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Influence of Time and Different Methods of Forcing on Citrus Scion Growth in the Nursery

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Abstract

Field trials were conducted between 1996 and 1999 to evaluate the effects of time and different methods of forcing on citrus budlings production. The purpose was to reduce the nursery period and also increase the production of citrus budlings. The forcing time were 1. No forcing. 2. Forcing immediately. 3. One week. 4. Two weeks. 5. Three weeks. 6. Four weeks 7. Five weeks and 8. Six weeks after budding. While the different methods of forcing included 1. Bending 2. Looping and 3. Complete cutting back. The experimental analysis involved analysis of variance (ANOVA).

Results showed that time of forcing affected percentage budsurvival. Five and six weeks forcing periods were significantly superior to forcing immediately after budding. There were interactions between forcing period and method of forcing for five weeks forcing period and bending method to produce significant effect on percentage bud survival over other interaction combinations. Observations on the later growth revealed that forcing three weeks and above increase scion number of leaves, while four and five weeks of forcing improved scion length of budlings. Bending method of forcing had better growth attributes in number of leaves, scion length and diameter than the rest forcing methods. Twenty-four weeks after budding, bending forcing method had 41.6cm scion length, a value more than the minimum 40cm recommended for citrus budling field planting. There were interactions between four weeks forcing period and bending method. Also five weeks forcing period combined with cutting back forcing method had significant values on scion length.

In this study five weeks period of forcing increased percentage seedling survival, while this same treatment and four weeks forcing period reduced the nursery period of budling production. Bending method of forcing was best for improving bud survival and growth of citrus budlings.

1. Introduction

The food security strategy by the Federal Government of Nigeria to move from oil dependent economy has led to the awareness of the need for increase fruit production. Citrus is among the high priority fruit crops listed to boost the economy in the non-oil sector. Internationally, it was regarded as one of

the top three cultivated fruit crops along side with grapevine and banana (Aubert and Vullin, 1998). Adewale *et. al*, 1996 identified citrus as one of the most cultivated fruit crop in south western Nigeria. One of the problems limiting increase citrus production is availability of improved planting materials. The early plantings are from seeds with long gestation period, low yield and poor fruit quality, susceptible to pest and diseases and thorny nature making citrus management difficult. Vegetative propagation of citrus through budding has been able to solve many of the problems encounter through propagation from seeds. Many factors affect budding success in citrus and the choice of budding technique to adopt is usually location specific, technology available and skill of budders. (Auber and Vullin, 1998. Olaniyan *et al*, 2003). Some of these factors include soil moisture, age/size of the rootstock, temperature, rootstock and scion compatibility, budding time/season, height of budding, wrapping materials, forcing methods and time of forcing. Forcing is a post budding operation employed in the production of citrus budded seedlings in the nursery. Its physiological basis is on the destruction of the apical dominance of the rootstock terminal stem and thus enabling growth processes to set out in the scion. If the apical dominance of the rootstock is not disturbed or destroyed, the bud success will be low and scion growth will be dormant or delayed (Young and Saule,1978). Three types of forcing are in use by citrus nursery farmers they are "Bending" "Looping" and "Topping" (Young and Crocker, 1998). There is little agreement on which forcing method is most suitable for any two given locations, Auber and Vullin (1998) reported that in Mediterranean climates Cut/Topping type of forcing is preferred over looping which is more adapted to the tropical climates of South America, Asia and Africa. In Nigeria cutting/.topping forcing is most commonly used by fruit nursery farmers (Olaniyan *et. al* 2003), however in his work he found out "Bending" method of forcing to perform better than "cutting" method. Also time of forcing is also an important factor for development of scion, Young and Crocker (1998) recommended 3 to 4 weeks after budding for the sub-tropical regions however he stated that it could be longer for the tropical regions. Untimely forcing may result in total failure of the budlings or delayed scion growth. The best time of forcing is therefore necessary for a good nursery citrus programme. The aim of this study was to identify the best type of forcing and the most appropriate time of forcing suitable for Sweet orange scion development in Ibadan tropical rainforest region of Nigeria.

Materials and Methods

The study site was at the fruit nursery of the National Horticultural Research Institute (NIHORT) Head Quarters in Ibadan. The site lies between longitudes $3^{o}50'$ and $3^{o}52'$ East and Latitude $7^{o}23'$and $7^{o}25'$ North. The soils in the experimental area belong to the main soil series of Egbeda, Olorunda and Iwo (Jaiyeola, 1974). The area has wet season with high rainfall, from April to October and the dry season with low rainfall is from December to February with annual rainfall of 1280mm. The maximum temperature range is about 27. $9^{o}C$ – $37.7^{o}C$ and minimum temperature range is about $20.0^{o}C$ – $22.8^{o}C$. There is a wide range in temperature during the harmattan between December and February, with relatively cold late evenings and early morning and exceptionally hot noon. Relative humidity of NIHORT area is fairly high with ranges of about 73-87%, 38 – 47% and 83-95% at 09hrs, 15hrs and 21hrs respectively. The weather conditions prevailing during the period of the experiment is presented in Table 1.

Table 1: Prevailing Weather Conditions at the Experimental site during the period of the experiment (1997 – 1999).

1997	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct.	Nov	Dec.
R. Humidity (%)	80	52	74	81	80	86	87	88	84	84	85	78
Air Temp. (%)	27.0	27.0	28.0	27.2	27.0	26.0	25.0	24.4	26.0	27.0	27.0	27.0
Sunshine Hours	6.2	4.3	4.2	6.2	6.1	4.0	2.8	2.0	4.0	5.6	4.8	5.4
Evaporation (mm)	4.6	5.5	5.0	4.4	4.0	2.7	2.4	3.9	4.3	4.2	42	4.3
Total Rainfall (mm)	9.6	1.2	85.8	215.6	141.5	205.1	53.0	109.3	188.4	188.4	66.3	8.7
1998												
R. Humidity (%)	58	68	65	75	81	82	86	85	84	85	80	77
Air Temp. (%)	26.0	29.0	30.0	30.0	28.1	27.0	25.2	25.0	26.0	27.0	28.1	26.0
Sunshine Hours	5.3	4.1	4.9	6.2	6.8	5.7	1.9	2.4	2.6	5.1	7.4	5.7
Evaporation (mm)	5.2	6.3	7.0	6.1	4.0	5.8	6.2	3.5	4.2	3.8	5.1	4.9
Total Rainfall (mm)	0.0	0.3	14.6	77.0	192.5	120.5	78.4	68.0	249.7	119.6	67.4	26.0
1999												
R. Humidity (%)	77	77	83	81	80	82	86	86	86	85	83	73
Air Temp. (%)	27.0	28.0	28.0	28.0	28.0	27.0	25.3	25.0	25.0	26.0	27.1	27.0
Sunshine Hours	8.0	6.3	6.5	5.0	5.9	4.7	3.2	2.1	2.4	4.1	6.8	6.3
Evaporation (mm)	4.8	5.9	5.3	5.1	5.1	4.7	2.9	2.8	3.2	4.0	4.6	5.2
Total Rainfall (mm)	0.0	78.5	97.2	155.4	164.5	320.4	264.5	146.3	216.0	355.3	56.8	0.5

Source: Meteorological Section National Horticultural Research Institute, Ibadan.

In two separate field nursery experiments between 1996 and 1999, Twelve (12) months old Cleopatra mandarin rootstock seedlings transplanted 40 x 30cm in staggered spacing were budded with scions of Agege 1 using shield budding method in 1997 and 1999. Eight periods (time) of forcing and three forcing treatment methods were employed in a 8 x 3 factorial arrangement in a randomized complete block design and replicated four times. The plot size was 2.0m x 2.0m comprising 36seedling for each treatment. The eight periods (time) of forcing were 1. No forcing, 2, Forcing immediately, 3. One week forcing. 4. Two weeks forcing, 5. Three weeks forcing , 6. Four weeks, 7. Five weeks after budding and 8. Six weeks forcing after budding. The three forcing methods were: complete cutting back/topping (CCB), Looping/partial cutting back ½ - ⅔ of the stem and bending and tying (B/T). Data were collected on percent scion survival. Later growth recorded included number of leaves, scion length and diameter at two weeks interval. Statistical analysis of variance (ANOVA) was performed on all the data and the means were separated by least significant difference (LSD at $P<0.05$).

Results and Discussions

Delayed forcing periods of five, six and no forcing had significant effect on percent bud survival over forcing immediately, eight weeks after budding (Table 2). There was no significant difference in the percent bud survival among forcing immediately and up to forcing four weeks after budding. Bending and tying method of forcing was superior in percent bud survival than looping forcing method. There were interactions between forcing periods and method of forcing especially for five weeks forcing period, and bending and tying method to produce significant effect on bud survival over many of the treatments combinations (Table 2).

Table 2: Effect of methods and time of forcing on percent (%) bud survival of sweet Orange seedling eight weeks after budding in the nursery

Time of forcing weeks	Method of forcing			Time of forcing means
	CCB	L	B/T	
No forcing	76.20	76.21	72.71	75.04
Forcing immediately	60.96	54.82	67.90	61.23
One week	64.36	60.43	62.31	62.37
Two weeks	59.80	56.00	73.61	63.14
Three weeks	67.10	67.35	77.77	70.74
Four weeks	66.63	68.45	74.40	69.83
Five weeks	73.77	69.32	81.05	74.71
Six weeks	76.16	7.00	77.00	74.39
Methods of forcing means	68.12	65.32	73.43	74.39

	Forcing methods	Time of forcing
Cv%	14.42	18.12
LSD (P=0.05)	6.37	12.78

Forcing methods x time of forcing
CV% = 16.22
LSD (P=0.05) = 12.78
CCB = Complete cutting back, L = Looping, BT = Bending and tying.

On the scion later growth, scion length was significantly influenced by the time of forcing from twelve weeks after budding (Table 3), late forcing from four weeks after budding improved scion length. Five weeks forcing period stood out though not significantly superior to four and six weeks forcing period. Scion diameter was influenced by time of forcing at twenty-four weeks after budding, there were no significant differences between no forcing, forcing immediately, one and two weeks forcing periods. Forcing time of five weeks enhanced scion diameter, twenty four weeks after budding than any of the above mentioned forcing periods (Table 3). Late forcing also affected number of leaves produced twenty four weeks after budding, three weeks forcing and above were significantly superior influencing leaf production to earlier forcing periods including no forcing also (Table 3). Bending and tying method of forcing influenced growth variables of Agege 1 Sweet orange scion in the nursery. Scion length, scion diameter and number of leaves recorded using Bending and tying method of forcing were significantly superior to looping and topping /cutting back forcing methods (Table 4). Table 5 shows interaction between time of forcing and methods of forcing twenty-four weeks after budding. There were interactions among late forcing periods from three weeks forcing period and the different methods of forcing.

Table 3: Influence of time of forcing on Scion growth of Sweet orange (Citrus sinensis (L) Osbeck. Agege 1) seedlings in the nursery.

Time of forcing	Scion length (cm)				Scion diameter				No. of leaves			
	6	12	18	24	6	12	18	24	6	12	18	24
No forcing	6.00	22.09	27.08	32.44	0.18	0.28	0.29	0.40	2.00	10.13	16.34	21.31
Forcing immediately	5.14	18.24	23.51	30.36	0.16	0.25	0.26	0.28	3.17	11.42	17.79	20.19
One week	4.95	22.90	28.48	34.26	0.18	0.23	0.26	0.31	4.08	11.75	20.74	25.20
Two weeks	7.13	22.51	27.74	34.62	0.19	0.28	0.36	0.42	6.01	10.44	22.55	27.30
Three weeks	5.48	24.50	29.50	39.28	0.23	0.28	0.40	0.53	4.62	10.75	26.88	35.70
Four weeks	9.12	28.00	36.62	43.12	0.21	0.27	0.44	0.54	7.81	12.75	24.10	34.70
Five weeks	8.20	32.61	38.32	45.33	0.20	0.27	0.45	0.62	5.75	13.88	26.2	37.70
Six weeks	8.04	30.82	36.61	42.00	0.22	0.28	0.44	0.55	4.04	11.88	24.20	33.80
LSD (P=0.05)	ns	5.72	7.31	3.27	ns	ns	ns	0.18	ns	ns	ns	6.3

Table 4: Influence of different methods of forcing on the growth of Sweet orange (Citrus Sinensis (L.) Osbeck Cv. Agege 1) seedling in the nursery

	Scion length (cm)				Weeks after budding Scion diameter				No. of leaves			
	6	12	18	24	6	12	18	24	6	12	18	24
Complete cutting back	9.66	19.53	25.92	35.22	0.14	0.22	0.35	0.49	7.78	13.77	17.35	21.63
Looping	10.20	21.14	27.66	36.20	0.13	0.24	0.41	0.54	8.01	13.05	16.55	19.35
Bending and tying	13.21	28.21	37.88	41.48	0.21	0.45	0.59	0.74	10.55	17.88	22.49	26.59
LSD (P=0.05)	ns	ns	6.52	2.05	ns	0.17	0.15	0.10	ns	3.12	5.15	2.47

Table 5: Effect of methods and time of forcing on of Sweet orange (Citrus Sinensis (L.) Osbeck Cv. Agege 1) scion length (cm) 24 weeks after budding in the nursery.

Time of forcing weeks	Method of forcing			Time of forcing means
	CCB	L	B/T	
No forcing	30.31	32.22	34.78	32.44
Forcing immediately	24.95	31.57	34.57	30.36
One week	31.67	33.30	37.82	34.26
Two weeks	30.22	33.76	39.88	34.62
Three weeks	36.47	34.92	46.44	39.28
Four weeks	44.09	37.50	47.77	43.12
Five weeks	47.00	42.75	46.23	45.33
Six weeks	37.03	43.59	45.38	42.00
Methods of forcing means	35.23	36.20	41.61	

	Forcing methods	Time of forcing
Cv%	11.11	9.27
LSD (P=0.05)	2.05	3.27

Forcing methods x time of forcing
CV% = 10.14
LSD (P=0.05) = 4.96
CCB = Complete cutting back, L = Looping, BT = Bending and tying.

Time of healing of scion with the rootstock seem to have effect on bud survival of citrus scion in the nursery. Five weeks and above had the highest bud survival because the healing process had been completed while forcing before five weeks would disturbed the healing process, resulting in death of the scion, therefore reducing scion percent survival. Bending and tying method supporting higher percent bud survival might have been caused by accumulation of specific carbohydrates and high indo-acetic acid (IAA) as reported by Van der Poll *et al*; (1993). This was corroborated by Olaniyan et al. (2003) that reported that bending and tying method favoured more carbohydrates and higher production of IAA which enhanced bud success. Environmental conditions have also been reported to play a major role in bud survival of citrus scion (Olaniyan, 1992), however in this study all the scions enjoyed the same environmental conditions.

Late forcing up to six weeks that enhanced the development of scion growth might have been caused by the forcing periods supporting the production of carbohydrates by the citrus rootstock to support citrus scion growth. Young and Crocker (1998) recommended above 4 weeks forcing time for citrus scion in the tropical and subtropical environment. However, No forcing led to competition between the rootstock and the newly produced scion leading to reduction of the growth of the scion. Bending and tying forcing method have the highest citrus scion growth among the other two methods. Bending and tying forcing methods have been reported to suppress growth of the citrus rootstock sprout, while also supporting photosynthesis through its undisturbed plant parts (Olaniyan *et.al* 2003).

Conclusion

Forcing periods of four weeks and above improved citrus percent bud survival and scion development. The superiority of five weeks forcing period on citrus scion development over early forcing periods made it the most preferred forcing period. Bending and tying forcing method also enhanced percent bud survival and scion growth more than cutting back and looping forcing methods.

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Impact of Working Capital Management on the Pofitability of Oil and Gas Sector of Pakistan

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Abstract

Working capital in an important component of financial management, this study investigates a relationship between working capital and the profitability of listed companies of Oil and Gas sector of Pakistan for the period 2001-2005. We can analyze working capital management through working capital ratios. Working capital ratios are stock or inventory turnover, receivables ratio, payables ratio, current ratio, quick ratio, and cash conversion cycle. Cash conversion cycle is one of the important measuring tools to calculate the efficiency of working capital. Working capital some times called gross working capital means current assets towards business operations. Net working capital is the current assets less current liabilities. Applying correlation and OLS method using Fixed Effect Estimation model, results show a negative relationship between gross profit marigin and number of day's inventory and number of day's accounts receivable, cash conversion cycle and sales growth. Where as there is positive relation between gross profit margin and the number of day's accounts payables. Results show the existence of firm effect. The analysis also suggest that managers can generate positive returns for the shareholders by managing the working capital. This indicates that working capital management practices adequately explain changes in profitability of the firm.

1. Introduction

Working capital of any firm shows the position of liquid assets it holds to build its business. Working capital sometimes called *gross working capital* simply refers to current assets used in operations. Networking capital is current assets minus current liabilities. Net working capital shows the success of the business operations where as negative working capital shows lack of funds, which are necessary for growth. Every business needs sufficient liquid assets to meet its day-to-day requirements. It needs enough cash o pay wages and salaries as they fall due and to pay creditors if it is to keep its work force and ensure its supplies. To manage working capital is not only sufficient or short-term but also important for the survival of the business in long run. Even a profitable business may fail if it does not have adequate cash flow to meet its liabilities as they fall through. There are three approaches or financing policies (a) Hedging Approach, (b) Conservative Approach, (c) Aggressive Approach. There are basically five most common sources of short-term working capital financing, trade creditors, equity, factoring, line of credit, and short-term loan. Flow of cash in a cycle, inside and outside the business, becomes lifeblood of every business. If a business is operating profitably, then it should generate more or surplus cash. If it doesn't generate surpluses, the business will eventually run out of

cash and near to expire. The above discussion highlight the importance of managing working capital for firms in emerging markets with less developed financial and capital markets for countries like Pakistan. It is important to analyze the situation as to how the companies manage their working capital and find out a relationship between firm's profitability and the working capital management. There are certain measures, which help us to calculate working capital like, Inventory turnover ratio, Accounts receivable ratio, Account payable ratio, Current ratio, quick ratio, Working capital ratio. Section (1) of this research paper contains the literature review on working capital management, section (2) contains explanation of variables and methodology, the last section (3) contains empirical analysis and last section contains conclusion of this research.

