transparent ruler. Fresh weight of cassava tubers per stand was taken from selected 10 plants. Total tuber yield from the net plot was recorded at maturity. All morphological characteristics, yield and yield components of pepper and cassava were subjected to statistical analysis using ANOVA based on the split plot design.

III. Results

Pepper plots treated with NPK and ½ NPK + ½ PM reduced number of days to 50 % flowering and days to reach first time of harvest which was significantly different ($P < 0.05$) from the control and PM alone treated plots across the cropping systems in two successive seasons (Table 2).

Application of fertilizers significantly increased the number of fruits per plant with sole pepper plot treated with NPK had the highest number of fruits per plant though not significantly different ($P > 0.05$) from the values recorded from pepper plots treated with NPK where *Oko Iyawo* was relayed into pepper (Table 3). Fresh fruit yields of pepper obtained from the plots treated with NPK alone were significantly ($P < 0.05$) higher than the yields obtained from the plots treated with ½ NPK + ½ PM and other treatments across the cropping systems. The yields of pepper under different fertilizer applications followed the trend of NPK > NPK + PM > PM. The highest fresh fruit yield of 13.6 t/ha. was recorded from the plot where *Oko Iyawo* was relayed into pepper under NPK alone treatment. However, the fresh fruit yield obtained from NPK treated plot where TMS 30572 was intercropped with pepper was significantly ($P < 0.05$) low compared to the yield obtained from the plot where *Oko iyawo* was relay cropped with pepper. (Table 4).

All the fertilizer treatments yielded more than the control in the following order: NPK alone, ½ NPK + ½ PM and PM alone. Averaged yield (10.1 t/ha) of pepper obtained under '*Oko Iyawo*' across the fertilizer treatments was 14.4 % greater than the average yield

(8.7 t/ha) obtained with TMS 30572. Similar trend was observed in the following cropping season (Table 4).

Yield of cassava as affected by different fertilizers in the intercrop is presented in table 5. Significant differences ($P < 0.05$) were recorded in the tuber yield in 2000/2001 across the treatments. In both seasons, cassava tuber yield recorded across the fertilizer treatments followed a similar trend of PM > ½ NPK + ½ PM >NPK. *Oko Iyawo* gave the highest tuber weight of 25.0 t/ha under PM, which was significantly ($P < 0.05$) higher than that obtained from the tuber weight of 22.2 t/ha produced by TMS 30572 under the PM alone. A similar occurrence was observed in 2001/2002 cropping season. Significant differences were observed in the yield of pepper obtained across the fertilizer treatments in the following season. The highest fresh fruit yield of 298.61 kg/ha was obtained from the cropping system where *Oko Iyawo* was relay cropped with pepper and treated with PM. However, the lowest yield of 98.3 kg/ha was recorded from the control. The fresh fruit yield of pepper obtained in the following season from all the cropping systems treated with fertilizer followed the order of PM > ½ NPK + ½ PM > NPK (Table 6).

IV. Discussion

The result of this study demonstrated that highest yields of pepper were obtained from the plots treated with NPK fertilizer compared to other fertilizer treatments and the control. A similar finding of 12.3 t/ha of pepper yield with the application of 150 kg/ha N and 100 kg/ha P had been reported by May *et al.*, 1982) while Aliyu *et al.*, (1996) reported predicted yields of pepper at high levels of 205 N kg/ha and 25 P kg/ha. Asiegbu and Oikeh (1995) reported the efficiency of NPK fertilizer in the supply of N, P and K to tomato plants in the short run than the organic manure.

The mixture of NPK and poultry manure produced fresh fruit yields greater than the application of poultry manure alone. The higher response of pepper to the mixture might be due to the differences in the availability of essential elements from inorganic and organic sources of fertilizer. This observation is in agreement with that of Okonkwo and Chibuzo (2000). Ayoola and Adeniyan (2006) also found that crops were lower under the application of poultry manure alone in comparison with NPK plus poultry manure or NPK alone in cassava/maize/melon mixture. Aliyu (2000) reported good establishment of pepper plants and superior yield with the application of poultry manure supplemented with inorganic fertilizer. However, Alabi (2006) reported that application of poultry droppings increased the growth and yield components of pepper significantly more than phosphorous fertilizer.

Highest yields of cassava were obtained from the application of poultry manure alone. A possible reason for this is that poultry manure ensured a season long supply of nutrients, which benefited cassava that stayed longer in the field due to its slow release of nutrients. Kumar *et al.* (1977) reported a good response of cassava to poultry manure and Hemeng *et al.* (1995) obtained highest yield of 10.2 t/ha when plantain was supplied with poultry manure as compared to 7.2 t/ha obtained in unfertilized controls. Application of poultry manure alone also gave the highest yield of pepper in the following cropping season when compared to other fertilizer treatments and the control. This implies that by the end of the first growing season, the manure had already decomposed which ensured release of nutrients for plant use.

The mixture of NPK and PM also gave better yields of both crops than the PM alone. This could be attributed to the complimentary roles of organic and inorganic fertilizers in improving crop yield. This observation agrees with that of Agboola and Odeyemi (1972), Agboola (1988) and Eneji *et al.* (1997). The combined yield of the intercrop under mixture of NPK and PM was about 1.5 greater than that of NPK alone. Similar finding was reported by McCollum (1983), in his work on multiple cropping systems and fertilizer application involving maize and rice followed by cassava and groundnut. The study also revealed that fertilizer treatments promoted early flowering and maturity of pepper compared to the control that took longer days to reach flowering stage and maturity. This might be due to availability of sufficient nutrients for the growth and development of the plants. Siti-Aishah-Hassan (1993) reported that doubling the application of N rate from 112 to 224 resulted in a 21 % increase in flower bud.

Table 2 : Growth attributes of pepper as affected by fertilizer in cassava +pepper intercrop

Treatments	Days to 50 % flowering		Days to maturity	
	2001	2002	2001	2002
Sole P 0 Fertilizer	88	88	146	146
P + C1 + 0 Fertilizer	88	89	146	145
P + C1 + NPK	76	75	133	132
P + C1 + NPK + PM	76	77	134	132
P + C1 + PM	86	86	144	140
P + C2 + 0 Fertilizer	88	87	147	146
P + C2 + NPK	76	76	135	133
P + C2 + NPK + PM	76	75	135	135
P + C2 +PM	86	87	144	144
LSD (0.05)	1.2	1.3	1.8	1.2

P = Pepper; C1 = *Oko Iyawo*; C2 = TMS 30572, PM = Poultry manure,

Table 3 : Yield attributes of pepper as affected by fertilizer in cassava + pepper intercrop

Treatments	Number of fruits/plant		Fruit length (cm)	
	2001	2002	2001	2002
P + C1 + 0 Fertilizer	23	22	8.2	8.6
P + C1 + NPK	76	74	9.2	9.5
P + C1 + NPK + PM	74	73	9.1	9.3
P + C1 + PM	67	66	8.3	8.6
P + C 2 + 0 Fertilizer	19	20	8.0	8.2
P + C2 + NPK	67	65	9.1	9.3
P + C2 + NPK + PM	64	62	8.7	9.2
P + C2 +PM	57	55	8.1	8.2
LSD (0.05)	3.3	3.6	1.09	1.17

P = Pepper; C1 = *Oko Iyawo*; C2 = TMS 30572, PM = Poultry manure,

Table 4 : Pepper yield as affected by fertilizer in cassava + pepper intercrop

Treatments	Fresh fruit yield, t/ha	
	2001	2002
P + C1 + 0 Fertilizer	4.2	4.4
P + C1 + NPK	13.4	13.6
P + C1 + NPK + PM	12.1	12.8
P + C1 + PM	10.7	10.2
P + C2 + 0 Fertilizer	3.3	3.4
P + C2 + NPK	11.8	12.6
P + C2 + NPK + PM	11.0	11.2
P + C2 +PM	8.5	8.3
LSD (0.05)	0.92	0.44

P = Pepper; C1 = *Oko Iyawo*; C2 = TMS 30572, PM = Poultry manure,

Table 5 : Cassava tuber yield as affected by fertilizer in cassava + pepper intercrop

Treatments	Tuber yield, t /ha	
	2001	2002
P + C1 + 0 Fertilizer	18.1	17.2
P + C1 + NPK	21.7	20.3
P + C1 + NPK + PM	22.9	21.2
P + C1 + PM	25.0	24.3
P + C2 + 0 Fertilizer	17.4	18.9
P + C2 + NPK	20.6	21.6
P + C2 + NPK + PM	21.8	23.0
P + C2 +PM	22.2	21.6
LSD1 (0.05)	1.12	0.44
LSD2 (0.05)	0.78	1.13

P = Pepper; C1 = *Oko Iyawo*; C2 = TMS 30572, PM = Poultry manure (alone)
LSD1 = LSD Fertilizer, LSD2 =LSD Variety

Table 6 : Residual harvest of pepper as affected by fertilizer in cassava + pepper intercrop in the following season

Treatments	Fresh fruit yield kg /ha	
	2001	2002
P + C1 + O Fertilizer	98.3	93.5
P + C1 + NPK	112.4	111.6
P + C1 + NPK + PM	189.5	193.7
P + C1 + PM	298.6	302.6
P + C2 + O Fertilizer	91.3	89.2
P + C2 + NPK	103.2	99.3
P +C2 + NPK + PM	142.3	137.2
P + C2 +PM	256.4	279.3
LSD (0.05)	0.92	0.44

P = Pepper; C1 = *Oko Iyawo*; C2 = TMS 30572, PM = Poultry manure

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Comparative Study of Biogas Generations from Pineaple Peels and Spent Maize Grains Wastes and Their Ph - Parametric Correlations Using A Galvanized Iron Fixed-Dome Biodigester

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Abstract - Comparative study of biogas generations of pineapple peels (pp) and spent maize grains (SMG) wastes in terms of the pH-values using a constructed 0.459 m3 galvanized iron fixed-dome biodigester within 100 days retention period was carried out at Abakaliki area at 1:2.5 and 1:2 optimal ratio respectively.The measurements of the biogas volumes and pH values using the downward displacement techniques of water in a 25 litres calibrated white jerry can and the jean way 2020 pH-meter respectively were conducted at 9.30 am, 12.00 noon and 2.30 pm and the corresponding mean values computed for each day. Results showed peak values of 0.3378 litres at standard temperature and pressure (stp) at 22nd day (corresponding to 11.84 litres cumulation and 0.1518 litres at per day production rate) and 0.7814 litres at stp at 7th day (corresponding to 23.140 litres cumulation and 0.2822 litres at stp per day production rate) respectively. Also the flammable biogas productions commenced on 12th day for pp-wastes and 8th day for SMG-wastes and their pH-value ranges are 5.568-6.548 and 4.475-6.395.

Keywords : *Biogas-volume, pH, digestion, regression-approximations.*

Strictly as per the compliance and regulations of :

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Abstract - Comparative study of biogas generations of pineapple peels (pp) and spent maize grains (SMG) wastes in terms of the pH-values using a constructed 0.459 m^3 galvanized iron fixed-dome biodigester within 100 days retention period was carried out at Abakaliki area at 1:2.5 and 1:2 optimal ratio respectively.

The measurements of the biogas volumes and pH values using the downward displacement techniques of water in a 25 litres calibrated white jerry can and the jean way 2020 pH-meter respectively were conducted at 9.30 am, 12.00 noon and 2.30 pm and the corresponding mean values computed for each day. Results showed peak values of 0.3378 litres at standard temperature and pressure (stp) at 22nd day (corresponding to 11.84 litres cumulation and 0.1518 litres at per day production rate) and 0.7814 litres at stp at 7th day (corresponding to 23.140 litres cumulation and 0.2822 litres at stp per day production rate) respectively. Also the flammable biogas productions commenced on 12th day for pp-wastes and 8th day for SMG-wastes and their pH-value ranges are 5.568-6.548 and 4.475-6.395.

Spent maize grains wastes produced more qualitative and quantitative biogas than pp-wastes in the leakage and corrosion free biodigester. This is due to wider pH-value range indicating energization of micro-organisms resulting to more stability of micro organisms in SMG-wastes in the initial stage and other environmental factors such as moderately low. $^C/_N$ ration. Other reasons for low production of biogas from pp-wastes include the presence of cellulose and indigestible like materials.

This study recommends SMG as a better raw materials for biogas productions for domestic and small / medium scale industries in the developing countries of the world.

Keywords : Biogas-volume, pH, digestion, regression-approximations.

I. Introduction

Many of the world's present problems are closed related to those of energy production, supply, distributions and utilizations. This is due to upholding to one major source – conventional source of energy . This source especially fossil source is unreplenishable and the energy produced is hazardous to life as it pollutes the environment.

The need to diversify the dependence on conventional energy sources such as oil and other non – renewable sources of energy especially in developing countries can not be overemphasized. The sun is an already made source of energy if carefully harnessed and handled. Solar energy is free, natural and non – polluting energy that man can harness for many useful applications according to Nnabuchi, 2004. In some countries of the world for example, the United State of American, until the late 19th century, depended on renewable sources of energy in its many forms as their sole energy resources (Paul, 2007).

Solar energy includes not only direct sunlight but also several indirect forms such as photosynthetic fuels, energy from water power and winds. They are regarded as solar energy because their energies are derived from the sun: the energy of wood and other plant materials is solar energy fixed by the process of photosynthesis (Chang, 2003). Biomass materials are also examples of indirect sources of energy from the sun. The lack of utilizations of this source of energy is much observed in the developing countries like Nigeria. World over, the use of the common types such as cow dung, poultry droppings, peels of cassava, rice husks etc for biogas productions provided clean energy, organic fertilizers, reduction of wastes and pathogens. In Nigeria such biomass include wood, forage grasses and shrubs, other animal wastes and wastes arising from forestry, agricultural, municipal and industrial activities as well as aquatic materials and some of them have been tried (ECN, 1997) .But, over decades, some wastes have not been tried for energy supply - biogas yields though they have the same nutrients especially, carbon, nitrogen and phosphorus which maintained the growth and catabolism of microbes that help in biogas production just like the above mentioned wastes (Dioha ,et. al. 2006) and the energy produced can be used in small and medium scale business enterprises. Examples of such wastes are pineapple peels (PP) and spent maize grains (SMG).

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The chemistry of the biogas production from biomass including the above is as given in the three stage process below: This perspective is divided into two sections. They are the biogas formations and yields which exist in the three stages and the pH-parameter involvements.

The three stage process can be chemically described as the first consisting of micro organisms attacking the organic materials, that is, complex organic compounds such as cellulose, soluble organic compounds such as glucose and fructose. Polymers are transformed into soluble monomers through enzymatic hydrolysis (http:// www.cropgen.soton.Ac. UK., 2007)

ie

$$n(C_6H_{10}O_5) + nH_2O \xrightarrow{\text{Hydrolysis}} n(C_6H_2O_6) \quad (1.0)$$

The monomers become the substrate for the micro organisms in the second stage where soluble organic compounds are converted into organic acids by a group of bacteria collectively called 'acid formers'.

$$n(C_6H_{12}O_6) \xrightarrow{\text{acid forming bacteria}} 3n(H_3\ COOH) \quad (2.0)$$

The soluble organic acids consisting primarily of acetic acid, form the substrate for the third stage (http:// www.Biotank10.UK, 2007)

$$\text{ie } 3n\ CH_3\ COOH \xrightarrow{\text{methane forming bacteria}} CH_4 + CO_2 \quad (3.0)$$

In this very last stage, methanogenic bacteria generate methane by two distinct routes. One is by fermenting acetic acid to methane and carbon dioxide, the other consisting of reducing carbon dioxide gas generated by other species;

$$CO_2 + 4H_2 \xrightarrow{\text{Reduction}} CH_4 + 2H_2O \quad (4.0)$$

carbondioxide hydrolysed to carbonic acid;

$$CO_2 + H_2O \xrightarrow{\text{Hydrolysis}} H_2CO_3 \quad (5.0)$$

Then the carbonic acid generated is reduced to methane and water by hydrogen as follows

$$H_2CO_3 + 4H_2 \xrightarrow{\text{Reduction}} CH4 + 3H2O \quad (6.0)$$

The organic matter used in the methane fermentation generally contains volatile solids and ashes. And the remaining non-digestible materials along with dead bacteria (digestate) are used as fertilizer as mention in section 1.0.

Therefore the generic chemical equation for the formations and yields of biogas as depicted in four key biological and chemical stage of anaerobic digestion; hydrolysis, acidogenesis, acetogenesis and methano - genesis above is given by

$$C_6H_{12}O_6 + 4H_2 \longrightarrow 3\ CH_4 + 3CO_2 \quad (7.0)$$

The medium environmental factors such as temperature and pH affect the production of the biogas. Maishanu and Seekimpi, (1988) and Anonymous, (1992) observed that micro organisms never require a too acidic or too alkaline environment but a neutral or mild alkaline condition for optimal biogas productions. This is a measure of the pH of the system. The organic matters contain volatile solids which are made up of carbohydrates, proteins, fats and tannins. Also ashes are components of the organic materials. The proteins, lipids etc are responsible for variations in pH - values affecting methanogenesis and possibly improve biogas generations (Meybell, 1981). For optimal biogas production in slurries http://www.green-trust.org/methane.htm, (2008), Buren (1983), Maishamu and Seekimpi, (1988), Dioha et al. (2003), Anonymous (1992) and Blandchard and Gill, (1964) maintained 6.2 – 7.8, 70 - 8.5, 6.6 – 7.5, 6.6 – 7.6, 6.0 – 8.0 and 5.5 – 8.0 for wastes respectively.

For these two wastes the researchers wanted to investigate the generations of biogas of the wastes in terms of the PH – values of their slurries. This is hoped to determine whether the PH- parameter of these wastes aid their biogas production and to aligned developing countries like Nigeria of the usage of these common and available wastes in addressing our domestic/ rural energy problems. It is also hoped to help improve our small and medium scale energy needs. The use of their constructed galvanized iron fixed - dome biodigester was made. This is an improved version of the Chines fixed – dome biogas plant developed from the State – planning institute Lukenows first concrete fixed – dome biodigester in 1978. The construction cost is Low. The digester has very low corrosion effects and more life span and has simple technologies as against the old version and other classes of digesters. The biodigester slurries absorbed solar energy radiations including heat through the surface of the digester. The slurries comprising of carbohydrates, proteins, fats and water are worked upon by the consortium of bacteria to produced biogas.

II. Materials and Methods

The 0.459 m^3 galvanized iron fixed-dome biodigester was constructed with the help of technicians of engineering workshop of National Centre for Energy, Research and Development, NCERD, University of Nigeria, Nsukka.

The fresh bio-wastes were collected from Abakaliki meat market. Also the pineapple peels and spent maize grains were prepared, after sorting, in the mixing ratios of 1:2.5 ((ie 77: 193 of wastes (kg): water (kg)), and 1:2 ((ie 90: 180 of wastes (kg): water (kg)) respectively and each introduced in batch mode operations into the biodigester. Each engagement lasted for about 100 days. Five goat model Z 051299 weighing balance graduated in kilogrammes (kg) was used in the weight measurements.

After introducing the slurry, all openings were closed tightly. The setup was monitored and the readings and measurements of the biogas volumes in litres and pH-values were carried out each day at 9.30 am, 12.00 noon and 2.30 pm with occasional stirring to break the sum formed on the surface of the slurry and redistribute the even temperature within the content. The pH-values were measured with pH-meter and the volumes of the biogas produced were measured by subsequent downward displacements of water in the 25 litres calibrated jerry can. The volume measurements were carried out successively until the biogas produced was exhausted in the constructed digester below. The flammability tests were carried out each day using a burning burnsen burner.

Fig 1.0 : The Picture of the constructed Biodigester

III. Results and Discussions

The results of this study were displayed in figure 2.0 – 7.0 using Mathcad 7 professional package. Figures 2.0 and 3.0 below showed the novel 5th and 6th order regression approximations of biogas volumes (litres) at stp with retention time (days) of pineapple peels and spent maize grains wastes.

The regression approximated curves

$$y_{pp} = -0.18 + 0.0161x - 2.478 \times 10^{-3} x^2 + 4.069\ 10^{-5} x^3 - 3.091 \times 10^{-7} x^4 + 9.046 \times 10 - 10 \times 5 \text{ of R} - \text{squared } 0.562$$

and

$$y_{smg} = 0.382 + 0.144x - 0.017x^2 + 7.140 \times 10^{-4} x^3 - 1.409 \times 10^{-5} x^4 + 1.304 \times 10^{-7} x^5 - 4.589 \times 10^{-10} x^6 \text{ of R} - \text{squared } 0.437$$

, have peak values of 0.33 7 litres at stp on 22nd day and 0.7814 litres at stp on 7th day respectively.

Also the minimum volumes (litres) obtained from the curves are 0.0017 litres at stp on 89th day and 0.090 litres at stp on 73rd day respectively.

The cumulative flammable biogas volumes (litres) at stp shown in figures 4.0 and 5.0 which indicated 11.848 litres and 23.140 litres showed production rates of 0.1518 litres per day and 0.2822 litres per day for pp and SMG wastes respectively (see table 1.0). The flammable biogas productions with the two wastes commenced on 12th day for pp and 8th day for SMG.

Also presented are the 6th order and cubic order regressive approximated curves indicating the variations of the pH-values of pp and SMG-wastes with retention time in figures 6.0 and 7.0. These are represented by approximated curve equations:

$$y_{pp} = 5.568 - 0.084x + 0.018x^2 - 9.16 \times 10^{-4} x^3 + 2.006 \times 10^{-5} x^4 - 1.984 \times 10^{-7} x^5 + 7.285 \times 10^{-10} x^6 \text{ of R} - \text{squared } 0.436$$

and

$$y_{smg} = 6.381 + 6.678 \times 10^{-3} x - 1.303 \times 10^{-3} x^2 + 1.17 \times 10^{-5} x^3 \text{ of R} - \text{squared } 0.725$$

From the two curves pH peak values of 6.558 on 68th day and 6.3395 on 1st day existed for PP and SMG wastes. Also minimum values of 5.568 on the 3rd day and 4.475 on the 22nd days existed respectively.

From figure 2.0 and 3.0, 4.0 and 5.0, and table 1.0 above, SMG-wastes produced more flammable biogas faster and with higher production rate per day although the pp - wastes lasted longer. Though the micro-organisms in SMG medium seemed to be much viable, the gas production reached maximum within few days than in pp-medium. Cumulatively biogas production is higher in SMG-slurry than in pp-slurry although we have few cases of fluctuations in the volumes of biogas production in SMG-wastes.

From figures 6.0 and 7.0 of pH -value ranges, 5.56 – 6.54 and 4.47 – 6.39 pH-value for pp and SMG – wastes existed respectively. The R-squared in pH-plot of SMG is higher showing that the graph better represents the relationship. The maximum value was obtained at the initial stage showing that the organisms were almost stable and active. Within the first 20 days the SMG organisms were stabilized than the pp organisms. It takes more time for the organisms in pp-slurry to reach stability. Hence they were not stabilized until very late and after few weeks from this point, the nutrients got exhausted. Also here more acids were obtained at the initial stage in order to break down the wastes and this reduced the gas production. The wide pH-value range with more biogas productions of SMG-slurry was due to non availability of the cellulose and wax-like materials as in the pp-slurry. This wideness in pH-value range quite conformed with those values obtained by Buren (1983), Maishanu and Seekimpi, (1988), Dioha et. al., (2003), Anonymous (1992), and http://www.green-- htm, (2008), although the alkalinity level was lower than that of PP – waste.

Hence this wide pH-value range indicated that the micro-organisms in SMG-slurry have been energized more by other environmental factors such as optimal temperature and moderate $^{C}/_{N}$ - ratio than in pp-slurry which contains more cellulose and some indigestible wax -like materials. The moderate / optimal ambient and slurry temperatures in the medium are very important indications that the bacteria are stable and lead to optimal biogas production. Also low C/N – ratio value which corresponds to moderate and relative proportions of carbon and nitrogen aid the stability of the micro organisms in the charged digester.

IV. Conclusions

Spent maize grains wastes produced more quantitative and qualitative biogas than pineapple wastes. This is due to more stability of micro organisms in the SMG-slurry especially at the initial stage than in pp-slurry. Also this is as a result of the wide PH value range due to the energization from other factors such as moderate $^{C}/_{N}$ - ratio, since the initial stage value is within the more expected range for more stability and higher production of biogas indicated by other researchers. Also the pp-slurry contains more cellulose and undigested wax-like materials which aided lower production rate than in SMG-slurry.

Therefore, the researchers recommended the use of spent maize wastes as better wastes for biogas production than pineapple peels wastes. The SMG-wastes are more readily available than pp-wastes as raw materials for biogas production in linkage and corrosion free biodigester in Nigeria. Also material resources such as steel, polyethylene or rubber are available as potential materials and in large quantity too, for the construction and sustainable usage of galvanized iron fixed dome – biodigester. Hence uncentralized power units can be established and operations of small and medium scale industries which is a sine qua non for the achievement of poverty alleviation as described by the united Nation MDG_S of which Nigeria is a part too, is possible.