2. Literature Review

Marc Deloof(2001) carried out research on "*intragroup relations and the determinants of corporate liquid reserves"*. According to the theoretical world in perfect capital markets, liquid reserves do not matter. A firm will always be able to obtain the necessary funds at zero cost. On the other hand the real or practical world is opposite that means "imperfect", and some of these "imperfections" lead to costs, which a firm can avoid by holding liquid reserves.

Marc Deloof(2003) carried out research based on Belgian firms in article named *"Does working capital management affect profitability of Belgian firms?"* This research investigates a relation between working capital management and the profitability of firms. A significant negative relation found between gross operating income and the number of days accounts receivables inventories and accounts payables for a large number of a sample of Belgian firms.

Dev Strischek (2001) discusses that lending bankers judge a company's working and cash flow management skills, which certainly impact the cost of capital. This is why a lender has a vested interest in three key areas namely; sound collection practices, inventory controls and trade credit disciplines.

Hyun-Han Shin and Luc Soenen (1998) carried out research on a large sample of listed American firms for the 1975-94 periods titled *"Efficiency of Working Capital Management and Corporate Profitability"*. Stated efficient working capital management is an important part of the overall corporate strategy to create shareholder value and the profitability of firms. Results show a strong negative relation between the cash conversion cycle and corporate profitability

Carol Howarth , Paul Westhead(2003) discussed the working capital management routines of a large random sample of small companies in the UK. Considerable variability in the take up of 11 working capital management routines was detected. Principal components analysis and cluster analysis confirm the identification of four distinct types of companies with regard to pattern of WCM. The first three types of companies focus upon cash management, stock or debtor's routines respectively, while the fourth types was less likely to take up any WCM routines. Influences on the amount and focus of working capital management were discussed. Regression analysis suggests that the selected independent variables successfully discriminated between the four types of companies. The results suggest that small companies focus only on areas of working capital management where they expect to improve marginal return.

Khan Safi Ullah, Shah Amir and Hijazi Syed conducted a research based on listed Pakistani companies, named *"impact of working capital management on the profitability of firms"*. This study analyzes the effect of working capital on the profitability of firms and investigates a relation between working capital management and the corporate profitability of the non-financial firms. For this research they took sample size of 30 firms. There results showed a significant negative relationship between firm's gross profit and the number of days inventories, accounts payable and cash conversion cycle.

C.R.Sathyamoorthi (2000) conducted a research on management of working capital in cooperatives in Botswana. The paper focused on how the current assets components on the basis of

four years data of some selected organizations. The study covered the period of 1994-97. The study showed that the cooperatives had how liquidity resulting their weak position to pay short-term debts.

Ananth Raman Bowon Kim (2001) models the impact of inventory holding cost and reactive capacity on Northco's targeted under stocking and overstocking cost and offers a solution methodology for such problems. Quantifying the impact of varying inventory-carrying cost on stock out cost and the value of additional capacity, their results illustrate that manufacturers with high working capital cost, and hence high inventory carrying costs, should target higher stock out cost and achieve lower capacity utilization.

3. Methodology

In this Research, we examined the relationship between working capital management and the profitability of Pakistan's Oil and Gas Exploration Sector Companies. There are eleven companies in this sector listed on Karachi stock exchange, out of witch complete data for seven companies from the year 2001-2005 was available. Rest of the four companies for which incomplete data was available, were excluded from the sample. Ratios for working capital items were calculated like number of days accounts receivables, number of day's inventory turnover and number of day's accounts payables. The cash conversion cycle is one of the important measures of working capital management. Then Statistical tests, correlation analysis, OLS using fixed effect estimation model were applied.

Sources of Data

Items relate to the working capital, taken from the annual reports of the companies from 2001-2005.

Variables

Which help to measure profitability of companies are Gross Profit Margin, which calculated as (Sales - cost of goods sold)/total assets. Number of days accounts receivables defined as (accounts receivable * 365)/sales. Number of days inventories calculated as (inventories*365)/cost of goods sold. Number of days accounts payables is (accounts payable*365)/purchases. The cash conversion cycle is calculated as (number of day's accounts receivable + number of day's inventory –number of days accounts payable). Sales growth is (current year's sale – previous year's sales)/previous year's sales.

Variables							
Years	**G.P Margin**	**No. of Day Rec.**	**No. of Day inv**	**No. of days payables**	**CCC**	**Goss OP. Margin**	**Sales Growth**
2001	0.358	14.708	26.255	73.881	32.918	0.024	0.461
2002	0.558	20.121	25.686	108.145	-62.338	0.07	0.0776
2003	0.0615	28.93	25.591	100.856	-46.345	0.029	0.13
2004	0.0754	46.79	32.57	130.968	-51.608	0.034	0.086
2005	0.1315	38.405	24.597	121.63	-58.628	0.06	0.637
2001	0.439	74.47	35.06	204.54	-95.01	0.0571	-0.0975
2002	0.488	30.131	23.699	60.461	-6.631	0.046	0.086
2003	0.569	29.436	28.388	54.128	2.872	0.04	-0.018
2004	0.549	23.34	33.035	71.925	-15.54	0.031	0.0947
2005	0.476	33.893	26.422	36.627	23.68	0.018	-0.04
2001	0.079	107.07	38.4	131.57	13.43	0.034	0.158
2002	0.106	56.442	25.462	15.064	-73.16	0.038	-0.064
2003	0.164	67.883	28.561	58.25	38.194	0.043	0.12
2004	0.175	76.501	4.233	93.597	-12.863	0.053	0.911
2005	0.208	22.972	25.177	60.886	-12.737	0.052	0.503
2001	0.031	65.07	24.88	74.827	15.123	0.018	0.22
2002	0.055	32.576	33.698	60.341	5.933	0.007	-0.165
2003	0.292	26.71	5.098	25.96	5.848	0.045	0.348
2004	0.221	31.401	23.482	87.57	-32.687	0.04	0.021
2005	0.383	33.01	19.96	69.03	-14.06	0.059	0.55
2001	0.037	35.58	19.707	43.26	12.027	0.019	0.256
2002	0.044	34.118	20.911	43.97	11.059	0.029	-0.097
2003	0.051	26.95	18.787	56.24	-10.503	0.035	0.126
2004	0.056	29.872	36.324	54.061	12.135	0.045	0.315
2005	0.064	29.46	38.039	60.132	7.367	0.039	-0.063
2001	0.269	100.13	9.238	136.92	-27.552	0.142	0.23
2002	0.296	96.19	9.23	118.52	-13.1	0.157	0.15
2003	0.289	71.69	8.071	99.2	-19.439	0.125	0.072
2004	0.204	58.561	6.071	89.878	-25.246	0.046	0.408
2005	0.187	63.44	5.421	101.04	-32.179	0.054	0.317
2001	0.186	132.65	17.56	10.9	139.21	0.08	0.267
2002	0.2	104.885	14.6	10.54	108.945	0.07	0.267
2003	0.224	14.86	11.477	8.877	17.46	0.065	0.12
2004	0.191	75.27	9.359	69.801	14.82	0.032	0.309
2005	0.156	86.21	9.01	10.84	84.38	0.04	0.148

Empirical Analysis and Results

Table no. 1 shows descriptive statistics. The average Gross profit margin is 22.4% of total assets, where as median is 19.1%. Cash conversion cycle is on average of -1.835 days and median is -6.631. The average number of days accounts payables 72.983 days, while median is 69.03 days. Where as the average number of days accounts receivables is 51.99 days and median is 35.58 days. Gross operating profit margin is on average of 5.0% and median is 4.3%. The average sales growth is 19.5% and median is 14.8%.

Empirical evidence from the principal component analysis indicated that smallholders' farm forestry is an investment with multi-objectives, primarily focussing on monetary and other economic objectives. This finding has significant implications on agricultural technology adoption in general, and tree farming in particular. Thus, it is likewise important to know the farmers' characteristics and conditions that would likely influence tree growing potential goals and objectives.

Descriptive Statistics

Table 1

Results	Mean	Standard. Deviation	Maximum	Minimum	Median
Gross Profit margin	0.224	0.162	0.569	0.031	0.191
No. of Days Accounts Receivables	51.992	30.655	132.65	14.708	35.58
No. of Days inventories	21.258	10.329	38.4	4.233	23.699
No. of days Accounts Payables	72.983	43.13	204.54	8.877	69.03
Cash Conversion Cycle	-1.835	46.752	139.21	-95.01	-6.631
Sales Growth	0.195	0.228	0.911	-0.165	0.148

Correlation Analysis

Table No. 2 shows the correlation among variables. When we see the correlation between gross profit margin (1) and No. of days accounts receivable (-0.176), there is negative relation between them, means when No. of days accounts receivable decreases the profit increases because when a firm receives money it may invest the money in some other projects which increase the profit of the firm. When we examine the correlation between gross profit margin and No. of day's inventories (-0.006) is also negative relationship, means when the inventory takes more days to be converted into cost of goods sold, profit decreases and vise versa. Cash conversion cycle show negative relationship with profitability, means that wider the cash conversion cycle the firm will have to arrange finance for more number of days hence pay interest which becomes the source of reduction in profit. Sales growth show a negative relationship with profitability which apparently show abnormal results but it does not seem abnormal in Oil and Gas Sector as its demand is more than supply, for more sales the company has to invest a lot initially which reduces the profit. However, results may be confirmed by conducting research on data for long time period. Whereas there is a positive relation between gross profit margin and number of days accounts payable (0.138), which means that when number of days accounts payable increases the profit also increases, firms may invest that money in somewhere else to generate profit.

Correlation Coefficients

Table 2

Results	Gross profit	No. of days account Rec.	No. of days Inv.	No. of days acc payables	CCC	Sales growth
Gross profit margin	1					
No. of days acc receivable	-0.176	1				
No. of days inventories	-0.006	-0.313	1			
No. of days acc payables	0.138	0.143	0.181	1		
CCC	-0.146	0.389	-0.169	-0.669	1	
Sales growth	-0.079	0.103	-0.435	0.0438	0.082	1

Regression Analysis

Fixed effect model has been used to capture the firm effect. Results show (i2 is significant at P .001) the existence of firm effect, which is a different management style of the companies and different working capital needs. Regression analysis shows P- values of Independent variables individually are not significant. However, joint effect of all coefficients is significant (F= 5.1 at P 0.0005) which means working capital management effects profitability of the firm. R- squared= 0.7098. The independent variables jointly have strong explanatory power. This indicates that working capital management practices adequately explain changes in profitability of the firm.

$$Y_{it} = a_1 + a_2 D_{2i} + a_3 D_{3i} + a_4 D_{4i} + a_5 D_{5i} + a_6 D_{6i} + a_7 D_{7i} + B_2 nrd_{2it} + B_3 ndi_{3it} + B_4 ndp_{4it} + B_5 ccc_{5it} + B_6 sgh_{6it} + U_{it}$$

Table 3

Number of obs	=	35
F(11, 23)	=	5. 11
Prob > F	=	0.0005
R-squared	=	0.7098
Adj R-squared	=	0.5710

GPmargin	Coef.	Std.	Err.	t	P>|t|	[95% Conf. Interval]
i1	(dropped)					
i2	.2909505	.0742488	3.92	0.001	.1373551	.4445458
i3	-.036854	.0890724	-0.41	0.683	-.2211143	.1474064
i4	-.0426322	.0771642	-0.55	0.586	-.2022584	.1169941
i5	-.1853617	.078292	-2.37	0.027	-.3473211	-.0234024
i6	.0335775	.1098526	0.31	0.763	-.1936699	.2608248
i7	-.0290723	.1231351	-0.24	0.815	-.2837967	.2256522
ndr	-.0017692	.001239	-1.43	0.167	-.0043321	.0007938
ndi	-.0027749	.0036572	-0.76	0.456	-.0103403	.0047905
ndp	.0004991	.0010052	0.50	0.624	-.0015802	.0025785
ccc	.0007302	.0008858	0.82	0.418	-.0011022	.0025625
sgh	.01909	.1187545	0.16	0.874	-.2265724	.2647525
_cons	.3327327	.1214373	2.74	0.012	.0815204	.583945

i1-i7 are firm dummies to show the firm effect on working capital management.
ndr stands for number of days receivable
ndi stands for number of days inventory
ndp stands for number of days payable.
ccc stands of cash conversion cycle.
sgth stands for sales growth

Conclusion

Working capital management is an integral part of financial management that's why most of the firms make huge investments in their working capital. The study investigates through correlation analysis and Regression analysis using fixed effect model to analyze the relationship between working capital management and the profitability of oil and Gas sector of Pakistan.

Results show a negative relationship between gross profit marigin and number of day's inventory and number of day's accounts receivable cash conversion cycle and sales growth. Where as there is positive relation between gross profit margin and the number of day's accounts payables. Results also show the existence of firm effect, which is a different management style of the companies and different working capital needs. Regression analysis shows that joint effect of all coefficients is significant which means working capital management effects profitability of the firm. The independent variables jointly have strong explanatory power. This indicates that working capital management practices adequately explain changes in profitability of the firm.

Cash conversion cycle has been found negative. On the surface it would seem that a relatively short cash cycle would be a sign of good management. A firm is quick to collect cash from sales once it pays for purchases. But here the catch is that negative cash conversion cycle is due to pending payments of bills on time. That is why the payment cycle is longer than operating cycle. This measure reflects both operating and financing decisions of the firm. Sales growth show negative correlation with profitability which apparently show abnormal results but it does not seem abnormal in Oil and Gas Sector as its demand is more than supply, for more sales the company has to invest a lot initially which reduces the profit. However, results for sales growth may be confirmed by conducting research on data for long time period.

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Stone Settlements of Tivland, Nigeria

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Abstract

This piece of work looks at stone settlements located on the local granitic outcrops that dot Tivland. Oral historical and archaeological findings show that the mode of settlement during the pre-colonial times (at least 500 years ago, based on the limited radiocarbon dates at our disposal) was nucleation. This is opposed to the dispersed settlement system that now exists in the area (in the adjoining plains). These two modes of settlement were a response to changing ecological and social challenges in the region. The identified clusters of houses and cooking structures among other settlement features correspond to the contemporary Tiv compounds. This compound is made of members of an extended polygynous family. These clusters and the living houses on the hill complexes were circular in shape, reflecting their cosmic view that the universe is a round phenomenon.

Keywords: Tivland, Nigeria, Stone Settlements, Hills, Oral Traditions, Archaeology.

1. Introduction

Tivland in the Middle Benue Valley region of Nigeria offers a great deal of opportunities for developing an understanding and appreciation of how ecology affects human culture with emphasis on settlement behaviour and how the latter also makes some impacts on the former. The region which is dotted by granitic outcrops ranging in height between 350 and 600 metres above sea level is a continuation of the Cameroon highlands (Udo 1982: 20 – 22).

Tivland shares a boundary with the north-western part of Cameroon (see fig. 1). This geographical location also plays a significant role in the early history and migrations of the Tiv. The ancestors of the present-day Tiv entered the Middle Benue Valley of Nigeria from north-western Cameroon. According to oral traditions and the limited written documents, one popular reason for the series of migratory waves of the Tiv in pre-colonial times was land hunger including security (Bohannan 1954: 10 – 12).

Therefore, the numerous stone settlements on hilltops and slopes in the study area are an embodiment of the chequered history, culture and general adaptational behaviour of the Tiv which cannot be separated from contemporary lifeways of the people in a neat way. Tiv stone settlements represent a crossroads of ecological behaviour, technology, architecture and history. The need to properly decode the messages they (stone settlements) contain cannot be over-emphasized in order to develop a fuller understanding of the Tiv essence today (Bohannan 1954: 10 – 15; Ogundele 2004: 20 – 70; Kurita 1993: 188; Stone 1992: 153).

Methodology

The Middle Benue Valley/ Cross River Archaeological Project is a long-term and multi-dimensional research of the University of Ibadan, Ibadan, Nigeria. It started in 1975 under the direction of Professor Bassey Andah. I joined this team in 1982 and has continued ever since to conduct research in the region (Andah 1983: 50). My focus is on the settlement history of the Tiv.

The research methods are as follows: oral history and archaeology (Gamble 2001: 15 – 20). Fieldwork exercise embarked upon to-date shows that oral traditions are central to the collection, analysis and interpretation of the Tiv settlement history. The people have well-developed oral traditions, which contain some significant aspects of their history and culture. It (oral history) is an important indigenous knowledge system (Ogundele 2004).

The study area (Tivland) has been divided into two major parts for field operations. They are as follows:

1. North-western Tivland
2. South-eastern Tivland

North-Western Tivland

The north-western section is made up of contemporary compounds/ settlements like Tse-Agwa, Tse-Dura, Mbaibon, Tse-Khuhe and Ushongo. The study populations for oral historical work cut across age, sex and social status. It is pertinent to note that the Tiv are a highly egalitarian people. Even with respect to the narration of their settlement history, everybody is free to contribute. As a matter of fact, a very young Tiv boy or girl about the age of fifteen years knows some aspects of the people's settlement histories, which he/she has learnt or heard from the elders. The target of this method of collecting oral historical data is to have a representative picture, thereby increasing the amount of reliance one can place on oral traditions as a source of history. The other study populations include the following:

1. Compound or settlement heads
2. Priests/ religious leaders
3. Elders – males and females within the age bracket of 50 and 90 years
4. Young adults – males and females between the ages of 18 and 49 years

An open method of approach (a minimally structured approach) was used in collecting oral historical information from the locals. In other words, no tape recorders or questionnaire methods were used. This was to ensure that the people relate to us as freely as possible. Such an approach at least in the context of Tivland reduced suspicions to the barest minimum. At least five elderly members of each of the investigated compounds were interviewed.