V. Acknowledgement

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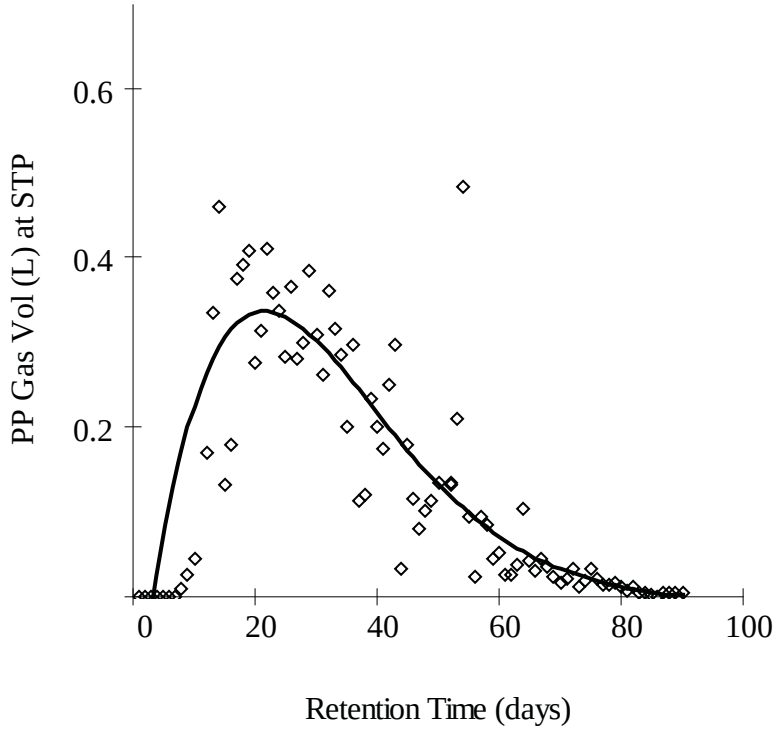
References Références Referencias

1. Anonymous, (1992). A paper titled Biogas technology in China, Chengau Biogas Research Institute of the Ministry of Agriculture.
2. Blanchard, P. and Gill, M. O. (1964). In Eze, J. I. and Onwuka, N. D.(2007). Biodigester. Nigerian Journal of Solar Energy, Volume 18, P. 63 – 67.
3. Buren, K. A. V. (ed) (1983). A Chinese Biogas Manual Popularizing Technology in the Country Side, 5th edition, Intermediate Technology Publication Ltd, London, P. 51.
4. Chang .R. (2003). General Chemistry. McGraw – Hill Companies Inc, New York, P. 234 – 245.
5. Dioha, I. J., Gulma, M. A and Nabade, K. (2003). A Modified $10m^3$ Fixed - Dome Community Biogas Plant, Nigerian Journal of Solar Energy, Volume 14, P. 126-134.
6. http://www.green-trust.org/methane.htm. (2008)
7. http://www.cropgen.solon.Ac.UK., (2007)
8. Maishanu, S. M and Seekimpi, R. S. N. A (1998). Characterization of Bacteria Isolates from Anaerobic Digestion of Fresh Water Need. Pistia.
9. Meybell, P. (1981). Planning a Digester Prism Press, Stable Courts,Chalmington, Dorset.
10. Nnabuchi, M.N. (2004). Ph.D Thesis, University of Nigeria Nsukka, PP 12 – 45
11. Paul, A.T. (2007). College Physics. Worth Publishers, NewYork. P. 314 - 317

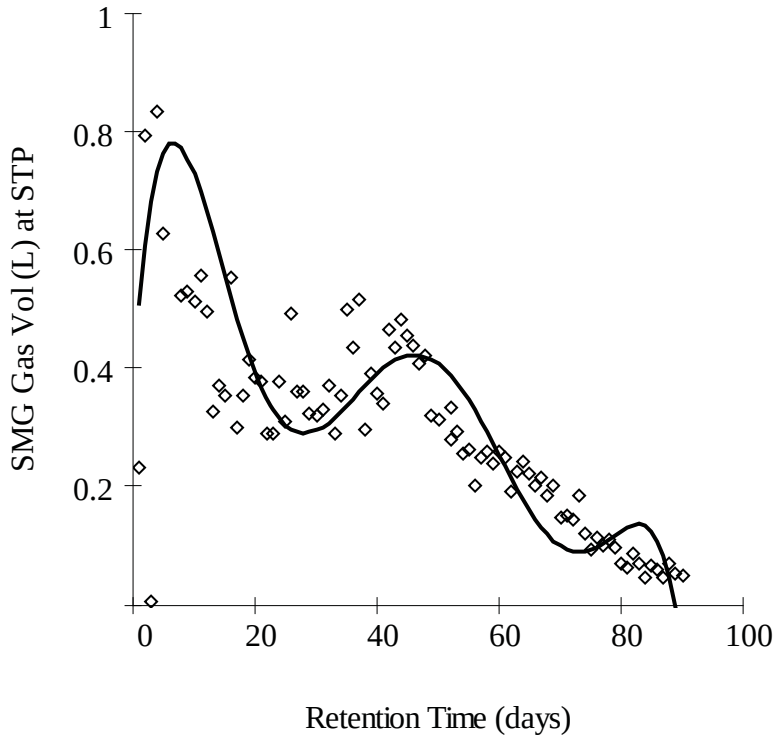
Appendix (1.0) : Figures and Tables



Max value = 0.33782 at RT = 22 Min value = 0.001753 at RT = 89, $R^2 = 0.562$

$$y = -0.18 + 0.061x - 2.478\times10^{-3}x^{2} + 4.069\times10^{-5}x^{3} - 3.091\times10^{-7}x^{4} + 9.046\times10^{-1}x^{05}.$$

Fig. 2.0 : Graph of PP Biogas Volume (L) at stp And Retention time (days)



Max value = 0.78147 at RT = 7 Min value = 0.090136 at RT = 73, $R^2 = 0.432$

$$y = 0.383 + 0.144x - 0.017x^{2} + 7.14\times10^{-4}x^{3} - 1.409\times10^{-5}x^{4} + 1.304\times10^{-7}x^{5} - 4.589\times10^{-1}x^{06}.$$

Fig. 3.0 : Graph of SMG Biogas Volume (L) at stp And Retention time (days)

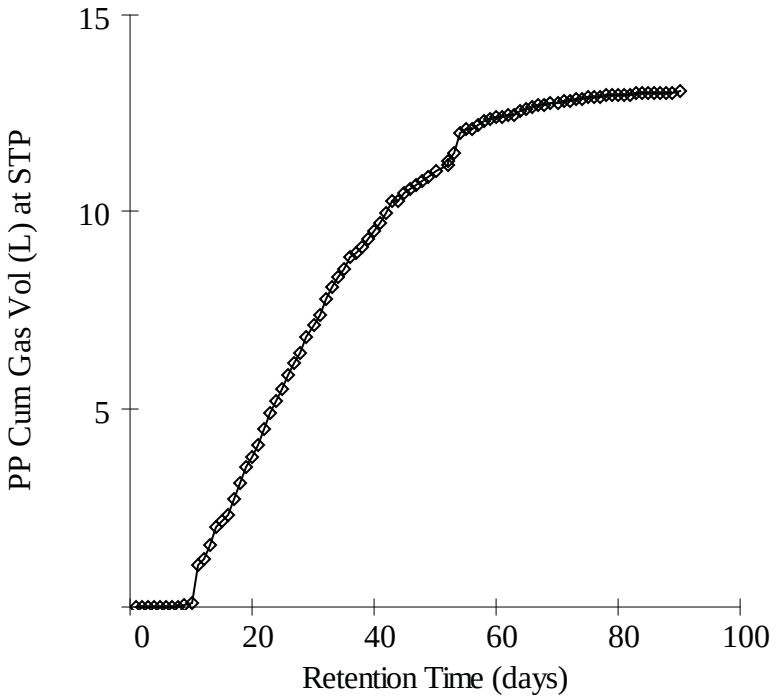


Fig. 4.0 : Graph of PP Cumulative Gas Volume (L) at stp Against Retention Time (days)

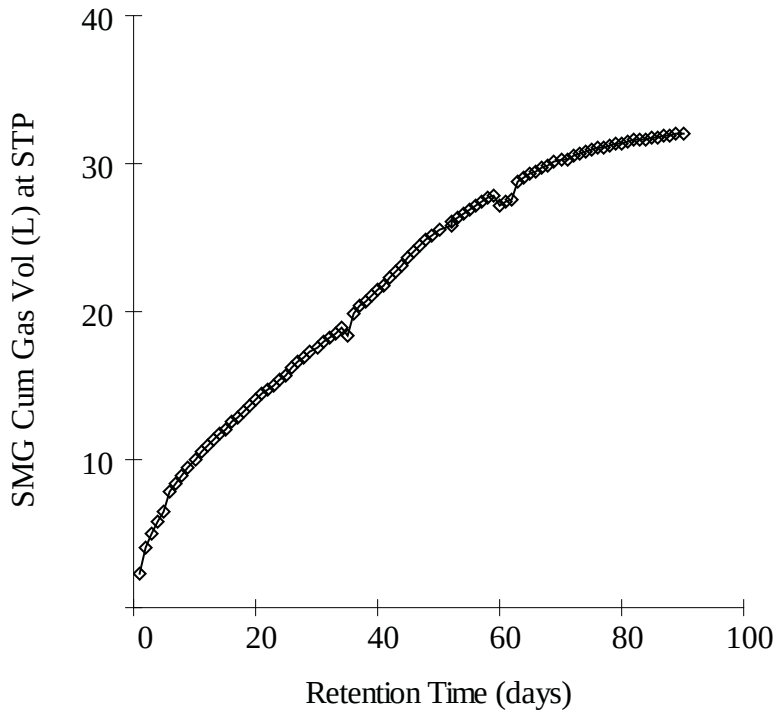
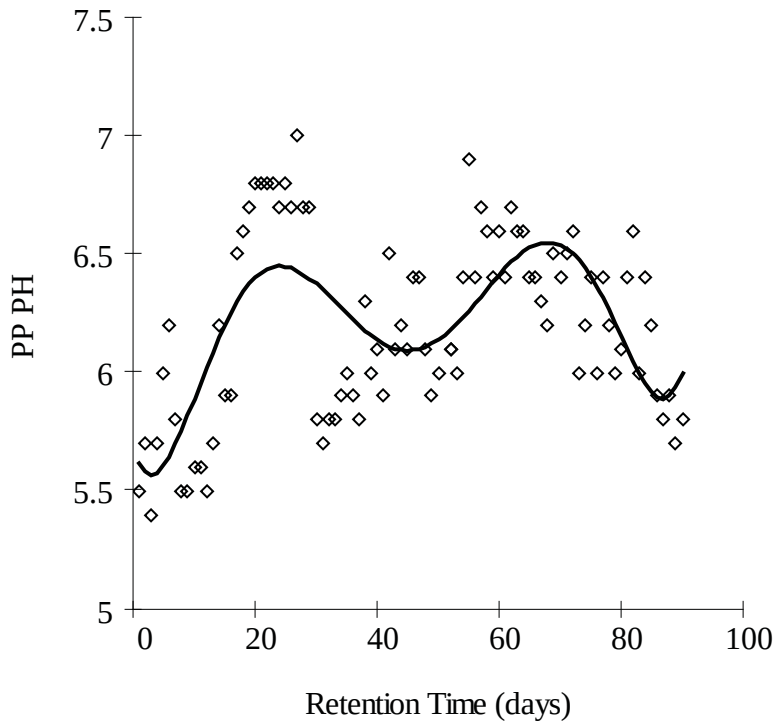


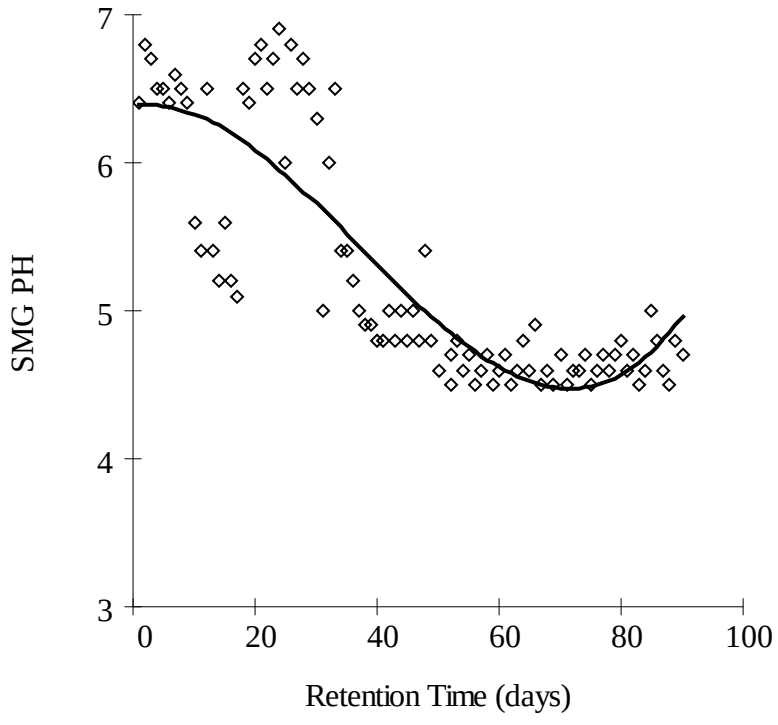
Fig. 5.0 : Graph of SMG Cumulative Gas Volume (L) at stp Versus Retention Time (days)



Max value = 6.5482 at RT = 68 Min value = 5.5682 at RT = 3, R2 = 0.436

$$y = 5.568 - 0.084x + 0.018x^2 - 9.16\times10^{-4}x^3 + 2.006\times10^{-5}x^4 - 1.984\times10^{-7}x^5 + 7.285\times10^{-1}x^{06}$$

Fig. 6.0 : Plot of PP pH Against Retention Time (days)



Max value = 6.3959 at RT = 1 Min value = 4.475 at RT =72, R^2 = 0.725

$$y = 6.381 + 6.678\times10^{-3}x - 1.303\times10^{-3}x^2 + 1.17\times10^{-5}x^3$$

Fig. 7.0 : Plot of SMG pH Versus Retention time (days)

S/N	Name of Wastes	Commencement of Gas Production (Days)	Commencement of Gas Flammability (Days)	Volume of Inflammable Gas at stp (L)	Volume of Flammable Gas at stp(L)	Flammable Gas Production Rates (L/day)
1	PP	8th	12th	1.2334	11.8480	0.1518
2	SMG	1st	8th	8.8953	23.1407	0.2822

Table 1.0 : Data on Gas Flammability and Flammable Volumes (L) at stp for the Wastes

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Species Composition And Range Condition of Jibiro Grazing Reserve, Adamawa State, Nigeria

By Khobe, D.

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Abstract - This study assessed the flora species composition and range condition of Jibiro grazing reserve in Song Local Government Area of Adamawa State, Nigeria. Range factors used for the assessment include botanical composition of herbaceous vegetation, ground cover, litter cover, plant vigour, erosion level, and trees/shrubs density on range sites. Plant health (vigour) was rated as stunted, erosion was slight, the mean tree/shrub density per hectare was 475 trees/shrubs and litter cover was 27%. The relative density of the herbaceous species shows that Aristida longiflora had the highest with 24.66% (1953 species) while Cacia obtusifella has the lowest of 0.89% (71 species). The overall results were scored on the range condition score card; giving a total score of 45%. This was then compared to a key for rating condition, which puts the range in a fair condition. Range management and improvement practices such as prescribed burning, range seeding and reseeding, control of rate of grazing and other sustainable management practices that will range trend and improvement within the reserve were recommended.

Keywords : *Range condition, Evaluation, botanical composition, grazing reserve, Song .*

Strictly as per the compliance and regulations of :

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Keywords : Range condition, Evaluation, botanical composition, grazing reserve, Song .

I. Introduction

Range condition is the state of health and vigour of a range in relation to its full productive potential. It is one of the important methods of range evaluations that enable judgement to be made of the adequacy of stocking and management practices (Khobe *et al.*, 2009). It has become the basis for the adjustment of stocking figures and revision of management plans. It measures the degree range deterioration and improvement (Akosim *et al.*, 2004).

The purpose of classifying range condition is to measure any deterioration that has taken place in the plant community. It also provides a basis for predicting the degree of improvement that is possible under various management situations. Successful range management depends on establishing and recognising the relationship amongst the resources that make up rangelands. Range professionals and ranchers are recognising the fact that successful range management depends on stocking rangelands, so adequate vegetation residues remain to protect rangeland health, maintain multiple values, and insure economic viability (Khobe *et al.*, 2009).

Most grazing reserves are situated on impoverished lands, with little agronomic potential (Goldschmidt, 1980). A close inspection of many of these sites reveals inferior fodder characterised with protein deficiency. For example, in Borno State, which has the largest population of livestock in Nigeria, there is hardly enough grass for year round grazing. In the early dry season, herds in this State browse on trees, branches and farm residues/wastes (Ismail, 2003). Animals feeding on such herbage suffer hypo-proteinamia and subcutaneous oedema. The required 7.5% crude protein, if not consumed by fire is available for only one-third of the year (Bekure, 1993).

The major attributes that need to be monitored and inventoried to determine the condition of rangelands are vegetation cover, frequency, abundance or density and yield of herbage (Kefa and oche, 1989; Kallah, 1982).

This paper reviews the range condition Jibiro grazing reserve with the aim of ascertaining the possibility of range improvement or deterioration.

II. Materials and Methods

The research was conducted in Jibiro grazing reserve, which lies in Song Local Government Area of Adamawa State, about 32 km north-east of Jimeta town along Jimeta-Gombi Road. A reconnaissance survey was carried out in July, 2010 for the purpose of identifying and delineating major range sites. Five range sites (A, B, C, D, and E) were delineated. A survey of vegetation was conducted where only lower layer cover was considered. This included the grass and forbs as well as shrubs up to a maximum height of one meter.

a) Layout of the study

Permanent vegetation transects were established in the Gongoshi Grazing Reserve following the method outlined by Weeks (1996). This involved division of the study area into large adjacent and parallel strips (each 2 km wide). The strips were further sub-divided along their lengths using natural features such as roads, tracks or trees to give a number of blocks. Each block was sub-divided across its width into ten (10) sections and the central longitudinal axis of each section served as the main transect. The transects were numbered 0 – 9. Using a table of random numbers, two transects were chosen per block and used as the sampling transects. Sampling of the vegetation at the herbaceous layer for yield, botanical composition, litter cover, herbaceous ground cover, plant vigour, was

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carried out in these selected transects. Assessment of the site to determine the extent of erosion was carried out within each block.

b) Assessment of Range Condition

Range condition parameters measured were litter cover, plant vigour, erosion, number of trees/shrubs/ha, cover, relative density of plant species, desirable and undesirable species (Khobe *et al.,* 2009; Akosim *et al*., 2004).

c) Determination of botanical composition

The Step-point method as outlined by Sutherland (1999) and modified by Khobe *et al*. (2009) was used for the determination of the botanical composition of herbaceous vegetation. Sampling was carried out along the permanent transects. Sampling points occurred along the transects at two paces (four strides) intervals. At each point, the researcher places his boot at a 30° angle to the ground, so as not to disturb the plants. The pin was lowered perpendicular to the sole of the boot, at an angle to the ground. The point or the side of the pin either touched an herbaceous plant, or reached bare ground. In the later case, the pin was pushed into the ground and the nearest plant to it in a forward direction (180° arc) was recorded. The plants were classified into desirable and undesirable on the basis of whether they are selected by the livestock for food or not, and the result was expressed in percentage.

d) Determination of herbaceous ground cover

The Step-point method as outlined by Sutherland (1999) was also used to determine herbaceous ground cover. Sampling points occurred along the transects at every 15th pace intervals. A square frame, 30cm x 30xm subdivided internally into four 15cm squared was employed. The frame was located by aligning one of the subdivision crossbars of the frame with the sampling pin, which have been pushed into the ground. Estimate of total herbaceous cover were made in terms of percentage in the area bounded by the frame (all herbaceous material, green or dry, of the current growing season was considered as herbaceous cover).

e) Determination of litter cover

The Step-point method as outlined by Sutherland (1999) was used to determine litter cover. Sampling points occurred along the transects at every one pace (two strides) intervals. At each point, the pin was lowered perpendicular to the sole of the boot, at an angle to the ground. It was then observed and recorded.

f) Determination of plant vigour

Plant vigour was measured using the method by Kershaw (1979). This involved evaluation using the colour of leaf and the general plant appearance.

g) Assessment of range sites for erosion

Assessment of range sites for erosion followed the method outlined by Ola-Adams (1985) and modified by Akosim *et al*. (2004). Assessment for erosion took place within the blocks. Erosion was none, when soil was covered with vegetation or litter and no apparent soil removal; slight, when there was evidence of some soil removal and exposure of rock and pebbles and severe when subsoil was exposed and gullies or sheet erosion was formed or in progress.

h) Determination of tree and shrub density

The point-centred quarter method as outlined by Nigerian Conservation Foundation (NCF)/World Wide Fund (WWF) (1987) for sampling trees and shrubs in the savannah woodland was used because of its rapidity, simplicity and relative accuracy. Sampling points were located along the transects at ten pace intervals. This interval was chosen to ensure that: -

i. An individual plant was located within each quarter of each sampling point.
ii. An individual plant was not measured more than once.

The procedure consists of starting at the transect pole, and proceeding ten paces down the transect and placing the pointer into the ground at the tip of the boot, thus marking the sampling point. One then faces down the transect and spread his arms to the sides, thus marking four quadrants. These were indicated as A, B, C and D respectively, from left front clockwise to left rear. From the sampling point, the closest tree or shrub to the pointer in each quadrant was chosen as the sample. The distance from pointer to plant was measured and the species noted. The density of the woody plant species was calculated from the mean distance (Khobe *et al*., 2009).

1. Determination of Range Condition

A range condition score card as developed by Ola-Adams (1985) was used for quantification and evaluation of range condition. Factors that were used for evaluation included herbaceous cover, species composition, litter cover, plant vigour, erosion and the density of trees and shrubs. Numeral ratings were assigned to each factor to provide a means of aggregating the separate judgments into single overall numeral figure that range from 1% - 100%. These were then compared to a standard range condition class to establish the condition rating of the study area.

2. Relative Density

Relative density of herbaceous species was determined as:

III. Results and Discussion

Assessment of litter cover, plant vigour, erosion and density of trees/shrubs/ha in the range sites .

Results of plant vigour in Table 1 showed that the plants are stunted in all the sites. Erosion observation revealed severity in one of the sites while the others remain slight. The mean percentage litter

cover was 27%. The mean trees/shrubs/ha was 405 trees/shrubs/ha.

Table 1: Assessment of litter cover, plant vigour, erosion and density of trees/shrubs/ha in the range sites

Parameter	Range Sites A	B	C	D	E	Mean
Plant vigour	Stunted	Stunted	Stunted	Stunted	Stunted	
Erosion	Slight	Slight	Severe	Slight	Slight	
No. of trees/ shrubs/ha	451	593	606	245	480	475
% Litter	40	35	15	20	25	27.0

Table 2 : Relative Density of the herbaceous species

S/No.	Species	No. of Species	Relative density (%)
1.	*Chasmopodium candatum*	419	5.29
2.	*Andropogon gayanus*	424	5.35
3.	*Hyparrhenia rufa*	407	5.14
4.	*Pennisetum pedicellatum*	342	4.32
5.	*Zornia latifolia*	351	4.43
6.	*Hyptis suaveolens*	351	4.43
7.	*Cassia obtusifolia*	71	0.89
8.	*Waltheria indica*	113	1.43
9.	*Setaria pallidefusca*	787	9.94
10.	*Eragrostis tremula*	640	8.08
11.	*Loudetia simplex*	43	0.54
12.	*Aristida longiflora*	1953	24.66
13.	*Setaria pallidefusca*	787	9.94
14.	*Hyparrhenia ripens*	1231	15.55

Akosim *et al*. (2004)

Table 3 : Range condition Score Card

Factors	Quantity (%)	Scale of Score	Actual Score
Percentage herbaceous cover	75-100	25-32	
	50-74	19-24	20
	25-49	9-16	
	6-24	2-8	
	0-5	0-2	
Percentage Botanical composition			
Desirable	0-5	0	
	6-25	1-6	
	26-50	7-12	10
	51-75	13-18	
	76-100	19-24	
Undesirable	0-5	16-13	
	6-25	12-9	
	26-50	8-5	
	51-75	4-1	
	76-100	0	
Plant Vigour	Healthy	4-3	
	Stunted	2-1	2
	Weak	0	
Soil Condition (Litter)	20% hits	0	
	20-50% hits	1-2	1.5
	100% hits	3-4	
Erosion:			
None	0-8% slope	4-3	
Slight	8-16% slope	2-1	1.5
Severe	16-100% slope	0	

Severe	16-100% slope	0	
Tree/Shrub Density	1-250/ha	16-13	
	251-500/ha	12-9	
	501-1000/ha	8-5	10
	1001-2000/ha	4-1	
	≥ 2001/ha	0	
Total Score			45%

Table 4 : Key for Rating Condition

S/No.	Range condition class	Total score (%)
1	Excellent	80 – 100
2	Good	60 – 79
3	Fair	40 – 59
4	Poor	20 – 39
5	Very Poor	0 – 19

V. Conclusion

The result of this study showed presented the overall condition of the range to be fair (45%). However, results of the analysis of soil factors such as litter cover and erosion; and plant factor, such as vigour tend to suggest the range to be trend to be tilting towards a poor condition. This implies that the trend of the range depends on how the range is utilised subsequently and on other activities such as burning and farming. Lauvenroth and Laycock (1989) observed that indiscriminate and unplanned use of burning and grazing management have been the principal causes of deterioration in range condition.

VI. Recommendations

Range management and improvement practices such as prescribed burning, range seeding and reseeding, control of rate of grazing and other sustainable management practices that will range trend and improvement within the reserve were recommended.

References Références Referencias

1. Akosim, C., Mbaya, P. and Nyako, H.D. (2004). Evaluation of Range Condition and Stocking Rate of Jibiro Grazing Reserve, Adamawa State, Nigeria. *Journal of Arid Agriculture*. 14: 35-39.
2. Bekure, S. (1993). *Livestock Development: Issues and Opportunities*. Washington, D.C. World Bank. Draft Report No. 12058-UNI.
3. Goldschmidt, W. (1980). The Fulani of Pastoral economic development program in Africa. In: The Fulani of Pastoral People. *Proceedings of a Conference held in Nairobi,* August 4th - 8th, 1980 by the Institute of Development Studies. Nairobi: I.D.S. 101-117.
4. Ismail, I. (2003). Grazing reserve development: a panacea to the intractable strife between farmers and herders. An unpublished manuscript.
5. Kallah, M.S. (1982). Grazing Land Management. In *Proceedings of National Conference on Beef Production in Nigeria,* Kaduna; NAPRI/ABU, Zaria. 651.
6. Kefa, B.S. and Oche, O.M. (1989). Range inventory and evaluation. In *Range and Pasture Development and Management in Nigeria: Training Manual*. NAPRI/ABU, Zaria. 16 – 21.
7. Khobe, D., Sanu, K.M., and Kwaga, B.T. (2009). Assessment of Range Condition of Gongoshi Grazing Reserve, Adamawa State, Nigeria. *International Journal of Tropical Agriculture and Food Systems*, 3(3): 261-266.
8. Sutherland, W. J. (ed.). (1999). *Ecological Census Techniques: A Handbook.* University Press, Cambridge.

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Relaxation processes and ultrasonic attenuation in KDP-type ferroelectrics

By V S Bist , N S Panwar

HNB Garhwal University Srinagar (Garhwal) Uttrakhand, India

Abstract - The anharmonic four - particle cluster model Hamiltonian for stochastic motion of $H_2PO_4^-$ groups has been used to study the physical properties of KDP type ferroelectrics. Using Green's function method and Dyson's equation the renormalized frequency of the coupled system and collective wave half width have been evaluated with the help of model Hamiltonian by considering the anharmonicity upto fourth order. The higher order correlations have been decoupled using symmetric decoupling scheme at the later stage after applying the Dyson's treatment and have been evaluated using the renormalized Hamiltonian. The relaxational behaviour and ultrasonic attenuation have been related to the width of collective mode. The temperature dependence of ultrasonic attenuation coefficient, dielectric constant and loss tangent has been discussed in terms of a relaxational soft mode.

Keywords : collective proton wave half width, collective phonon mode frequency shift, and relaxation time.

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V S Bist[α] , N S Panwar[Ω]

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Keywords : collective proton wave half width, collective phonon mode frequency shift, and relaxation time.

I. Introduction

The study of KH_2PO_4 type ferroelectrics has great significance because the varying properties of these materials are directly related to the industrial applications. The static and dynamical properties of KDP family have been tried on the basis of order-disorder model of dipoles[1] by Tokunaga. These results, however, are in good agreement with experimental results but could not explain the observed relaxational behaviour of dielectric properties and ultrasonic attenuation in KDP type ferroelectrics explicity. Many workers [2-7] have experimentally studied the dielectric properties of KDP type ferroelectrics. Formulae were developed to explain ferroelectric transitions in order-disorder [8-10] type crystals.

In the present study the four particle cluster model , propsed by Blinc and Zeks [11] has been extended to explain the observed relaxational behaviour of dielectric properties and ultrasonic attenuation in KDP-type ferroelectrics.

The model Hamiltonian includes; the proton Hamiltonian, the lattice Hamiltonian, the proton-lattice interaction terms and the anharmonicity upto fourth order . Using the double time thermal retarded Green's function method and Dyson's equation[12-13] the collective mode frequencies and widths have been calculated. The double time thermal Green's function method offers a convenient approach to evaluate the static and dynamical properties in the same formalism.