This is in addition to the other categories of interviewees. As noted above, the very young Tiv (ranging in age between 15 and 18 years) were not disallowed from taking part in the exercise. The atmosphere was free. Questions raised by me include the following:

1. Where did the ancestors of the present-day Tiv come from or were they in the Middle Benue Valley, all along?
2. If they came from somewhere else, what was the name of the place?
3. When did they move out of the place?
4. Why did they move out?
5. Did they meet some people on getting to Middle Benue Valley?
6. Why did they build stone walls round their hilltop settlements?
7. How were these walls constructed?
8. How high were the walls?

Several group photographs were taken with the local people and copies given to them later. This was an attempt to motivate them and to increase the level of friendship between them and I. Many of the contemporary settlements were revisited many months after the first exercise with a view to cross-checking the information earlier obtained.

Archaeological reconnaissance and excavations of the north-western part of Tivland were guided to a large extent, by the available oral historical findings. Some of the local informants took part in surveying the local granitic outcrops or hill complexes where the stone settlements were located.

Reconnaissance work involved climbing up and traversing these hilltops and slopes, which were settled by the ancestors of the present-day Tiv. Two categories of sites were identified as follows:

1. Rockshelters
2. Open settlements

I have focused on the latter category because it is closely linked to the available oral traditional evidence. In addition, it has relics of stone walls.

Items of field equipment used for this exercise included prismatic compasses, ranging poles and tapes. The average elevation of this area (north-western Tivland) is 350 metres above sea level. This exercise has led to the location of such archaeological settlement features and artifacts as stone walls, relics of stone houses, potsherds (broken pieces of pottery) and fragments of iron slag.

Some of the discovered sites have been designated as follows:

Tse-Dura open settlements 1,2,3,4 and 5. This is in addition to the Ushongo open settlement (KAS2). This reconnaissance work was followed up by mapping the hilltop/ slope settlements using the plane-table method. Several household clusters were identified from the sites. Similarly, a lot of fairly dressed stones litter each site. The exercise has enabled us to obtain some knowledge of the archaeological distribution maps of the stone settlements including the relationships to each other. Such a step was helpful in determining where to carry out excavations on each of the mapped stone settlements. The follow-up excavations were in form of test pit (1m by 1m) and quadrant method for some of the circular structures. Excavations were by spit level method (10cm per spit level). This exercise was to enable us to have some glimpses of artifact distributions and their relationships to one another. We are however, not unaware of the difficulties posed by the degree of intensity of research in this locality as well as preservation conditions

(Hodder and Orton 1976: 15 – 20; Mangut 1988: 199 – 240).

South-Eastern Tivland

The contemporary settlement investigated in this locality include Tse-Gbashanam, Akuji, Usamber, Wombo, Nyiev and Ashiakaa. The study populations for oral history were similar to those from the north-western Tivland. In other words, such groups of Tiv as compound heads, priests/ religious leaders, elders between the ages of 50 and 90 years and young adults (between 18 and 49 years of age) were involved. No tape recorders and questionnaire methods were used, so that suspicions among other fears would not be a hindrance to a free flow of information from the members of the local communities. I was also staying directly in one of the houses given me by the compound head of Tse-Gbashanam.

Such an anthropological method of approach led to my developing interest in Tiv diets among other facets of their culture. More than 8 elders were interviewed in each settlement and this was usually done in a most relaxed or informal way. Group photographs were taken as a method of increasing their level of interest and/or enthusiasm about my research in their locality. The settlements were revisited after one year for the purpose of further work and re-checking of the earlier oral traditional evidence and other related information. The questions raised by me were similar to those in the north-western part of Tivland.

Based on the available oral historical findings, we commenced a reconnaissance survey of the locality. Prominent contemporary settlements in the south-eastern part of Tivland include Nyiev, Jato-Aka and Usamber while the investigated ancient stone settlements located on hilltops and slopes were Binda, Bako and Kpe. These three hill complexes have an average length of 1 kilometre while the average height above sea level is 600 metres. Bako hilltop settlement is about two kilometres south-

east of the Binda hill complex, while the Kpe hill is roughly 800 metres west of the Bako hilltop settlement.

Several local members of these communities within the Turan and Ikurav-Ya clans served as guides/ informants during the reconnaissance surveys. Stone walls, relics of stone houses, tuyeres (broken clay pipes for smelting) and fragments of slag (impurities from iron ore following smelting) were discovered during the reconnaissance. This exercise was followed up by mapping of each settlement site using a plane-table method. These settlement features and/or artifacts were in clusters just like those obtained from the north-western Tivland. So far, only the Binda hilltop settlement has been minimally excavated, using test-pit (1m by 1m) and quadrant methods.

Results

According to the findings during the oral historical surveys, the ancient Tiv entered the Middle Benue valley from the north-western part of Cameroon. The migrations were in waves involving members of different Tiv clans such as Ukan, Ikurav-Ya, Shitire and Turan. They occupied the local granitic hilltops and slopes for security reasons (see fig. 2). These ancient Tiv people descended to the adjoining plains towards the end of the 19th century when peace began to reign in the region.

The hills in the south-eastern part were higher in elevation than those in the north-west. Settlement relics such as stone walls and houses were better preserved in the former region than the latter because of limited human disturbance since their abandonment. For example, the Binda, Bako and Kpe hill complexes were too rugged and high for the contemporary Tiv to do farming there.

Plane-table mapping of the Binda hills show that the settlement features and/or artifacts were in clusters. These clusters were located inside the four identified stone enclosures. These features were non-random and the stone houses were circular in shape. These boulders or stones for house construction were maximally dressed and used unmortared. Two or three stone arrangements having a rough oval shape and ranging in length between 1 and 1.5 metres were identified in each of the clusters.

3 categories of houses on the basis of their floor diameters have been identified and mapped as follows:

1. Small stone houses (2.70 – 3.15 metres)
2. Medium stone houses (3.20 – 4 metres)
3. Large stone houses (4.50 – 5.50 metres)

The medium-sized category is the most predominant. The limited excavations on the Binda hill complex show that the archaeological deposit was very shallow ranging in depth between 30 and 40 cm. In the north-western part of Tivland, the traditions of settlement history were broadly similar. The hilltops and slopes were occupied by the ancestors of the Tiv on arrival from the north-western section of Cameroon. The local granitic hills were generally dome-shaped and lower in elevation. The slopes were much more gentle and were also larger in number. All these hills and slopes were occupied as evident from the relics of stone walls and houses among other settlement features.

Each of these stone settlements has clusters of houses and possible cooking structures as well as granaries. A lot of the artifacts have been destroyed or displaced as a result of contemporary human activities like farming and hunting. Stones or boulders litter each site. The stones for the construction of living houses and protective walls were used unmortared. Three categories of houses have been identified and mapped on the basis of the floors and their diameters. The picture was similar to what was obtained from south-eastern Tivland.

The archaeological deposits in this locality vary from 40cm to 80cm in depth (see fig. 3). These are much deeper than the excavations in south-eastern Tivland.

Discussion

The oral historical and archaeological findings obtained from Tivland reveal the inseparable character of the people's settlements from ecology, level of technology, culture and kinship system. The stone walls surrounding each hilltop settlement in the study area were a reflection of the high level of security-consciousness of the ancient Tiv. These stone walls were constructed by communal efforts as shown by the available oral traditional evidence.

Stones were quarried from the local granitic outcrops and used without mortar (see fig. 4). The lower portions of these constructions – walls and houses were usually made of bigger boulders ranging in diameter between 30 and 35 cm. This technique was to ensure their durability. The defensive and to a lesser degree, demarcatory walls must have ranged in height from 1.5 metres to 2 metres, given the amount of stones littering their surroundings.

The heights of houses were shorter averaging 1.5 metres. These houses according to the available oral traditions had thatched roofs. No direct archaeological evidence was available about the nature of the roofs in the face of preservation problems arising basically from the vagaries of time, erosion and human activities. The round shape of the houses as well as clusters is a reflection of the cosmic view of the Tiv. This world view continues up to now.

The hills in the south-eastern Tivland were not occupied for a long period of time compared to what happened in the north-western part. Indeed, these hills were settled during the most turbulent period of their history. At this time, the need for security from external and internal aggression was very great. Such neighbours as the Junkun and Idoma were waging wars against the Tiv. Similarly, one Tiv clan fought against the other in order to settle on these hills for protection.

Nucleated mode of settlement made it possible for several polygynous families to live together on a given hill complex. The identified clusters show that despite the fact that many Tiv were living on a hill complex, the kinship system still survived. The clusters were representing extended polygynous families. This settlement behaviour represents an important component part of the Tiv essence. It (kinship system) goes on up to now.

The arrangements of stones in an oval shape (ranging in length between 1 and 1.5 metres) on the hills represent burials. However, this tentative inference based on oral traditions and field observations needs to be tested later by archaeological excavations. This would be done as soon as we have the relevant expertise and funds. The tripods of stones located in the settlements were cooking structures or places. This settlement feature was also observed from the ethnographic context among the Tiv (Bohannan 1954: 10 – 12; Ogundele 2004: 25 – 30).

Conclusion

The ancestors of the contemporary Tiv of the Middle Benue valley region of Nigeria settled on the granitic hill complexes that dot the landscape, on their arrival from the north-western part of Cameroon. This research has benefited enormously from oral history and archaeology. The hill settlements were fortified with stones quarried from the hillsides in order to reduce the menace of internal and external aggression to the barest minimum. The ancient Tiv used these stones unmortared. Their circular houses were also constructed with stones without any mortar. Despite the constraint of space on these hilltops and slopes, clusters that are tantamount to contemporary compounds were identified and mapped. This shows that the Tiv settlement is indeed, a crossroads of such domains as ecology, science, technology, history and culture.

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Experimental Protective Effects of Yersinia Anti -Antibodies in Mice

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Abstract

The experimental protective effect of Yersinia anti-idiotype sera was carried out in mice using standard methods. Results show that 20-50% of a set of mice died when they were injected simultaneously with a suspension of Yersinia species (Y. pseudotuberculosis, Y. enterocolitica (0:3), Y,. enterocolitica (0:8), Y. kristensenii (0:11,23), Y. intermedia (0:52,53) and Y. intermedia-like bacteria (0:52,53)) and colloidal carbon particles (CCP), but when another set of mice immunized with Yersinia anti-idiotype sera, 24hr before being challenged with the respective test organisms and CCP, only 10-20% died. Similarly, only 10% of the mice died when mice previously immunized with Yersinia anti-idiotype sera were challenged with the respective test organisms. The results of this study demonstrate a prophylactic (protective) effect of anti-idiotype sera (anti-antibodies) against Yesinia species infections. Clinical trails on the use of idiotypic network for passive immunization against Yersinia species is therefore recommended.

Keywords: Anti-idiotype sera Protective effect Challenged

Introduction

When an animal is injected with an immunogen, there is the formation of specific antibody due to the inducing immunogen (Oudin and Michael, 1963; Weir, 1983; Agbonlohor, 1986; Obi and Coker, 1989c; Ndip, 1994; Murray, *et al.*, 1998). An enhancing antibody or a new determinant or antigenic stimulus resulting from the combination of antibody to antigen has been reported by Nemazee and Sato (1982). The antigen – antibody complexes, may initiate the activation of the complement system, and sensitise other components of the immune system, thus resulting in the clearance of the antigen from the body circulation, by lysing the bacterial cells (Fukutome *et al.*, 1980; Obi and Coker, 1989a).

Antibodies that are elicited when an antigen is introduced into the animal body have been generally shown to confer some protective effects against related organism(s). Similarly, antibody, formed when anti-antibody is injected into an animal body, may as well have the potential to confer immunity (protection) in line with the phenomenon of antigen – antibody interaction.

A crucial role has been advanced to antibody in vaccine – induced protection against the development of sepsis and other lethal effects of infection with massive doses of a gram negative bacteria (*Pseudomonas aruginosa*) (Fukutome *et al.*, 1980). The protective effects of anti-idiotype antibody against *C. jejuni* and *P. shigelloides* have been respectively documented by Obi and Coker,

(1989a) and Ndip, (1994) in rats. The report of Fujimura *et al.* (1989) revealed that, though an antibody – independent protection can be induced by introduction of an antigen into an animal body, macrophage activation plays a major role in its expression.

Considering the significant role played by antibodies in the elimination of several bacterial agents from the recticuloendothelial system of animals, (or human) and the prevalence of *Yersinia species* in our environment (Igumbor *et al.,* 1994), the use of immunological procedures in the prevention of yersiniosis in addition to oral rehydration therapy (ORT) and antibiotics in the management of these diseases is important.

The report of this study is on the successful protection of mice from experimental *Yersinia species* infection using *Yersinia* anti-idiotype obtained from rabbits immunised with a locally produced idiotype raised against local strains of *Yersinia species.*

Materials and Methods

Animals and Bacterial Strains

The mice used in this study (10.6 to 14.2g in weight) were obtained from the Animal HOUSE of college of Medicine, University of Lagos, and were quarantined for two weeks before use. The *Yersinia species.* used for this study were obtained from Prof. D. E. Agbonlahor's Laboratory, Department of Microbiology, Ambrose Alli University Ekpoma, Nigeria. These include; *Yesrsinia pseudotuberculosis, Y. enterocolitica* (0:3), *Y. enterocolitica* (0:8), *Y. krestensenii* (0:11,23), *Y. intermedia* (0:52,53) and *Y. intermedia-like bacteria,* (0:52,53). All the *Yersinia species* were resuscitated and re-characterized to confirm their identity. The criteria previously used by Agbonlahor, *et al.*, (1983); and Agbonlahor, (1986) and adopted by Owhe-Ureghe *et al,* (2002) were employed. These involved testing for Gram reactions, motility (at 25^0C and 37^0C), auto-agglutination, sugar fermentation, urease production, citrate utilization, oxidase reaction and invasive property (Sereny,1955; Agbonlahor *et al*; 1983; Cowan, 1985; Agbonlahor, 1986).

Production of *Yersinia* Anti-Antisera

The *Yersinia* anti-antibody sera were produced and their titre level determined as previously reported (Owhe-Ureghe, 1999; Owhe-Ureghe, *et al*., 2002). Briefly; the Yersinia species were grown an macChonkey agar plates for 18-48hrs and were harvested into 10-12ml sterile PBS (pH 7.4) each and washed thrice in PBS. The washed cells were heat killed in water bath for 1hrs, and re-washed thrice in sterile PBS. These were re-suspended in PBS to yield a cell count of approximately 1.0 x 10^9 cell/ml. After pre-immune bleeding, the rabbits were injected intravenously with increasing doses (0.5 1.0 1.5 and 2.0ml) of *Yersinia species* antigen at 4 – 7 days intervals for 4 weeks. The antisera which were obtained from the above experiment were injected into the rabbits to produce *Yersinai* anti-antisera. The rabbits were bled 10 days after the last injection and the sera separated to obtain *Yersinia* anti-antibody. These were stored at 4^0C in 1% sodium benzoate. Determination of the specificity and titre levels of the anti-idiotype sera against their specific antigens.

The *Yersinia* vaccine suspension (50µl) was mixed with equal amount of antisera diluted serially two folds in PBS in microtitre plate and incubated in a water bath at 50oC for 4hr. The initial serum was diluted 1:10 and the end titre was the reciprocal of the highest dilution, showing a partial agglutination with crude antisera diluted 1:5 in PBS. Positive or negative agglutination, was ascertained about 45 seconds after a loop full of bacteria was mixed with a drop (50µl) of antiserum. A loopful of bacteria was mixed with a drop of PBS to test for autoagglutination

Lethality Test

The method of Fujimura *et al*., (1989) was employed in this study. A group of 300 mice (10 mice per inoculation type) were used for this investigation. In each case, when the various *Yersinia species* were used, about 1 x 10^8 CFU/ml was taken for oral inoculation into the mice.

A set of 50 mice were used to test the protective effect of each *Yersinia* anti-antiserum. The first 10 mice were each inoculated simultaneously with the test organism(s) and 0.4 ml of colloidal carbon particles (CCP); for the second group of 10 mice, they were first inoculated with the *Yersinia* anti-antiserum, and then inoculated with a mixed inoculum of test organism and 0.4ml of CCP; the third group of 10 mice, were inoculated first with *Yersinia* anti-antiserum and challenged with the organism 24 hrs later. The forth and fifth sets of mice were inoculated with only CCP and test organism respectively.

Result

The results obtained as presented on Table 1 below shows that when the various *Yersinia species* plus the CCP was simultaneously inoculated into the mice, the death rate range from 20% for *Y.kristensenii* (0:11, 23) to 50% for *Y.intermedia-like bacteria* (0:52, 53); but when the various test organisms plus the CCP were inoculated into mice previously immunised (24 hrs earlier) with *Yersinia* anti-antibody, the death rate now ranged from 10% for *Y. pseudotuborculosis, Y .enterocolitica,* (0:8) *Y. kristensenii,* (0:11 23), and *Y. intermedia-like bacteria* (0:52, 53) to 20% for *Y. enterocolitica* (0:3). For *Y. intermedia* (0:52, 53) there was diarrhoea production without death. However, when previously immunised mice were challenged with the respective *Yersinia* species, only *Y. enterocolitica* (0:3) and *Y. intermedia-like bacteria*, (0:52, 53) caused the death of mice. *Yersinia kristensenii* (0:11, 23), and *Y. intermedia* (0:52, 53); produced mild diarrhoea, while no death were recorded for *Y. pseudotuberculosis and Y. enterocolitica,* (0:8). Colloidal carbon particle alone did not cause any death, but when a set of mice was injected with the various test organisms, the death recorded ranges from 10% For *Y. pseudotuberculosis*, *Y. enterocolitica* (0:8) and *Y. kristensenii,* (0:11, 23) to 30% for *Y. intermedia-like bacteria* (0: 52, 53).

Table 1: Protective effect of *Yersinia* anti-antibody in mice.

Mice inoculation	Mean number of Death (%). N = 10					
	a	**b**	**c**	**d**	**e**	**f**
O/CCP	3(30%)	4(40%)	3(30%)	2(20%)	3(30%)	5(50%)
O/CCP/A	1(10%)	2(20%)	1(10%)	1(10%)	++	1(10%)
O/A	-	1(10%)	-	+	+	1(10%)
CCP	-	-	-	-	-	-
O	1(10%)	2(20%)	1(10%)	1(10%)	2(20%)	3(30%)

Key:

+	=	MILD DIARRHOEA
++	=	SEVERE DIARRHOEA
A	=	*YERSINIA PSEUDOTUBERCULOSIS*
B	=	*Y. ENTEROCOLITICA* (0:3)
C	=	*Y. ENTEROCOLITICA (0:8)*
D	=	*Y. KRISTENSENII* (0: 11, 23)
E	=	*Y. INTERMEDIA* (0: 52, 53)
F	=	*Y. INTERMEDIA-LIKE BACTERIA* (0:52, 53)
O/CCP	=	TEST ORGANISM + COLLOIDAL CARBON PARTICLES (CCP)
O/CCP	=	TEST ORGANISM + CCP/ *YERSINIA* ANTI-ANTIBODY
O/A	=	TEST ORGANISM + *YERSINIA* ANTI-ANTIBODY
CCP	=	COLLOIDAL CARBON PARTICLES ONLY
O	=	TEST ORGANISM ONLY

Discussion

The results of this investigation (Table 1) confirmed earlier report that antibodies (Fukutome *et al.,* 1980, Obi and Coker, 1989a; Ndip, 1994; Jawetz *et al.,* 1998) introduced into an animal or human body could confer some protective effects against related organism(s). A similar phenomenon has been demonstrated in this locality by Ndip (1994) using *Plesiomonas* anti-antisera.

In this investigation the vaccination of mice with *Yersinia* anti-antisera conferred some level of protection on the mice. The death rate was reduced to 10% or mild diarrhoea, when the mice were immunised with the *Yersinia* anti-antisera. This agrees with the results obtained by earlier workers who immunised mice or rat with vaccine preparations of *Pseudomonas aeruginosa* (Fujimora *et al;* 1989), *Campylobacter jejuni* (Obi and Coker 1989a) and *Plesiomonas shigelloides* (Ndip, 1994).

The results also suggest that the colloidal carbon particle (CCP) impacted or confer some virulence on the Yersinia species or lowered the immune system of the test animals (when the organism and CCP were simultaneously inoculated into the animal) rendering the mice more susceptible to the various *Yersina species* as suggested by Jones (1971). This is associated with the effect (negative) of CCP on the activity of macrophages (Obi and Coker, 1989b).

The prophylactic (protective) potentials demonstrated by the anti-idotype (anti-anti-bodies) against *Yersinia species* infections in this investigation is innovative in this Nigeria environment. Clinical trails on the use of idiotypic network for passive immunization against *Yersinia species* is recommended.

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Quality Evaluation of Water Sources in Ife North Local Government Area of Osun State, Nigeria

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Abstract

The quality examination of water in Ife – North Local Government of Osun State Nigeria was conducted by determining the physico – chemical parameters. Fourty samples including surface water, bore holes, well and pipe borne water were collected from major towns in the Local Government Area and analyzed. Results showed temperature range of 26.5 – 33.0oC, pH (6.526 – 8.905), conductivity (63.0 – 1039.0 □S/cm), resistivity (0.00 – 0.02mΩ.cm), salinity (300.0 – 700.0 mg/l), total solids (90.0 – 1175.0 mg/l), total dissolved solids (37.8 – 622.5mg/l), suspended solids (34.5 – 794.0 mg/l),dissolved oxygen (4.483 – 9.483 mg/l), Biological oxygen demand-BOD5 (0.690 – 6.745 mg/l), chloride (3.64 – 184.04 mg/l), Nitrate (1.08 –53.03 mg/l), phosphate (4.99 – 23.07 mg/l) and sulphate (6.02 – 28.95 mg/l). The results obtained agreed with the limits set by both national and international bodies for drinking and domestic water with few exceptions. Pipe borne water was observed to be safest while the surface waters would support aquatic life and recreational activities.

Keyword: Path finding, Collision avoidance, behavioural animation, Crowd simulation

Introduction

Water is a universal solvent essential to man for various activities such as drinking, cooking, industrial and agricultural processes, waste disposal and human recreation.

The two main problems man contends with are the availability (source and amount) and quality of water (Adeniyi, 2004). In view of its occurrence and distribution pattern, water is rarely easily available to man in the right desirable amount and quality for most of its application. This is no doubt the problem experienced in most cities and towns in the developing nations not to mention their rural settings. These factors had lead to the growing rate of water borne diseases like typhoid fever and Cholera experienced in this part of the world. Even in the developed nation like the United State of America, for the 2- year period (1991 to 1992), cases of outbreaks of diseases associated with contaminated portable water intended for drinking have been reported (Moore et.al.,1993).The outbreak caused an estimated 17464 person to become ill. A large outbreak of cryptosporidiosis in some states in this country in 1993 was attributed to failure in the water treatment system (Edwards, 1993).

Water quality is a term that is most frequently used, but rarely defines probably because it has not a fixed definition, but apparently fairly well understood by users. Thus, the quality of water is a reflection of the source environment and the activities of man, including the use and management measures put in place by him. However, the desirable properties of water quality should among others include the following, viz: adequate amount of dissolved oxygen at all time, a relatively low organic content, pH value near neutrality, moderate temperature, and freedom from excessive amount of infectious agents, toxic substances, mineral matter (Adeniyi 2004).

Sewage discharge is a major component of water pollution, contributing to oxygen demand and nutrient loading to a destabilized aquatic ecosystem (DWAF and WRC, 1995; WRC, 2000). This problem is also serious in areas where wastewater treatment systems are simple and not efficient (Morrison et.al., 2001). Although, it is possible to renovate polluted surface waters to portable standards, this would be both complex and very expensive (Quality of Domestic Water supplies, 1998). This may make water supply unsustainable.

Groundwater is far more protected from pollution than is surface water. It has significantly less self – cleasing ability and is more difficult to treat. Contaminants in surface water can be broken down by exposure to natural oxidants (oxygen and sunlight), or biologically degraded. The rate of chemical reactions is influenced by temperature, which in surface water is variable and can be quite warm. The ground water environment is dark, oxygen – deficient, cool, and supports very limited biological activities so that contaminants may remain quite unchanged over long periods. Howerver, as water percolates through the soil to become part of the ground water, the process of filtration and absorption may significantly improve its quality. Still, water applied for irrigations or as rain to land covered with pesticides or fertilizers can carry nutrients and toxic chemicals into the groundwater unimpeded.

Ife–North Local Government area is one of the fast growing local government area in Osun State, Nigeria in the recent time. The positioning of the Pre – Degree study center run by the authority of Obafemi Awolowo University (O.A.U), Ile – Ife, plus the already existing Federal Government College and the State School of Science are some of the factors for the population upsurge. An investigation through major towns in the local government revealed that the major source of water for most activities is groundwater (well and boreholes), and sometimes streams and rivers most especially in the dry season. These water sources are the alternatives to the epileptic pipe borne water supply, which would have been more reliable source of safe water for the growing population. In the face of this ambiguity, a research was conducted on the different water sources from the major towns in the local government. The towns include: Edunabon, Moro, Yakoyo and Ipetumodu. The results of the analysis are expected to provide information on the quality and the safety of the water, and to serve as a guide in suggesting the best treatment and application the water can be subjected to, in order to produce a good portable water for the communities to supplement the public pipe borne water supply.

Materials and Methods

Materials: The polythene containers used for sampling were washed with ions free detergent, rinsed with distilled- deionized water and then pre – treated with 20% nitric acid (HNO_3). They were finally rinsed thoroughly with distilled- deionized water followed by drying in the oven to eliminate errors due to metals contamination.

Sampling site and Period:

The sampling was carried out in the dry months of March and April, year 2004. The last sampling was carried out in the month of May of the same year for all the towns. The month of May marks the beginning of the raining season in the year after a long dry season characterized with one or two rainfalls. Ten samples (including surface water, well water, bore holes and pipe borne water) were collected from each town using the already treated polythene containers.

Methods: The pH, temperature, depth and dissolved oxygen (DO) were determined and recorded immediately at the site. The dissolved oxygen (DO) was determined by using the Winkler's Method (Ademoroti, 1996). The conductivity, total dissolved solid (TDS), salinity and resistivities were determined in the laboratory using the Jenway conductimeter model MC METTLER TOLEDO. The chloride was determined by argentiometric method, phosphate by Vanadate-molybdate method while sulphate was determined by turbidimetry method and Nitrate (NO_3^-) was determined by UV spectrophotometeric method. (American Public Health Association, 1992) The Total Solids (TS), Dissolved Solids (DS), and Suspended Solids (SS) were determined gravimetrically (Ademoroti, 1996).

Result and Discussion

The results of the analysis of physico–chemical parameters of the water samples from each town are presented in Tables 1- 4. The pH values of the water ranged from about neutral to alkaline (i.e. 6.526 – 8.905). The mean pH values of the water from each town compared with the pipe borne water is presented in Figure 1. The values fall within the range of 6-9 set by World Health Organization (WHO) and the country's Federal Ministry of Environment (formerly, Federal Environmental Protection Agency, FEPA, 1991). The pH values which give the indication of acidity and alkalinity of the waters show that the surface and ground waters in the area are safe for agricultural, recreational and domestic uses.

Table 1: Physico-Chemical Properties of Water Sources from Edun-abon Town

Parameters	Minimum	Maximun	Mean	Coeff of Variance	Pipe-Borne Water	Fed. Min. of Envt. Limit
PH	7.670	8.713	8.01 ±0.32	3.94	7.666	6.5-9.2*
Temp(ºC)	26.250	30.500	28.95 ±1.25	0.04	39.000	-
DO(mg/l)	5.517	8.104	7.26 ±0.78	0.11	9.483	-
BOD(mg/l)	1.035	6.552	3.16 ±1.69	0.52	4.311	-
TS(mg/l)	90.000	860.000	404.00 ± 247.62	0.61	140.000	-
TDS(mg/l)	42.300	622.500	307.96 ± 202.82	0.66	80.950	-
SS(mg/l)	34.500	237.500	96.05 ± 63.59	0.66	59.050	-
Conductivity(µS/cm)	70.650	1039.000	498.39 ± 350.10	0.70	133.500	-
Resistivity(mΩ)	0.000	0.010	0.003 ± 0.0048	1.61	0.010	-
Salinity(mg/l)	300.000	700.000	490.00 ± 119.72	0.24	400.000	-
Chloride(mg/l)	12.760	184.040	76.17 ± 66.39	0.87	16.400	200-600
Nitrate(mg/l)	1.900	52.150	32.35 ± 22.26	0.69	1.080	50.100
Sulphate(mg/l)	6.020	27.940	15.66 ± 8.41	0.54	21.020	150
Phospate(mg/l)	5.370	10.510	7.50 ± 1.65	0.22	6.630	-

*-- International Maximum Permissible limit

Figure: 1. DO and BOD of Water Samples from the Four towns

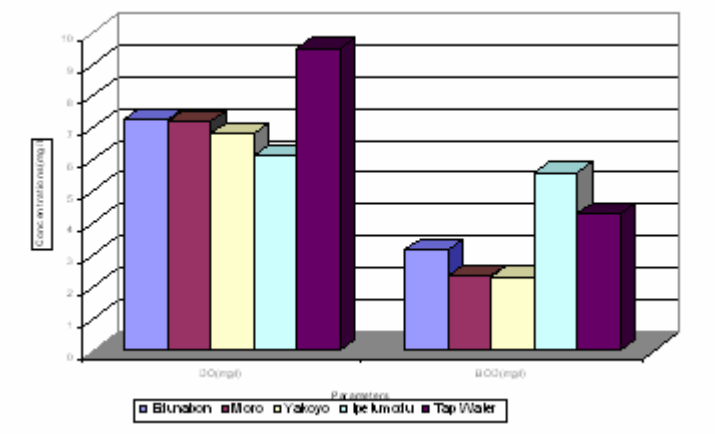


Table 2: Physico-chemical Properties of Water Sources From MoroTown.

Parameters	Minimum	Maximum	Mean	Coeff. Of Variance	Pipe-borne Water	Fed. Min. Of Envt. Limits
PH	7.10	8.028	7.693 ± 0.33	0.04	7.666	6.5-9.2*
Temp(°C)	27.50	32.000	29.950 ±1.40	0.05	29.000	-
DO(mg/l)	5.86	9.483	7.197 ± 1.025	0.14	9.483	-
BOD(mg/l)	1.035	4.311	2.346 ± 1.06	0.45	4.311	-
TS(mg/l)	140.00	525.000	317.50 ±156.23	0.49	140.000	-
TDS(mg/l)	37.80	327.000	169.06 ±109.49	0.65	80.950	-
SS(mg/l)	55.05	351.700	157.45 ± 87.37	0.56	59.050	-
Conductivity (µS/cm)	63.00	728.000	346.68 ±213.68	0.62	133.500	-
Resistivity (mΩcm)	0.00	0.020	0.01 ± 0.01	1.42	0.010	-
Salinity(mg/l)	300.00	500.000	410.00 ± 73.79	0.18	400.000	-
Chloride(mg/l)	3.64	58.310	33.62 ± 17.97	0.54	16.400	200-600
Nitrate(mg/l)	1.08	52.160	27.36 ± 21.33	0.78	1.080	50.100
Sulphate(mg/l)	6.21	28.950	15.55 ± 8.73	0.56	21.020	150
Phosphate (mg/l)	4.99	10.890	7.09 ± 1.62	0.23	6.630	-

Table 3: Physico-chemical Properties of Water Sources From Yakoyo Town.

Parameters	Minimum	Maximum	Mean	Coeff. Of Variance	Tap Water	Fed. Min. Of Envt. Limits
PH	6.526	8.267	7.57 ±0.68	0.09	7.67	6.5-9.2*
Temp(°C)	29.500	33.00	30.80 ±0.98	0.03	29.00	-
DO(mg/l)	5.690	7.414	6.81 ±0.64	0.09	9.483	-
BOD(mg/l)	1.035	7.242	2.30 ±1.84	0.08	4.311	-
TS(mg/l)	250.000	890.00	517.00 ±216.95	0.42	140.00	-
TDS(mg/l)	83.400	773.00	288.9 ±255.25	0.88	80.95	-
SS(mg/l)	77.200	607.00	339.66 ±155.29	0.46	59.05	-
Conductivity(µS/cm)	136.900	474.50	307.79 ±120.51	0.39	133.50	-
Resistivity(mΩcm)	0.000	0.010	0.002 ±0.0042	2.1	0.010	-
Salinity(mg/l)	400.000	500.00	435.00 ±47.43	0.11	400.00	-
Chloride(mg/l)	18.230	69.75	47.42 ±22.91	0.48	16.40	200-600
Nitrate(mg/l)	4.070	75.23	36.32 ±21.03	0.58	1.080	50.100
Sulphate(mg/l)	6.160	23.61	14.55 ±5.83	0.40	21.02	150
Phosphate (mg/l)	5.620	13.40	8.09 ±2.10	0.26	6.63	-

Table 4: Physico-chemical Properties of Water Sources From Ipetumodu Town.

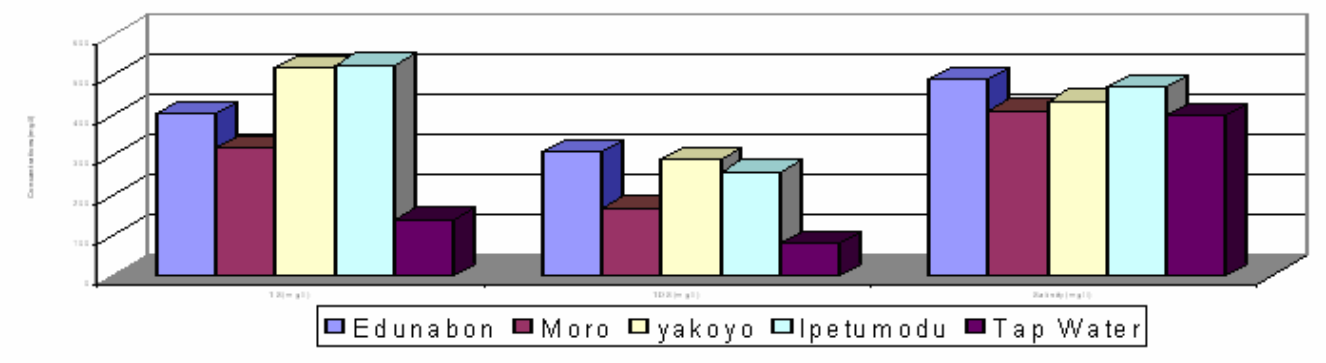
Parameters	Minimum	Maximum	Mean	Coeff. Of Variance	Tap Water	Fed. Min. Of Envt. Limits
PH	7.550	8.905	8.16 ±0.38	0.05	7.67	6.5-9.2*
Temp(ºC)	30.000	32.500	31.15 ±0.85	0.03	29.00	-
DO(mg/l)	4.483	7.414	6.12 ±0.98	0.16	9.48	-
BOD(mg/l)	3.104	6.745	5.59 ±1.13	0.20	4.31	-
TS(mg/l)	212.500	1175.000	525.70 ±358.71	0.68	140.00	-
TDS(mg/l)	83.900	545.000	258.62 ±147.98	0.57	80.95	-
SS(mg/l)	84.000	794.000	267.18 ±271.63	1.02	59.05	-
Conductivity (µS/cm)	143.000	907.500	430.96 ±245.90	0.57	133.50	-
Resistivity (mΩcm)	0.000	0.010	0.002 ±0.0042	2.10	0.010	-
Salinity(mg/l)	400.000	600.000	470.00 ±82.33	0.18	400.00	-
Chloride(mg/l)	7.290	171.090	77.24 ±50.98	0.66	16.40	200-600
Nitrate(mg/l)	5.110	53.030	38.10 ±18.57	0.49	1.080	50.100
Sulphate(mg/l)	7.440	25.330	14.02 ±5.76	0.41	21.02	150
Phosphate (mg/l)	5.990	23.070	10.45 ±5.43	0.52	6.630	-

The electrical conductivity (EC) of the water ranged between 63.0 and 1039.0µS/cm. Electrical conductivity of water is a useful and easy indicator of its salinity or total salt content. High salt content in waste effluents can increase the salinity of the receiving water, which may result in adverse ecological effects on aquatic biota (fried, 1991). In this study, it was discovered that the EC of some borehole waters from Edunabon and Ipetumodu (Tables 1 & 4) were quite high (907.5 – 1039 µS/cm) which is likely due to some soluble minerals from the bedrocks. However, they are still less than the European Union recommended limit (2500µS/cm) for potable water.