II. Theory

a) Model Hamiltonian and Equation of Motion

The four particle cluster Hamiltonian by Blinc and Zeks [11] has been modified by considering the lattice anharmonicity upto fourth order for the stochastic motion of $H_2PO_4^-$ groups in a KDP - system. The model Hamiltonian, considered in the present study, includes the proton Hamiltonian, the lattice Hamiltonian, the latticeproton interaction and the anharmonic terms. With these all interaction terms the total Hamiltonian is given by[12] :

$$H = -2\Omega\sum_i S_i^x - \frac{1}{2}\sum_{ij} J_{ij}\, S_i^z S_j^z - \frac{1}{4}\sum_{ijkl} J'_{ijkl}\, S_i^z S_j^z S_k^z S_l^z + \frac{1}{4}\omega_k \left({}^{+}A_k A_k + {}^{+}B_k B_k \right) + \sum_i \overline{V}_{ik} S_i^z A_k + \sum_{k_1,k_2,k_3} V_3\left(\vec{k_1},\vec{k_2},\vec{k_3}\right) A_{k_1} A_{k_2} A_{k_3} + \sum_{k_1,k_2,k_3,k_4} V_4\left(\vec{k_1},\vec{k_2},\vec{k_3},\vec{k_4}\right) A_{k_1} A_{k_2} A_{k_3} A_{k_4}. \quad (1)$$

Where S_i^x is the tunneling operator, Ω is the proton tunneling frequency, S^z and the half of difference of the occupation probability of the proton in the equilibrium position of a hydrogen bond. J_{ij} is the two body - coupling coefficient and J'_{ijkl} refers to the four body coupling coefficient. ω_k is bare phonon frequency; A_k and B_k are displacement and momentum operators. $\overline{V_{ik}}$ is proton-lattice interaction term; $V_3\left(\vec{k_1},\vec{k_2},\vec{k_3}\right)$ and $V_4\left(\vec{k_1},\vec{k_2},\vec{k_3},\vec{k_4}\right)$ are third - and fourth - order anharmonic coefficients.

The proton Green's function $\langle\langle S_q(t); S_{q'}(t')\rangle\rangle$ and the phonon Green's function $\langle\langle A_q(t); A_{q'}(t')\rangle\rangle$ have been evaluated for the collective motion of the system, using the model Hamiltonian, Eq.1. The higher order correlations in the proton Green's function have been evaluated using the symmetrical decoupling scheme, after applying the Dyson's treatment. With this approach, one gets[12] :

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$$\lim_{\varepsilon\to 0} G^{zz}_{qq'}(\omega + j\varepsilon) = \frac{\Omega < S^x_q > \delta_{qq'}}{\pi\left[\omega^2 - \tilde{\tilde{\Omega}}^2 + j\Gamma_s(q,\omega)\right]}, \quad (2)$$

where $\tilde{\tilde{\Omega}}$ is the proton renormalized frequency of the coupled system, $\Gamma_s(q,\omega)$ and is the collective proton wave half width, given by

$$\Gamma_s(q,\omega) = \pi \sum_{i=1}^{3} G''_{si}(q,\omega) \quad (3)$$

$$\Gamma_s(q,\omega) = \frac{-4\pi \bar{V}_q^2 \omega_q^2 < S^x_q > \delta'_{qq} \Gamma_p}{\Omega\left[(\omega^2 - \tilde{\tilde{\omega}}_q^2)^2 + 4\omega_q^2 \Gamma_p^2\right]} + \frac{\pi bc^2}{2\tilde{\Omega}} \delta\{(\omega - \tilde{\Omega}) - \delta(\omega + \tilde{\Omega})\} + \frac{\pi a^2 \hat{\Omega}}{2b} \delta\{(\omega - \hat{\Omega}) - \delta(\omega + \hat{\Omega})\} \quad (4)$$

where

$$a = J_0 < S^z_q > + J'_0 < S^z_q >^3,\ b = 2\Omega,$$
$$c = J'_0 < S^z_q > + 3J'_0 < S^x_q >< S^z_q >^2,$$
$$\tilde{\Omega} = (a^2 + b^2 - bc)^{1/2}, \hat{\Omega} = (a^2 + n_q \bar{V}_q^2)^{1/2},$$

$\tilde{\tilde{\omega}}_q^2$ is the renormalized phonon frequency, Γ_p is the coupled phonon width, $n_q = \frac{\omega_q}{\tilde{\omega}_q} \coth\left(\frac{\beta\tilde{\omega}_q}{2}\right)$ is the phonon occupation number and $\beta = (k_B T)^{-1}$, k_B is Boltzman constant and T the absolute temperature. Similarly, on solving the phonon Green's function, one obtains

$$G_{qq'}(\omega) = << A_q; A_q^+ >>_{\omega} = \frac{\omega_q \delta_{qq'}}{\pi(\omega^2 - \tilde{\tilde{\omega}}_q^2 + 2j\omega_q \Gamma_p(q,\omega)} \quad (5)$$

Where $\tilde{\tilde{\omega}}_q$ is the renormalized coupled phonon frequency which is obtained, by calculating self consistently, as

$$\tilde{\tilde{\omega}}^2_{q\pm} = \frac{1}{2}(\tilde{\omega}_q^2 + \tilde{\tilde{\Omega}}^2) \pm \frac{1}{2}\left\{(\tilde{\omega}_q^2 + \tilde{\tilde{\Omega}}^2)^2 + 16\bar{V}_q^2 \omega_q \Omega < S^x >\right\}^{1/2} \quad (6)$$

Where

$$\tilde{\omega}_q^2 = \omega_q^2 + 8\omega_q(2V_3 + V_4)\coth\left(\frac{\beta\omega_q}{2}\right) \quad (7)$$

These frequencies $\tilde{\tilde{\omega}}_{\pm}$ are the normal modes of the system and are the frequencies which may be used for comparison with other measured response of the system. Furthermore, $\tilde{\tilde{\omega}}_{\pm}$ are approximately the same frequencies that are obtained by fitting each part of the spectrum independently. The $\tilde{\tilde{\omega}}_-$ mode frequency approaches zero at the T_c. The $\tilde{\tilde{\omega}}_+$ mode, on the other hand, has no critical temperature dependence. The mode $\tilde{\tilde{\omega}}_-$ corresponds to the longitudinal soft $B_2(Z)$ mode which softens when temperature approaches to T_c and $\tilde{\tilde{\omega}}_+$ mode corresponds to the transverse $E(x,y)$ mode which is by far less temperature dependent than the $\tilde{\tilde{\omega}}_-$ mode. $\tilde{\tilde{\omega}}_-$ and modes originate from a zone center ($q = 0$) corresponding to a collective proton motion in the a - b plane . The higher order correlations in the phonon response function have been calculated without any decoupling and using the renormalized Hamiltonian:

$$H_{ren.} = -2\Omega \sum_q S^x_q - \frac{1}{2}\sum_{q,q'} J_q S^z_q S^z_{q'} - \frac{1}{4}\sum_{q,q',-q,-q'} J'_q S^z_q S^z_{q'} S^z_{-q} S^z_{-q'} + \frac{1}{4}\sum_q \frac{\tilde{\omega}_q^2}{\omega_q}\left(A_q^+ A_q + B_q^+ B_q\right) \quad (8)$$

b) Relaxation Time and Ultrasonic Attenuation

The Green's function method and Dyson's equation treatment conveniently describe the transition properties of KDP - system. The coupled frequency and width are measurement of relaxational behavior in this system. In the presence of resonant interaction the relaxation time with the width (Γ_P) [Eq. 4] and collective phonon mode frequency ($\tilde{\tilde{\omega}}^2_{\pm}$) [Eq. 6] is related as[15]:

$$\tau_p = \frac{2\Gamma_p}{\tilde{\tilde{\omega}}^2_{\pm}}. \quad (9)$$

From equation (9) we obtain two relaxation times corresponding to $\tilde{\tilde{\omega}}_+$ and $\tilde{\tilde{\omega}}_-$. One corresponding to $\tilde{\tilde{\omega}}_-$ tend to infinity as $T \to T_c$ and the other corresponds to $\tilde{\tilde{\omega}}_+$ be weakly temperature dependent. Due to decoupling of the correlation function in the very beginning the expression for width could not be obtained by Ganguli *et al* [16].The collective frequencies and width give an account of the relaxational behaviour of KDP-system. The respective relaxation times (corresponding to $\tilde{\tilde{\omega}}_+$ and $\tilde{\tilde{\omega}}_-$) lead to the expressions for dielectric constant, tangent loss and acoustic attenuation in the order-disorder system. As from equation (9) the polarization time (τ_p) significantly appears in Eq. (4), its contribution due to the resonant interaction to the attenuation may be written as :

$$\alpha(q,\omega) = \frac{\Gamma(q,\omega)}{C_\mu} \qquad (C_\mu \text{ is ultrasound velocity})$$
$$= \frac{2\pi \bar{V}_q^2 < S^x > \omega^2 \tau_p}{C_\mu \tilde{\tilde{\omega}}_q^2 \Omega(1 + \omega^2 \tau_p^2)} + \frac{\pi bc^2}{2\tilde{\Omega} C_\mu} \delta\{(\omega - \tilde{\Omega}) - \delta(\omega + \tilde{\Omega})\} \frac{\pi a^2 \hat{\Omega}}{2bC_\mu} \delta\{(\omega - \hat{\Omega}) - \delta(\omega + \hat{\Omega})\} \quad (10)$$

The ultrasonic attenuation given by Eq. (10) peaks for $\omega\tau_p \cong 1$. Corresponding to $\tilde{\tilde{\omega}}_-$ mode and for the temperature such that $\omega\tau_p << 1$, Eq.(10) can be written, in the first approximation, as :

$$\alpha(q) = \frac{k\omega^2 \tau_p}{|T_c - T|} + \alpha_0. \quad (11)$$

Equation (11) explains the experimental observations, the anomaly near T_c the ω^2 and dependence of attenuation coefficient. In the absence of

tunneling, the polarization relaxation time (τ_p) can be easily related to the microscopic motion of the hydrogen or deuteron in the bond and the net charge in the z-direction polarization is a consequence of proton jumps that create Takagi groups, $H_2PO_4^-$. Eq.(11) predicts that is proportional to the ω^2 , for temperature above T_c . The fact that α is proportional to the $\tilde{\tilde{\omega}}_-^2$ is equivalent to saying that $\omega\tau_p << 1$; which is true for KDP.

c) Dielectric Constant and Loss Tangent

The real and imaginary parts of dielectric constant can be written as :

$$\varepsilon'(\omega) = -8\pi N\mu^2 G'(\omega), \tag{12}$$

and

$$\varepsilon''(\omega) = -8\pi N\mu^2 G''(\omega), \tag{13}$$

Where $G'(\omega)$, and $G''(\omega)$ are the real and imaginary parts of the Eq. (5). N is the number of unit cells in the sample and the effective dipole moment per unit cell. For the experimental range of frequencies, $\omega << \tilde{\tilde{\omega}}$ and $\omega\tau_p << 1$ for KDP, Eq.(12) reduces to :

$$\varepsilon'(\omega) = \frac{8\pi N\mu^2 \tilde{\omega}}{\tilde{\tilde{\omega}}^2} \tag{14}$$

Where $\tilde{\omega}$ is given by Eq.(7) and $\tilde{\tilde{\omega}}$ by Eq.(6). The $\tilde{\tilde{\omega}}_+$ mode corresponds to E(x,y) mode and may be attributed to the observed transverse dielectric properties of KDP. In the simplest approximation $\tilde{\tilde{\omega}}_+ = K_1 + K_2 T$, where K_1 and K_2 are temperature independent parameters. This mode along with Eq.(14) explains the observed transverse dielectric constant ε_a' obtained from integrated intensity of Raman spectroscopy[15] and those measured by Kaminow *et al*[17]. This indicates that the low frequency $\tilde{\tilde{\omega}}_-$ mode is closely related to the macroscopic dielectric constant ε_c' .This also suggests that the $\tilde{\tilde{\omega}}_+[E(x,y)]$ mode Raman spectrum originates neither from the second order Raman scattering nor from density of states due to the local disorder above T_c but from one of the collective modes at the center of the Brillouin zone. This low frequency $\tilde{\tilde{\omega}}_+$ mode appears also in a deuterated KDP (DKDP), although the intensity is about one-third of the KDP, which indicates the possibility that the spectrum in due to the hydrogen collective motion.

The observed dielectric constant (ε_c') of KDP along c-axis may be explained in terms of $\{\tilde{\tilde{\omega}}_-(B_{2(z)})\}$ mode. As $\tilde{\tilde{\omega}}_- \propto (T - T_c)$, Eq. (14) can be expressed as:

$$\varepsilon_c' = \frac{C}{(T - T_C)}, \tag{15}$$

which explains the observed Curie-Weiss behaviour of dielectric constant along the c-axis in KDP[17]. As temperature $T \to T_c$, ε_c' tends to maximum value, which is consistent with the theory of Upadhyay[10] for ADP-type crystals. The dielectric loss ($\tan\delta$) for the dissipation of power in a dielectric crystal is defined as

$$\tan\delta = \frac{G''(\omega)}{G'(\omega)}, \tag{16}$$

which can be written as :

$$\tan\delta = \frac{-\omega\Gamma_p}{(\omega^2 - \tilde{\tilde{\omega}}^2)}. \tag{17}$$

For experimental values of the applied field frequency ω ,one has $\omega\tau_p << 1$ for KDP system, then Eq. (17) can be written as:

$$\tan\delta = \frac{\omega\tau_p}{2} \tag{18}$$

Where τ_p is given by Eq . (9). The $\tilde{\tilde{\omega}}_+$ mode gives the contribution for weakly temperature dependent transverse relaxational behaviour of the observed transverse tangent loss ($\tan\delta_a$) and $\tilde{\tilde{\omega}}_-$ mode contributes to the longitudinal relaxational behaviour of the observed longitudinal tangent loss ($\tan\delta_c$) in KDP[14].

III. Temperature Dependence of Relaxation Time

The relaxation time (τ_p) has been calculated from the attenuation and dielectric data and compared with the observations from other methods [13,15]. These values have been given in Table-1. The temperature dependence of relaxation time calculated form different data for KDP-type crystals is shown in Fig.1.

Table 1 : Temperature dependence of Relaxation time in paraelectric phase for KH_2PO_4

Temperature (K)	Relaxation time calculated from attenuation data(α)[15]	Relaxation time calculated from dielectric data[17]		Relaxation time obtained by spectral line width[18]
	$\tau(\times10^{-12})$sec.	$\tau_a(\times10^{-13})$sec.	$\tau_c(\times10^{-12})$sec.	$\tau(\times10^{-12})$sec.
125	2.24	1.38	2.28	2.50
130	1.26	1.37	1.21	1.31
135	0.90	1.37	0.90	0.91
140	0.84	1.37	0.88	0.85
145	0.80	1.36	0.86	0.80

The soft mode in this system is of classical relaxational charcter. Polarization relaxation time (τ_p), calculated from [Eq. (18)] using the loss data and attenuation coefficient data, are consistent and give the $\omega\tau_p$ values well below unity for KDP-type system. These results suggest that the observed dielectric and attenuation behaviour of the KDP is of relaxational type.

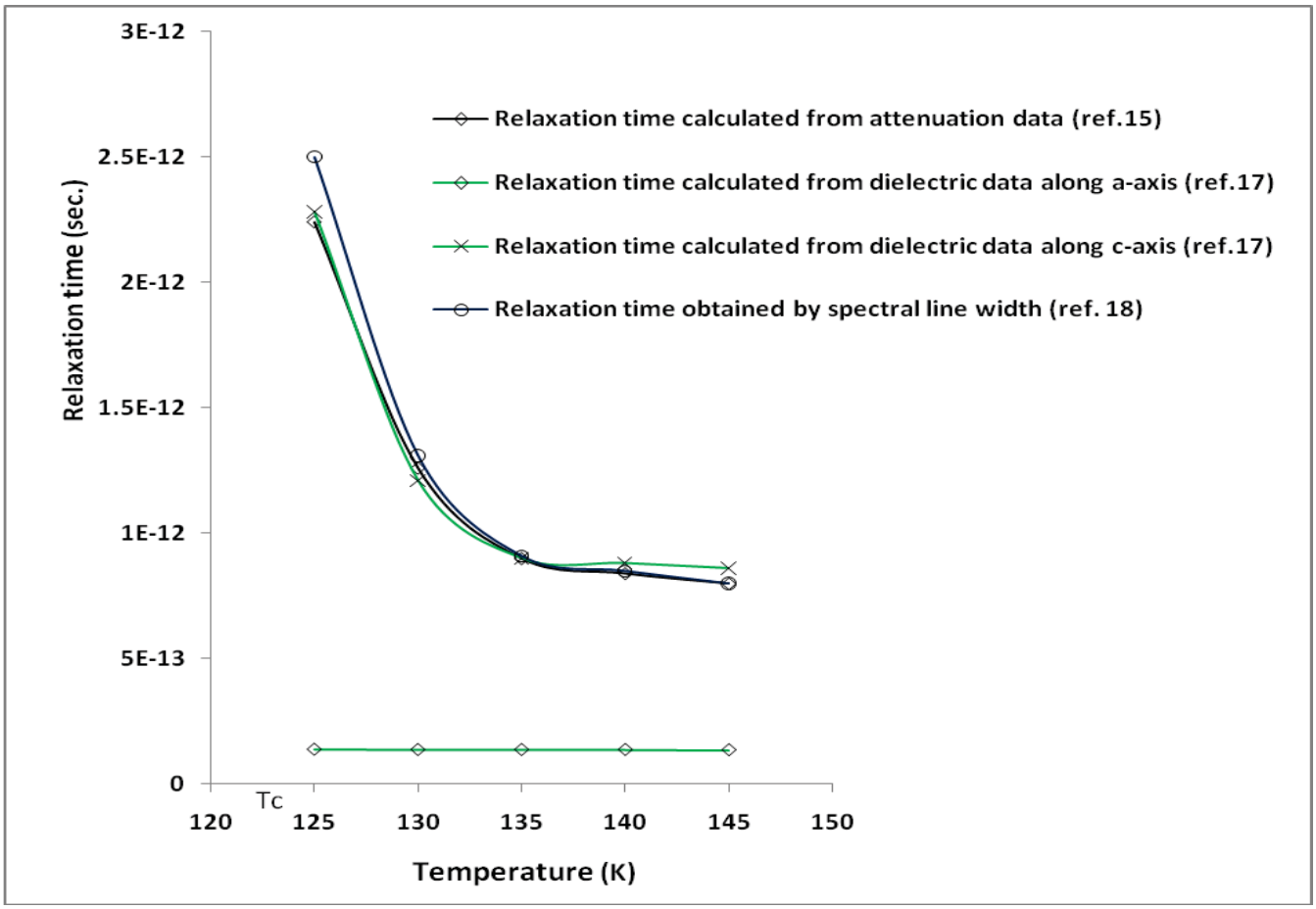

Fig.1: Temperature dependence of relaxation time calculated form different data in paraelecteic phase for KDP-type crystals.

The tangent loss is associated with the damping parameter (Γ_p). Damping can be understood as the creation of a virtual polarization mode excited by the transverse electromagnetic radiation and its subsequent decay into phonons by scattering from crystal defects, anharmonicity, etc. At the higher temperature the loss deviates from the Curie-Weiss behaviour and increases linearly with temperature. This behaviour suggests that at higher temperatures the phonon anharmonicity contributes significantly to the observed loss.

IV. Result and Discussion

From the present study, it can be concluded that the consideration of four cluster Hamiltonian alongwith the third - and fourth - order anharmonicities for the KDP-type ferroelectrics lead to the renormalization and stabilization of the relaxational soft mode and renormalization of the pseudo-spin exchange interaction constant. After applying Dyson's treatment and the decoupling of the correlation, appearing in the dynamical equation, it results, shift in frequency and facilitates the calculation of damping parameter, which is related to the relaxation time.

The present results reduce to the results of others [16, 19] if the width and shift are neglected. The method of double time thermal Green's function and Dyson's equation formalism have been found convenient and systematic to give the static and dynamical properties of a single framework of KDP-type system using four-cluster Hamiltonian alongwith phonon anharmonicities.

The anomalous behaviour of order-disorder KDP type ferroelectrics finds explanation by the consideration of collective proton-phonon interaction and third-and fourth- order phonon anharmonicities in the four-particle cluster Hamiltonian. The dielectric properties and ultrasonic attenuation strongly depend on the relaxational behaviour of the stochastic motion of $H_2PO_4^-$ group in KDP type ferroelectrics.

V. Conclusions

From this study we have calculated collective proton wave half width, collective phonon mode frequency shift in the frerquency response by considering higher order anharmonicity upto fourth order, which was not done by earlier workers, hence they could not calculate width and shift in the frequency response. We have calculated the relaxation time by using both the formalism i.e., proton Green's function methods and phonon Green's function method. We compare the present obtained relaxation time with those calculated by earlier worker and conclude that our result are good agreement with those of earlier worker [15,17,18], which is shown in Table-1 and Fig. 1.

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References

1. Tokunaga M, *Prog Theor phys, 80* (1985) 156.
2. Sengupta S & Sengupta SP, *Bull Mat Sc, 15 (1992) 333*.
3. Khan H & Khan AH, *Ind J Pure & Applied Phys, 33* (1995) 333.
4. Wada K, Yoshida S & Ihara N, *J Phys Soc Jpn, 70 (2001) 1019*.
5. Van S J, Reeuwijk, Monoka A P & Graafsma H, *Phys Rev B, 62 (2000-II) 6192*.
6. Kim S H, Oh B H, Lee K W & Lee CE, *Physical Review, B73* (2006) 134114.
7. Kim S H, Oh B H,Han J H, Lee C E, Cho J Y, Hahn K D, Jang C Y, Youn B H & Kim J, *Current Applied Physics*, 9 (2009) 1307
8. Upadhyay T C, Panwar N S & Semwal B S, *Ind. J Mod Phys,* 9 (1995) 45.
9. Upadhyay T C & Semwal B S, *Pramana,* 60 (2003) 525.
10. Upadhyay T C, *Ind J Pure & Applied Phys, 45 (2007) 157;* 47 (2009) 66. ; 47 (2009) 119; 48 (2010) 550.
11. Blinc R &B, *J Phys, C15* (1982) 4661. s k e Z
12. Bist V S , Bhatt SC & Panwar NS, *GJSFR,* 10 (2010) 18.
13. Panwar N S, Upadhyay T C & Semwal B S, *Indian J Pure & appl. phys,* 27(1989) 765.
14. Upadhyay T C & Semwal B S, *Ind J Pure & Applied Phys*, 40 (2002) 615.
15. Litov E & Garland C W, *Ferroelectrics,* 72 (1987) 22.
16. 16 Ganguli S, Nath D & Chaudhary B K, *Phys Rev*, B21 (1980) 2937.
17. Kaminow I P & Harding G O, *Phys Rev,* 129 (1963) 1562.
18. Tominaga Y, Tokunaga M, and Tatsugaki I, *Japanese Journal of Applied Physics,* 24 (1985) 917.
19. Ramakrishana V & Tanaka T, *Phys Rev*, B16 (1977) 422.

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Two Ordinary Hypergeometric Definite Integrals Involving Ramanujan's Formula

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Abstract - The aim of this paper is to develop certain ordinary definite integrals in association with Ramanujan's formula .

Keywords : *Generalized Gaussian hypergeometric function,Fox H-function.*

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Strictly as per the compliance and regulations of :

Two Ordinary Hypergeometric Definite Integrals Involving Ramanujan's Formula

Salahuddin

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Keywords : *Generalized Gaussian hypergeometric function,Fox H-function.*

I. Introduction

The Pochhammer's symbol is defined by

$$(b)_k = \frac{\Gamma(b+k)}{\Gamma(b)} = \begin{cases} b(b+1)(b+2)\cdots(b+k-1); & \text{if } k = 1,2,3,\cdots \\ 1 \quad ; & \text{if } k = 0 \\ k! \quad ; & \text{if } b = 1,\ k = 1,2,3,\cdots \end{cases}$$

where b is neither zero nor negative integer and the notation Γstands for Gamma function.

$$(\lambda)_{mn} = m^{mn}\left(\frac{\lambda}{m}\right)_n\left(\frac{\lambda+1}{m}\right)_n\left(\frac{\lambda+1}{m}\right)_n\cdots\left(\frac{\lambda+m-1}{m}\right)_n$$

where m is a positive integer and n is a non negative integer.

The notation $\Delta(N;b)$ is used to denote the set of N parameters given by $\frac{b}{N}, \frac{b+1}{N}, \ldots, \frac{b+N-1}{N}$.

Generalized Gaussian hypergeometric function of one variable is defined by

$${}_AF_B\left[\begin{matrix} a_1, a_2, \cdots, a_A \\ b_1, b_2, \cdots, b_B \end{matrix} ; \quad z\right] = \sum_{k=0}^{\infty} \frac{(a_1)_k (a_2)_k \cdots (a_A)_k z^k}{(b_1)_k (b_2)_k \cdots (b_B)_k k!}$$

or

$${}_AF_B\left[\begin{matrix} (a_A) \\ (b_B) \end{matrix} ; \quad z\right] = \sum_{k=0}^{\infty} \frac{[(a_A)]_k z^k}{[(b_B)]_k k!}$$

where denominator parameters $b_1, b_2, \cdots, b_B$ are neither zero nor negative integers and A, B are non-negative integers.

If A _ B, then series ${}_AF_B$ is always convergent for all finite values of z(real or complex).

In 1933, E. M. Wright defined a more interesting generalized hypergeometric function of one variable[12, p.287; 13 , p.11(1.7.8)] in the following forms:

$${}_p\Psi_q\left[\begin{matrix} (\alpha_1, A_1), \cdots, (\alpha_p, A_p) \\ (\beta_1, B_1), \cdots, (\beta_q, B_q) \end{matrix} ; z\right] = \sum_{n=0}^{\infty} \frac{\Gamma(n\alpha_1 + A_1)\ \Gamma(n\alpha_2 + A_2)\cdots\Gamma(n\alpha_p + A_p)\ z^n}{\Gamma(n\beta_1 + B_1)\ \Gamma(n\beta_2 + B_2)\cdots\Gamma(n\beta_q + B_q)\ n!}$$

$$= H^{1,\ p}_{p,\ q+1}\left[-z \left| \begin{matrix} (1-\alpha_1, A_1), \ldots\ldots\ldots\ldots, (1-\alpha_p, A_p) \\ (0,1), (1-\beta_1, B_1), \ldots\ldots, (1-\beta_q, B_q) \end{matrix} \right.\right]$$

where the coefficients $A_1,\ A_2,\ A_3, \cdots,\ A_p,\ B_1,\ B_2,\ B_3\ \cdots,\ B_q$ are positive rational numbers and $\alpha_1,\ \alpha_2,\ \alpha_3, \cdots, \alpha_p,\ \beta_1,\ \beta_2,\ \beta_3, \cdots, \beta_q$ are complex parameters .