The salinity values of all the water sources ranged between 300 – 700 mg/l. They are less than the value of 1000 mg/L set by the World Health organization (WHO, 1979). This implies that the water is safe and not polluted. A very high salt concentration (≥1000mg/l) imparts a brackish, salty taste to water and is discouraged because of the potential health hazard. However, salts build-up as a result of waste discharge to the surface water around these towns should be discouraged as it will prevent the water from being reused by the municipalities for domestic and industrial processes such as food preparation, textiles and paper manufacturing and for irrigation in agriculture.

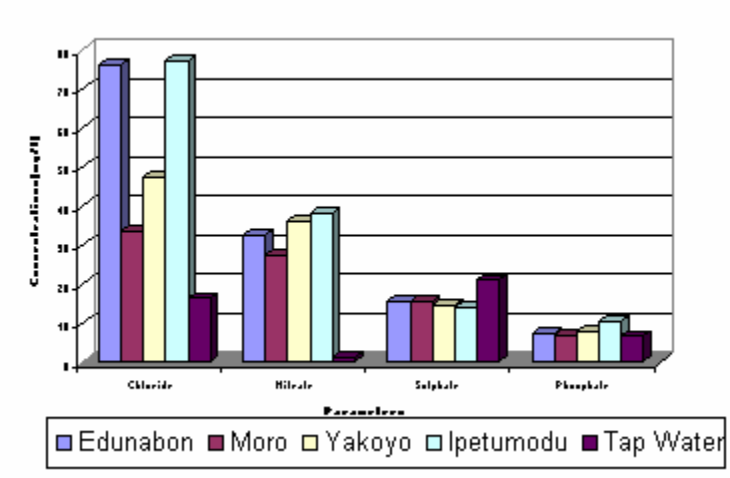
The total solids (90.00—1175.00mg/l) and the total dissolved solids (37.80-622.50mg/l) of the water samples in the area (Figure 2), are below the limit of 1500mg/l for total solids and 500mg/l for total dissolved solids in drinking water (EPA, 1978). Few exceptions are found in boreholes at Edunabon and Ipetumodu where the total dissolve solids are 622.50 and 545.00mg/l respectively. Two well waters near the borehole at Edunabon have dissolve solids 501.00 and 565.50mg/l close to the set standard values. Some treatments may be required to make the waters suitable for domestic purposes.

Figure 2: TS, TDS and Salinity of Water Sources From The Four Towns



The mean concentrations of Chloride, Nitrate, Sulphate and Phosphate for the four towns are presented in Figure 3. The chloride concentrations ranged between 3.64 and 184.04mg/l. The lowest value in this study was obtained for the surface water at Moro Town. This parameter is an indication that the stream will conveniently support aquatic life with no ecological effect (Fried, 1991). Thus, the surface water could be a major source of aquatic food for the communities in the Local Government Area. Moreover, the water could also be good for domestic purposes bearing in mind that the values are below the recommended standards of 250mg/L by the United State of American Public Health service (Peters and Odeyemi, 1985) and 600mg/l recommended by WHO (1970) for water intended for domestic use.

Figure 3: Chloride,Nitrate, Sulphate and Phosphate of Water Samples from The Four Towns



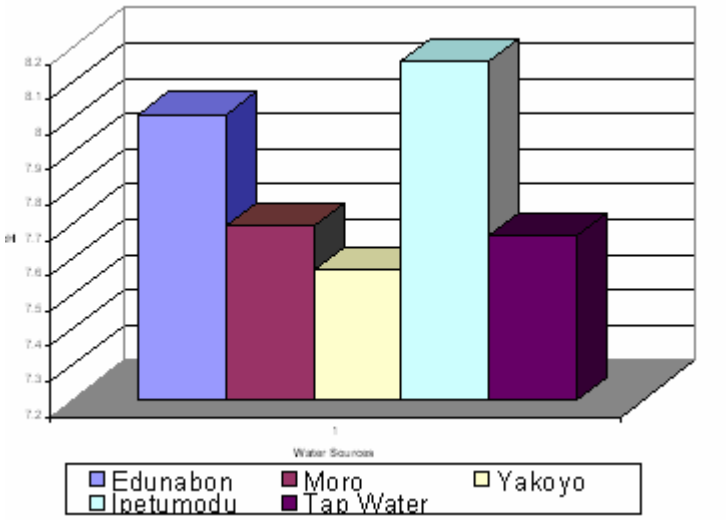
The nitrate concentrations range from 1.08—53.03mg/l. The high concentration of nitrate in water may give rise to methaenoglobinemia in children bottle-fed with such water. It was reported that the concentration of nitrate above the threshold of 45mg/l is likely to cause methaenoglobinemia while high level of nitrate and phosphates may bring about the problem of euthrophication in reservoirs and streams (Gadd, 1976). Our results showed nitrate content to be high in most of the underground water samples but low in the surface water and the pipe-borne water. The surface water is free of Algae cover as a result of eutrophication, and consequently suffers no depletion in the dissolved oxygen unlike the ground waters. The use of ground water as potable water in this local government could pose serious health problems associated with high nitrate concentration.

The highest phosphate and sulphate values of 23.07mg/l and 28.95mg/l respectively are obtained for the water samples. The phosphate levels are generally high due to blue-green alga growth

on the walls of most of the wells from which the water were sampled. While all the values obtained for the concentrations of sulphate in water samples fall below the recommended values for drinking water (FEPA, 1991), most of the concentrations of phosphate exceed the 5-mg/l set as standard in South Africa (Morrison et.al., 2001). Persistence of high concentration of phosphate at this level in the surface water for a long time may lead to eutrophication of the water body, which can reduce their recreational use and also endanger aquatic life.

The Dissolved Oxygen, (DO), and Biochemical Oxygen Demand after five days (BOD_5) are within the range of 4.483—9.483mg/l and 0.690—6.745mg/l respectively. The mean values of the DO and BOD_5 for the four towns are plotted in Figure 4. In this work, only 15% of the water samples have BOD values above the 6mg/l recommended limit for BOD in drinking water set by The World Health Organization (WHO, 1971). The BOD of a system is usually increased by the addition of both organic and inorganic substances to the environment. The organic contaminant may come from municipal sewage treatment plants, or as raw sewage of some major sources of organic wastes. In this work, the BOD values are found to be high in the water from Ipetumodu town (3.104—6.745mg/l) and this suggests that the water from this area are polluted with organic matter which could be as a result of run-off or draining of organic fertilizer from farmlands into the groundwater during raining season (Okonkwo and Odeyemi, 1985). However, water samples from Yakoyo are less polluted by organic matter as indicated by their BOD values (0.690 - 2.242mg/l. The low BOD values (1.380 - 4.655mg/l) of the surface water further confirm that the stream could support aquatic life.

Figure 4: pH of Water Sources from The Four Towns



The Dissolved Oxygen (DO) is an important physico-chemical parameter of water quality and has special significance for aquatic organisms in natural waters (Willock et al, 1981). The highest DO value (9.485mg/l) obtained for the tap water may be due to aeration process during water treatment.

The quality evaluation of water samples in Ife North Local Government, Area of Osun State, Nigeria revealed that the pH, conductivity, salinity, total solids, total dissolve solids, suspended solids and the chloride contents are found mostly within the limits set by both national and international standard regulatory bodies, such as FEPA (1991), WHO (1970, 1971, 1979), QDWS (1998), EPA (1978), for drinking and domestic water. Few exceptions were observed in the phosphate concentration, BOD_5 and the total dissolved solids which were found to be a little above the set standards in few samples.

There is a perfect correlation and a direct relationship between the conductivity, salinity and the total dissolved solids in most of the samples. This phenomenon is expected, as it is an appraisal to the accuracy and reliability of our findings.

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A Comparative Study of Various Unequal Probability Sampling Estimators

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Abstract

The performance of Modified Murthy Estimator (MME) of population total developed by Hina and Shahbaz (2004), with various unequal probability sampling estimators, has been compared. For empirical study 20 natural populations from literature on sampling are used. The procedures adopted are relative efficiencies and design effects. The MME showed reduction in the variance of Murthy Estimator (ME) up to 16% and design effect as minimum as zero.

Key words: Efficiency, design effect, variance

1. Introduction

A lot of work on unequal probability sampling estimator has been done since middle forties. Hansen and Hurwitz (1943) were the first to develop unequal probability sampling estimators.

Midzuno (1952), Sen (1953) extended the Hansen and Hurwitz (1943) scheme, to sampling a combination of *n* elements from a stratum, with probability proportional to size (PPS) of the combinations. Sen (1953) further generalized the scheme for obtaining an unbiased estimator of the population total when the first *r* units are selected with PPS. The remaining *n-r* units are selected with equal probability and without replacement. He has also derived an estimator of the variance estimator. Horvitz and Thomson (1952) presented another technique for selecting n primary sampling units (PSUs) without replacement and with varying probabilities from a finite population. Sen (1954) derived an unbiased variance estimator of an estimator developed by Sen (1953) and showed that this estimate will be always positive. He has also developed a biased estimator for the sample variance, which was more efficient than Horvitz and Thompson's unbiased variance estimator. Hartley and Rao (1962) derived variance estimator of the population total together with variance estimates for the selection procedure.

Rao (1972) showed that the generalized π ps sampling strategy consisting of the design with πi, the probability of inclusion of the ith unit in the sample, proportional to the modified size together with the corresponding Horvitz-Thompson estimator, is superior to the symmetries. Hanif and Brewer (1979) presented a general theory of sampling with unequal probability, which allowed population units to appear more than once in a sample. They presented two estimators for use in both single stage and multi-stage sampling design. Shahbaz and Hanif (2003a) developed a new estimator of population

total and obtained design based expectation and variance of the estimator. Shahbaz and Hanif (2003b) developed approximate formulae for the variance of Horvitz-Thompson estimator by using the first order inclusion probabilities. They also checked the validity of the formulae through empirical study. Shahbaz et al (2002) has given a selection procedure with Horvitz-Thompson estimator by merging Brewer (1963) and Durbin (1967) selection procedures.

Hina and Shahbaz (2004) by using the selection procedure of Shahbaz and Hanif (2003), in Murthy (1957), developed an estimator of population total, named as Modified Murthy Estimator (MME) in this study. The objective of this paper is to look at the performance of MME as compared to other estimators available in the literature, with reference to the relative efficiency and design effect. These are described briefly in section 2.

2. Comparison of Different Estimators

Numbers of estimators are available in literature for use in unequal probability sampling. Some important estimators compared in this study are described in the following sub sections.

2.1. Hansen – Hurwitz Estimator (HH)

Hansen and Hurwitz (1943) proposed the idea of probability proportional to size sampling with replacement (PPSWR). One unit was selected at each of n draws. They allocate the selection probability to i-th unit of the population given by $p_i = \frac{Z_i}{Z}$ where Zi is the measure of size for i-th population unit and $Z = \sum_{i=1}^{N} Z_i$.

Hansen and Hurwitz proposed the following estimator for population total Y, denoted by y'_{HH}, for use with unequal probability sampling with replacement:

$$y'_{HH} = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{p_i}$$

Where
yi is measurement for the i-th unit
The variance of this estimator is given by

$$Var\left(y'_{HH}\right) = \frac{1}{n}\left[\sum_{i=1}^{N}\frac{Y_i}{P_i} - Y^2\right]$$

2.2. Horvitz–Thompson Estimator (HT)

Horvitz and Thompson (1952) were the first to provide a complete theoretical framework for unequal probability sampling without replacement. They suggested the following estimator of population total for use with unequal probability sampling without replacement:

$$y'_{HT} = \sum_{i\in S}\frac{Y_i}{\pi_i}$$

Where
Yi measurement for the i-th unit
πi probability of i-th unit in sample
πij probability of i-th and j-th units in sample
Horvitz and Thompson (1952) developed the following variance formula for y'_{HT} :

$$Var_{HT}\left(y'_{HT}\right)=\sum_{i=1}^{N}\frac{1-\pi_i}{\pi_i}Y_i^2+\sum_{i=1}^{N}\sum_{\substack{j=1\\ j\neq i}}^{N}\frac{\pi_{ij}-\pi_i\pi_j}{\pi_{ij}}Y_iY_j$$

2.3. Rao, Hartley, Cochran Estimator (RHC)

Rao – Hartly – Cochran (1962) developed sampling strategy with unequal probability sampling and the estimator of population total.

$$y'_{RHC}=\sum_{i=1}^{n}\frac{\pi_i y_{iT}}{p_{iT}}$$

where p_{iT} is the probability of t-th unit selected from the i-th group. Also $\pi_i=\sum_{T=1}^{N_i}p_{iT}$ and $\sum_{i=1}^{n}\pi_i=1$.The of Rao – Hartly – Cochran estimator can be used for any sample size. The variance is

$$Var\left(y'_{RHC}\right)=\frac{n\left[\sum_{i=1}^{n}N_i^2-N\right]}{N(N-1)}.\left[\sum_{i=1}^{n}\sum_{T=1}^{N_i}\frac{Y_{iT}^2}{P_{iT}}-\frac{Y^2}{n}\right]$$

2.4. Raj Estimator

Raj (1956) proposed the series of ordered estimators that can be used with unequal probability sampling without replacement. The estimator proposed by Raj has the general form as

$$t_{mean}=\frac{1}{n}\sum_{r=1}^{n}t_r$$

where $t_r=\sum_{i=1}^{r-1}y_i+\frac{y_r}{p_r}\left(1-\sum_{i=1}^{r-1}p_i\right)$

The Raj estimator tmean for a sample of size two is:

$$t_{mean}=\frac{1}{2}\left[\frac{y_i}{p_i}(1+p_i)+\frac{y_i}{p_i}(1-p_j)\right]$$

The variance of the estimator

$$Var(t_{mean})=\frac{1}{8}\sum_{i=1}^{N}\sum_{\substack{j=1\\ j\neq i}}^{N}p_ip_j(2-p_i-p_j)\left(\frac{Y_i}{\pi_i}-\frac{Y_j}{\pi_j}\right)^2$$

2.5. Murthy Estimator (ME)

A Modified Murthy Estimator of population total has been developed by using the estimator of Murthy (1957), which is defined as:

$$t_{symm}=\frac{1}{P(S))}\sum_{i=1}^{n}P(S|\ i)y_i$$

where $P(s|i)$ is the probability of obtaining a sample "s" given that i-th unit has been already selected and $P(s)$ is the probability of obtaining a sample "s".

Murthy (1957) used the Yates – Grundy draw – by –draw procedure to obtain following unbiased estimator of population total for a sample of size 2

$$t_{symm} = \frac{\left[\frac{y_i}{p_i}(1-p_j)+\frac{y_j}{p_j}(1-p_i)\right]}{(2-p_i-p_j)}$$

2.6. Modified Murthy Estimator (MME):

This estimator is obtaining by Hina and Shahbaz (2004) by using the selection procedure of Shahbaz and Hanif (2003) in Murthy (1957) estimator given in subsection 2.5. The modified Murthy estimator is:

$$t_{mm} = \frac{b(1-4p_i)(1-4p_j)}{4(1-2p_i-2p_j)(1-p_i)(1-p_j)}\left[\frac{y_i(1-p_j)}{p_i}+\frac{y_j(1-p_i)}{p_j}\right]$$

t_{MM}

$$V(t_{mm}) = \frac{b}{8}\sum_{i=1}^{N}\sum_{\substack{j=1\\ j\neq i}}^{N} D_{ij}\left[A_{ij}\frac{Y_i^2}{P_i^2}+B_{ij}\frac{Y_j^2}{P_j^2}-2C_{ij}\frac{Y_iY_j}{P_iP_j}\right]$$

where

$$A_{ij} = \frac{b(1-4P_i)(1-4P_j)-4P_i(1-2P_i-2P_j)(1-P_i)P_i}{(1-P_i)^2(1-4P_i)(1-4P_j)b}$$

$$B_{ij} = \frac{b(1-4P_i)(1-4P_j)-4(1-2P_i-2P_j)(1-P_j)P_j}{b*(1-P_J)^2(1-4P_i)(1-4P_j)}$$

$$C_{ij} = \frac{-b(1-4P_i)(1-4P_j)+4(1-2P_i-2P_j)(1-P_i)(1-P_j)}{b*(1-P_i)(1-P_j)(1-4P_i)(1-4P_j)}$$

$$D_{ij} = \frac{P_iP_j(1-4P_i)(1-4P_j)}{1-2P_i-2P_j}$$

3. Empirical Study

The estimators described in section-2 are compared by using 20 natural populations from literature on sampling. These are given in Table-A1. For empirical study procedures adopted are relative efficiencies and design effects.

3.1. Relative Efficiency

Relative efficiency of various estimators with respect to MME are obtained and placed in Table-A2. The graph of relative efficiencies for selected twenty populations is given as Figure-1.

The performance of MME with respect to relative efficiency is better as compared to other estimators for the populations 2, 6, 7, 10, 15, 17 and 19. For these populations the relative efficiency of ME ranges from 1.00 to 1.19. It means that the variance of MME may be 84% of variance ME. Thus, the modification introduced by Hina and Shahbaz (2004) reduced the variance of ME up to 16%. It can be considered a reasonable reduction in variance. The MME may produce 21%, 18%, 16%, 17% and 17% smaller variance than HH, HT, HTBDS, RHC, and RAJ estimators, respectively.

3.2. Design Effects

The design effects are computed and placed in Table A3. The graph is given as Figure 2.

The design effect of MME is higher than 1 only for populations 3, 12 and 14. For all other populations the design effect of MME is smaller than 1. It ranges from zero to .88. It implies that variance of MME ranges from extremely smaller to 88% of the variance by simple random sampling.

4. Conclusion

The Modified Murthy estimator of population total, proposed by Hina and Shahbaz (2004), has shown:

1. 16% reduction in variance of ME
2. Design effect as small as zero.

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Appendix

Table-A1: Natural Populations

Sr. No.		Values of Variables
1	X	0.3, 0.5, 0 .4, 0.9, 0.7, 0.2, 0.6, 0.5, 0.8, 0.4, 0.8, 0 .6
	Y	6, 9, 7, 19, 15, 5, 12, 9, 20, 9, 18, 13
2	X	12, 11.4, 7.9, 9.0, 10.5, 7.9, 7.3, 10.2, 11.7, 11.3, 5.7, 8.0, 10.3, 12.0, 9.2
	Y	125, 119, 83, 85, 99, 117, 69, 133, 154, 168, 61, 80, 114, 147, 122
3	X	62, 62, 87, 65, 58, 92, 88, 79, 83, 62, 63, 62, 60, 75, 90
	Y	2, 3, 3, 5, 4, 7, 2, 4, 2, 5, 3, 6, 4, 4, 2
4	X	80, 81, 117, 85, 12, 342, 32, 190, 852, 78, 55, 638, 100, 532, 132, 11, 318
	Y	117, 287, 250, 244, 0, 1806, 64, 328, 4813, 89, 53, 1368, 316, 1035, 256, 9, 471
5	X	3, 4, 4, 6, 8, 10, 12, 11, 14, 17, 20
	Y	2, 5, 4, 5, 9, 8, 9, 8, 12, 15, 17
6	X	104, 106, 106, 106, 102, 104, 102, 104, 102, 102, 101, 105, 106
	Y	38.9, 40.4, 39.9, 40.8, 33.7, 39.5, 33.0, 39.5, 37.0, 33.9, 29.9, 39.5, 40.6
7	X	453, 460, 462, 467, 501, 503, 514, 515, 541, 542, 543, 562, 570, 586, 601
	Y	194, 161, 222, 223, 96, 164, 318, 272, 155, 292, 214, 275, 100, 418, 189
8	X	7, 3, 5, 8, 12, 4, 6, 11, 8, 9, 5, 7, 6, 11, 5, 5, 7, 17, 12, 10, 10, 6, 5, 8
	Y	3.2, 1.1, 2.4, 3.7, 6.2, 1.7, 2.1, 3.9, 4.7, 5.1, 2.3, 1.8, 1.6, 3.5, 4.1, 2.4, 6.8, 11.7, 8.3, 5.9, 6.1, 2.3, 7.5, 8.4
9	X	12, 12, 12, 12, 12, 12, 12, 12, 11, 11, 11, 11, 10, 10, 10, 10
	Y	762, 651, 461, 521, 653, 544, 542, 590, 533, 517, 520, 539, 509, 449, 492, 498
10	X	6, 6, 6, 6, 6, 5, 5, 5, 4, 4, 4, 4, 4, 4, 4
	Y	165, 224, 192, 161, 104, 94, 102, 115, 110, 109, 83, 36, 61, 92, 75, 64
11	X	94, 85, 85, 80, 82, 79, 86, 82, 93, 88
	Y	16, 20, 18, 17, 14, 15, 19, 13, 19, 17
12	X	2, 3, 3, 5, 4, 7, 2, 4, 2, 5, 3, 6, 4, 4, 2, 5, 3, 4, 2, 4
	Y	14.3, 20.8, 22.7, 30.5, 41.2, 28.2, 24.2, 30.0, 24.2, 44.4, 13.4, 19.8, 29.4, 27.1, 22.2, 37.7, 22.6, 36.0, 20.6, 27.7
13	X	7, 3, 5, 8, 12, 4, 6, 11, 8, 9, 5, 7
	Y	3.2, 1.1, 2.4, 3.7, 6.2, 1.7, 2.1, 3.9, 4.7, 5.1, 2.3, 1.8
14	X	6, 11, 5, 5, 7, 17, 12, 10, 10, 6, 5, 8
	Y	1.6, 3.5, 4.1, 2.4, 6.8, 11.7, 8.3, 5.9, 6.1, 2.3, 7.5, 8.4
15	X	7, 6, 3, 3, 8, 5, 5, 7, 9, 1, 3, 4, 6, 4, 7, 6, 4, 3, 7, 5, 5
	Y	0.82, 3.0, 3.32, 5.0, 7.92, 1.62, 2.66, 4.66, 6.64, 18.0, 0.0, 0.16, 0.50, 4.80, 2.65, 1.95, 2.0, 0.44, 1.98, 3.57
16	X	8, 10, 7, 5, 12, 4, 10, 6, 7, 5, 11, 3, 7, 8, 11
	Y	9.2, 15.7, 8.4, 7.5, 18.3, 7.6, 9.5, 9.3, 8.4, 16.5, 20.1, 7.2, 11.6, 9.2, 18.9
17	X	1, 1, 2, 3, 4, 4, 5, 5, 55, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5
	Y	21, 23, 40, 43, 50, 96, 145, 156, 127, 161, 214, 143, 201, 198, 173, 220, 297, 151, 158, 163
18	X	95, 79, 30, 45, 28, 142, 125, 81, 43, 53, 148, 89, 57, 132, 47, 43, 116, 65, 103, 52
	Y	9, 7, 3, 2, 3, 8, 9, 10, 6, 2, 16, 4, 5, 13, 4, 9, 12, 8, 9, 8
19	X	51, 51, 52, 52, 53, 54, 57, 60, 65, 67, 68, 70, 71, 73, 74, 76, 78, 80, 81, 85
	Y	1350, 1176, 1841, 2606, 2656, 2546, 2911, 3280, 3425, 3416, 3390, 3395, 3417, 3290, 3481, 3520, 3570, 330, 520, 3601
20	X	6.7, 8.2, 7.9, 6.4, 8.3, 7.2, 6.0, 7.4, 8.1, 9.3, 8.2, 6.8, 7.4, 7.5, 8.3, 9.1, 8.6, 7.9, 6.3, 8.9
	Y	7.1, 8.4, 8.2, 6.9, 8.4, 7.9, 6.5, 7.6, 8.9, 9.9, 9.1, 7.3, 7.8, 8.3, 8.9, 9.6, 8.7, 8.8, 7.0, 9.4

Table- A2: Relative Efficiencies of the estimators described in subsections 2.1 to 2.5 with reference to the Modified Murthy estimator

Estimator / Population	HH	HT	HTBDS	RHC	RAJ	MURTHY
1	0.58	0.60	0.52	0.53	0.53	0.52
2	1.11	1.05	1.03	1.03	1.03	1.03
3	0.96	0.87	0.89	0.89	0.89	0.89
4	0.76	0.65	0.68	0.70	0.69	0.68
5	1.06	0.95	0.94	0.91	0.94	0.92
6	1.24	1.16	1.14	1.14	1.15	1.14
7	1.08	1.00	1.00	1.01	1.01	1.00
8	1.02	0.97	0.98	0.97	0.97	0.97
9	1.07	1.00	0.99	1.00	1.00	1.00
10	1.28	1.22	1.19	1.20	1.20	1.19
11	1.03	0.91	0.91	0.91	0.92	0.91
12	0.75	0.67	0.70	0.71	0.70	0.70
13	0.83	0.78	0.74	0.76	0.75	0.75
14	0.68	0.61	0.63	0.62	0.52	0.62
15	1.26	1.19	1.16	1.19	1.18	1.18
16	0.82	0.75	0.78	0.77	0.77	0.77
17	1.18	1.14	1.12	1.12	1.12	1.12
18	0.85	0.79	0.81	0.80	0.80	0.80
19	1.08	1.04	1.03	1.02	1.03	1.03
20	0.51	0.45	0.48	0.48	0.48	0.48

Figure – A1: Relative Efficiencies of the estimators described in subsections 2.1 to 2.5 with reference to the Modified Murthy estimator

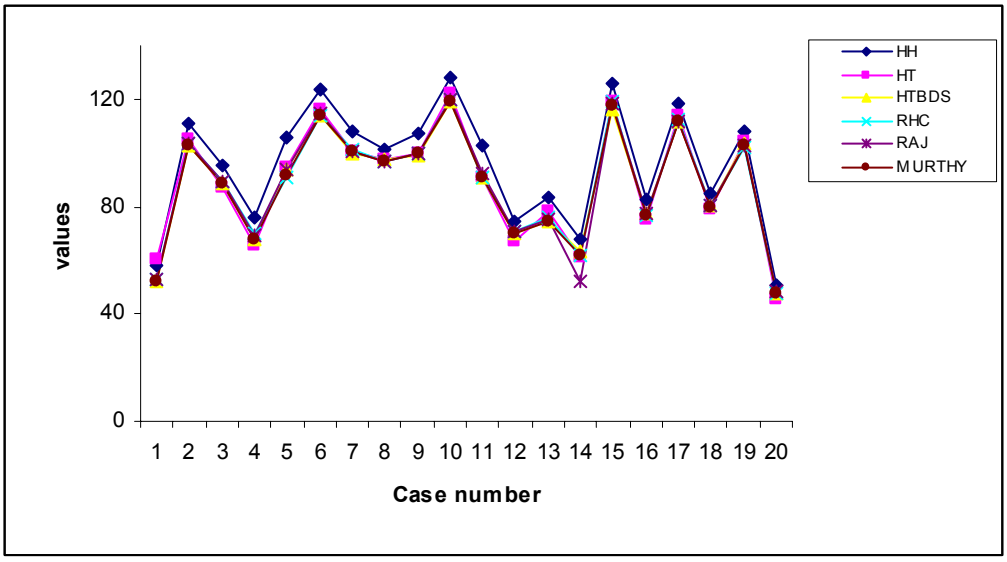
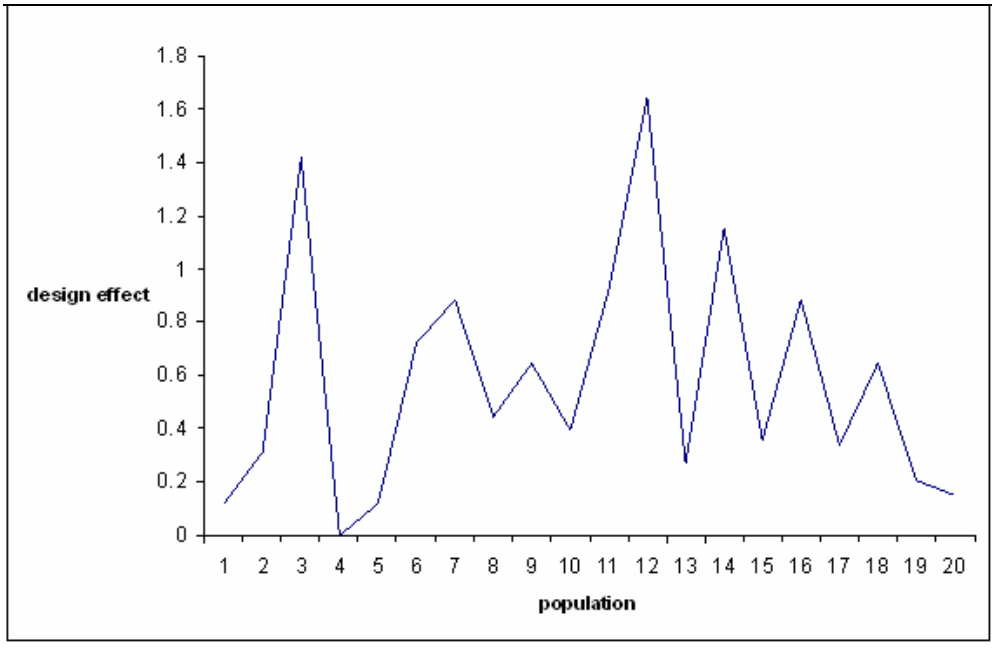


Table- A3: Design Effect of Modified Murthy Estimator of Population Total $(\hat{Y})$

Population No.	$Var(\hat{Y})_{SRS}$	$Var(\hat{Y})_{MM}$	**Deff.**
1	1612.727	194.5197	0.120615
2	98370.07	31051.92	0.315664
3	229.3571	324.7853	1.416068
4	1.78E+08	2127.426	1.2E-05
5	1062.9	128.5696	0.120961
6	918.94	660.5193	0.718784
7	710508.5	628093.1	0.884005
8	1913.885	849.226	0.443718
9	720850.2	466323.4	0.646907
10	283385.7	111366.2	0.392985
11	211.5556	194.5471	0.919603
12	12149.53	19990.79	1.645397
13	146.6	39.65136	0.270473
14	552.8545	636.8251	1.151885
15	2898.503	1044.86	0.360483
16	2119.576	1872.936	0.883637
17	983823.2	331138.8	0.336584
18	2582.053	1660.952	0.643268
19	2.02E+08	41551304	0.205197
20	164.8942	24.80693	0.150441

Figure – A2 Design Effect of Modified Murthy Estimator of Population Total $(\hat{Y})$



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Germination and Seedling Growth as Influenced by Seed Size of *Dacroyodes Edulis (G. Don) H. J. Lam* in Nigeria

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Abstract

Dacryodes edulis (G. Don) H. J. Lam was classified into characteristic sizes and evaluated for germination, seedling growth and biomass in six seed size classes. The germination and growth of the seeds were high. The viability and germination of the seeds were between 96-100%. Germination was linearly and positively correlated with seed and fruit weights and lengths. Heavier seeds and fruits showed early and rapid germination. Contribution of fruit dry weight to fresh fruit biomass was 30.90-35.97%. The relative growth rate was high in LB and MB seed size class (0.023-0.026cm/wk) and least in SB seed size class (0.011cm/wk). The study concludes that the variations in fruits and seed size have a significant influence on growth and biomass accumulation in *Dacryodes edulis*. Such variation manifests in the germination and growth of the species.

Introduction

Dacryodes edulis (G. Don) H. J. Lam is an oleiferous fruit tree of the familyBurseracceae, locally known as African Pear. It is an indigenous African tropical forest tree species, which has made transition from the forest to the farm because of the valued fruits.(Awono et al 2002). It is commonly cultivated in agroforestry systems as a shade provider and secondary crop in cocoa and coffee farms (Sonwa et al, 2002). In common with many non-timber forest products (NTFPs), it plays an important role both in household consumption and a source of income (Awono et al, 2002). The nutritional value of the fruit is significant with a fat content of 50%, 27% fibre, 10% protein and 10% sugar (Silou, 1994). Many studies have been carried out on Dacryodes edulis in recent times. Okafor (1983) defined two varieties D. edulis var edulis and D. edulis var. parvicarpa; which was based mainly on fruit size. Some parts of Nigeria (mainly the Ibo speaking areas) in the South-east have identified varieties of the

fruit by giving names to different cultivars of the fruit depending on its size, shape, colour, pulp thickness, taste, time of maturity etc. (Okorie 1985). Leakey and Ladipo (1996) reported continuous variation in fruit size, pulp seed ratio and other fruit characteristics between different fruitlots of different origins. Yombi et al (1980) indicated that there are two morphological types in markets in Cameroon: a large fruit with a large seed and a small (short) fruit with a well-developed mesocarp.

Though, the effect of seed size and weight on growth of tree species have been studied by many researchers (Ayuk et al, 1999; Black and Janssens 1996; Bouqest 1969; Dalziel 1937; FAO 1982), there is dearth of information about the relationship of seed traits on seedling growth of *dacroyodes edulis*. For *Dacryodes edulis*, which is propagated through seeds, the tree growth correlation with seed is useful for selection of fruits.

The present study was taken up to explore the relationship of fruit and seed size variation on germination and seedling growth of *Dacryodes edulis*.

Materials and Methods

Study site

This study was carried out in Port Harcourt, in the Forestry Nursery of University of Science and Technology, Rivers State, situated at the Eastern coast of Nigeria at latitude 4.51o North and longitude 7.01o East on an elevation of 18m above sea level (FAO, 1984). Port Harcourt lies in the humid tropical zone with annual rainfall which ranges from 2000 – 2,470mm, with an annual temperature ranges from minimum 23oC to average maximum 32^{o}C (RISADEP, 1995).

Seed procurement

Ripe fruit collection was done in four local markets in Rivers State of Nigeria, which were Obigbo Market, Borokiri Market, Etche market and Oil Mill market. A fruit is ripe when it changes from the unripe pink colour to blue. Questionnaires were administered personally to each *D.edulis* trader. The fruits were bought from randomly selected traders where the fruits appeared to be similar morphologically confirming common tree origin. Two hundred and forty fruits were randomly selected for identification. The fruit size was initially used for identification and they were Large-Big (LB), Large-Small (LS), Medium-Big (MB), Medium-Small (MS), Small-Big (SB) and Small-Small (SS) (Table1). Thus, six fruit types were identified based on the fruit and seed sizes classification and there were forty of each identified fruit type.

Simple linear correlation and Regression analyses were used to test for association between the fruit lengths and seedling heights, fruit weight and seed weight and for prediction of the fruit type.

Fruit and Seed Assessment and Germination

The six identified fruit types were further assessed for fruit weight by weighing with a balance, fruit length and fruit breadth by direct measurement, then fruit shape and colour by visual observation. After these measurements a utility nursery knife was used to open up the fruits to extract the seeds. This was done carefully with the hand in order not to destroy the mesocarp and the seed.

After extraction, the seeds were sown in germination boxes measuring 42cm X 29cm x 8cm and containing river-washed sand and completely decomposed sawdust, in a ratio of 1:2 by volume, respectively in accordance with Okorie and Ezeanyika (2000).

The mesocarp and the endocarp of these seed were previously removed before sowing in the germination media. Each germinaion box contained 10 seeds of a fruit type and there were four replications of each fruit type giving 24 sowing boxes laid out in completely randomized design. These were watered immediately. Watering was also done every morning until the seeds germinated.

Germination counts were taken at intervals of 2 days and germination was deemed successful when the plumule emerged above the soil surface.

The seedlings were transplanted according to the fruit types into polypots measuring 26cm x 19cm x 19cm in size and laid out in completely randomized design. The transplant medium was a mixture of forest topsoil and river sand in a ratio 1:1. Watering was done daily. Total seedling height (cm), and number of leaves were assessed weekly. Biomass was assessed for each fruit type at the end of twelve weeks. The total leaf area and number of roots for each fruit type seedling were also determined.