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$$ {}_p\Psi_q^*\left[\begin{array}{l}(\alpha_1,A_1),\cdots,(\alpha_p,A_p)\ ;\\ \\ (\beta_1,B_1),\cdots,(\beta_q,B_q)\ ;\end{array} z\right]=\sum_{n=0}^{\infty}\frac{(\alpha_1)_{nA_1}\ (\alpha_2)_{nA_2}\cdots(\alpha_p)_{nA_p}\ z^n}{(\beta_1)_{nB_1}\ (\beta_2)_{nB_2}\cdots(\beta_q)_{nB_q}\ n!} $$

The Fox H-function makes sense when either

$$ \delta\ \equiv\ (1+B_1+B_2+\cdots+B_q)-(A_1+A_2+\cdots+A_p)>0 $$

and $0<\ \natural\ |<\infty\ ;\ \ z\neq 0$

The equality holds only for suitably constrained values of $|z|$ or appropriately bounded $|z|$ i.e. $\delta=0$ and $0<|z|<R\equiv {A_1}^{-A_1}{A_2}^{-A_2}\cdots{A_p}^{-A_p}{B_1}^{B_1}{B_2}^{B_2}\cdots{B_q}^{B_q}$.

$$ {}_p\Psi_q\left[\begin{array}{l}(\alpha_1,1),\cdots,(\alpha_p,1)\ ;\\ \\ (\beta_1,1),\cdots,(\beta_q,1)\ ;\end{array} z\right]\ =\ \frac{\prod_{j=1}^{p}\Gamma(\alpha_j)}{\prod_{j=1}^{q}\Gamma(\beta_j)}\ {}_pF_q\left[\begin{array}{l}\alpha_1,\cdots,\alpha_p\ ;\\ \\ \beta_1,\cdots,\beta_q\ ;\end{array} z\right] $$

The function $H_{p,\,q}^{m,\,n}$ was given by C. F. Fox in 1961.

$$ H_{p,\,q}^{m,\,n}\left[z\ \left|\begin{array}{l}(a_1,A_1),\ (a_2,A_2),\cdots,(a_n,A_n),\ (a_{n+1},\ A_{n+1}),\cdots,(a_p,A_p)\\ \\ (b_1,B_1),\ (b_2,B_2),\cdots,(b_m,B_m),\ (b_{m+1},B_{m+1}),\cdots,(b_q,B_q)\end{array}\right.\right] $$

$$ =\ H_{p,\,q}^{m,\,n}\left[z\ \left|\begin{array}{l}((a_p,A_p))\\ \\ ((b_q,B_q))\end{array}\right.\right]\ =\ H_{q,\,p}^{n,\,m}\left[\frac{1}{z}\ \left|\begin{array}{l}((1-b_q,B_q))\\ \\ ((1-a_p,A_p))\end{array}\right.\right] $$

where $m,\ n,\ p,\ q$ are non-negative integers such that $p\geq n\geq 0,\ q\geq m\geq 1.\, a_j,\ b_j$ are complex numbers and are positive numbers.

The H-function is an analytic function of z and makes sense if the following existence conditions are satisfied.

For all $z\neq 0$ and $(B_1+B_2+\cdots+B_q)-(A_1+A_2+\cdots+A_p)>0$. For $0<|z|<{A_1}^{-A_1}{A_2}^{-A_2}\cdots{A_p}^{-A_p}{B_1}^{B_1}{B_2}^{B_2}\cdots{B_q}^{B_q}$ and $(B_1+B_2+\cdots+B_q)-(A_1+A_2+\cdots+A_p)=0$.

The H-function is symmetric in the set of pairs $(a_1,A_1),\cdots,(a_n,A_n)$; in the set of pairs $(a_{n+1},A_{n+1}),\cdots,(a_p,A_p)$ in the set of pairs $(b_1,B_1),\cdots,(b_m,B_m)$ in the set of pairs $(b_{m+1},B_{m+1}),\cdots,(b_q,B_q)$.

Ramanujan's Formula is defined as

Ramanujan[1,p.191(2.20,2.21)]

$$ \int_0^{\infty}x^{P-1}\left(\frac{2}{1+\sqrt{1+4x}}\right)^N dx=\frac{N\ \Gamma(P)\Gamma(N-2P)}{\Gamma(N-P+1)} $$

where, $N>0$ and $0<P<\frac{N}{2}$.

II. Main Formulae of The Integrals

$$ \int_0^{\infty}\frac{x^{c-1}}{\left(x+\sqrt{1+x^2}\right)^p}\ {}_AF_B\left[\begin{array}{l}(a_A)\ \ ;\\ \\ (b_B)\ \ ;\end{array}\ yx^g\left(\frac{1}{x+\sqrt{1+x^2}}\right)^h\right]dx $$

$$= \frac{\prod_{i=1}^{B}\Gamma(b_i)}{2^{c+1}\prod_{j=1}^{A}\Gamma(a_j)}\,{}_{A+3}\Psi_{B+2}\left[\begin{matrix}(a_1,1),\ \ldots,\ (a_A,1),\ (p+1,h),\ (\frac{p-c}{2},\frac{h-g}{2}),\ (c,g)\ ;\\ (b_1,1),\ \ldots,\ (b_B,1),\ (p,h),\ (\frac{p+c+2}{2},\frac{h+g}{2})\ ;\end{matrix}\ \frac{y}{2^g}\right] \quad (2.1a)$$

$$= \frac{p\ \Gamma(c)\ \Gamma(\frac{p-c}{2})}{2^{c+1}\ \Gamma(\frac{p+c+2}{2})}\,{}_{A+3}\Psi^{*}_{B+2}\left[\begin{matrix}(a_1,1),\ \ldots,\ (a_A,1),\ (p+1,h),\ (\frac{p-c}{2},\frac{h-g}{2}),\ (c,g)\ ;\\ (b_1,1),\ldots,\ (b_B,1),\ (p,h),\ (\frac{p+c+2}{2},\frac{h+g}{2})\ ;\end{matrix}\ \frac{y}{2^g}\right] \quad (2.1b)$$

$$\int_0^{\infty}\frac{x^{c-1}}{\left(x+\sqrt{1+x^2}\right)^{k}}\,{}_p\Psi_q\left[\begin{matrix}(\alpha_1,A_1),\ \cdots,\ (\alpha_p,A_p)\ ;\\ (\delta_1,B_1),\ \cdots,\ (\delta_q,B_q)\ ;\end{matrix}\ yx^g\left(\frac{1}{x+\sqrt{1+x^2}}\right)^{h}\right]dx$$

$$= \frac{\prod_{i=1}^{p}\Gamma(\delta_i)}{2^{c+1}\prod_{j=1}^{q}\Gamma(\alpha_j)}\,{}_{p+3}\Psi_{q+2}\left[\begin{matrix}(\alpha_1,A_1),\ \cdots,\ (\alpha_p,A_p),\ (k+1,h),\ (\frac{k-c}{2},\frac{h-g}{2}),\ (c,g)\ ;\\ (\delta_1,B_1),\ \cdots,\ (\delta_q,B_q),\ (k,h),\ (\frac{k+c+2}{2},\frac{h+g}{2})\ ;\end{matrix}\ \frac{y}{2^g}\right] \quad (2.2a)$$

$$= \frac{k\ \Gamma(c)\ \Gamma(\frac{k-c}{2})}{2^{c+1}\Gamma(\frac{k+c+2}{2})}\,{}_{p+3}\Psi^{*}{}_{q+2}\left[\begin{matrix}(\alpha_1,A_1),\ \cdots,\ (\alpha_p,A_p),\ (k+1,h),\ (\frac{k-c}{2},\frac{h-g}{2}),\ (c,g)\ ;\\ (\delta_1,B_1),\ \cdots,\ (\delta_q,B_q),\ (k,h),\ (\frac{k+c+2}{2},\frac{h+g}{2})\ ;\end{matrix}\ \frac{y}{2^g}\right] \quad (2.2b)$$

III. Derivations of the Main Formulae

First of all we shall derive the integrals (2.1a) and (2.1b). Let the integral in left hand side is denoted by Υ

$$\Upsilon = \int_0^{\infty}\frac{x^{c-1}}{\left(x+\sqrt{1+x^2}\right)^{p}}\,{}_AF_B\left[\begin{matrix}(a_A)\ ;\\ (b_B)\ ;\end{matrix}\ yx^g\left(\frac{1}{x+\sqrt{1+x^2}}\right)^{h}\right]dx$$

$$= \int_0^{\infty}\frac{x^{c-1}}{\left(x+\sqrt{1+x^2}\right)^{p}}\left\{\sum_{m=0}^{\infty}\frac{[(a_A)]_m\ y^m\ x^{gm}}{[(b_B)]_m\ m!}\left(\frac{1}{(x+\sqrt{1+x^2})^{hm}}\right)\right\}dx$$

$$= \sum_{m=0}^{\infty}\frac{[(a_A)]_m\ (p+hm)\ \Gamma(gm+c)\ \Gamma(\frac{p+hm-c-gm}{2}\ y^m}{[(b_B)]_m\ 2^{c+gm+1}\ \Gamma(\frac{p+hm+c+gm+2}{2})\ m!}$$

$$= \sum_{m=0}^{\infty}\frac{[(a_A)]_m\ \Gamma(p+hm+1)\ \Gamma(gm+c)\ \Gamma((\frac{p-c}{2}+(\frac{h-g}{2})m)\ y^m}{[(b_B)]_m\ 2^{c+1}\ 2^{gm}\ \Gamma(p+hm)\Gamma((\frac{p+c+2}{2}+(\frac{h+g}{2})m)\ m!}$$

$$= \frac{\prod_{i=1}^{B}\Gamma(b_i)}{2^{c+1}\prod_{j=1}^{A}\Gamma(a_j)}\,{}_{A+3}\Psi_{B+2}\left[\begin{matrix}(a_1,1),\ \ldots,\ (a_A,1),\ (p+1,h),\ (\frac{p-c}{2},\frac{h-g}{2}),\ (c,g)\ ;\\ (b_1,1),\ \ldots,\ (b_B,1),\ (p,h),\ (\frac{p+c+2}{2},\frac{h+g}{2})\ ;\end{matrix}\ \frac{y}{2^g}\right] \quad (3.1a)$$

On the same way ,it is proved that

$$\Upsilon = \frac{p\ \Gamma(c)\ \Gamma(\frac{p-c}{2})}{2^{c+1}\ \Gamma(\frac{p+c+2}{2})} {}_{A+3}\Psi^{*}_{B+2}\left[\begin{array}{ll} (a_1,1),\ \ldots,\ (a_A,1),\ (p+1,h),\ (\frac{p-c}{2},\frac{h-g}{2}),\ (c,g) & ; \\ (b_1,1),\ldots,\ (b_B,1),\ (p,h),\ (\frac{p+c+2}{2},\frac{h+g}{2}) & ; \end{array}\ \frac{y}{2^g}\right] \quad (3.1b)$$

Similarly we can obtain remaining integrals on the same parallel lines of the derivation of (2.1a) and (2.1b).

The integrals established here are quite general in nature due to the presence of general quadruple hypergeometric function of Saigo.

References Références Referencias

1. Agarwal, R. P.; Resonance of Ramanujan's Mathematics. Vol. I, New Age International (P) Ltd., New Delhi, 1996.
2. Agarwal, R. P.; Resonance of Ramanujan's Mathematics. Vol. II, New Age Inter-national (P) Ltd., New Delhi, 1996.
3. Agarwal, R. P.; Resonance of Ramanujan's Mathematics. Vol. III, New Age Inter-national (P) Ltd., New Delhi, 1999.
4. Berndt, B. C.; Ramanujan's Notebooks. Part I, Springer-Verlag, New York, 1985.
5. Berndt, B. C.; Ramanujan's Notebooks. Part II, Springer-Verlag, New York, 1989.
6. Berndt, B. C.; Ramanujan's Notebooks. Part III, Springer-Verlag, New York, 1991.
7. Berndt, B. C.; Ramanujan's Notebooks. Part IV, Springer-Verlag, New York, 1994.
8. Berndt, B. C.; Ramanujan's Notebooks. Part V, Springer-Verlag, New York, 1998.
9. Saigo, M. and Srivastava, H. M.; The behavior of the fourth type of Lauricella'shypergeometric series in n variables near the boundaries of its convergence region.
10. J. Austral. Math. Soc., Series A, 57(1994), 281-294.
11. Srivastava, H.M. and Daoust, M.C. ; A note on the convergence of Kamp´e de F´eriet double hypergeometric series.Math.Nachr.53(1972).151-159.
12. Srivastava, H. M., Gupta, K. C. and Goyal, S. P.; The H-Functions of One and TwoVariables with Applications. South Asian Publishers, New Delhi and Madras, 1982.
13. Wright, E.M.; The asymptotic expansion of the generalized hypergeometric function-I. J. London Math. Soc., 10(1935), 286-293.
14. Wright, E.M.; The asymptotic expansion of the generalized hypergeometric function-II. Proc. London Math. Soc., 46(2)(1940), 389-408.

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Comparative Technical Efficiency of Concrete and Earthen Fish Pond in Oyo State-Nigeria

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Abstract - The study analysed the technical efficiency of earthen and concrete ponds in Oyo State from a sample of 80 earthen fish farmers and 120 concrete fish farmers selected from two Agricultural zones in Oyo state given a grand total of 200 fish farmers using Data Envelopment Analysis (DEA) approach to analyse the technical efficiency of earthen and concrete ponds under the Constant Return to Scale (CRS) and Variable Return to Scale (VRS) specifications. In order to identify the derterminants of earthen and concrete ponds inefficeinecy, a tobit analysis was conducted on the efficiency indices and suspected correlates of inefficiency. The average overall technical efficiency estimates obtained under the CRS and VRS specifications for earthen pond fish farmers are respectively 0.91 and 0.94. The mean overall technical efficiency estimates obtained under the CRS and VRS specifications for concrete pond fish farmers are 0.93 and 0.97. The study concluded that substantial inefficiency in earthen and concrete ponds occurred in the area.

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Strictly as per the compliance and regulations of :

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I. Introduction

In Nigeria the production of fish is about 0.7 million metric tons annually which results in shortfall of about 1.0 million metric tons annually. Only 5% of this 0.7million metric tons produced locally is from aquaculture while the remaining 95% is from the captured fisheries which is dominated by the artisanal fish farmers. (Aliu and Abolagba, 1998). Production levels and trends for food fish from the baseline projections are shown in table 2, a snapshot of world fisheries in the late 1990s can be derived from the figures in the table. The developed countries accounted for 27 percent of the world food fish, with the remainder fairly evenly split between China and the rest of the developing world. Worldwide, the share of aquaculture in total food fish in 1996/98 was under 31 percent, but the share in China was over 58 percent, with other developing countries producing 17 percent of their food fish from aquaculture. Low value species accounted for about 48 percent of food fish worldwide but for only 19 percent in the developed countries. Thus capture fisheries in the late 1990s accounted for more than two-thirds of the world's food fish, China accounted for the large majority of aquaculture and low value species accounted for just under half the fish used as food.

Table 2 shows a projected growth in total food fish production to 2020 of 40 percent , equivalent to an annual rate of increase of 1.5 percent from 1996/98 onwards. Over two-thirds of this growth is projected to come from aquaculture. The table shows that aquaculture growth trends projected to 2020 are almost twice as high as for capture fisheries in most of the world. China is a notable exception; capture fisheries are projected to grow at 2 percent per annum through 2020 in China, partially in substitution of the fishing effort of other nations. It should be noted that capture fisheries projections are largely influenced by (conservative) assumptions about non-price factors driving capture fisheries, whereas aquaculture growth rates are more influenced by relative prices and thus have a higher endogenous component in the modeling. The picture that emerges of changes to 2020 on the production side for food fish can be summarized into three sets of points. First, the production share of the developing countries rises from 73 percent in 1996/98 to 79 percent in 2020, and about 5 of the 6 percent increase in share is accounted for by China. Second, the share of aquaculture worldwide is projected to increase from 31 to 41 percent in 2020. While China, share of food fish production from aquaculture increases from 59 to 66 percent, other developing countries. Share of production from aquaculture increases from 17 to 27 percent, a larger relative change. The share of aquaculture will increase worldwide, but especially in the developing countries, and not just in China. Third, the share of low value fish in total food fish is remarkably stable, at about 48 percent. The overall shares in total food fish production of high and low value finfish capture species fall (by 4 and 6 percent of total production, respectively), but the production shares of low value finfish and (high value) mollusks and crustaceans from aquaculture rise enough by 2020 to compensate for this.

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Table 2 : Production of total food fish, 1997 (actual) and 2020 (projected)

Region	1997		2020		Annual % growth, 1997 -2020	
	(000 mt)	(% from aq.)	(000 mt)	(% from aq.)	(total)	(aquaculture)
China	33,339	58	53,074	66	2.0	2.6
Southeast Asia	12,632	8	17,521	29	1.4	3.6
India	4,768	40	7,985	55	2.3	3.7
Other South Asia	2,056	23	2,999	39	1.7	4.0
Latin America	6,380	10	8,807	16	1.4	3.5
WANA	2,248	9	2,776	16	0.9	3.6
SSA	3,738	1	6,015	2	2.1	5.8
United States	4,423	10	4,927	16	0.5	2.7
Japan	5,188	15	5,172	20	0.0	1.2
EU-15	5,926	21	6,716	29	0.5	2.1
E. Europe & former USSR	4,896	4	5,024	4	0.1	0.4
Other developed	4,761	12	5,779	20	0.8	2.9
Developing world	67,973	37	102,495	47	1.8	2.8
Developing world excl. China	34,634	17	49,421	27	1.6	3.6
Developed world	25,194	13	27,618	19	0.4	2.1
World	93,167	31	130,112	41	1.5	2.8

Sources : 1997 data are three year averages centered on 1997, calculated from FAOSTAT (2000). Projections for 2020 are from IFPRI.s IMPACT model (July 2002).

Notes : Growth rates are exponential growth rates compounded annually using three-year averages as endpoints

Fish plays a vital role in feeding the world's population and contributing significantly to the dietary intake of hundreds of millions of the populace. On a global scale, almost 16 percent of total average intake of animal protein was attributed to fish in 1998 (FAO, 1990). In the developing world, fish is a highly acceptable food that supplies as much as 40 percent of all animal protein available and also countries where fish is the main source of animal protein, 39 out of the top 40 are found in the developing world (FAO, 1990). Moreover, the poor spend proportionally more on fish than on meat or other sources of animal protein. Fish can be consumed in different forms by both man and animals and it can be preserved using different method such as drying, salting, canning, freezing, smoking etc. Fish is a vital source of food for people and it is man's most important single of high quality protein, providing 16% of the animal protein consumed by world's population according to the Food and Agriculture Organization (1997). Fish is widely accepted because of its high nutritive value being rich in vitamins, fat and other nutrients needed for human growth and health. It is also palatable and tender. Moreover, it is free from cultural and religions taboos, thus making it acceptable to people of all nations, tribes and religions.

Fisheries subsector which is composed of marine, brackish and freshwater plays some roles in the Nigeria economy which includes being a source of cheap animal protein, employment and foreign exchange earning for the nation. The fisheries sub-sector also gives an opportunity to generate income and production of fish processing offers the advantage of improved local nutrition since it provides ready source of high quality protein (Otubusin, 1999). Although their production is still below expectation but several attempts have been made over the years to boost their productivity through institution reforms and various fiscal and economic measures. Some of these measures involved tax exemption and input subsidy schemes for distribution of fishermen to stimulate increased production. (Olujimi, 2002).

In Nigeria, the prevailing economic situation has produced poverty and increased cases of malnutrition. The need to provide adequate food especially animal protein for the ever-growing population is on the increase. Over 90 percent of domestic fish supply emanates from fishing in natural waters. Many Nigerians depend on meat production for protein supply. In 1970's and 1980's the intermittent outbreak of rinderpest coupled with desert encroachment has drastically affected meat production which has forced many more Nigerians to continually depend upon fish supply as source of animal protein. (Dada and Gmnadoess, 1986). The cost of meat, which is beyond the reach of many Nigerian, has forced many individual to shift to fish supply, which has been relatively cheaper. Production from fish culture is still low as well as that from industrial fishing which comprises the commercial trawlers when compared to the artisanal. On the whole, fish production in Nigeria is still largely dependent on the small scale fisherman. The demand for fish in Nigeria today is certainly greater than the total production from her domestic sources, thus imports account for about 50% of fish consumption in the country (Federal Ministry of Agriculture and Rural Development, 2001). Fish farming as an industry is faced with some problems one of them is inadequate supply of food. Insufficient production of fingerlings of cultivable fish species and lack of sufficient least discourteously effective feed for fish culture, the better performance in quality and quantity of fish nutrient is responsible for its increase in demand and investment in fishery in Nigeria. However, the higher demand refused to meet with the supply of the product. A report from Oyo State Ministry of Agriculture and Natural Resource (Agricultural unit) had reported that existing fishpond on paper are quite more than ones in ground. This could cause a supply deficit, since the physically present fishpond cannot meet the demand for fish products. It therefore implies that most ground fishpond could not operate due some technical insufficiency. A research into the problem on nutrition reveals that many people in the developing countries of the world are under nourished at least one out of nine persons sampled (FAO, 1991). Despite all developmental programmes on food accessibility and availability carried out by the Nigerian government, hunger and malnutrition still exists in most part of the country. In a meeting of the African Regional Nutrition strategy in 1993, Nigeria was included as one of the countries having the lowest daily per capita supplies of between 70-90 percent of nutrition requirements. In view of this, It important to consider the comparative efficiency of earthen and concrete fish pond in relationship to productions and to suggest the measure that could promote improvements in both in order to foster more fish availability for consumption of the rapidly increasing Nigerian populace.

II. Materials and Method

Data Envelopment Analysis (DEA)

DEA is a linear programming based technique for measuring the relative performance of Decision Making Units (DMUs) where the presence of multiple inputs and outputs makes comparisons difficult. DEA is a relatively new approach for evaluating the performance of set of decision-making units (DMUs), which convert multiple outputs. The definition of a DMUs is generic and in recent years has been a great variety of applications of DEA in evaluating the performances of many different kinds engaged in many different activities in many countries.DEA provides a means of calculating apparent efficiency levels within a group of DMUs. The efficiency of a DMU is calculated relative to the group's observed best practice. When there are multiple inputs and multiple outputs, a common measure for relative efficiency is

$$\text{Efficiency} = \frac{\text{Weighted Sum of outputs}}{\text{Weighted Sum of inputs}}$$

Each DMU picks weights such that it maximize its own efficiency subject to constraints that ensure: (1) no unit can have an efficiency score greater than 1 and (2) every weight must be strictly greater than 0. Let us assume there are n DMUs, each DMU has t outputs and in inputs. Let us take DMU, as the example the linearised output oriented DEA model is:

Maximise $h = \sum^{t} u_r y_{r_1}$

Subject to: $\sum^{m} v_i^{r=1} x_{i_1} = 1$

$$\sum_{r=1}^{i_t=1} u_r y_{r_j} - \sum_{i=1}^{m} v_i x_{i_j} \leq 0 \qquad j = 1,2.....n$$

$$u_r \geq \varepsilon, r = 1,2,...t$$

$$v_i \geq \varepsilon, i = 1,2,...m$$

Where U_r is the weight of output r v_i is the weight of input i, y_{rj} is the amount of output r of DMU_j (j =1, ….n), X_{ij} is the amount of input i DMU_j (j = 1, ….n) and ε is a small positive number. The result of the DEA is the determination of the hyperplanes that define an envelope surface or pareto frontier. DMUs that lie on the surface determine the envelope and are deemed efficient, whilst those that do not are deemed inefficient. A complete DEA solves n linear programs, one for each DMU. DEA has been applied to a variety of industrial and service landscapes banks, airports, hotels, hospitals. The aim here is to determine corporate or branch efficiency compared to a competitor or ideal. Often the main goal of measuring efficiency is to determine which companies to do business with Weber and Desal highlight DEA's ability to distinguish between material suppliers and then use this distinction as a bargaining tools for less efficient suppliers DEA is so often applied to the "bottom line" that is use in areas outside strict profitability. These DEA applications have various forms of evaluating the performance of entities such as hospitals, Air force wings, universities cities, court, firms and others including the performance of countries (Cooper, et al., 1999) As pointed out by Cooper, Seiford and Zhu (1999), DEA has been used to supply new insights into activities (and entities) previously been evaluated by other methods, for instance, benchmarking practices with DEA has identified numerous inefficiencies in some of the most profitable firms, firms served as benchmarks by reference profitability has provided a vehicle for identifying better benchmarks for many applied studies. DEA utilizes techniques such as mathematical programming, which can handle numbers of variables and relations (constraints) and this relaxes the requirements that are often encountered when one is limited to choosing only few inputs and outputs because the techniques employed will otherwise encounter difficulties. DEA provides dual collabaration between analyst and decision makers, which extend from collaboration in choice of the inputs and outputs to be used and includes choosing the type of "what-if" question to be addressed, such collaborations extend to bench marking of "what-if" behaviour of competitors and include identifying (new) competitors that may emerge for consideration in some of the scenarios that might be generated (Zhu and Sarkis, 2004),

Additional advantage of DEA where also noted in terms of (a) its ability to identify sources and amount of inefficiency in each input and each output for each entity (hospital, firm, store etc) and (b) its ability to identify the benchmark members of the efficient set used to effect these sources (and) amount of inefficiency. Data envelopment analysis is a non-parametric mathematical programming analysis model may be classified into two groups oriented model such as those of Charnels *et al.,* (1978) and additive model, such as that of Charnels (1985). An appropriate method for anlaysing technical efficiency is the Data Envelopment Aanalysis method (Banker et al., 1984). Banker states that "Using DEA the weighted input firms have considerable flexibility in determining combinations of inputs to produce different combinations of outputs according to their preferred weights". Therefore more than one firm can be technically efficient only a small percentage of agricultural frontier applications have used the DEA approach for frontier estimation. Given the popularity of mathematical programming method on other of agricultural economics research during the 1960s and 1970s. However, DEA has a very large percentage in other professions especially in the management output such as banking, health and telecommunications and electricity distribution (Cooper *et al.*, 1999). The envelopment solution to a DEA mind produces two useful by-products as follows one, it supplies information on the peers and two, it supplies information on the target of each inefficient firms in the sample. The peers of inefficient firms are to be model firms. They are efficient firms, which have similar input mixes with the inefficient firms. The targets are coordinates of the efficient projected point (for the inefficient firm) and now provide the input and output qualities that the inefficient firm should be able to achieve, if it were to operate on efficient frontier (Coelli, 1997) for instance, efficiency consideration which are central to the DEA evaluations of interest are introduced by using the familiar and every simple ratio definition of output divided by input. This ratio formulation is then extended to multiple outputs and multiple inputs in a manner that makes contact with more complex formulation. (Cooper *et al.,* 1999).

Kareem *et al.*, (2008) analyzed the technical, allocative and economic efficiency of different pond systems in Ogun state, Nigeria. The study investigated the costs and returns analysis of the respondents and the stochastic frontiers production analysis was applied to estimate the technical, allocative and economic efficiency. The results of the returns to Naira invested shows that earthen pond system yielded than concrete pond system. The results of economic, allocative and technical efficiency revealed that earthen pond system is higher than concrete pond system. Stochastic frontier production models showed that pond area, quantity of lime used, and number of labour used were found to be the significant factors that contributed to the technical efficiency of concrete pond system. While pond, quantity of feed and labour are the significant factors in earthen pond system. The result therefore concluded that only years of experience is the significant factors in concrete pond system in the inefficiency sources model. On the basis of findings, the study suggested that government of Nigeria should provide a conducive environment for the establishment of both concrete & earthen pond system, encourage more citizenry, mostly youth to set up both pond systems in a bid to alleviate poverty status and un-employment rate in the state and the country at large.

Sharma and Leung (1998) examined the technical efficiency of carp production in Nepal. In Nepal, productivity in aquaculture is much lower compared to other countries in the region which suggests that there is potential for increased fish production through technological progress and improvement in farm level technical efficiency. However, no formal analysis has yet been conducted to assess the productive performance of Nepales aquaculture and its potential for future improvement. Against this background, it examines the technical efficiency and its determinants for a sample of fish pond farms from the Tarai region of the country using a stochastic production frontier involving a model for technical efficiency of intensive farms being more efficient that extensive farms. The adoption of regular fish, water, and feed management activities has a strong positive effect on technical efficiency.

Adeokun *et al.,* (2006) investigated children's involvement in fish production in waterside local Government Area, Ogun State, Nigeria. Multi-stage technique was used. The findings of the research showed that male children dominated fish catching and net making and mending while the female children were mainly involved in processing. All other activities in which the children were involved were water fetching, fish marketing, fish processing and fish storage among others gave no significant difference on gender basis. Based on the findings, it was recommended that government and non-governmental agencies should come up with special programmes and incentives for revering fishing village's that will ensure effective integration of children into national programmes for food itself sufficiency and poverty alleviation at household and national levels.

Anetekhai *et al.,* (2004) conducted a study on aquaculture development in Nigeria. The current production from aquaculture is about 26,000 metric tones which is less than 0.01% of the national capacity. The major constraints identified as being responsible for the low production from aquaculture are shortage of inputs (fingerlings and feed), lack of knowledge resulting in poor management, inadequate funding, theft and direct involvement of the government in production. The study recommends some measures to be taken for the development of aquaculture in Nigeria particularly the creation of a ministry of fisheries to co-ordinate all activities in the sector and provides an enabling environment for aquaculture.

Sampling Procedure and Sample Size

Multi-stage sampling procedure was used. Firstly, two agricultural zones were selected from all the agricultural zones in Oyo-State. These were Ogbomoso and Ibadan/Ibarapa zones. Ogbomoso Agricultural Zone and Ibadan - Ibarapa agricultural zone was selected due to the present of many aquaculture farmers in the area. Secondly, all Local Government Areas were sampled from Ogbomoso zone and Ibadan/Ibarapa zone. Thirdly, registered fish farmers were chosen and fourthly from these registered fish farmers, 80 earthen fish farmers and 120 concrete fish farmers were randomly selected. In all, 200 fish farmers were selected.

The data that was used in this study is essentially from primary sources namely the fish-farmers in the study area. Structured questionnaires were used to collect information needed from the sample of fish farmers. The structured questionnaires were used to draw out information on variables such as pond data, land data, stocking or pond number source of stocking material, feed, labour data, harvesting time data, marketing, loan inventory of asset data cost etc. These variables were identified within the framework of the study objectives.

For the purpose of this study the major variables that were considered are the following output and input.

Y = Fish output (kilogram)
X_1 represented the quantity of fingerlings (kg).
X_2 represented fish pond (m^2)
X_3 represented the quantity of feed that was used on the farm (kg of dry matter weight)
X_4 represented the quantity of supplementary feed like: (waste of animal by product) used to feed the animal in kilogram
X_5 represented the fertilizer used to culture the fish (kilogram)
X_6 represented labour. (man-day)

Analytical Technique

Multi-stage DEA was used to analysed the data obtained. In Multi-stage DEA, the outputs from one process can be the inputs for the next. However, it is sometimes possible to merely "line up" outputs with wherever they occur again as inputs, not necessarily in the next consecutive node. Unique features of multi-stage DEA make it useful. That is, data flow from stage to stage in the model just as work parts. There is evidence that DEA conducted in multiple stages yields more reliable data and also has been configured to place more emphasis on inputs which are within management control.

III. Results and Discussion

Overall efficiency estimates of earthen pond farmers

The frequency distribution of the earthen pond fish farmers technical efficiency under the constant Return to Scale and the Variable Return to Scale (CRS and VRS) efficiency estimates is given in table 2.

The average overall technical efficiencies are 0.91 and 0.94 for CRS and VRS respectively. Substantial inefficiencies occurred in the fish pond farming of the sampled earthen pond fish farmers in the study area. Under this current circumstances, about 5% and 13.8% of ponds were identified as fully technically efficient under the CRS and VRS specification respectively. The observed difference between the CRS and VRS measures further indicated that some of the earthen pond fish farmers did not operate at an efficient scale and improvement in the overall efficiencies could be achieved if the farmers adjusted their scales of operation. Under the CRS, the group with the highest frequency of technical efficiency is 0.90-0.94 amounting to 50% of the sampled earthen pond fish farmers. This was followed by group 0.85-0.89 with a percentage of 25% of the total respondents under earthen pond. Under the VRS, the group with the highest frequency of technical efficiency is also 0.90-0.94 amounting to 46.3% of the sampled earthen pond fish farmers, followed by the group 0.95-0.99 with 25%. The lowest technical efficiency scores fall within the 0.75-0.84 group under VRS specification. The mean of the distribution under CRS and VRS are 0.91 and0.94, the minimum are 0.812 and 0.83, maximum 1.00 and standard deviation are 0.044 and 0.0.041respectively.

Table 2 : Overall efficiency of earthen pond farmers.

	Constant return to scale		Variable return to scale	
Technical Efficiency	Frequency	Percentage	Frequency	Percentage
0.80-0.84	06	7.5	01	1.3
0.85-0.89	20	25.0	11	13.8
0.90-0.94	40	50.0	37	46.3
0.95-0.99	10	12.5	20	25
1.00	04	5	11	13.8
Total	**80**	**100**	**80**	**100**
Mean	0.913898		0.941013	
Minimum	0.812		0.83	
Maximum	1.0		1.0	
Standard dev.	0.043696		0.040873	

Source : Field survey, 2010.

Overall efficiency estimates of concrete pond farmers.

Table 3 gives the frequency distribution of the concrete pond CRS and VRS efficiency estimates. The average overall technical efficiency under CRS is 0.93 while the average technical efficiency under the VRS specification is respectively 0.97. This result also reveals that substantial resource use inefficiencies occurred in the fish pond farming of the sampled concrete pond fish farmers in the study area. Under the prevailing condition, the percentage of ponds that achieved full efficiency technically under the CRS is 5%, under the VRS, those that are technically efficiency is 39.2% respectively. The large difference between the technical efficiency under the CRS and VRS specification justifies further the need for the concrete pond fish farmers to adjust their scale of operation by optimizing the resources available to them at present like the other pond above, it is obvious that the technical efficiency measures under the VRS are higher than those under the CRS. The technical efficiency of 35% between CRS and VRS specifications revealed the weakness in the scale of operation more than the other pond. The result also adduced to the substantial inefficiency of the concrete pond fish farmers in the study area.

Table 3 : Overall efficiency of concrete pond farmers.

Constant return to scale			Variable return to scale	
Technical Efficiency	Frequency	Percentage	Frequency	Percentage
0.75-0.79	01	0.8	00	00
0.80-0.84	02	1.7	00	00
0.85-0.89	21	17.5	01	0.8
0.90-0.94	63	52.5	27	22.5
0.95-0.99	27	22.5	45	37.5
1.00	6	5.0	47	39.2
Total	120	100	120	100
Mean	0.931142		0.967117	
Minimum	0.796		0.876	
Maximum	1.0		0.9785	
Standard dev.	0.036918		0.053351	

Source : Field survey, 2010.

Earthen and concrete ponds scale efficiency

Table 4 shows that the average scale efficiency indices for earthen and concrete ponds are respectively 0.97 and 0.96. Earthen ponds demonstrating the lowest scale inefficiency and concrete pond operating at the highest scale inefficiency. However, the results show that there are substantial scale inefficiencies in both earthen and concrete ponds. This implies that most of the fish ponds should be larger than their present sizes in order to achieve higher production.

Table 4 : Summary of earthen and concrete ponds scale efficiency

	Earthen pond		Concrete pond	
Efficiency indices	No of ponds	Percentage of ponds	No of ponds	Percentage of ponds
0.80-0.84	01	1.3	02	1.7
0.85-0.89	03	3.8	07	5.8
0.90-0.94	13	16.3	31	25.8
0.95-0.99	49	6.1	69	57.5
1.00	14	17.5	11	9.2
Total	80	100	120	100
Mean	0.97175		0.959738	
Minimum	0.812		0.872	
Maximum	1		1	
Standard dev.	0.035089		0.035773	

Source : Field survey, 2010.

Optimal, sub optimal and super optimal output of the earthen and concrete ponds

Earthen and concrete ponds optimal, suboptimal and super optimal output are reported in table 5. In term of economics of scale, 14 ponds were characterized by constant return to scale, 48 ponds had increasing return to scale and 18 ponds was characterized by decreasing return to scale among earthen pond fish farmers. In concrete pond, 11 ponds operated under the constant return to scale. 106 ponds were characterized by increasing return to scale and only 3 ponds was characterized by decreasing return to scale. If all ponds using the same technology, then it would be expected that return to scale would increase for ponds with a relatively low outputs and decreasing return to scale ponds with a relatively high outputs. Constant return to scale would be expected for ponds with output level equals to the mean output. The mean output of the suboptimal scale is larger than the mean output of the optimal as well as super optimal scales for concrete ponds while that of earthen pond the mean outputs of the super-optimal scale are larger than the optimal and sub-optimal scales. The results indicates that the super optimal output levels overlap a substantial portion of the optimal and sub-optimal outputs, while for concrete pond, the sub-optimal output value overlaps that of optimal and super optimal value.

Table 5 : Distribution of earthen and concrete ponds optimal suboptimal and super optimal outputs

Earthen pond/scale	No of ponds	Percentage of ponds	Mean Output (kg)
Optimal	14	17.5	2250
Sub-optimal	48	60.0	1430
Super-optimal	18	22.5	2975
Concrete pond/scale	**No of ponds**	**Percentage of ponds**	**Mean Output (kg)**
Optimal	11	9.2	2150
Sub-optimal	106	88.3	3000
Super-optimal	03	2.5	1513

Source : Field survey, 2010.

Summary of ponds output slack

Table 6 shows the ponds summary of the output slack under the CRS DEA and VRS DEA specifications. Under the constant return to scale, the output slacks for the earthen ponds and concretes ponds was zero for each of them. This result indicates that, given the present scale of operation and the available resources, the fish farmers could not do anything to increase their output levels beyond the present values irrespective of the adjustment in their input levels because of the difficulty of resource fixity. In the case of the VRS specifications, the output for earthen ponds and concrete ponds are 151kg and 275kg respectively. This result indicates the amount by which the output levels could be increase without a corresponding increase in the amount input used.

Table 6 : Distribution of ponds output slack

Ponds	CRS	VRS
Earthen ponds	0	151
Concrete ponds	0	275

Source : Field survey 2010.

Summary of ponds VRS input slacks

Table 7 gives the summary of the input slacks under the VRS specification. The fingerlings slack is the amount of the excess quantity of the fingerlings used in fish culture. The output levels realized could still have been realized if the quantity of fingerlings used in culturing had been reduced by 2141. 845kg, the slacks for ponds, feed, fertilizer, labour are 4.205m^2, 17.849kg, 3.917kg, 263.575kg respectively. These values correspond to the excess input used in the farming operation.

Table 7 : Distribution of VRS input slacks

Input	Slacks
Fingerlings (kg)	2141. 8
Ponds (m^2)	4.2
Feeds (kg)	263.6
Fertilizer (kg)	3.9
Labour (man day)	17.9

Source: Field survey 2010

Summary of pond output target

Table 8 gives the summary of the output targets. The output target refers to the amount of output the decision making units should aims at producing given the available units inputs. For example in concrete ponds, the minimum output target that some of the DMU should aim at producing fell within the range of 8001- 10,000. Only 1 DMU amounting to 0.83% of the total DMU's in the pond is applicable. None of the DMU in earthen pond had such a low output target range. The same maximum output target range is 10,000 above. Only 5% of the concrete pond fish farmers should aim at producing at this level of output.

Table 8 : Distribution of ponds output target

Target	Earthen ponds		Concrete ponds	
	Frequency	%	Frequency	%
< 2000	9	11.3	3	2.5
2001-4000	27	33.8	58	48.3
4001– 6000	31	38.8	47	39.2
6001– 8000	7	8.8	5	4.2
8001-10,000	6	7.5	1	0.8
> 10,000	0	0	6	5.0
Total	**80**	**100**	**120**	**100**

Source : Field survey 2010

IV. Conclusion

The study was designed to familiarize fish farmers attention with an area in fish production where the use of efficiency is becoming increasingly important. The study concluded that substantial inefficiencies occurred among concrete and earthen ponds fish farmers in the study area but surprisingly more evidenced in earthen pond. Available evidence from this study has shown that only four farms were fully efficient under the Constant Return to Scale for the earthen pond

fish farmers. While only 11 were fully efficient under the Variable Return to scale from earthen pond fish farmers. Also under Constant Return to Scale for concrete pond fish farmers five farms were fully efficient while under Variable Return to Scale for concrete pond fish farmers 47 were fully efficient.

References Références Referencias

1. Adeokun, O.A., Adereti, F. O. and Akanni, K.A. (2006): "Children Involvement in Fish Production: A Strategy For Poverty Alleviation in Waterside Local Government Area,Ogun State" Research Jounal of Fishery and Hydrobiology, 1(1): 10-13
2. Aliu, B.S and O.J Abolagba, (1998): "Feed as an Essential input in Agricultural Production in Nigeria. In sustainable utilization of Aquatic Netland Resources. Eds: Otubusin S.O., G.N.O. Ezeri O.A Ugwumba, A.A.A. Ugwumba, selected papers from the 9th 10th Annual conference of Nigerian Association for Aquatic Sciences, 30th November-2nd December 1995 Pp. 155-159.
3. Anetekhai, M. A.,Akin-oriola, G.A, Aderinola and Akintola S.L.,(2004) "Steps Ahead for Aquaculture Development in Sub-Sahara Africa-the case of Nigeria. Faculty of Science Fishries, Lagos state University, Apapa-P.M.B 1087, Lagos, Nigeria.
4. Banker, R.D. Charnes, A. and W.W. Cooper (1984) "Some Models for Estimating Technical and scale inefficiencies in Data Envelopment Analysis" Management Science, 30, 1078-1092.
5. Charnes, A. Cooper, W.W. and Rhodes, E. (1978): "Measuring the Efficiency of Decision Making Units". European Journal of Operational Research, 2(6): 429-444.
6. Charnels, J.G. (1985): A review of the fishing industry in worlds and status of fish preservation methods and future growth pre-requisite to cope with anticipated increase in production, NIOMR Tech paper No. 17.
7. Cooper, W.W., Seiford, L.M. and Zhu (1999): Data Envelopment Analysis Model and Interpretation Pp. 1-39; Handbook Envelopment Analysis.
8. Coelli, T.J (1997): A multistage Methodology for the Solution of Oriented DEA Models, Mimeo, centre for Analysis, University of New England , Armidale.
9. Dada, B.F. and B.D.S Gmnadoess, (1986): Nigerian fisheries Development: challenges and opportunities of the 1980's FISH, Maiduguri, Nigeria. Pp. 14-22.
10. FAO (1990): Commodity Review and outlook (1990-1991).
11. FAO (1991): Fish For Food and Development . FAO Annual Publication, Rome.
12. FAO (1997): Review of the state of World Aquaculture FAO fisheries circular No 886, Rev. 1 Rome, Italy Pp 10.
13. Federal Ministry of Agriculture and Rural Development (2001): A publication on opportunities business in Nigeria's agriculture sector Pp.4.
14. Kareem, R.O, Dipeolu, A.O, Aromolaran, A. B and Akegbejo-Samson.(2008) "Analysis of Technical Allocative and Economic Efficiency of Different Pond System in Ogun State, Nigeria" African Jounal of Agricultural Research,Vol.3(4),Pp.246-254.
15. Olujimi O. Jinadu (2000): Economic Efficiency in the coastal small scale fisheries in Lagos State, Nigeria Federal College of Fisheries and marine technology wilmot point, Victoria island Pp 1-6.
16. Otubusin, S.O. (1999). Fish for thought COLERM Seminar Series No. 4 University of Agriculture Abeokuta. Pp. 15.
17. Sharma, K.R and Leung, P. (1998), "Technical efficiency of carp production Nepal: An Application of stochastic Frontier production function Approach". Aquaculture Economics and management vol. 2, Iss 3, Pp. 23-35
18. Zhu.O. and J. Sarkis (2004): "Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises" Journal of Operations Management, volume 22, No. 3 Pp 265-289.

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Homotopy Perturbation Transform Method for solving nonlinear wave-like equation with variable coefficients

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Abstract - In this paper, we apply homotopy perturbation transform method **(HPTM)** for solving nonlinear wave-like equations of variable coefficients. This method is the coupling of homotopy perturbation method and Laplace transform method. The nonlinear terms can be easily obtained by the use of He's polynomials. **HPTM** present an accurate methodology to solve many types of linear and nonlinear differential equations. The approximate solutions obtained by means of **HPTM** in a wide range of the problem's domain were compared with those results obtained from the actual solutions, the Variational iteration method **(VIM)** and the Adomain decomposition method **(ADM)**. The fact that proposed technique solves nonlinear problems without using Adomain's polynomials can be considered as a clear advantage of this algorithm over the decomposition method. The comparison shows a precise agreement between the results.

Keywords & Phrases : *Homotopy perturbation method, Laplace Transform method, nonlinear wave-like equation, He's polynomials.*

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Homotopy Perturbation Transform Method for solving nonlinear wave-like equation with variable coefficients

Sumit gupta[α] ,V.G.Gupta[Ω]

Abstract - In this paper, we apply homotopy perturbation transform method **(HPTM)** for solving nonlinear wave-like equations of variable coefficients. This method is the coupling of homotopy perturbation method and Laplace transform method. The nonlinear terms can be easily obtained by the use of He's polynomials. **HPTM** present an accurate methodology to solve many types of linear and nonlinear differential equations. The approximate solutions obtained by means of **HPTM** in a wide range of the problem's domain were compared with those results obtained from the actual solutions, the Variational iteration method **(VIM)** and the Adomain decomposition method **(ADM).** The fact that proposed technique solves nonlinear problems without using Adomain's polynomials can be considered as a clear advantage of this algorithm over the decomposition method. The comparison shows a precise agreement between the results.

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I. Introduction

Nonlinear phenomena appear everywhere in our daily life and our scientific works, and today nonlinear science represents one of the most challenging promising, and romantic fields of research in science and technology [1-2]. It was very difficult to solve nonlinear problems effectively either numerically or analytically, an even more difficult to establish models for real world problems. In recent years, many authors have paid attention to studying the solutions of nonlinear partial differential equations by Adomain decomposition method [3-6], the tanh method [7], the sine-cosine method [8-9] the differential transform method [10-11], the variational iteration method [12-17] and the Laplace decomposition method [18-22]. In numer methods, computers codes and more powerful processors are required to achieve methods. The main advantage of semi-analytical methods, compared with others methods, is based on the fact that they can be conveniently applied to solve various complicated problems with accurate approximation , but this approximation is acceptable only for small range [23], because boundary conditions in one dimension are satisfied via these methods. Consequently, this shows that most of these semi-analytical methods encounter inbuilt deficiencies like he calculation of Adomain polynomials, huge computational works and divergent results. One of these semi-analytical methods is the homotopy perturbation method (HPM). He [24-32] developed the homotopy perturbation method for solving linear, nonlinear, initial and boundary value problems [33-38] by merging two techniques, the standard homotopy and the perturbation technique. The homotopy perturbation method was formulated by taking the full advantage of the standard homotopy and perturbation technique and has been modified by the some scientists to obtain more accurate results, rapid convergence, and to reduce the amount of computation [39-44]. Everyone familiar the term namely, Laplace transform [45], is a powerful technique for solving various linear partial differential equations having considerable significance in various fields of science and engineering. But it incapable of solving nonlinear system of equations because of the difficulties that are arises due to nonlinear terms. Various techniques have been proposed to handle these nonlinearities to produce a highly effective technique for solving the nonlinear problems [46-48].

In this paper we use a new modification of HPM to overcome the difficulties of handling nonlinear terms. HPTM provides the solution in a rapid convergent series which may lead the solution in rapid convergent series which may lead the solution in closed form. The nonlinear terms can be easily handled by the use of He's polynomials [49-50]. HPTM is applied without any discretization or restrictive assumptions and avoids round-off errors. Several examples are given to verify the reliability and efficiency of the homotopy perturbation transform method. In this paper, we consider the following nonlinear wave-like equations

$$u_{tt} = \sum_{i,j=1}^{n} F_{1ij}(X,t,u)\frac{\partial^{k+m} F_{2ij}(u_{xi},u_{xj})}{\partial x_i^k\, \partial x_i^m} +$$

$$\sum_{i=1}^{n} G_{1i}(X,t,u)\frac{\partial^{p}}{\partial x^{p}} G_{2i}(u_{xi})$$

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$$+ H(X,t,u) + S(X,t) \quad (1)$$

with the initial conditions

$$u(X,0) = a_0(X),$$
$$u_t(X,0) = a_1(X).$$

Here $X = (x_1, x_2, \ldots, x_n)$ and F_{1ij}, G_{1i} are nonlinear function of X, t and u. F_{2ij}, G_{2i} are nonlinear function of derivatives of x_i, x_j. While H, S are nonlinear functions and k, m, p are integers. These types of equations are of considerable significance in various fields of applied sciences, mathematical physics, nonlinear hydrodynamics, engineering physics, biophysics, human movement sciences, astrophysics and plasma physics. These equations describe the evolution of stochastic systems. For example, they describe the erratic motions of small particles that are immersed in fluids, fluctuations of the intensity of laser light, velocity distributions of fluid particles in turbulent flows and the stochastic behavior of exchange rates. M. Ghoreishi [51] has been solved this type of equation by Adomain Decomposition method (ADM) to avoid unrealistic assumptions in calculating the Adomain polynomials. ADM is the most transparent method for solutions of the nonlinear problems; however, this method is involved in the calculation of complicated Adomain polynomials which narrows down its applications. To overcome this disadvantage of the Adomain decomposition method, we consider the homotopy perturbation transform method to solve various nonlinear wave-like equations of variable coefficients.

II. Homotopy Perturbation Transform Method (HPTM)

This method has been introduced by Y.Khan and Q.Wu [52] by combining the Homotopy perturbation method and Laplace transform method for solving various types of linear and nonlinear systems of partial differential equations. To illustrate the basic idea of HPTM, we consider a general nonlinear partial differential equation with the initial conditions of the form [52].

$$Du(x,t) + Ru(x,t) + Nu(x,t) = g(x,t), \quad u(x,0) = h(x), \quad u_t(x,0) = f(x) \quad (2)$$

where D is the second order linear differential operator $\boldsymbol{D = \partial^2 / \partial t^2}$, R is the linear differential operator of less order than D; N represents the general nonlinear differential operator and $g(x,t)$ is the source term. Taking the Laplace transform (denoted in this paper by L) on both sides of Eq. (2):

$$L[Du(x,t)] + L[Ru(x,t)] + L[Nu(x,t)] = L[g(x,t)] \quad (3)$$

Using the differentiation property of the Laplace transform, we have

$$L[u(x,t)] = \frac{h(x)}{s} + \frac{f(x)}{s^2} - \frac{1}{s^2}L[Ru(x,t)] + \frac{1}{s^2}L[g(x,t)] - \frac{1}{s^2}L[Nu(x,t)] \quad (4)$$

Operating with the Laplace inverse on both sides of Eq. (4) gives

$$u(x,t) = G(x,t) - L^{-1}\left[\frac{1}{s^2}L[Ru(x,t) + Nu(x,t)]\right] \quad (5)$$

where $G(x,t)$ represents the term arising from the source term and the prescribed initial conditions. Now we apply the homotopy perturbation method

$$u(x,t) = \sum_{n=0}^{\infty} p^n u_n(x,t) \quad (6)$$

and the nonlinear term can be decomposed as

$$Nu(x,t) = \sum_{n=0}^{\infty} p^n H_n(u) \quad (7)$$

for some He's polynomials $H_n(u)$ (see [49-50]) that are given by

$$H_n(u_0, u_1, \ldots, u_n) = \frac{1}{n!}\frac{\partial^n}{\partial p^n}\left[N\left(\sum_{i=0}^{\infty} p^i u_i\right)\right]_{p=0}, \quad (8)$$

$n = 0, 1, 2, 3\ldots$

Substituting Eq. (8), Eq. (7) and Eq. (6) in Eq. (5) we get

$$\sum_{n=0}^{\infty} p^n u_n(x,t) = G(x,t) - L^{-1}\left(\frac{1}{s^2}L\left[R\sum_{n=0}^{\infty} p^n u_n(x,t) + N\sum_{n=0}^{\infty} p^n H_n(u)\right]\right) \quad (9)$$

which is the coupling of the Laplace transform and the homotopy perturbation method using He's polynomials. Comparing the coefficient of like powers of p, the following approximations are obtained.

$$p^0 : u_0(x,t) = G(x,t)$$
$$p^1 : u_1(x,t) = -\frac{1}{s^2}L\left[Ru_0(x,t) + H_0(u)\right],$$
$$p^2 : u_2(x,t) = -\frac{1}{s^2}L\left[Ru_1(x,t) + H_1(u)\right],$$
$$p^3 : u_3(x,t) = -\frac{1}{s^2}L\left[Ru_2(x,t) + H_2(u)\right], \quad (10)$$
$$\vdots$$

and so on

III. Applications

In this section, we apply the homotopy perturbation transform method (HPTM) for solving various types of nonlinear wave-like equations with variable coefficients.

Example 3.1 Consider the following two dimensional nonlinear wave-like equations with variable coefficients [51].

$$u_{tt} = \frac{\partial^2}{\partial x\,\partial y}\left(u_{xx}\,u_{yy}\right) - \frac{\partial^2}{\partial x\,\partial y}\left(x\,y\,u_x\,u_y\right) - u \qquad (11)$$

with the initial conditions

$$u(x,y,0) = e^{xy},\quad u_t(x,y,0) = e^{xy}$$

The exact solution is given by $u(x,y,t) = e^{xy}\left(\cos t + \sin t\right)$; by means of homotopy perturbation transform method,

Taking Laplace transform both of sides, subject to the initial condition, we get

$$L[u(x,y,t)] = \frac{(s+1)}{s^2}e^{xy} + \frac{1}{s^2}L\left[\frac{\partial^2}{\partial x\partial y}\left(u_{xx}\,u_{yy}\right) - \frac{\partial^2}{\partial x\partial y}\left(xyu_x\,u_y\right) - u(x,y,t)\right] \qquad (12)$$

Taking inverse Laplace transform, we get

$$u(x,y,t) = (1+t)e^{xy} + L^{-1}\left[\frac{1}{s^2}L\left[\frac{\partial^2}{\partial x\partial y}\left(u_{xx}\,u_{yy}\right) - \frac{\partial^2}{\partial x\partial y}\left(xyu_x\,u_y\right) - u(x,y,t)\right]\right] \qquad (13)$$

by homotopy perturbation method, we get

$$u(x,y,t) = \sum_{n=0}^{\infty} p^n u_n(x,y,t) \qquad (14)$$

using equation (14) in equation (13), we get

$$\sum_{n=0}^{\infty} p^n u_n(x,y,t) = (1+t)e^{xy} + pL^{-1}\left[\frac{1}{s^2}L\left[\left(\sum_{n=0}^{\infty} p^n H_n(u)\right) - \left(xy\left(\sum_{n=0}^{\infty} p^n K_n(u)\right)\right) - \sum_{n=0}^{\infty} p^n u_n(x,y,t)\right]\right] \qquad (15)$$

Where $H_n(u)$ and $K_n(u)$ are the He's polynomials having the value $H_n(u) = \frac{\partial^2}{\partial x\partial y}\left(u_{xx}u_{yy}\right)$ and $K_n(u) = \frac{\partial^2}{\partial x\partial y}\left(u_x u_y\right)$.