Results and Discussion

Fruit Characteristics

The fruit shape varied from oblanceolate and lanceolate, which had the largest length, breadth and weight, found among the Large-Big, Large-small, to obovate which was found among the Medium sizes, then the ovate and elliptic found among the small sizes. The fruit length is highest (7.81cm) in the fruit type L-B (Large-Big) and lowest (3.68cm) in the fruit type S-S (Small –Small). The same trend was observed in the fruit breadth with 3.37cm in L -B and 2.07cm in S-S.

The fruit weight also followed the same sequence. This same trend was observed in the seed length, seed breadth and seed weight (Table 1).

This trend confirms that variations indeed exist in the fruit sizes and the variations also cut across into the seeds, that is, the bigger the fruits, the bigger the seeds or the smaller the fruits, the smaller the seeds. This trend appears to be consistent with fruits of particular parent trees. No morphological variations were observed amongst fruits from the same parent tree. This can help farmers or private individuals in fruits selection for planting, knowing fully well from the market survey, that bigger fruits get bigger sales (prices). (Okorie and Ezeanyika 2000).

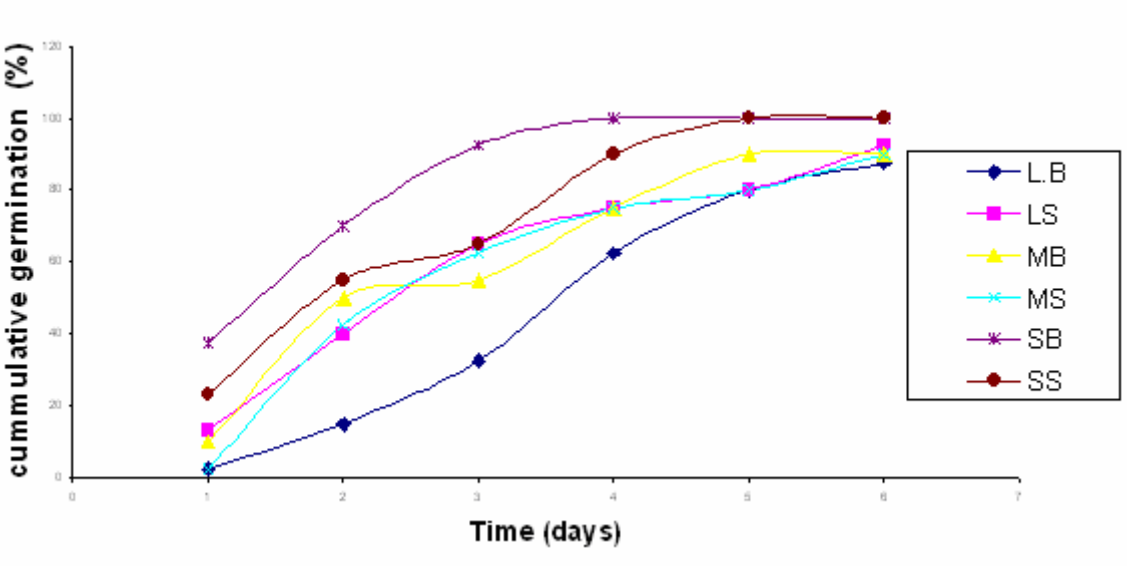
Table 1: Morphological Characteristics of Dacryodes edulis (G. Don) H. J. Lam

	Seed weight classes					
Parameters	**LB**	**LS**	**MB**	**MS**	**SB**	**SS**
Fruit length (cm)						
Fruit length	7.81^{a}	6.55^{b}	5.66^{c}	4.73^{d}	4.06^{e}	3.68^{f}
Fruit breadth	3.37^{a}	3.06^{b}	2.7^{c}	2.5^{d}	2.21^{e}	2.07^{f}
Fruit weight	46.13^{a}	40.00^{b}	27.00^{c}	20.00^{d}	16.25^{e}	14.00^{f}
Seed length (cm)						
Seed length	4.75^{a}	4.51^{b}	4.26^{c}	3.65^{d}	3.34^{e}	3.14^{f}
Seed breadth	2.47^{a}	2.26^{b}	2.12^{c}	2.03^{d}	1.74^{e}	1.77^{f}
Seed weight	15.24^{a}	11.5^{b}	9.5^{c}	7.73^{d}	6.25^{e}	5.60^{f}
Leaf attribute						
Seedling leaves No	4^{a}	3 b	3^{c}	3^{d}	2^{e}	2^{f}
Seedling Leaf area (cm2)	29.86^{a}	26.67^{b}	25.66^{c}	23.44^{d}	18.81^{e}	24.57^{f}
Root count	21.75^{a}	17.08^{b}	25.75^{c}	16.75^{d}	15.00^{e}	18.5^{f}
Relative Growth Rate (RGR – cm)	0.026^{a}	0.023^{b}	0.025^{c}	0.012^{d}	0.011^{e}	0.014^{f}

Seed Germination

Commencement of germination among all the fruits types was fourteen days after sowing. Small fruit types however had higher percentage germination than the medium and large fruit types (Table 2 and 3).

Figure: 1: Cumulative Germination curve



The cumulative germination rate is shown on Fig.1. The germination rates are also higher in small fruits types. This follows that seeds of the small fruit type (SB and SS) will surely germinate and grow up to seedlings stages that can withstand environmental stress according to Nwoboshi (1982).

Germinative energy or seed vitality therefore follows the same trend (Fig.1). The small fruit type (SB) reached the peak of its germinative energy at week four (4) with 65% germination count while the large fruit type (LB) at week four (4) had about 28% germination count. This suggests that the seed of the small fruit type may have greater capacity to thrive even in adverse environmental conditions than the Large or Medium fruit types. Oni and Gbadamosi (1998) reported that the rate of germination and percentage germination of seeds are important factors in nursery and field establishment of forest crops.

This same trend was observed in the germinative capacity or seed viability. The highest recorded seed viability was found among the small fruit type with 100% germination count (Table 3). This also confirms that the seed of the small fruit type has the potential to withstand more environmental stress and can have a higher yield than the seed of the large fruit type. The results suggest that trees of smaller seed types may be reliable as environmental management trees for shade and erosion control. Ability to germinate early and grow may be a genetic quality for survival in adverse environmental conditions. Selection for environmental management functions may consider small seed/fruit types as a planting option.

Seedling growth

Height: Table 2 shows the variation in the shoot height of various fruit seed sizes. At the 84 DAS, the lowest height was observed in SB and SS (25.44cm and 24.65cm respectively) while LB fruit type had the highest shoot height at the 84 DAS (LB 32.85cm, LS 31.72cm). There was also significant and positive linear relationship between seedling height and fruit length, (R^2 =0.981), and between seedling height and seed length (R^2 = 0.934) as shown in (Fig.2). This indicates that fruit and seed lengths affect the seedling height, that is small fruits or seeds tend to grow slower than large fruits or seeds. This also can be a guide to farmers in choosing the type of fruits to plant, since fruits and seeds with higher length will give seedlings with higher height and faster growth rate.

Table 2: Germination and Shoot growth in different Seed size classes of Dacryodes edulis (G. Don) H. J. Lam

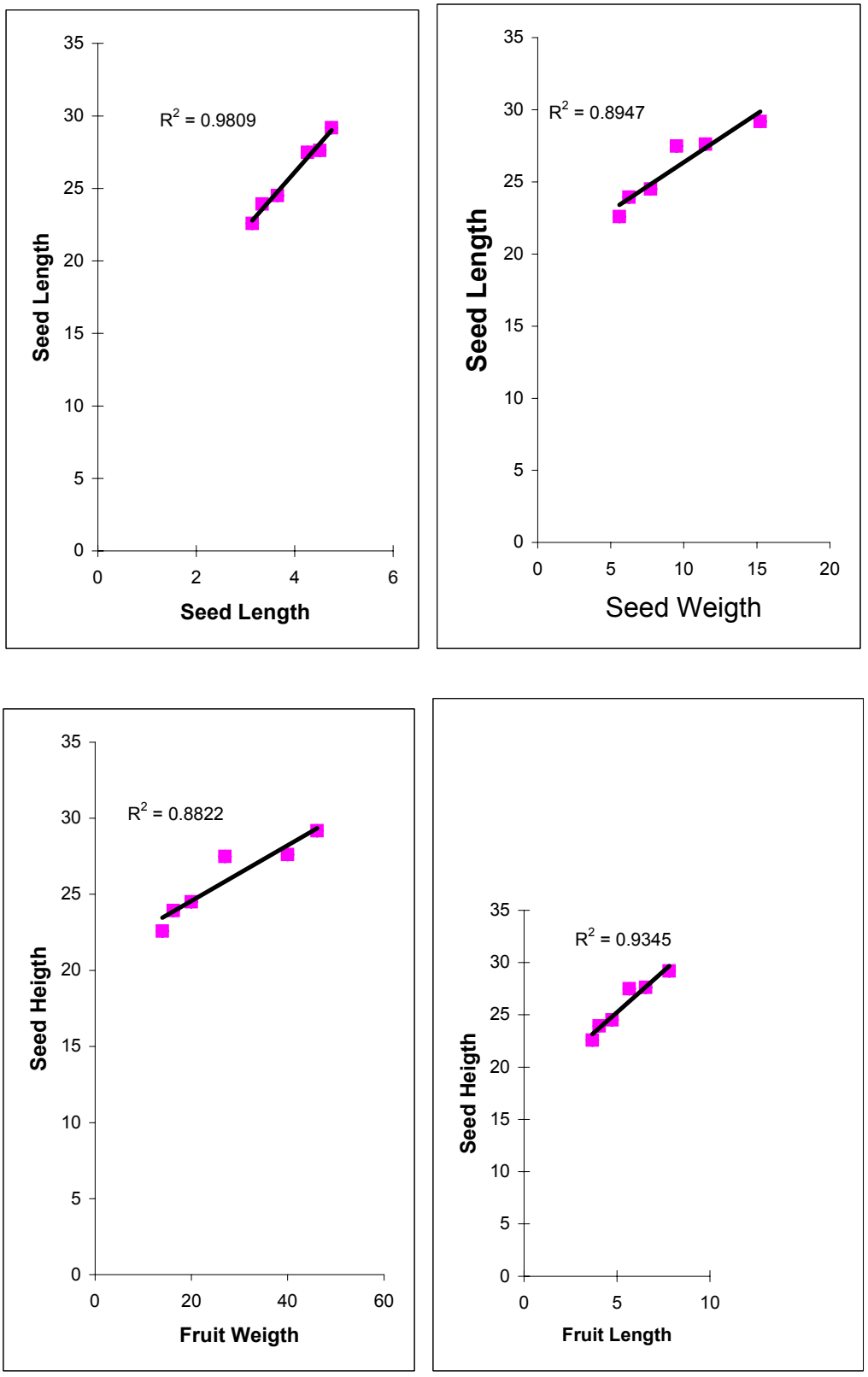
Seed weight classes						
Time (day)	**LB**	**LS**	**MB**	**MS**	**SB**	**SS**
	Germination %					
14 DAS	2.5^{a}	13.3^{a}	10^{a}	2.5^{a}	37.5^{a}	23.3^{a}
28DAS	1.5^{b}	40^{b}	50^{b}	42.5^{b}	70^{b}	55^{b}
42 DAS	32.5^{c}	65^{c}	55^{c}	62.5^{c}	92.5^{c}	65^{c}
56 DAS	62.5^{d}	75^{d}	75^{d}	75^{d}	100^{d}	90^{d}
70 DAS	80^{e}	80^{e}	90^{e}	80^{e}	100^{d}	100^{e}
84 DAS	87.5^{f}	92.5^{f}	90^{e}	90^{f}	100^{d}	100^{e}
	Shoot height (cm)					
14 DAS	25.24^{a}	24.78^{a}	23.97^{a}	23.13^{a}	22.84^{a}	21.28^{a}
28 DAS	26.16^{b}	25.52^{b}	25.25^{b}	23.61^{b}	23.26^{b}	21.54^{b}
42 DAS	28.77^{c}	27.06^{c}	27.06^{c}	24.10^{c}	23.60^{c}	21.86^{c}
56 DAS	30.17^{d}	27.51^{d}	28.20^{d}	24.78^{d}	23.83^{d}	22.16^{d}
70 DAS	31.61^{e}	29.86^{e}	29.52^{e}	25.27^{c}	24.63^{e}	23.74^{e}
84 DAS	32.85^{f}	31.72^{f}	30.93^{f}	26.18^{f}	25.44^{f}	24.65^{f}

Note: The value was counted from the day of sowing; **DAS (Days After Sowing)** Values having similar superscripts across each column are not significantly different at $P< 0.05$.

Table 3: cumulative germination and Fruit / Seed Dacryodes edulis (G. Don) H. J. Lam

Fruit Classes	Germination (%)	Fruit Gross Fresh weight (g)	Fruit Gross Dry weight (g)	Weight of Seed (%)
LB	90	383.74	138.06	35.97
LS	97.5	347.97	124.12	35.66
MB	95	295.04	91.20	30.81
MS	97.5	212.37	68.25	32.14
SB	100	162.80	53.63	32.94
SS	100	151.37	46.78	30.90

Figure 2: Showing the seedling length in relation to seed weight, seed length, fruit weight and fruit length with R^2 of the Regression models.



Leaf Development: The leaves were compound imparipinnate, though in three or four (leaflets). The highest mean numbers of leaves at the 84 days were recorded among the large fruit type (LB), which was approximately 4, and the lowest mean number of leaves were recorded among the small fruit type, which was approximately 2 in SS and SB. This can now explain seedling height variation because the

greater the number of leaves, the larger the photosynthetic area, and therefore, the higher the food storage in the plant, which leads to higher seedling height in the large fruit types than in the small fruit type.

Leaf Area: It was observed that the leaves of the large fruit types (LB 29.86cm^2) were larger than the leaves of the medium fruit type (MB 25.66 cm^2), and the leaves of the medium fruit type were larger than the leaves of the small fruit type (SB 18.81 cm^2) (Table 1). This variation observed follows the same trend in previous characters reported on. That is, the fruit size affects or influences the leaf area, the larger the fruit, the greater the leaf area with the exception of Small – Big (SB) that might be due to the leaf position on the seedling.

Total Biomass: Total biomass accumulation also varies accordingly. Large fruit type had the highest dry weight (LB 138.06gm) as shown in Table 3 while the small fruit type had the lowest dry weight (SS 46.78gm). This also indicates that the fruit size and seed size influenced the seedling height, leaf number and leaf area, due to the amount of biomass accumulation for each of the fruit type of the seedling.

Relative Growth Rate: The relative growth rates showed that LB had the highest R.G.R (0.026cm/wk), followed by MB with 0.025cm/wk while SS with 0.011cm/wk had the least (Table 1). Since R.G.R. shows the efficiency of growth rate, it follows that the fruit size affect the growth efficiency of the seed planted since large fruit size (fruit length and breadth) gave a higher R.G.R in the seedling growth analysis than smaller fruit size. However, there is need for further studies about the genetic attributes of the fruit varieties to advance the irregularity observed in the values of relative growth rate.

Conclusion

Results of this study had shown that there is a lot of morphological variation of genetic and horticultural interest existing in the African Pear fruits and seeds. This variation may assist in fruit selection by individuals for commercialization since bigger sized -fruits (seeds) are likely to bring bigger sales while smaller sized-fruits may bring smaller sales. Similarly, it was found out that the bigger fruits tended to accumulate more biomass and offered better growth rate and efficiency. However, small fruit types appeared to have good potential for more regeneration capacity. And while the small fruit type may not be attractive for sales in the market, it may be of immense environmental importance for production of shade and erosion control tree and for pulp oil extraction. More studies are however required in the areas of the species genetics and pollination control if the useful variants already identified within the species are to be maximally exploited for their improvement.

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Fingerprint Matching Algorithm Based on Ridge Path Map

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Abstract

A robust fingerprint recognition algorithm should treat the rotation and translation of the fingerprint image. One popular solution is to consistently detect the coordinates and orientation of each minutia and convert the fingerprint image to ridge path map file that can be used as an input file to a matching algorithm. This paper proposes an effective algorithm to match two fingerprints using there ridge path map files by calculating the matching score in order to do some judgment. The proposed algorithm increases the accuracy of fingerprint matching system and decreases the efforts of image processing cycle.

1. Introduction

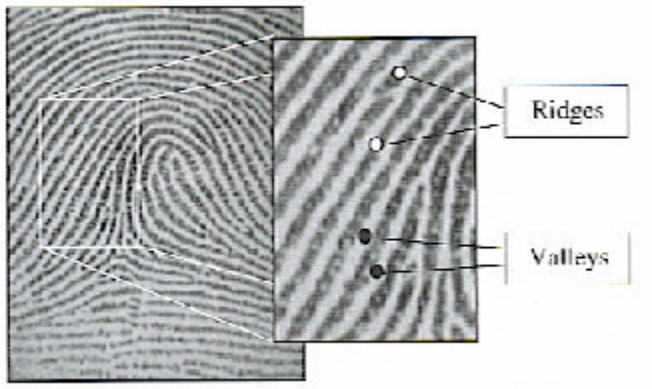
Nowadays, the need of identifying users is becoming more and more necessary for several typical operations as access controls, workstation login or electronic banking. In this way, many systems as credit cards, mobile phones or computers require keys or alphanumeric passwords. Biometrics recognition is envisaging new solutions using constant features of the user's body with the convenience that they can't be lost, forgotten or stolen. We can give as examples the human speech, the characteristic of the face, the pattern of the iris and so on. Most of the applications are based on the fingerprint pattern that is the easiest to use [1-6].

A typical fingerprint covers an area of about 100 mm² and includes several characteristic points which called minutia (generally a number from 12 to 20). Extracting their relative positions, these minutias allow creating a specific signature for each user guaranteeing a secured identification. The criminal science has been using fingerprints for more than 150 years therefore a complete theoretical and practical knowledge has been developed on signatures extraction and comparison.