The first few components of $H_n(u)$ and $K_n(u)$ are given by

$$H_0(u) = \frac{\partial^2}{\partial x\partial y}\left((u_0)_{xx}(u_0)_{yy}\right)$$

$$H_1(u) = \frac{\partial^2}{\partial x\partial y}\left((u_1)_{xx}(u_0)_{yy} + (u_1)_{yy}(u_0)_{xx}\right)$$

$$H_2(u) = \frac{\partial^2}{\partial x\partial y}\left((u_0)_{xx}(u_2)_{yy} + (u_1)_{xx}(u_1)_{yy} + (u_0)_{yy}(u_2)_{xx}\right)$$

$$\vdots$$

and

$$K_0(u) = \frac{\partial^2}{\partial x\partial y}\left((u_0)_x(u_0)_y\right)$$

$$K_1(u) = \frac{\partial^2}{\partial x\partial y}\left((u_1)_x(u_0)_y + (u_1)_y(u_0)_x\right)$$

$$K_2(u) = \frac{\partial^2}{\partial x\partial y}\left((u_0)_x(u_2)_y + (u_1)_x(u_1)_y + (u_0)_y(u_2)_x\right)$$

$$\vdots$$

Comparing the coefficients of various powers of p, we get

$$p^0 : u_0(x,y,t) = (1+t)e^{xy}$$

$$p^1 : u_1(x,y,t) = L^{-1}\left[\frac{1}{s^2}L\left[\left(H_0(u)\right) + \left(x\,y\,K_0(u)\right) - u_0(x,y,t)\right]\right]$$

$$= -e^{xy}\left(\frac{t^2}{2} + \frac{t^3}{6}\right)$$

$$p^2 : u_2(x,y,t) = L^{-1}\left[\frac{1}{s^2}L\left[\left(H_1(u)\right) + \left(x\,y\,K_1(u)\right) - u_1(x,y,t)\right]\right] \qquad (16)$$

$$= e^{xy}\left(\frac{t^4}{24} + \frac{t^5}{120}\right)$$

$$p^3 : u_3(x,y,t) = L^{-1}\left[\frac{1}{s^2}L\left[\left(H_2(u)\right) + \left(x\,y\,K_2(u)\right) - u_2(x,y,t)\right]\right]$$

$$= -e^{xy}\left(\frac{t^6}{720} + \frac{t^7}{5040}\right)$$

$$\vdots$$

and so on

$$\vdots$$

Therefore the approximate solution is given by

$$u(x,t) = u_0(x,t) + u_1(x,t) + u_2(x,t) + u_3(x,t) + \ldots$$

$$= e^{xy}\left(1 + t - \frac{t^2}{2} - \frac{t^3}{6} + \frac{t^4}{24} + \frac{t^5}{120} - \frac{t^6}{720} - \frac{t^7}{5040} + \ldots\right) \qquad (17)$$

which converges to the exact solution and is same as obtained by M.Ghoreishi [51]

Example 3.2 Consider the following nonlinear wave-like equation with variable coefficients [51].

$$u_{tt} = u^2 \frac{\partial^2}{\partial x^2}\left(u_x\, u_{xx}\, u_{xxx}\right) + u_x^2 \frac{\partial^2}{\partial x^2}\left(u_x^3\right) - 18u^5 + u, \tag{18}$$

with the initial conditions

$$u(x,0) = e^x, \quad u_t(x,0) = e^x.$$

By applying above said method, we get

$$\sum_{n=0}^{\infty} p^n u_n(x,t) = e^x(1+t) + pL^{-1}\left[\frac{1}{s^2}L\left[\sum_{n=0}^{\infty} p^n H_n(u) + \sum_{n=0}^{\infty} p^n K_n(u) - 18\sum_{n=0}^{\infty} p^n J_n(u) + \sum_{n=0}^{\infty} p^n u_n(x,t)\right]\right] \tag{19}$$

Where $H_n(u), K_n(u)$ and $J_n(u)$ are He's polynomials. First few components of He's polynomials are given by

$$H_0(u) = u_0^2 \frac{\partial^2}{\partial x^2}\left((u_0)_x (u_0)_{xx} (u_0)_{xxx}\right)$$

$$H_1(u) = 2u_0 u_1 \frac{\partial^2}{\partial x^2}\left((u_0)_x (u_0)_{xx} (u_0)_{xxx}\right) + u_0^2 \frac{\partial^2}{\partial x^2}\left[(u_1)_x (u_0)_{xx} (u_0)_{xxx} + (u_0)_x (u_1)_{xx} (u_0)_{xxx} + (u_0)_x (u_1)_{xxx} (u_0)_{xx}\right]$$

$$\vdots$$

$$K_0(u) = \left(u_0^2\right)_x \frac{\partial^2}{\partial x^2}\left(u_0^3\right)_{xx}$$

$$K_1(u) = 2(u_0)_x (u_1)_x \frac{\partial^2}{\partial x^2}\left(u_0^3\right)_{xx} + 3\left(u_0^2\right)_x \frac{\partial^2}{\partial x^2}\left(\left(u_0^2\right)_{xx} (u_1)_{xx}\right)$$

$$\vdots$$

$$J_0(u) = (u_0)^5$$

$$J_1(u) = 5(u_0)_4 (u_1)$$

$$\vdots$$

Comparing the coefficients of various powers of p, we get

$$p^0 : u_0(x,y,t) = (1+t)e^x$$

$$p^1 : u_1(x,y,t) = L^{-1}\left[\frac{1}{s^2}L\left[(H_0(u)) + (K_0(u)) - (18J_0(u)) + u_0(x,t)\right]\right] = e^x\left(\frac{t^2}{2} + \frac{t^3}{6}\right)$$

$$p^2 : u_2(x,y,t) = L^{-1}\left[\frac{1}{s^2}L\left[(H_1(u)) + (K_1(u)) - (18J_1(u)) + u_1(x,t)\right]\right] = e^x\left(\frac{t^4}{24} + \frac{t^5}{120}\right)$$

$$\vdots$$

and so on

$$\vdots$$

Therefore the approximate solution is given by

$$u(x,t) = u_0(x,t) + u_1(x,t) + u_2(x,t) + u_3(x,t) + \ldots$$

$$= e^x\left(1 + t + \frac{t^2}{2} + \frac{t^3}{6} + \frac{t^4}{24} + \frac{t^5}{120} + \frac{t^6}{720} + \frac{t^7}{5040} + \ldots\right) = e^{x+t} \tag{20}$$

which converges to the exact solution and is same as obtained by M.Ghoreishi [51]

Example 3.3 Consider the following nonlinear wave-like equation with variable coefficients [51].

$$u_{tt} = x^2 \frac{\partial}{\partial x}\left(u_x\, u_{xx}\right) - x^2\left(u_{xx}^2\right) - u, \quad 0 < x < 1, t > 0 \tag{21}$$

with the initial conditions

$$u(x,0) = 0, \quad u_t(x,0) = x^2.$$

By applying above said method, we get

$$\sum_{n=0}^{\infty} p^n u_n(x,t) = x^2 t + pL^{-1}\left[\frac{1}{s^2}L\left[\left(x^2\sum_{n=0}^{\infty} p^n H_n(u)\right) - \left(x^2\sum_{n=0}^{\infty} p^n K_n(u)\right) - \sum_{n=0}^{\infty} p^n u_n(x,t)\right]\right] \tag{22}$$

Where $H_n(u)$ and $K_n(u)$ are He's polynomials. First few components of He's polynomials are given by

$$H_0(u) = \frac{\partial}{\partial x}\left((u_0)_x (u_0)_{xx}\right)$$

$$H_1(u) = \frac{\partial}{\partial x}\left((u_0)_x (u_1)_{xx} + (u_0)_{xx} (u_1)_x\right)$$

$$H_2(u) = \frac{\partial}{\partial x}\left((u_0)_x (u_2)_{xx} + (u_1)_{xx} (u_1)_x + (u_0)_{xx} (u_2)_x\right)$$

$$\vdots$$

$$K_0(u) = \left(u_0^2\right)_{xx}$$

$$K_1(u) = 2(u_0)_{xx} (u_1)_{xx}$$

$$K_2(u) = \left(u_1^2\right)_{xx} + 2(u_0)_{xx} (u_2)_{xx}$$

$$\vdots$$

Comparing the coefficients of various powers of p, we get

$$p^0 : u_0(x,t) = x^2 t$$

$$p^1 : u_1(x,t) = -x^2 \frac{t^3}{6}$$

$$p^2 : u_2(x,t) = L^{-1}\left[\frac{1}{s^2}L\left[\left(x^2 H_1(u)\right) - \left(x^2 K_1(u)\right) - u_1(x,t)\right]\right] = x^2 \frac{t^5}{120}$$

Therefore the approximate solution is given by

$$u(x,t) = u_0(x,t) + u_1(x,t) + u_2(x,t) + u_3(x,t) + \ldots$$

$$= x^2\left(t - \frac{t^3}{6} + \frac{t^5}{120} - \ldots\right) = x^2 \sin t \tag{23}$$

which converges to the exact solution and is same as obtained by M.Ghoreishi [51]

IV. Conclusion

In this paper, we applied the homotopy perturbation transform method (HPTM) for solving nonlinear wave-like equations with variable coefficients. The proposed method is applied successfully without any discretization, linearization or restrictive assumptions. It may be concluding that the HPTM by using He's polynomials is simple, but the calculation of Adomain's polynomials is complex. Its small size of computation in comparison with the computational size required in other numerical methods and its rapid convergence show that the method is reliable and introduces a significant improvement in solving nonlinear differential equations over existing methods.

References Références Referencias

1. J.H.He and E.W.M.Lee, New analytical methods for cleaning up the solution of nonlinear equations, Computers and Mathematics with Applications 58 (2009) 2081-2083
2. J.A.Krumhansl, Nonlinear Science: Towards the next frontier, Physica D68 (1993), 97-103.
3. G.Adomain, Solving Frontier problem of Physics: The Decomposition Method, Kluwer Acad.Publ., Boston, 1994.
4. A.M.Wazwaz, A new algorithm for calculating Adomain polynomials for nonlinear operators, Applied Mathematics and Computation 111 (2000) 53-59.
5. A.M.Wazwaz, Constructing of solitary wave solutions and rational solutions for the KdV equation by Adomain Decomposition Method, Chaos Solitons Fractals 12 (2001) 2283-2293.
6. A.Sadighi, D.D.Ganji, Y.Sabzehmeidani, A Decomposition method for Volume Flux and Average Velocity of thin film flow of a third grade film down an inclined plane, Advance in Theoretical and Applied Mechanics 1 (2008) 45-49.
7. D.J.Evans, K.R.Raslan, The Tanh-Function method for solving some important nonlinear partial differential equation, International Journal of Computer Mathematics, 82 (2005), 897-905.
8. A.M.Wazwaz, A sine-cosine method for handling nonlinear wave equations, Mathematical and Computer Modeling 40(2004) 499-508.
9. A.M.Wazwaz, The tanh and sine cosine methods for the complex modified and generalized KdV equations, Computers and Mathematics with Applications 49 (2005) 1101-1112.
10. Y.Keskin, G.Oturanc, Reduced Differential Transform Method for Partial differential equations, International Journal of Nonlinear Sciences and Numerical Simulation 10 (6) (2009)741-749.
11. Y.Keskin, G.Oturanc, Reduced Differential Transform Method for Fractional Partial Differential equations, Nonlinear Sciences Letters A 1 (2) (2010) 61-72.
12. J.H.He, Variational Iteration method-a kind of nonlinear analytical techniques: some examples, International Journal of Nonlinear Mechanics 34 (1999) 699-708.
13. J.H.He, X.H.Wu, Variational Iteration Method: new development and applications, Computers and Mathematics with Applications 59 (2007) 881-884.
14. L.A.Soltani, A.Shirzadi, A new modification of the variational iteration method, Computers and Mathematics with Applications 59 (2010) 2528-2535.
15. N.Faraz, Y.Khan, A.Yildirim, Analytical Approach to two dimensional viscous flows with a shrinking sheet via variational iteration algorithm-II, Journal of King Saud University (2010) doi:10.10161j.jksus 2010.06.010.
16. G.C.Wu, E.W.M.Lee, Fractional variational iteration method and its application, Physics Letters A (2010) doi: 10.1016 / j.physleta.2010.04.034.
17. C.Chun, Fourier-Series based variational iteration method for a reliable treatment of heat equations with variable coefficients, International Journal of Nonlinear Sciences and Numerical Simulation 10 (2009) 1383-1388.
18. S.A.Khuri, A Laplace decomposition algorithm applied to a class of nonlinear partial differential equations, Journal of Applied Mathematics 1 (2001) 141-155.
19. E.Yusufoglu, Numerical solution of the Duffing equation by the Laplace decomposition method, Applied Mathematics and Computation 177 (2006) 572-580.
20. Y.Khan, An efficient modification of the Laplace decomposition method for nonlinear equations, International Journal of Nonlinear Sciences and Numerical Simulation 10 (2009) 1373-1376.
21. Y.Khan, N.Faraz, A new approach to differential-difference equations, Journal of Advanced Research in Differential Equations 2 (2010) 1-12.
22. S.Islam, Y.Khan, N.Faraz, Numerical solution of logistic differential equations by using the Laplace decomposition method, World Applied Sciences Journal 8 (2010) 1100-1105.
23. B.Jang, Exact solution of one dimensional non-homogeneous parabolic problem by the homogeneous Adomain decomposition method, Applied Mathematics and Computation 186(2) (2007) 969-979.

24. J.H.He, Homotopy perturbation techniques, Computer Methods in Applied Mechanics and Engineering 178 (1999) 257-262.
25. J.H.He, Homotopy perturbation method: a new nonlinear analytical technique , Applied Mathematics and Computation 135 (2003) 73-79.
26. J.H.He, Comparison of Homotopy perturbation method and Homotopy analysis method, Applied Mathematics and Computation 156 (2004) 527-539.
27. J.H.He, The homotopy perturbation method for nonlinear oscillator with discontinuities, Applied Mathematics and Computation 151 (2004) 287-292.
28. J.H.He, Some asymptotic methods for strongly nonlinear equation, International Journal of Modern Physics B 20 (2006) 1144-1199.
29. J.H.He, Homotopy perturbation method for solving Boundary Value Problems, Physics Letters A 350 (2006) 87-88.
30. J.H.He, Limit cycles and bifurcations of nonlinear problems, Chaos Solitons Fractals 26 (2005) 627-633.
31. J.H.He, A coupling of homotopy technique and perturbation technique for nonlinear problems, International Journal of Nonlinear Mechanics 35(1) (2000) 37-43.
32. J.H.He, A note on the Homotopy perturbation method, Thermal Science 14 (2) (2010) 565-568.
33. O.Martin, a homotopy perturbation method for solving a neutron transport equation, Applied Mathematics and Computation 217 (21) (2011) 8567-8574.
34. K.A.Gepreel, The homotopy perturbation method applied to the nonlinear fractional Kolomogrov-Petrovskii-Piskunov equations, Applied Mathematics Letters 24 (8) (2011) 1428-1434.
35. S.Das, P.K.Gupta, Application of homotopy perturbation method and homotopy analysis method to fractional vibration equation, international Journal of Computer Mathematics 88 (2) (2010) 85-89.
36. P.K.Gupta, M.Singh, Homotopy perturbation method for fractional Fornberg- Whitham equation, Computers and Mathematics with Applications 61 (2) (2011) 250-254.
37. S.T.Mohyud-Din, A.Yildirim, G.Demirli, Travelling wave solutions of Whitham-Broer-Kaup equations by homotopy perturbation method, Journal of King Saud University 22 (3) 2010 173-176.
38. H.Kocak, A.Yildirim, D.Zhang, .T.Mohyud Din, The comparative Boubaker Polynomials Expansion Scheme (BPES) and Homotopy perturbation method for solving a standard nonlinear second-order boundary value problem, Mathematical and Computer Modeling 54 (2) (2011) 417-422.
39. S.Momani, Z.Odibat, Homotopy perturbation method for nonlinear partial differential equations of fractional order, Physics Letters A 365 (2007) 345-350.
40. Z.Odibat, S.Momani, Modified homotopy perturbation method: Application to Riccati differential equation, Chaos Solitons Fractals 36 (2008) 167-174.
41. X.Feng, Y.We, Modified homotopy perturbation method for solving the Stoke's equations, Computer and Mathematics with Applications 6 (8) (2011) 2262-2266.
42. J.Nadjafi, M.Tamamgar, Modified Homotopy perturbation method for solving integral equations, International Journal of Modern Physics B 24 (2) (2010) 4741-4746.
43. M.A.Jafari and A Aminataei, Improvement of the homotopy perturbation method for solving diffusion equations Physica Scripta 82(1) (2010), 1-8.
44. M.A.Jafari, A.Aminataei, An efficient algorithm for solving multi-term diffusion- wave equations of fractional order, Computer and Mathematics with Applications (Article in Press).
45. J.L.Schiff, The Laplace transform: theory and applications, Springer Verlag (1999).
46. J.Biazar, M.Gholami, P.Ghanbari, Extracting a general iterative method from an adomain decomposition method and compare it to the variational iteration method, Computers and Mathematics with Applications 59 (2010) 622-628.
47. M.Madani, M.Fatizadeh, Homotopy perturbation algorithm using Laplace transformation, Nonlinear Science Letters A 1 (2010) 263-267.
48. M.A Noor, S.T.Mohyud-Din, Variational homotopy perturbation method for solving higher dimensional initial boundary value problem, Mathematical Problems in Engineering (2008) Article ID 696734 doi: 10.1155 / 2008 / 696734.
49. A.Ghorbani, J.Saberi-Nadjafi, He's homotopy perturbation method for calculating Adomain's polynomials, International Journal of Nonlinear Sciences and Numerical Simulation 8 (2007) 229-232.
50. A.Ghorbani, Beyond Adomain's polynomials: He's polynomials, Chaos Solitons Fractals 39 (2009) 1486-1492.
51. M. Ghoreishi, A.I.B. Ismail, N.H.M.Ali, Adomain decomposition method for nonlinear wave-like equation with variable coefficients, Applied Mathematical Sciences 4 (2010) 2431-2444.
52. Y.Khan, Q.Wu, Homotopy perturbation transform method for solving nonlinear equations using He's polynomials, Computers and Mathematics with Applications (Article in Press) doi: 10.1016 / j.camwa 2010.08.022.

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A Quarter Symmetric Non-metric Connection in a Generalized Co-symmpletic Manifolds

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Abstract - In this paper, we have derived some properties of quarter symmetric non – metric connection in a generalized co-symplectic manifold.

Keywords : *Quarter symmetric non-connections, Almost contact metric manifolds, generalized co-symplectic manifold, generalized quasi-Sasakian manifold.*

Strictly as per the compliance and regulations of :

A Quarter Symmetric Non-metric Connection in a Generalized Co-symmpletic Manifolds

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Abstract - In this paper, we have derived some properties of quarter symmetric non – metric connection in a generalized co-symplectic manifold.

Keywords : Quarter symmetric non-connections, Almost contact metric manifolds, generalized co-symplectic manifold, generalized quasi-Sasakian manifold.

I. Introduction

In 1975, S. Golab [4] introduced the notion of quarter symmetric non-connections in a Riemannian manifold with affine connection. After that S. C. Rastogi ([5],[6]) continue the systematic study quarter symmetric metric connection. In 1980, R. S. Mishra and S. N. Pandey [3] study a quarter symmetric metric connections in Riemannian, Kaehlarian and Sasakian manifolds. In 1992, S. Mukhopadhya, A. K. Roy and B. Barua [7] studied quarter symmetric metric connection in a Riemannian manifold with almost complex structure. In 1997, U. C. De and S. C. Biswas [8] studied quarter symmetric metric connection on an SP-Ssaskian manifold. Also in 2008, Sular, Ozgur and De [9] quarter symmetric metric connection in Kenmotsu manifold. In 2009, Abul Kalam, Mondal and De [1] studied some properties quarter symmetric metric connection on a Sasakian manifold. In this paper we studied a type of quarter symmetric non-metric connection in a generalized cosyplectic manifold and investigated the properties of this connection in the same manifold.

II. Preliminaries

An n – dimensional differentiable manifold M_n is an almost contact manifold if it admits a tensor field of type F, a vector field U and 1-form u satisfying for arbitrary vector field X.

$$\text{(a)} \quad \bar{\bar{X}} + X = A(X)\,T \qquad \text{(b)} \quad \bar{U} = 0 \tag{2.1}$$

where $\bar{\bar{X}} \overset{def}{=} FX$

Again (2.1) (a) and (2.1) (b), gives

$$\text{(a)} \quad u(\bar{X}) = 0 \qquad \text{(b)} \quad u(U) = 1 \tag{2.2}$$

An almost contact manifold M_n in which a Riemannian metric tensor g of type $(0, 2)$ satisfies

$$\text{(a)} \quad g(\bar{X},\bar{Y}) = g(X,Y) - u(X)u(Y) \qquad \text{(b)} \quad g(X,U) = u(X) \tag{2.3}$$

for arbitrary vector field X and Y, is called an almost contact metric manifold.

Let us put

$${}^{/}F(X,Y) = g(\bar{X},Y)$$

Then, we obtain

$$\text{(a)} \quad {}^{/}F(\bar{X},\bar{Y}) = {}^{/}F(X,Y) \qquad \text{(b)} \quad {}^{/}F(X,Y) = g(\bar{X},Y) = -g(X,\bar{Y}) = -{}^{/}F(Y,X) \tag{2.4}$$

An almost contact metric manifold satisfying

$$(D_X\,{}^{/}F)(Y,Z) = u(Y)(D_X u)(\bar{Z}) - u(Z)(D_Z u)(\bar{Y}) \tag{2.5}$$

$$\begin{aligned}(D_X\,{}^{/}F)(Y,Z) + (D_Y\,{}^{/}F)(Z,X) + (D_Z\,{}^{/}F)(X,Y) + u(X)\left[(D_Y u)(\bar{Z}) - (D_Z F)(\bar{Y})\right] \\ + u(Y)\left[(D_Z u)(\bar{Z}) - (D_X u)(\bar{Z})\right] + u(Z)\left[(D_X u)(\bar{Y}) - (D_Y u)(\bar{X})\right] = 0\end{aligned} \tag{2.6}$$

for arbitrary vector field X, Y, Z are respectively called generalized co-symplectic and generalized quasi-Sasakian manifolds[11].

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If on any manifold U, satisfies

$$\text{(a)} \quad (D_X u)(\bar{Y}) = -(D_{\bar{X}} u)(Y) = (D_Y u)(\bar{X}) \tag{2.7}$$

$$\text{(b)} \quad (D_X u)(Y) = -(D_{\bar{X}} u)(\bar{Y}) = -(D_Y u)(X) \text{ and}$$

$$\text{(c)} \quad (D_{U_1} F) = 0$$

then U_1 is said to be the first class.

If on an almost contact metric manifold U satisfies

$$\text{(a)} \quad (D_X u)(\bar{Y}) = (D_{\bar{X}} u)(Y) = -(D_Y u)(\bar{X}) \Leftrightarrow \tag{2.8}$$

$$\text{(b)} \quad (D_X u)(Y) = -(D_{\bar{X}} u)(\bar{Y}) = -(D_Y u)(X) \text{ and}$$

$$\text{(c)} \quad (D_{U_2} F) = 0$$

then U_2 is said to be the second class.

The Nijenhuise tensor in a generalized co-symplectic manifold is given by

$$\text{(a)} \quad N(X,Y) = (D_X F)Y - (D_{\bar{Y}} F)(X) - \overline{(D_X F)(Y)} + \overline{(D_Y F)(X)} \tag{2.9}$$

$$\text{(b)} \quad {}^{/}N(X,Y,Z) = (D_{\bar{X}}{}^{/} F)(Y,Z) - (D_{\bar{Y}}{}^{/} F)(X,Z) + (D_X{}^{/} F)(Y,\bar{Z}) - (D_Y{}^{/} F)(X,\bar{Z})$$

III. Quarter Symmetric Non-Metric Connection in a Generalized Co-Symplectic Manifold

Let (M_n, g) be a generalized co-symplectic manifold with Riemannian connection D. we define a linear connection B on (M^n, g) by

$$B_X Y = D_X Y + u(Y)X + a(X)FY \tag{3.1}$$

where u and a is 1-form associated with vector field ξ and A on (M^n, g) that is

$$\text{(a)} \quad g(X,U) = u(X) \quad \text{and} \tag{3.2}$$

$$\text{(b)} \quad g(X,A) = a(X)$$

for all vector field $X \in \chi(M_n)$, where $\chi(M_n)$ is the set of all differentiable vector fields on (M^n, g).

Using (3.1) the torsion tensor T of (M^n, g) with respect to connection B is given by

$$T(X,Y) = u(Y)X - u(X)FY + a(X)FY - a(Y)FX \tag{3.3}$$

A linear connection satisfying (3.3) is called Quarter-symmetric connection and metric tensor g satisfies [10].

$$(B_X g)(Y,Z) = -u(Y)g(FX,Z) - u(Z)g(FX,Y) - 2a(X)g(FY,Z) \tag{3.4}$$

for arbitrary vector field X, Y, Z.

Then a linear connection B defined by (3.1) satisfies (3.3) and (3, 4) is called a quarter - symmetric non-metric connection.

If we put

$$B_X Y = D_X Y + H(X,Y)$$

Where H is a tensor of type (0, 2), then we have

$$\begin{cases} (i) & H(X,Y) = u(Y)X + a(X)FY \\ (ii) & {}^{/}H(X,Y,Z) = u(Y)g(X,Z) + a(X)g(FY,Z) \\ (iii) & {}^{/}T(X,Y,Z) = u(Y)g(FX,Z) - u(X)g(FY,Z) + a(X)g(FY,Z) - a(Y)g(FX,Z) \\ (iv) & (B_X u)(Y) = (D_X u)(Y) + g(X,Y) + {}^{/}F(X,Y) \end{cases} \tag{3.5}$$

where

$$'H(X,Y,Z) \underline{\underline{def}} g(H(X,Y)Z)$$

$$'T(X,Y,Z) \underline{\underline{def}} g(T(X,Y)Z)$$

we have

$$X('F(Y,Z) = (D_X\,'F)(Y,Z) + 'F(D_XY,Z) + 'F(Y,D_XZ)$$
$$= (B_X\,'F)(Y,Z) + 'F(B_XY,Z) + 'F(Y,B_XZ)$$

Using (3.1) in the above equation, we get

$$X('F(Y,Z) = (B_X\,'F)(Y,Z) + 'F(D_XY + u(Y)X + a(X)FY,Z) + 'F(Y,D_XZ + u(Z)X + a(X)FZ)$$
$$(B_X\,'F)(Y,Z) = (D_X\,'F)(Y,Z) + u(Y)'F(X,Z) + a(X)'F(FY,Z) + u(Z)'F(Y,X) + a(X)'F(Y,FZ) \quad (3.6)$$

The Nijenhuis tensor N in term of quarter symmetric non metric connection B is given by

$$\begin{cases} (i) & N(X,Y) = (B_{\overline{X}}F)(Y) - (B_{\overline{Y}}F)(X) + \overline{(B_XF)(Y)} + \overline{(B_XF)(X)} \\ (ii) & 'N(X,Y,Z) = (B_{\overline{X}}\,'F)(Y,Z) - (B_{\overline{Y}}\,'F)(X,Z) - (B_X\,'F)(Y,\overline{Z}) - (B_Y\,'F)(X,\overline{Z}) \end{cases} \quad (3.7)$$

Theorem 3.1 : A generalized co-symplectic manifold admitting quarter symmetric non–metric connection such that $B_X\,'F = 0$, then $'F$ is locally killing provided the vector fields X,Y,Z are orthogonal to U .

Proof : From (3.6), we have

$$(B_X\,'F)(Y,Z) = (D_X\,'F)(Y,Z) + u(Y)'F(X,Z) + a(X)'F(\overline{Y},Z) + u(Z)'F(Y,X) + a(X)'F(Y,\overline{Z})$$

Since $B_X\,'F = 0$, we get

$$(D_X\,'F)(Y,Z) = -u(Y)'F(X,Z) - a(X)'F(\overline{Y},Z) - u(Z)'F(Y,Z) - a(X)'F(Y,\overline{Z}) \quad (3.8)$$

Similarly

$$(D_Y\,'F)(X,Z) = -u(X)'F(Y,Z) - a(Y)'F(\overline{X},Z) - u(Z)'F(X,Z) - a(Y)'F(X,\overline{Z}) \quad (3.9)$$

By virtue of equation (3.8) and (3.9), we get

$$(D_X\,'F)(Y,Z) + (DF)(X,Z) = [u(X) + u(Z)]'F(Y,Z) - [u(Y) + u(Z)]'F(X,Z) \quad (3.10)$$

Taking the vector field X,Y,Z orthogonal to U, we get
we get the required result.

Theorem 3.2 : A generalized co-symplectic manifolds admitting quarter symmetric non-metric connection is locally closed with respect to this connection D if and only if it is locally closed with respect to Riemannian connection provided the vector fields X,Y,Z orthogonal to ξ .

Proof : We have

$$X('F(Y,Z) = (D_X\,'F)(Y,Z) + 'F(D_XY,Z) + 'F(Y,D_XZ)$$
$$= (B_X\,'F)(Y,Z) + 'F(B_XY,Z) + 'F(Y,B_XZ)$$

Using (3.1), we get

$$(B_X\,'F)(Y,Z) = (D_X\,'F)(Y,Z) + u(Y)'F(X,Z) + a(X)'F(FY,Z) + u(Z)'F(Y,X) + a(X)'F(Y,FZ) \quad (3.11)$$

from (3.11), we obtained

$$(B_X\,'F)(Y,Z) + (B_Y\,'F)(Z,X) + (B_Z\,'F)(X,Y) = (D_X\,'F)(Y,Z) + (D_Y\,'F)(Z,X) + (D_Z\,'F)(X,Y)$$
$$+ 2u(Y)'F(X,Z) + a(X)\left['F(\overline{Y},Z) + 'F(Y,\overline{Z})\right]$$
$$+ 2u(Z)'F(Y,X) + a(Y)\left['F(\overline{Z},X) + 'F(Z,\overline{X})\right]$$
$$+ 2u(X)\left['F(Z,Y) + F(Z,Y)\right] + a(Z)\left['F(\overline{X},Y) + 'F(X,\overline{Y})\right]$$

Using (2.4)(b) in above, we have

$$(B_X\,'F)(Y,Z) + (B_Y\,'F)(Z,X) + (B_Z\,'F)(X,Y) = (D_X\,'F)(Y,Z) + (D_Y\,'F)(Z,X) + (D_Z\,'F)(X,Y)$$
$$+ 2\left[u(X)'F(Z,Y) + u(Y)'F(X,Z) + u(Z)'F(Y,X)\right]$$

Taking the vector field X,Y,Z orthogonal to U, we get

$$(B_X{}'F)(Y,Z)+(B_Y{}'F)(Z,X)+(B_Z{}'F)(X,Y) \\ =(D_X{}'F)(Y,Z)+(D_Y{}'F)(Z,X)+(D_Z{}'F)(X,Y)=0 \tag{3.12}$$

Theorem 3.3 : A generalized co-symplectic manifolds admitting quarter symmetric non-metric connection satisfies the following relations

i. $(B_{\bar{X}}{}'F)(Y)=(D_{\bar{X}}{}'F)(Y)$

ii. $(B_{\bar{X}}{}'F)(\bar{Y})=(D_{\bar{X}}{}'F)(\bar{Y})$

iii. $N(X,Y)=0$ (Complete integrable) if $D_X{}'F=0$

iv. ${}'H(\bar{X},\bar{Y},\bar{Z})={}'T(\bar{X},\bar{Y},\bar{Z})$

Proof : From (3.1), we have

$$B_XY=D_XY+H(X,Y) \tag{3.13}$$

where

$$H(X,Y)=u(Y)X+a(X)FY$$

for any vector field for $\bar{Y}$, equation (3.13) can be written as

$$(B_XF)(Y)=(D_XF)(Y)-\overline{B_XY}+(\overline{D_XY}-a(X)Y+A(Y)a(X)T \tag{3.14}$$

Operating both side equation (3.13) by

$$\overline{B_XY}-\overline{D_XY}=u(Y)\bar{X}-a(X)Y+a(X)A(Y)T \tag{3.15}$$

Using (3.15) in (3.14), we get

$$(B_X{}'F)(Y)=(D_X{}'F)(Y)-u(Y)\bar{X} \tag{3.16}$$

Barring X,Y and respectively in (3.16) and using (2.2) (a), we get the required the result (i, ii).

Since $(D_X{}'F)(Y)=0$,

Then from (3.16), we get

$$(B_X{}'F)(Y)=-u(Y)\bar{X} \tag{3.17}$$

Barring X and using (2.1)(a), we get

$$(B_{\bar{X}}{}'F)(Y)=u(Y)X-u(Y)A(X)T \tag{3.18}$$

Interchanging X and Y, we get

$$(B_{\bar{Y}}{}'F)(X)=u(X)Y-u(X)A(Y)T \tag{3.19}$$

Operating both side equation (3.17) by F, we get

$$\overline{(B_XF)(Y)}=u(Y)X-u(Y)A(X)T \tag{3.20}$$

Interchanging X and Y we get

$$\overline{(B_YF)(X)}=u(X)Y-u(X)A(Y)T \tag{3.21}$$

Using (3.18),(3.19),(3.20)and(3.21)in (3.7)(i), we get the result (iii).

Finally barring X,Y,Z in (3.5) (ii, iii), we get the result (iv).

Theorem 3.4 : If U is a killing on generalized co-symplectic manifolds with quarter symmetric non-metric connection then

$$(B_X{}'F)(Y,\bar{Z})+(B_Y{}'F)(\bar{Z},X)+(B_{\bar{Z}}{}'F)(X,Y)={}'N(X,Y,Z)-\{u(Y)+u(Z)\}{}'F(\bar{X},Z)$$

Proof : From (3.11) and (2.9) (b), we have

$$\begin{aligned}{}'N(X,Y,Z)-(B_X{}'F)(Y,\bar{Z})-(B_Y{}'F)(X,\bar{Z})-(B_{\bar{Z}}{}'F)(X,Y)&=(D_{\bar{X}}{}'F)(Y,Z)-(D_{\bar{Y}}{}'F)(X,Z)\\ &-(D_{\bar{Z}}{}'F)(X,Y)+u(Y){}'F(\bar{X},Z)+u(Z){}'F(Y,\bar{X})\\ &-u(X){}'F(\bar{Y},Z)-u(Z){}'F(X,\bar{Y})-u(Z){}'F(\bar{Z},X)\end{aligned}$$

$$-u(X)'F(Y,\bar{Z})$$

Again using (2.5) in above equation, we get

$$\begin{aligned}'N(X,Y,Z)-(B_X{}'F)(Y,\bar{Z})-(B_Y{}'F)(X,\bar{Z})-(B_{\bar{Z}}{}'F)(X,Y)&=-u(X)\left[(D_{\bar{Y}}u)(\bar{Z})+(D_{\bar{Z}}u)(Y)\right]\\&+u(Y)\left[(D_{\bar{X}}u)(\bar{Z})+(D_{\bar{Z}}u)(\bar{X})\right]+u(Z)\left[(D_{\bar{Y}}u)(\bar{X})-(D_{\bar{X}}u)(\bar{Y})\right]\\&+\left(u(Y)+u(Z)\right)'F(\bar{X},Z)\end{aligned}$$

Since U is a killing then putting $(D_X u)(Y)+(D_Y u)(x)=0$ in above equation, we obtained

$$\begin{aligned}(B_X{}'F)(Y,\bar{Z})+(B_Y{}'F)(\bar{Z},X)+(B_{\bar{Z}}{}'F)(X,Y)&='N(X,Y,Z)-u(Z)\left[(D_{\bar{Y}}u)(\bar{X})-(D_{\bar{X}}u)(\bar{Y})\right]\\&-\left(u(Y)+u(Z)\right)'F(\bar{X},Z)\end{aligned}\tag{3.22}$$

By virtue of equation (2.7) (b), equation (3.22) will be reduces

$$(B_X{}'F)(Y,\bar{Z})+(B_Y{}'F)(\bar{Z},X)+(B_Z{}'F)(X,Y)='N(X,Y,Z)-\left\{u(Y)+u(Z)\right\}'F(\bar{X},Z)$$

we get the required result.

Theorem 3.5 : A generalized co-symplectic manifold of first class with quarter symmetric non-metric connection satisfy

$$(B_{\bar{\bar{X}}}{}'F)(\bar{Y},\bar{Z})+(B_{\bar{\bar{Y}}}{}'F)(\bar{Z},\bar{X})+(B_{\bar{\bar{Z}}}{}'F)(\bar{X},\bar{Y})=0$$

Proof : From equation (2.5) and (3.11), we get

$$(B_{\bar{X}}{}'F)(Y,Z)=u(Y)\left[(D_{\bar{X}}u)(\bar{Z})+'F(\bar{X},Z)\right]-u(Z)(D_{\bar{X}}u)(\bar{Y})+a(\bar{X})'F(\bar{Y},Z)\tag{3.23}$$

Taking cyclic sum of equation (3.23) in X,Y,and Z we get

$$\begin{aligned}(B_{\bar{X}}{}'F)(Y,Z)+(B_{\bar{Y}}{}'F)(Z,X)+(B_{\bar{Z}}{}'F)(X,Y)&=u(X)\left[(D_{\bar{Z}}u)(\bar{Y})-(D_{\bar{Y}}u)(\bar{Z})\right]\\&+u(Y)\left[(D_{\bar{X}}u)(\bar{Z})-(D_{\bar{Z}}u)(X)\right]\\&+u(Z)\left[(D_{\bar{Y}}u)(\bar{X})-(D_{\bar{X}}u)(Y)\right]\\&+u(Y)'F(\bar{X},Z)+u(Z)'F(\bar{Y},X)\\&+u(X)'F(\bar{Z},Y)\end{aligned}\tag{3.24}$$

Barring X,Y and Z in equation (3.24) and using (2.2)(a), we get

$$(B_{\bar{\bar{X}}}{}'F)(\bar{Y},\bar{Z})+(B_{\bar{\bar{Y}}}{}'F)(\bar{Z},\bar{X})+(B_{\bar{\bar{Z}}}{}'F)(\bar{X},\bar{Y})=0$$

we get the required result.

Theorem 3.6 : An almost contact metric manifold admitting quarter symmetric non-metric connection B is a generalized co-symplectic if

$$(B_X{}'F)(Y,Z)=u(Y)\left[\ (B_X u)(\bar{Z})+2'F(X,Z)-'F(X,\bar{Z})\ \right]+u(Z)\left[2'F(X,Y)-(B_X u)(\bar{Y})+'F(X,\bar{Y})\right]$$

Proof : From equation (2.5) and (3.11), we have

$$(B_X{}'F)(Y,Z)=u(Y)\left[\ (D_X u)(\bar{Z})+'F(X,Z)\ \right]+u(Z)\left['F(Y,X)-(D_X u)(\bar{Y})\right]\tag{3.25}$$

Using (2.4)(b), (3.5)(iv) in (3.25), we obtain

$$(B_X{}'F)(Y,Z)=u(Y)\left[\ (B_X u)(\bar{Z})+2'F(X,Z)-'F(X,\bar{Z})\ \right]+u(Z)\left[2'F(X,Y)-(B_X u)(\bar{Y})+'F(X,\bar{Y})\right]\tag{3.26}$$

we get the required result.

Theorem 3.7 : A quasi-Sasakian manifold is normal if and only if

$$(B_X{}'F)(Y,Z)=u(Y)\left[\ (B_Z u)(\bar{X})-'F(Z,\bar{X})\ \right]+u(Z)\left[(B_{\bar{X}}u)(Y)-2'F(X,Y)-'F(\bar{X},Y)\right]$$

Proof : The necessary and sufficient conditions for a quasi-Sasakin manifold to be normal [11] is

$$(D_X{}'F)(Y,Z)=u(Y)(D_Z u)(\bar{X})+u(Z)(D_{\bar{X}}u)(Y)\tag{3.27}$$

Using (3.11) in (3.27), we get

$$(B_X{}'F)(Y,Z)=u(Y)\left[(D_{\bar{Z}}u)(\bar{X})+'F(X,Z)\right]+u(Z)\left[(D_{\bar{X}}u)(Y)+'F(Y,X)\right]\tag{3.28}$$

By virtue of equation (2.4)(b), (3.5)(iv) and (3.28), we obtain

$$(B_X\,{}'F)(Y,Z)=u(Y)\left[\,(B_Z u)(\bar{X})-{}'F(Z,\bar{X})\,\right]+u(Z)\left[(B_{\bar{X}}u)(Y)-2'F(X,Y)-{}'F(\bar{X},Y)\right]$$

we get the required result.

Theorem 3.8 : A generalized co-symplectic manifold is quasi-Sasakian manifold if

$$(B_X u)(\bar{Z})=(B_Z u)(\bar{X})+2'F(X,Y)$$

where B is the quarter symmetric non-metric connection.

Proof : From (3.11), we have

$$\begin{aligned}(D_X\,{}'F)(Y,Z)+(D_Y\,{}'F)(Z,X)+(D_Z\,{}'F)(X,Y)&=(B_X\,{}'F)(Y,Z)+(B_Y\,{}'F)(Z,X)+(B_Z\,{}'F)(X,Y)\\&\quad-2u(Y)'F(X,Z)-a(X)\left[{}'F(\bar{Y},Z)+{}'F(Y,\bar{Z})\right]\\&\quad-2u(Z)'F(Y,X)-a(Y)\left[{}'F(\bar{Z},X)+{}'F(Z,\bar{X})\right]\\&\quad-2u(X)\left[{}'F(Z,Y)+F(Z,Y)\right]-a(Z)\left[{}'F(\bar{X},Y)+{}'F(X,\bar{Y})\right]\end{aligned}\tag{3.29}$$

By virtue of equation (3.26) and (3.29), we get

$$\begin{aligned}(D_X\,{}'F)(Y,Z)+(D_Y\,{}'F)(Z,X)+(D_Z\,{}'F)(X,Y)&=u(Y)\left[(B_X u)(\bar{Z})-2'F(X,Z)-(B_Z u)(\bar{X})\right]\\&\quad+u(Z)\left[(B_Y u)(\bar{X})-(B_X u)(\bar{Y})-2'F(Y,X)\right]\\&\quad+2u(X)\left[(B_Z u)(\bar{Y})-(B_Y u)(\bar{Z})-2'F(Z,Y)\right]\end{aligned}\tag{3.30}$$

Since the manifold is quasi-Sasakian , therefore

$$(D_X\,{}'F)(Y,Z)+(D_Y\,{}'F)(Z,X)+(D_Z\,{}'F)(X,Y)=0\tag{3.31}$$

From equation (3.30) and (3.31) ,we get

$$(B_X u)(\bar{Z})=(B_Z u)(\bar{X})+2'F(X,Y)$$

we get the required result.

Theorem 3.9 : If the generalized co-symplectic manifold is of first class with respect to Riemannian connection D then it is also first class with respect to the quarter symmetric non-metric connection B and satisfies .

$$(B_X\,{}'F)(Y,Z)=u(Y)\left[\,(B_Z u)(\bar{Z})+2'F(X,Z)-{}'F(X,\bar{Y})\right]-u(Z)\left[(B_{\bar{X}}u)(\bar{Y})+2'F(X,Y)-{}'F(X,\bar{Y})\right]$$

Proof : Barring X and Y in (3.5)(iv) respectively and using(2.3)(a), we have

$$(D_{\bar{X}}u)(Y)=(B_{\bar{Z}}u)(Y)-g(\bar{X},Y)-{}'F(\bar{X},Y)\tag{3.32}$$

and

$$(D_X u)(\bar{Y})=(B_X u)(\bar{Y})-g(X,\bar{Y})-{}'F(X,\bar{Y})\tag{3.33}$$

Adding (3.32), (3.33) and using (2.4)(b), we get

$$(D_{\bar{X}}u)(Y)+(D_X u)(\bar{Y})=(B_{\bar{X}}u)(Y)+(B_X u)(\bar{Y})\tag{3.34}$$

By virtue of (2.7)(a) and (3.34), we have

$$(B_{\bar{X}}u)(Y)=-(B_X u)(\bar{Y})\tag{3.35}$$

Again in similar way, we have

$$(B_X u)(\bar{Y})=(B_Y u)(\bar{X})\tag{3.36}$$

From (3.35) and (3.36), we get

$$(B_X u)(\bar{Y})=-\,(B_{\bar{X}}u)(Y)=(B_Y u)(\bar{X})\tag{3.37}$$

Taking covariant derivative of $FY=\bar{Y}$ with respect to B and using (2.1)(a),(2.2)(a) and (3.11), we get

$$(B_X F)(Y)=(D_X F)(Y)-u(Y)\bar{X}\tag{3.38}$$

Replacing X by U in (3.38) and using (2.1)(a), (2.8)(c), we obtain

$$(B_U F)(Y)=0\tag{3.39}$$

By virtue of equation (2.5), (3.5) (iv) and (3.11), we get

$$(B_X\,{}^{/}F)(Y,Z) = u(Y)\left[\,(B_Z u)(\bar{Z}) + 2\,{}^{/}F(X,Z) - {}^{/}F(X,\bar{Y})\right] - u(Z)\left[(B_{\bar{Y}} u)(\bar{Y}) + 2\,{}^{/}F(X,Y) - {}^{/}F(X,\bar{Y})\right]$$

We get the required result.

References Références Referencias

1. A.Kalam. Mondal, and U.C.De, Some properties of quarter-symmetric metric connection on a Sasakian manifold. Bulletin of mathematical analysis and app.vol.1, Issue3 (2009), 99-108.
2. I.Mihai, and, K. Yano, Quarter-symmetric metric connection and there curvature tensor. Tensor, N.S., 38(1982), 13-18.
3. R.S. Mishra and S.N. Pandey, On quarter symmetric metric f-connections, Tensor, N.S.34 (1980), 1-7.
4. S. Golab, On semi-symmetric and quarter-symmetric linear connection, Tensor.N.S.29 (1975), 249-254.
5. S.C. Rastogi, On quarter-symmetric metric connection, Tensor, 44, 2(1987), 133-141.
6. S. C. Rastogi, On quarter-symmetric metric connection, CR. Acad. Sci. Bulgar, 31(1978),811-814.
7. S. Mukhopadhyay, A.K. Roy and B. Barua, Some properties of quarter symmetric metric connection\ Riemannian manifold. Soochaw J. of math.17, 2 (1991), 205-211.
8. S. C. Biswas, and U. C. De, Quarter-symmetric metric connection in an SP-Sasakian manifold, commn. Fac. sci. Univ. ank. Servies, 46(1997), 49-56.
9. S. Sular, C. Ozugar and U.C. De, Quarter-symmetric metric connection in a Kenmotsu manifold, SUT Journal of mathematics Vol.44, No.2(2008), 297-306.
10. S.K. Yadav and D. L .Suthar, On a quarter symmetric non-metric connection on a Lorentzian Para-cosympletic manifold(communicated for publication).
11. R. S. Mishra, Olmost contact metric manifold, Monograph (I) Tensor Society of India, Lucknow, (1991).

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Evolution of the Universe and Biological Organisms Progressively Involves More Information from the Mathematical World

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Abstract - Three kinds of worlds have been proposed by Roger Penrose, the physical world, the mental world and the mathematical world. The mathematical world may contain relations which do not exist in physical world. It is proposed in this paper that as the evolution of the universe and the biosphere progresses more and more relations from the mathematical world are needed to explain the universe and the biosphere. Specifically, the example from the membrane transporter systems in the prokaryotes and eukaryotes has been taken. It is observed that the membrane transporter systems in the eukaryotes are more complex than in prokaryotes and more and more relations from the mathematical world would be needed to explain these systems in eukaryotes as compared to prokaryotes. This is consistent with the hypothesis proposed in this paper since eukaryotes are considered more advanced than prokaryotes.

EVOLUTION OF THE UNIVERSE AND BIOLOGICAL ORGANISMS PROGRESSIVELY INVOLVES MORE INFORMATION FROM THE MATHEMATICAL WORLD

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Evolution of the Universe and Biological Organisms Progressively Involves More Information from the Mathematical World

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Abstract - Three kinds of worlds have been proposed by Roger Penrose, the physical world, the mental world and the mathematical world. The mathematical world may contain relations which do not exist in physical world. It is proposed in this paper that as the evolution of the universe and the biosphere progresses more and more relations from the mathematical world are needed to explain the universe and the biosphere. Specifically, the example from the membrane transporter systems in the prokaryotes and eukaryotes has been taken. It is observed that the membrane transporter systems in the eukaryotes are more complex than in prokaryotes and more and more relations from the mathematical world would be needed to explain these systems in eukaryotes as compared to prokaryotes. This is consistent with the hypothesis proposed in this paper since eukaryotes are considered more advanced than prokaryotes.

Penrose has proposed three kinds of worlds (Penrose, 1994). The first world proposed is the world of our conscious perceptions. This world contains the mental images of the objects existing in the 'physical world' (see later). In this world our perceptions intermingle with our thoughts and our decisions.

The second world has been proposed to be the physical world. It contains actual physical objects. The third world proposed is the Platonic world of mathematical forms. Besides, number, mathematical relationships etc., it has been proposed to consist of simulations of the objects in the physical world.

As the universe is evolving the mathematical relations needed to explain them are becoming more complex. Similarly as the biological organisms evolve the mathematical relations used to describe them are also becoming more complex. In the mathematical world a large number of relationships exist which may not be reflected in the physical world. It can be possibly inferred from the evolution of the universe and the biological organisms that representation of the mathematical world in the physical world is increasing with the increasing complexity of the universe and the biosphere.

The mathematical relations in the biological world

The mathematical relations in the biological world get more complex as the biological organisms evolve and utilize more from the mathematical world (Fig.1).

Here we take the example of fundamental differences in the membrane transport of prokaryotes and eukaryotes membrane transport systems play important roles in cellular activities and metabolism. Transporters function in several important cellular functions such as environmental sensing and cell communication, excretion of toxic compounds,

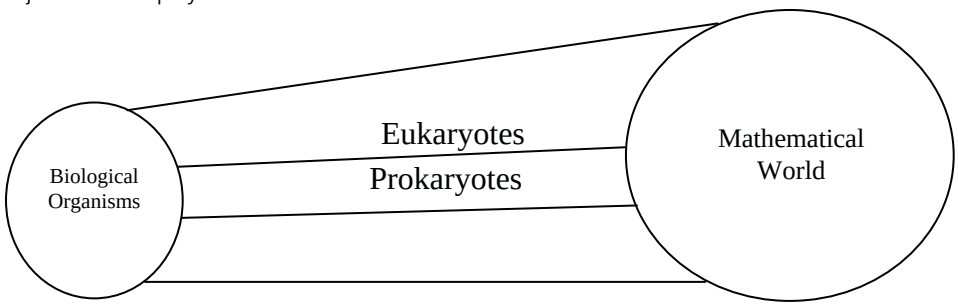

Fig.1 : The mathematical relations in the biological world get more complex as the biological organisms evolve and utilize more from the mathematical world.

maintenance of ion homeostasis and in acquisition of organic nutrients (Saier, 1999). The energy sources in the membrane transporters are chemiosmotic energy in the form of sodium ion or proton electrochemical gradients, phosphoenolpyruvate and adenosine triphosphate. Various transporter systems also differ in their membrane topology, substrate specificities and energy coupling mechanism and substrate specificities (Saier, 2000).

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Efforts have been made to classify the transporters. In this direction the transporter classification system attempts to classify membrane transporter systems according to their mode of transport, substrate specificity, molecular phylogeny and energy coupling mechanisms (Saier, 2000, Saier, 1999, Busch and Saier, 2002, Busch and Saier, 2004). Since transport mode and energy coupling have relatively stable characteristics, they serve as the primary basis of classification of transporters.

There are four major classes of solute transporters in the transport classification system. These are channels, primary (active transporters), secondary transporters and group translocators. Transporters of unknown mechanism or function constitute a distinct class. Channels are energy independent and transport water, specific type of ions, or hydrophilic (small) molecules down an electrical gradient or concentration channels have lower stereospecificity and higher rate of transport than other classes. Primary active transporters couple the transport process to a ATP hydrolysis. Secondary transporters utilize an ion or solute electrochemical gradient. Group translocators modify their substrates during the transport process. Each transporter class is further classified into individual families and subfamilies depending on function, phylogeny, and/or substrate specificity (Saier, 1999). Since the advent of genomic sequencing technologies, the complete sequences of a large number of organisms have been published covering a wide range of species from archaea to human. A large number of additional genome sequencing projects are also currently in progress around the world. An intensive look at transport processes is vital to the understanding of the metabolic capacity in sequenced organisms.

In a study (Ren and Paulsen, 2005) a total of 40,678 transport proteins from 141 species spanning 9 eukaryota, 17 Archaea and 115 eubacteria were predicted. These were classified into 134 families which included 13 unclassified families, 2 phosphotransferase systems and 32 channel protein families. These families are variable in size: some of these families are very large superfamilies with large number members such as the ABC superfamily, which is widely distributed in eukaryota, archaea and eubacteria. Some are small families with only a few members. The distribution of transporter families varies significantly across various phyla. 42 families specific to eukaryotes exist, these are mostly ion channel families existing exclusively in multicellular organisms such as *Homo sapiens, Arabidopsis thaliana* and *Drosophila melanogaster*. These channels are involved in important cellular responses such as maintenance of homeostasis in a multicellular environment, signal transduction and cell communication.

There are 38 transporter families (Ren and Paulsen, 2005) which are specific to prokaryotes, out of these 22 families are specific to eubacteria and 16 occur both in Archaea and eubacteria. There are 41 transporters which exist across all the three domains of living kingdom. This implies that these may be very ancient families. Most of these were found in secondary transporter class. However these families function in the transport of a variety of substrates which includes various cations and anions, nucleotides, carboxylates, sugars, amino acids. 14 families are shared by eubacteria and eukaryota and 16 are shared by Eubacteria and Archaea. Between 2% and 16% of ORFs in prokaryotic and eukaryotes were predicted to encode membrane transport proteins. The eukaryotes , especially the multicellular eukaryotes, display the largest total number of transport proteins, such as Drosophila has 682 proteins, 3.7% of total proteins , Arabidopsis has 882, 3.5% of total proteins, C.elegans has 669 proteins, 4.1% of total proteins and humans have 841, 3.0% of total proteins. However with regard to percentage of total ORFs the transport proteins of eukaryotic species (9.5% plus or minus 2.9%) account for a relatively smaller number of proteins than Archaea (average 6.7 %, plus or minus 2.3%). Groups belonging to same phylogenetic group show variations in the quantity of transport proteins. Organisms with a larger genome size and thus more ORFs generally encode a greater number of transporters (Paulsen et al. 2000, Konstantinidis and Tiedje, 2004). Besides transporters, transcription factors, secondary metabolism genes and regulatory genes also appear to increase with genome size (Konstatinidis and Tiedje, 2004, Cases et al. 2003, Jordan et al. 2001). The following reasons could account for the increased number of transporters in organisms with increasing genome sizes: A. an increased number of distinct transporter families and B. Greater number of paralogs in certain transporter families due to higher degree of expansion or duplication. Prokaryotes display relatively linear relationship between the number of transporter families and the genome size. With the increase in genome size, the rate of increase in number of families per organism is about 8 times greater than average number of paralogs per family. However the expansion of transporter families can only be partially explained by the increase in genome size(Ren and Paulsen, 2005). One of the factors influencing the above mentioned expansion could be strain specific properties and lifestyles.

The single celled eukaryotes such as the yeast appear to show characteristics similar to those of prokaryotes, showing expansions in paralogs and transporter families. By contrast, in plants and animals, the large number of paralogs in certain transporters is a major factor for increase in transporters. For example the Arabidopsis genome encodes 92 paralogs of the MFS and 110 paralogs of the ABC superfamily.

These differences in the relative abundances of distinct transporter families and transporter paralogs reflect basic differences in the transporter needs or

priorities of these organisms (Ren and Paulsen, 2005). A strategy of specialization is possibly being followed by multicellular organisms, with many apparently redundant transporter paralogs. Many of the closely related paralogous transporters are possibly expressed only in certain subcellular localizations or specific tissues, or at specific developmental stages. Many of these transporters in multicellular organisms appear to be involved in signal transduction processes and cell-cell communication. By contrast, the single celled eukaryotes and prokaryotes, with large number of different families of transporters and relatively fewer paralogs appear to emphasize on a strategy of diversification. This is corroborated by the fact that one of the primary roles of membrane transport systems in these organisms is nutrient acquisition. A large diversity of transporter types presumably allows for a broader range of substrate utilization (Ren and Paulsen, 2005). Thus the mathematical relations needed to describe membrane transport in multicellular eukaryotes would be more complex since the transporters in these organisms serve a variety of functions mentioned above. This is in contrast to prokaryotes where the mathematical relations used to elucidate membrane transport would be simpler as most of these transporters though diverse are involved in nutrient transport only.

In the same study (Ren and Paulsen 2005) a wide range of variations have been observed in the relative usage of energy coupling mechanisms to drive transport processes among the eukaryotes and prokaryotes studied. In this study transporters were categorized into five major groups according to energy coupling mechanisms and transport mode: primary transporters, secondary transporters, ion channels, group translocators and unclassified. Primary and secondary transporters are universal, as these are present in all the organisms analyzed in this study. However their percentage among the total transporters varies widely: 12% to 78% for primary carriers and 17 to 80% for secondary carriers. In prokaryotes and unicellular eukaryotes, primary and secondary transporters are the dominant type of transporters. These type of carriers contribute more than 90% of total transporters in the above mentioned organisms. In higher eukaryotic organisms channel proteins make up 12% to 43% of the total transporter proteins.

In contrast to eukaryotes, prokaryotic organisms primarily use primary active transporters, large because of predominant usage of the ABC uptake systems, which are absent in eukaryotes (Dean and Ailikmets, 2001). Organisms with the highest percentage of transporters usually belong to one of the following groups: A. The first group includes organisms that lack an electron transfer chain and a citrate cycle, and therefore proton motif force can be generated in these organisms through indirect means only such as substrate level phosphorylation followed by ATP hydrolysis. ATP is their primary source of energy and is primarily responsible for driving nutrient uptake and maintaining ion homeostasis (Saier, 2000). B. The second group includes photosynthetic organisms with the ability to synthesize ATP via photosynthesis. C. The third group consists of Proteobacteria that have a significant expansion of the ABC superfamily (Konstatinidis and Tiedje, 2004).

The phosphotransferase system is only present in a subgroup of eubacteria, and completely lacking in Archaea and Eukaryota. Channel proteins contribute a relatively smaller percentage of transporters in the prokaryotic species analyzed in the study by Ren and Paulsen. The percentage of channel proteins, however, increases significantly in multicellular eukaryotes. In animals ion channels with communication functions such as in signal transduction or as sensors for external stimuli constitute this group. For example members of the GIC family (Nakanishi and Masu, 1994) and ligand-gated ion channel family (Hong, 1998) are activated by major inhibitory (GABA) and major excitatory (glutamate) neurotransmitters in the brain (Lujan et al. 2005). Some evidence shows that GIC type channels and ion gated channels are expressed predominantly during embryonic and postnatal brain development, while others are expressed predominantly in the postnatal brain (Lujan et al. 2005). In plants about one third of the channel proteins are aquaporins (water channels) (Johansson et al. 2001), a large majority of which show a cell specific expression in root (Javot and Murrel, 2002). The tissue specific expression in multicellular eukaryotes adds another level of complexity to the mathematical relations used to describe membrane transport in eukaryotes, as compared to prokaryotes.

References Références Referencias

1. Busch W, Saier MH Jr (2002) The transporter classification (TC) system, 2002. Crit Rev Biochem Mol Biol 37: 287–337.
2. Busch W, Saier MH (2004) The IUBMB-endorsed transporter classification system. Mol Biotechnol 27: 253–262.
3. Cases I, de Lorenzo V, Ouzounis CA (2003) Transcription regulation and environmental adaptation in bacteria. Trends Microbiol 11: 248.
4. Dean M, Allikmets R (2001) Complete characterization of the human ABC gene family. J Bioenerg Biomembr 33: 475–479.
5. Hong X (1998) Identification of major phylogenetic branches of inhibitory ligand-gated channel receptors. J Mol Evol 47: 323.
6. Javot H, Maurel C (2002) The role of aquaporins in root water uptake. Ann Bot 90: 301–313.
7. Johanson U, Karlsson M, Johansson I, Gustavsson S, Sjovall S, et al. (2001) The complete set of genes encoding major intrinsic proteins in *Arabidopsis* provides a framework for a new nomenclature for

major intrinsic proteins in plants. Plant Physiol 126: 1358–1369.
8. Jordan IK, Makarova KS, Spouge JL, Wolf YI, Koonin EV (2001) Lineage-specific gene expansions in bacterial and archaeal genomes. Genome Res 11: 555–565
9. Konstantinidis KT, Tiedje JM (2004) Trends between gene content and genome size in prokaryotic species with larger genomes. Proc Natl Acad Sci U S A 101: 3160–3165
10. Lujan R, Shigemoto R, Lopez-Bendito G (2005) Glutamate and GABA receptor signalling in the developing brain. Neuroscience 130: 567–580
11. Nakanishi S, Masu M (1994) Molecular diversity and functions of glutamate receptors. Annu Rev Biophys Biomol Struct 23: 319–348.
12. Penrose, R. (1994) Shadows of the mind, Oxford University Press Ren Q, Paulsen IT (2005) Comparative Analyses of Fundamental Differences in Membrane Transport Capabilities in Prokaryotes and Eukaryotes. PLoS Comput Biol 1(3): e27.
13. Saier MH Jr (1999) Classification of transmembrane transport systems in living organisms. In: VanWinkle L,editor. Biomembrane transport. San Diego : Academic Press. pp. 265–276.
14. Saier MH Jr (2000) A functional-phylogenetic classification system for transmembrane solute transporters. Microbiol Mol Biol Rev 64: 354–411.
15. Saier MH Jr (1999) A functional-phylogenetic system for the classification of transport proteins. J Cell Biochem 75(Suppl 32): 84–94.

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On Hypergeometric Series Identities

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Abstract - H.Exton [J.Comput.Appl.Math.88(1997)269-274] obtained a quite general transformation involving hypergeometric functions by elementary manipulation of series, some of these results are erroneous. Four erroneous results have been corrected by Medhat A. Rakha et al, and made a remark on other three results in [4]. Here, we respond the remark and confirm that other three results are also erroneous.

Keywords : *Gauss's second theorem, Vandermonde's theorem, Dixon's theorem.*

GJSFR Classification: *33C20; 68Q40*

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On Hypergeometric Series Identities

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Abstract - H.Exton [J.Comput.Appl.Math.88(1997)269-274] obtained a quite general transformation involving hypergeometric functions by elementary manipulation of series, some of these results are erroneous. Four erroneous results have been corrected by Medhat A. Rakha et al, and made a remark on other three results in [4]. Here, we respond the remark and confirm that other three results are also erroneous.

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I. Introduction

Exton in [3], discovered a number of hypergeometric identities, which were previously not recorded in the literature. He established them by applications of Gauss's second summation theorem and other known hypergeometric theorems. Medhat A. Rakha et al, observed that there are errors in four results of Exton's [3; p.272 {(2.5) and (3.1)}, and p.273 {(3.2) and(3.3)}], and they obtained correct forms for the same. They further observed that the result present by equation (3.7) is not new as the right hand sides of the results presented by equations (3.6) and (3.7) are same and yields a simple identity between two 2F1(12) functions. They also observed that Exton's results given in [3; p.272(2.9), p.273 {(3.4) and (3.6)}] are correct. They cannot derive the Exton's results given in [3; p.273(3.5), p.274 {(3.8) and (3.9)}] nor could verify them numerically, but remarked that these three results therefore should be taken as incorrect [4]. The purpose of this note is, as- (i). To present four erroneous results [3; p.272 {(2.5) and (3.1)}, and p.273 {(3.2) and(3.3)}], along with their correct form given in [4]. (ii). To present two correct results [p.273 {(3.6) and (3.7)}] in a single equation. (iii). To examine the three erroneous results [3; p.273(3.5), p.274 {(3.8) and (3.9)}], and confirm the same.

II. Preliminaries

The generalized hypergeometric function is defined in [1, p.41], as

$$ {}_pF_q\left[\begin{array}{c} a_1, a_2, \cdots, a_p \ ; \\ \\ b_1, b_2, \cdots, b_q \ ; \end{array} x\right] = \sum_{n=0}^{\infty} \frac{(a_1)_n (a_2)_n \cdots (a_p)_n}{(b_1)_n (b_2)_n \cdots (b_q)_n} \frac{x^n}{n!} \tag{1} $$

where the Pochhammer symbol is defined as $(a)_n = (a, n) = \frac{\Gamma(a+n)}{\Gamma(a)}$. If $q = p$, the series given by equation (1) is converges for $|x| < \infty$, but when $q = p - 1$, then the series is convergence for $|x| < 1$. But, when only one of the parameters a_j is a negative integer or zero, then the series given by equation (1.1) terminates and always converges since it becomes a polynomial in x of degree −aj . Exton's investigation is based on following general transformation, which he obtained by techniques of elementary manipulation of of series [3, p. 270 (1.8)].

$$ \sum_{n=0}^{\infty} \frac{(c_1)_n (c_2)_n \cdots (c_p)_n}{(d_1)_n (d_2)_n \cdots (d_q)_n} \frac{(\frac{1}{2}a)_n (-2x)^n}{n!} \ {}_{p+1}F_q\left[\begin{array}{c} a+2n, c_1+n, \cdots, c_p+n \ ; \\ \\ d_1+n, \cdots, c_q+n \ ; \end{array} x\right] $$

$$ = {}_{2p+1}F_{2q}\left[\begin{array}{c} \frac{1}{2}a, \frac{1}{2}c_1, \frac{1}{2}c_2, \cdots, \frac{1}{2}c_p, \frac{1}{2}(1+c_1), \frac{1}{2}(1+c_2), \cdots, \frac{1}{2}(1+c_p) \ ; \\ \\ \frac{1}{2}d_1, \frac{1}{2}d_2, \cdots, \frac{1}{2}d_q, \frac{1}{2}(1+d_1), \frac{1}{2}(1+d_2), \cdots, \frac{1}{2}(1+d_q) \ ; \end{array} -4^{p-q}x^2\right] \tag{2} $$

If one of the numerator parameters cj equals a negative integer, the resulting equation (2) involves finite sums and convergence at $x = \pm 1$ is assured.

Gauss's second summation theorem:[3, p.270(1.6)]

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$$ {}_2F_1\left[\begin{array}{ll} a, & b \\ \frac{1}{2}(a+b+1) & ; \end{array}\ \begin{array}{l} ; \\ \frac{1}{2} \end{array}\right] = \frac{\Gamma(\frac{1}{2})\Gamma(\frac{a+b+1}{2})}{\Gamma(\frac{a+1}{2})\Gamma(\frac{b+1}{2})} \tag{3} $$

Vandermonde's theorem:[3, p.270(1.9)]

$$ {}_2F_1\left[\begin{array}{ll} a, -n & ; \\ c & ; \end{array}\ \begin{array}{l} \\ 1 \end{array}\right] = \frac{(c-a,n)}{(c,n)} = \frac{\Gamma(c)\Gamma(c-a+n)}{\Gamma(c+n)\Gamma(c-a)} \tag{4} $$

Kummer's theorem:[3, p.271(1.10)]

$$ {}_2F_1\left[\begin{array}{ll} a, & b \\ 1+a-b & ; \end{array}\ \begin{array}{l} ; \\ -1 \end{array}\right] = \frac{\Gamma(1+a-b)\Gamma(1+\frac{a}{2})}{\Gamma(1+a)\Gamma(1-b+\frac{a}{2})} \tag{5} $$

Dixon's theorem:[3, p.271(1.11)]

$$ {}_3F_2\left[\begin{array}{lll} a, & b, & -n \\ 1+a-b, & 1+a+n; & \end{array}\ \begin{array}{l} ; \\ 1 \end{array}\right] = \frac{[(1+a,n)(1+\frac{a}{2}-b,n)]}{[(1+\frac{a}{2},n)(1+a-b,n)]} $$

$$ = \frac{\Gamma(1+a-b)\Gamma(1+a-n)\Gamma(\frac{a}{2}+1)\Gamma(\frac{a}{2}+n-b+1)}{\Gamma(1+a)\Gamma(1+a-b+n)\Gamma(\frac{a}{2}+1-b)\Gamma(\frac{a}{2}+1+n)} \tag{6} $$

Erroneous results in [3] and corresponding corrected results in [4]

In [3, p.272 (2.5)], a result is recorded, as

$$ \frac{(d-a,N)}{(d,N)}\ {}_3F_2\left[\begin{array}{lll} -N & , \frac{a}{2} & , 1+a-d \\ \frac{1}{2}+\frac{a}{2}-\frac{d}{2}-\frac{N}{2}, & 1+\frac{a}{2}-\frac{d}{2}-\frac{N}{2}; & \end{array}\ \begin{array}{l} ; \\ \frac{1}{2} \end{array}\right] $$

$$ = {}_3F_2\left[\begin{array}{ll} -\frac{N}{2}, \frac{1}{2}-\frac{N}{2} & ; \\ \frac{1}{2}+\frac{a}{2}\frac{d}{2}, \frac{1}{2}+\frac{d}{2}; & \end{array}\ \begin{array}{l} \\ -1 \end{array}\right] \tag{7} $$

this result has been corrected and recorded in [4], as

$$ \frac{(b-a)_N}{(b)_N}\ {}_3F_2\left[\begin{array}{lll} -N & , \frac{1}{2}a & , 1+a-b \\ \frac{1}{2}(1+a-b-N), & \frac{1}{2}(2+a-b-N); & \end{array}\ \begin{array}{l} ; \\ \frac{1}{2} \end{array}\right] $$

$$ = {}_3F_2\left[\begin{array}{ll} \frac{1}{2}N, \frac{1}{2}-\frac{1}{2}N, \frac{1}{2}a & ; \\ \frac{1}{2}b, \frac{1}{2}+\frac{1}{2}b & ; \end{array}\ \begin{array}{l} \\ -1 \end{array}\right] \tag{8} $$

In [3, p.272 (3.1)], a result is recorded, as

$$ \frac{(1+a,N)}{(1+\frac{a}{2})}\ {}_2F_1\left[\begin{array}{ll} \frac{a}{2}, -N & ; \\ \frac{1}{2}+\frac{a}{2} & ; \end{array}\ \begin{array}{l} \\ -\frac{1}{2} \end{array}\right] = {}_3F_2\left[\begin{array}{lll} \frac{a}{2}, & -\frac{N}{2}, \frac{1}{2}-\frac{N}{2} & ; \\ \frac{1}{2}+\frac{a}{2}+\frac{N}{2}, & 1+\frac{a}{2}+\frac{N}{2}; & \end{array}\ \begin{array}{l} \\ -1 \end{array}\right] \tag{9} $$

this result has been corrected and recorded in [4], as

$$\frac{(1+a)_N}{(1+\frac{1}{2}a)_N}\ {}_2F_1\left[\begin{matrix} -N, \frac{1}{2}a; \\ \frac{1}{2}+\frac{1}{2}a; \end{matrix}\ \frac{1}{2}\right] = {}_3F_2\left[\begin{matrix} \frac{1}{2}N, \frac{1}{2}-\frac{1}{2}N, \frac{1}{2}a \\ \frac{1}{2}(1+a+N), \frac{1}{2}(2+a+N); \end{matrix}\ ; \ -1\right] \tag{10}$$

In [3, p.273 (3.2)], a result is recorded, as

$$\frac{(1+a,N)(1+\frac{a}{2}-b,N)}{(1+\frac{a}{2},N)(1+a-b,N)}\ {}_3F_2\left[\begin{matrix} b\ , \frac{a}{2}, -N \\ \frac{1}{2}+\frac{a}{2}, b-\frac{a}{2}-N; \end{matrix}\ ; \ \frac{1}{2}\right]$$

$$= {}_5F_4\left[\begin{matrix} \frac{b}{2}, \frac{b}{2}+\frac{1}{2}, \frac{a}{2}, -\frac{N}{2}, \frac{1}{2}-\frac{N}{2} \\ \frac{1}{2}+\frac{a}{2}-\frac{b}{2}, \frac{1}{2}+\frac{a}{2}-\frac{b}{2}, \frac{1}{2}+\frac{a}{2}+\frac{N}{2}, 1+\frac{a}{2}+\frac{N}{2}; \end{matrix}\ ; \ -1\right] \tag{11}$$

this result has been corrected and recorded in [4], as

$$\frac{(1+a)_N(1+\frac{1}{2}a-b)_N}{(1+\frac{1}{2}a)_N(1+a-b)_N}\ {}_3F_2\left[\begin{matrix} -N\ , \frac{1}{2}a, b \\ \frac{1}{2}+\frac{1}{2}a, b-\frac{1}{2}a-N; \end{matrix}\ ; \ \frac{1}{2}\right]$$

$$= {}_5F_4\left[\begin{matrix} -\frac{1}{2}N,\ \frac{1}{2}-\frac{1}{2}N,\ \frac{1}{2}a,\ \frac{1}{2}b,\ \frac{1}{2}+\frac{1}{2}b \\ \frac{1}{2}(1+a-b), \frac{1}{2}(2+a-b), \frac{1}{2}(1+a+N), \frac{1}{2}(2+a+N); \end{matrix}\ ; \ -1\right] \tag{12}$$

In [3, p.273 (3.3)], a result is recorded, as

$$(1+a,N)/\left(\frac{1}{2}+\frac{a}{2},N\right) \times {}_1F_0\left[-N; -; \left(\frac{1}{2}\right)^N\right] = (1+a,N)/\left[2^N\left(\frac{1}{2}+\frac{a}{2},N\right)\right]$$

$$= {}_4F_3\left[\begin{matrix} 1+\frac{a}{4}, \frac{a}{2}, -\frac{N}{2}, \frac{1}{2}-\frac{N}{2} \\ \frac{a}{4}, \frac{1}{2}+\frac{a}{2}+\frac{N}{2}, 1+\frac{a}{2}+\frac{N}{2}; \end{matrix}\ ; \ -1\right] \tag{13}$$

this result has been corrected and recorded in [4], as

$$\frac{(1+a)_N}{(\frac{1}{2}+\frac{1}{2}a)_N}\ {}_1F_0\left[\begin{matrix} -N\ ; \\ -\quad ; \end{matrix}\ \frac{1}{2}\right] = \frac{2^{-N}(1+a)_N}{(\frac{1}{2}+\frac{1}{2}a)_N}$$

$$= {}_4F_3\left[\begin{matrix} -\frac{1}{2}N,\ \frac{1}{2}-\frac{1}{2}N,\ \frac{1}{2}a, 1+\frac{1}{4}a \\ \frac{1}{4}a, \frac{1}{2}(1+a+N), \frac{1}{2}(2+a+N); \end{matrix}\ ; \ -1\right] \tag{14}$$

In [4], it is also observed that right hand sides of both equations in [3, p.273 {(3.6) and (3.7)}] are same, here we are writing both equations in joint form, as

$$\frac{(1+a,N)}{(1+a-b,N)} \times {}_2F_1\left[\begin{matrix} b, -N; \\ \frac{1}{2}+\frac{a}{2}; \end{matrix}\ \frac{1}{2}\right]$$

$$= \frac{[(\frac{1}{2}+\frac{a}{2}-b,N)(1+a,N)]}{[(\frac{a}{2}+\frac{1}{2},N)(1+a-b,N)]}{}_2F_1\left[\begin{matrix} b, -N \\ \frac{1}{2}+b-\frac{a}{2}-N; \end{matrix}\ ; \ \frac{1}{2}\right]$$

$$= {}_6F_5\left[\begin{array}{c} 1+\frac{a}{4}, \quad \frac{b}{2}, \quad \frac{b}{2}+\frac{1}{2}, \quad \frac{a}{2}, \quad -\frac{N}{2}, \quad \frac{1}{2}-\frac{N}{2} \quad ; \\ \frac{a}{4}, \frac{1}{2}+\frac{a}{2}-\frac{b}{2}, 1+\frac{a}{2}-\frac{b}{2}, \frac{1}{2}+\frac{a}{2}+\frac{N}{2}, 1+\frac{a}{2}+\frac{N}{2}; \end{array} -1\right] \tag{15}$$

Examination of three erroneous results in [3]

In this section, we response the remark of Medhat A. Rakha et al on Exton's three results given in [3; p.273(3.5), p.274 {(3.8) and (3.9)}], and confirmed the same.

In [3, p.273 (3.5)], a result is recorded, as

$$\frac{[(a-2b,N)(1+\frac{a}{2}-b,N)(-b,N)]}{[(\frac{a}{2}-b,N)(-2b,N)(1+a-b,N)]}\times$$

$$\times {}_5F_4\left[\begin{array}{c} \frac{b}{2}, \quad \frac{b}{2}+\frac{1}{2}, \quad \frac{a}{2}, \quad -\frac{N}{2}, \quad \frac{1}{2}-\frac{N}{2} \quad ; \\ \frac{1}{2}+\frac{a}{2}-\frac{b}{2}, 1+\frac{a}{2}-\frac{b}{2}, \frac{1}{2}+\frac{a}{2}+\frac{N}{2}, 1+\frac{a}{2}+\frac{N}{2}; \end{array} -1\right]$$

$$= {}_5F_4\left[\begin{array}{c} \frac{b}{2}, \quad \frac{b}{2}+\frac{1}{2}, \quad \frac{a}{2}, \quad -\frac{N}{2}, \quad \frac{1}{2}-\frac{N}{2} \quad ; \\ \frac{1}{2}+\frac{a}{2}-\frac{b}{2}, 1+\frac{a}{2}-\frac{b}{2}, \frac{1}{2}+\frac{a}{2}+\frac{N}{2}, 1+\frac{a}{2}+\frac{N}{2}; \end{array} -1\right] \tag{16}$$

We verified this result using computer programming languages Octave, Matlab and Mathematica, and confirmed that it is a erroneous result.

In [3, p.274 (3.8)], a result is recorded, as

$$\frac{[(a-2b,N)(-b,N)]}{[(1+a-b,N)(-2b,N)]}\times$$

$$\times {}_6F_5\left[\begin{array}{c} 1+\frac{a}{2}, \quad b, \quad \frac{1}{3}+\frac{2b}{3}-\frac{N}{3}, \quad \frac{2}{3}+\frac{2b}{3}-\frac{N}{3}, \quad 1+\frac{2b}{3}-\frac{N}{3}, \quad -N; \\ 1+2b+N, 1-a+2b-N, \frac{1}{2}+2b-\frac{N}{2}, 1+\frac{b}{2}-\frac{N}{2}, \frac{1}{2}+b; \end{array} \frac{27}{8}\right]$$

$$= {}_6F_5\left[\begin{array}{c} 1+\frac{a}{4}, \quad \frac{b}{2}, \quad \frac{1}{2}+\frac{b}{2}, \quad \frac{a}{2}, \quad -\frac{N}{2}, \quad \frac{1}{2}-\frac{N}{2}; \\ \frac{a}{4}, \frac{1}{2}+\frac{a}{2}-\frac{b}{2}, 1+\frac{a}{2}-\frac{b}{2}, \frac{1}{2}+b+\frac{N}{2}, 1+b+\frac{N}{2}; \end{array} -1\right] \tag{17}$$

We verified this result using computer programming languages Octave, Matlab and Mathematica, and confirmed that it is a erroneous result.

In [3, p.274 (3.9)], a result is recorded, as

$$\frac{[(a-2b,N)(\frac{1}{2}+\frac{a}{2}-b,N)(-b-1,N)]}{[(1+a-b,N)(\frac{a}{2}-\frac{1}{2}-b,N)(-2b-1,N)]}\times$$

$$\times {}_8F_7\left[\begin{array}{c} 1+\frac{a}{2}, \ b, \ 2+b, \ \frac{3}{2}-\frac{a}{2}+b-N, \ \frac{2}{3}+\frac{2b}{3}-\frac{N}{3}, \ 1+\frac{2b}{3}-\frac{N}{3}, \ \frac{4}{3}+\frac{2b}{3}-\frac{N}{3}, -N; \\ 3+2b, \ 2+2b-a-N, \frac{1}{2}+b-\frac{a}{2}-N, 1+\frac{b}{2}-\frac{N}{2}, \ \frac{3}{2}+\frac{b}{2}-\frac{N}{2}, \ 1+b, \frac{3}{2}+b; \end{array} \frac{27}{8}\right]$$

$$= {}_6F_5\left[\begin{array}{c} 1+\frac{a}{4}, \quad \frac{b}{2}, \quad \frac{b}{2}+\frac{1}{2}, \quad \frac{a}{2}, \quad -\frac{N}{2}, \quad \frac{1}{2}-\frac{N}{2}; \\ \frac{a}{4}, \frac{1}{2}+\frac{a}{2}-\frac{b}{2}, 1+\frac{a}{2}-\frac{b}{2}, \frac{1}{2}+\frac{a}{2}+\frac{N}{2}, 1+\frac{a}{2}+\frac{N}{2}; \end{array} -1\right] \tag{18}$$

We verified this result using computer programming languages Octave, Matlab and Mathematica, and confirmed that it is a erroneous result.

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References Références Referencias

1. L.J. Slater; Generalized hypergeometric functions, *Cambridge University Press, London* 1966.
2. H. Exton; Multiple hypergeometric functions*, Halsted, New York* 1976.
3. H. Exton; New hypergeometric identities arising from Gauss's second summation theorem, *J. Comput. Appl. Math*.88(1997) 269-274.
4. Medhat A. Rakha et al; Comments on "*New hypergeometric identities arising from Gauss's second summation theorem*", Miskolc Mathematical Notes, accepted for publication 2011.

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- Two Column with Equal Column with of 3.38 and Gaping of .2
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- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
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Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

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

Results:

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

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

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

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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