2. Fingerprint Techniques and Identification

The fingerprint of an individual is unique and remains unchanged over a lifetime. A fingerprint is formed from an impression of the pattern of ridges on a finger. A ridge is defined as a single curved segment, and a valley is the region between two adjacent ridges as shown in (Fig.1).

Figure1: Fingerprint ridges and valleys

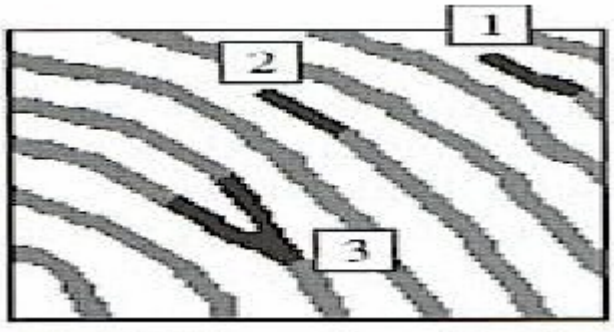


The lines that flow in various patterns across fingerprints are called ridges and the space between ridges is valleys. The minutiae, which are the local discontinuities in the ridge flow pattern, provide the features that can be used for identification.

Details such as the type, orientation, and location of minutiae are taken into account when performing minutiae extraction [8]. Galeton [4] defined a set of features for fingerprint identification, which since then, has been refined to include additional types of fingerprint features [5]. However, most of these features are not commonly used in fingerprint identification systems. Instead the set of minutiae types are restricted into only two types, ridge endings and bifurcations, as other types of minutiae that can be expressed in terms of these two feature types. Ridge endings are the points where the ridge curve terminates, and bifurcations are where a ridge splits from a single path to two paths at a Y-junction. Figure 2 illustrates an example of a ridge ending and a bifurcation. In this example, the black pixels correspond to the ridges, and the white pixels correspond to the valleys.

The lines that flow in various patterns across fingerprints are called ridges and the space between ridges is valleys.

Figure 2: Minutia Types 1 and 2 are endings; 3 is bifurcation



3. Fingerprint Preprocessing

3.1 The acquisition phase

Sensor should be used to acquire the fingerprint image. The device must provide 256 grey scale images whose width is fixed at least 256 pixels and height is variable between 128 and 384 pixels (at least).

3.2 The Pre-Processing Phase

During the fingerprint acquisition process the acquired image can be damaged and a low quality image may be obtained. Thus, an enhancement process is necessary to extract the singular points with precision. We directionally filter the image by block: the image is divided into blocks such that block's ridges are locally parallel [8, 9], the local direction is calculated and the block is filtered in that direction. Indeed this type of filtering enables a better enhancement than classical filtering by using the direction information. If ridges are locally parallel, the Fourier transforms shows two local maxima [7].

So before obtaining ridge map path, we recommend the following sequence of pre-processing operations as shown in Fig.3.

3.2.1 Image Noise Reduction and Enhancement

Noise in the fingerprint image is due to: dry or wet skin, dirt, cut, worn, noise of the capture device. Two image enhancement operations can be used as follows:

(i) The adaptive matched filter that enhances ridges oriented in the same direction as those in the same locality.

(ii) Adaptive threshold that based in using binary process (im2bw; gray thresh).

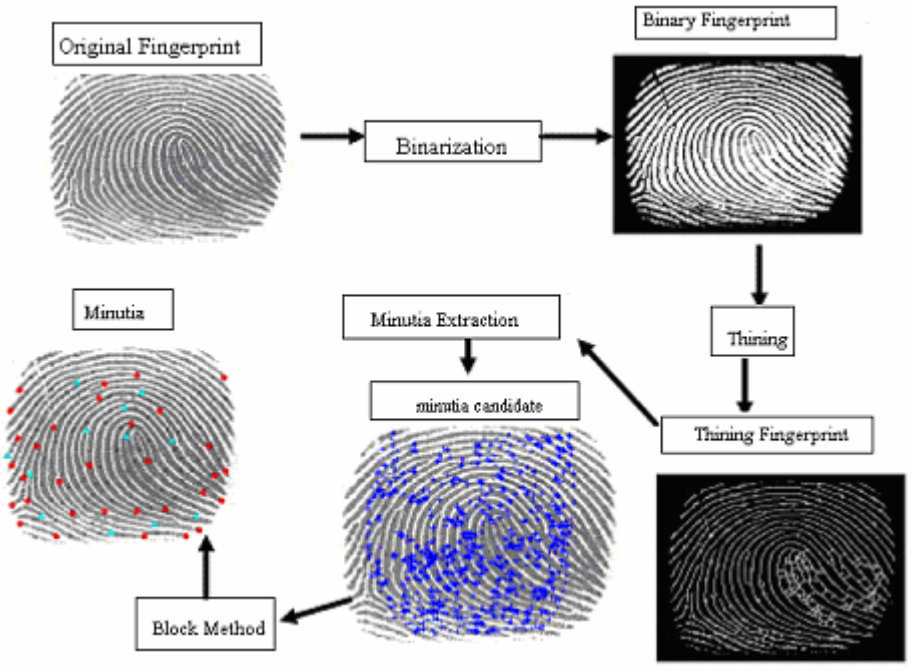
3.2.2 Thinning

which reduces ridge width to a single pixel (Matlab: bwmorph)[10]. Preserves connectivity and minimizes the number of artifacts, e.g. erroneous Bifurcations.

3-3 The Minutiae Extraction

Minutiae are ridge endings or ridge bifurcations, their positions are a unique signature for each person [1, 2, and 3]. Minutiae are easily extracted from the skeleton obtained in the previous phase. Indeed we can assume that [11, 12, 13, and 14] if a pixel is on a thinned ridge then it has a value 1 and 0 otherwise. Let (x, y) denote a pixel on a thinned ridge, and {Ni | i□[1..8]} denote its 8 neighbors. Then (x, y) is a ridge ending if (ΣNi) =1 and a ridge bifurcation if (ΣNi) > 2. For each detected minutia we record the coordinate, the type of minutia and the local ridge orientation.

Figure 3: Fingerprint processing cycle



4. Proposed Matching Algorithm

Using ridge information can convert the fingerprint image to a ridge map file that can eliminate the efforts when dealing with fingerprint processing (i.e. running time, memory space) [1, 2, 3].

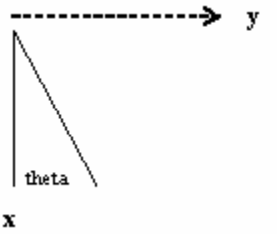
The proposed algorithm depends on performing the above mentioned sequence of fingerprint preprocessing in order to get the fingerprint features as a ridge map file, which contains information about each minutia (x and y coordinates, and orientation).

The algorithm accepts two fingerprints: template1 and template2, then it will return the maximum value of similar certainty of the two fingerprints. The following steps describe the proposed algorithm:

1. Get two fingerprints and store them in template files with three parameters(one record for each minutia):
   - Minutia X-coordinate position
   - Minutia Y-coordinate position
   - Minutia orientation.
2. Decompose the template file into minutia and ridge matrixes separately.
3. Check if templates are empty:
   - If it is empty go to step 1, otherwise proceed to step 4.
4. Initialize the parameters of two templates:
   - Initialize length of templates
   - Initialize size of templates
   - Initialize ridge map
5. Calculate the similarities between ridgeMap1(k1) and ridgeMap(k2), then choose the current two minutias as origins and adjust other minutia based on the origin minutia.
   - CALL module1 to find newxy2 by passing real_end,k,ridgeMap
   - Choose the minimum ridge length
   - Compare the similarity certainty of two ridges
   - Transfer the entire minutia in two fingerprints based on the reference pair of minutia by calling module2 2 times to find fullxy1 and fullxy2 by passing real_end and k, then assign the returned values to minimum.
   - If two minutias are within a box with width 20 and height 20, and they have small direction variation pi/3 then regard them as matched pair, otherwise increment number of matching.
6. Get the largest matching score, where the current_match_percent=num_match

Module1

1. Accept real_end, k, ridgeMap set the k-th minutia as origin and align its direction to zero(along x) and then, accommodate all other ridge points connected to the minutia to new coordinate system



Note that the coordination system and the angle are different:

position value toward bottom, right are positive. angle value are anti-clockwise from bottom to the top of the x axis on the right, within [0,pi] and are clockwise from bottom to top of the x axis on the left, within [0,-pi]

-construct the affine transform matrix

- cos(theta) -sin(theta)
- sin(theta) cos(thea)
- to rotate angle theta

2. locate all the ridge points connecting to the miniutia and transpose it as the form:
   x1 x2 x3...
   y1 y2 y3...
3. translate the minutia position (x,y) to (0,0)
   Translate all other ridge points according to the basis
4. rotate the point sets

Module2

1. Accept real_end,k -set the k-th minutia as origin and align its direction to zero(along x) and then accomodate all other minutia points in the fingerprint to the new origin. The difference between MinuOrigin and MinuOrigin_all is that the orientation of each minutia is also adjusted with the origin minutia
2. ensure the direction is in the domain[-pi,pi]

5. Implementation and Analysis of the Proposed Algorithm

The algorithm was tested on a personal computer using Mat lab environment, a fingerprints of 100 persons were collected, and processed using the above mentioned steps. After processing each fingerprint, the ridge-map-path file (template) was saved separately. The final step was applying the matching algorithm on each fingerprint template and compares it with all other fingerprints template, then for each matching test a record is made as follows:

Matching Score = Number of minutia pairs that match/Total number of minutia pairs *100%

Table 1 shows the experimental results (for only 20 templates). Also, to do some performance analysis template sizes and image sizes should be calculated, the result is shown in table2.

Table 1: Matching Scores

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
T1	100	27.7	30.3	36.6	42.4	27.2	27.2	21.2	24.2	27.7
T2	21	100	26.3	31.5	50	26.3	31.5	23.6	23.6	28.9
T3	30.7	30.7	100	35.9	41	30.7	28.2	23	28.2	25.6
T4	26.7	28.5	26.7	100	35.7	21.4	28.5	17.8	26.7	23.2
T5	20	34.2	22.8	28.5	100	24.2	20	15.7	15.7	18.5
T6	29	29	32.2	35.4	48.3	100	29	22.5	25.8	29
T7	24.1	24.1	27.5	31	34.4	27.5	100	17.2	20.6	17.2
T8	31.5	31.5	42.1	42.1	47.3	36.8	31.5	100	42.1	36.8
T9	31	34.4	37.9	41.3	37.9	27.5	27.5	27.5	100	27.5
T10	36.8	42.1	36.8	31.5	52.6	36.8	31.5	31.5	26.3	100
T11	16.4	14.9	20.8	20.8	20.8	14.9	17.9	10.44	16.4	10.4
T12	17.6	13.6	17.6	19.6	23.5	13.7	17.6	15.6	15.6	13.7
T13	16.1	22.5	16.1	24.1	29	16.1	20.9	16.1	17.7	14.5
T14	19.6	15.6	21.5	21.5	31.3	15.6	15.6	11.7	19.6	11.7
T15	21.4	25	32.1	28.5	32.1	25	25	17.8	32.1	21.4
T16	25.9	40.7	29.6	33.3	48.1	29.6	40.7	29.6	29.6	33.3
T17	26	39.1	39.1	34.7	27.8	26	30.4	30.4	26	26
T18	22.7	25	25	25	31.8	20.4	25	15.9	25	18.1
T19	28.2	30.7	30.7	43.5	35.8	23	20.5	20.5	25.6	23
T20	33.3	27.7	30.5	27.7	36.1	30.5	22.2	25	22.2	22.2

Table1 Continued

	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
T1	36.3	30.3	30.3	30.3	21.2	24.2	21.2	27.2	24.2	33.3
T2	28.9	23.6	34.2	31.5	21	26.3	28.9	26.3	23.6	28.9
T3	43.5	28.2	30.7	28.2	23	20.5	23	25.6	28.2	28.2
T4	32.1	26.7	30.3	30.3	32.2	21.4	21.4	25	25	26.7
T5	25.7	18.5	21.4	27.1	17.1	18.5	21.4	30	21.4	22.9
T6	41.9	29	32.2	32,2	25.8	32.2	22.5	32.2	25.8	29
T7	34.4	31	27.5	27.5	20.6	24.1	24.1	31	20.6	24.1
T8	42.1	36.8	47.3	31.5	21	36.8	36.8	36.8	31.5	36.8
T9	41.3	41.3	31	34.4	37.9	31	31	31	41.3	37.9
T10	42.1	31.5	36.8	36.8	26.3	42.1	31.5	36.8	36.8	31.5
T11	100	19.4	20.8	20.8	20.8	14.9	17.9	10.44	16.4	10.4
T12	23.5	100	21.5	23.5	13.7	15.6	15.6	27.4	15.6	15.6
T13	25.8	22.5	100	25.8	17.7	16.1	14.5	20.9	20.9	22.5
T14	25.4	21.5	21.5	100	17.6	19.6	15.6	29.4	21.5	17.6
T15	42.8	28.5	32.1	35.7	100	21.4	21.4	32.1	25	25
T16	37	29.6	37	33.3	29.6	100	40.7	33.3	25.9	29.6
T17	34.7	39.1	30.4	26	27.8	26	100	30.4	26	26
T18	31.8	31.8	29.5	25	31.8	20.4	25	100	25	18.1
T19	33.3	28.2	30.7	17.9	35.8	23	20.5	20.5	100	23
T20	33.3	22.2	33.3	25	36.1	30.5	22.2	25	22.2	100

Table 2: Templates and images sizes

Template	Dimension (double)	Size(bytes)	Ridge path map dimension	Size
T1	352x256	720896	361x3	8864
T2	288x352	811008	417x3	10008
T3	352x384	1081344	390x3	9360
T4	352x384	1081344	615x3	14760
T5	320x384	983040	630x3	15120
T6	224x384	688128	339x3	8136
T7	352x384	1081344	347x3	8328
T8	288x288	663552	246x3	5904
T9	352x384	1081344	384x3	8352
T10	256x384	786432	228x3	5472
T11	544x288	1253376	804x3	19296
T12	544x288	1253376	611x3	14664
T13	544x288	1253376	743x3	17832
T14	544x288	1253376	559x3	13416
T15	544x288	1253376	419x3	10056
T16	288x288	663552	323x3	7752
T17	288x288	663552	276x3	6624
T18	544x288	1253376	527x3	12648
T19	544x288	1253376	584x3	14016
T20	544x288	1253376	467x3	11208

While applying matching fingerprints the following problems can be encountered:

- Two fingerprints from two different individuals may produce a high Matching Score, which is considered as an error.
- Two fingerprints from the same individual may produce a low Matching Score, which is also an error.

So, there are **two types of error.**

1 **FAR** = ratio of number of instances of pairs of different fingerprints found to (erroneously) match to total number of match attempts.

2 **FRR** = ratio of number of instances of pairs of same fingerprint are found not to match to total number of matching attempts.

It can be found from table1 that the FAR error ranges from 10% to 52% so, 52% can be used as a maximum value for not matched templates, and thus the following can be recommended:

A Ratio of number of instances of pairs of same fingerprint is found not to match to total number of match attempts must be at least 60%

B From table 2 we can see that dealing with ridge-map-path instead of the fingerprint image can decrease the efforts of fingerprint recognition system as follows:

- Memory space will decreased at least:**min matrix size/max ridge path size** =663552/19296=34.388 times.
- Time (complicity) will be decreased al least: **(Min matrix searching time) /(max ridge searching time)**= (288*288 /(804 log2(804)= 10.6894 times.

5. Conclusion

An algorithm is proposed for fingerprint matching based on ridge path map. The algorithm was implemented using 100 different fingerprints. The obtained results were analyzed and some solutions were proposed for encountered errors. However, the obtained results have shown more accuracy and less processing time for image recognition.

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Implication of Infant Mortality on Population Growth in Nigeria: A Case Study of Ogwashi-Uku Town in Delta State of Nigeria

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Abstract

Basically the paper examined the implication of infant mortality on population growth in Nigeria. It has been observed that infant mortality is a basic index in determining longevity, population growth and overall economic development. Declining mortality, not rising fertility, is the root cause of current world population growth. The strength of the relationship between infant death and population growth needs to be examined. Data for the study was collected through primary and secondary sources. A total of 210 questionnaires were administered. Both the simple random sampling technique and the systematic sampling technique were employed in administering the questionnaires. The Spearman's rank correlation coefficient (rs) was used in the statistical analysis of the data. Solutions were proferred to the problem of infant mortality and population growth.

Keywords: Infant Mortality, Population Growth Delta State Nigeria

Introduction

Infant mortality rate simply put is the number of babies out of every 1,000 born each year that die before their first birth day (Huw, 1990). However mortality statistics such as the infant mortality rate and expectation of life at birth are often taken as fundamental measures of the welfare of a population. (Morris, 1978). In addition, over the years infant mortality has become a striking issue, which have equally been the subject of scientific policy and political interest (George et al, 1999).

Furthermore, Wayne (1990) have observed that life expectancy and infant mortality represent the effects of nutrition, public health, income, and the general environment. For example infant mortality reflects, the availability of clean water, the condition of the home environment and the mothers health. Thus, infant mortality is a basic index in determining longevity, population growth and overall economic development.

According to Weeks (2002), mortality, fertility, and migration are the dynamic elements of demographic analysis. They are the population process that had to change in the demographic structure and political structure and usually in the social, economic and political structure of societies as well. Declining mortality, not, rising fertility, is the root cause of current world population growth. Thus, human triumph over disease and early death surely represents one of the most significant improvements ever made in the conditions of human life.

It has been observed by Blacker (1991) that infant mortality has generally been most severe in West Africa, Nigeria inclusive. This has been attributed to both the level of socio-economic development and environmental factors. Again, infant mortality is often used as a key indicator of socio-economic development. This may appear odd because it concerns a death rate which applies only to infants. The infant mortality rate is used mostly as an indicator of mortality in the whole population

since estimates of infant mortality are available for many populations that lack reliable estimates of adult mortality (Adam et al, 1966).

In addition, in some of the less developed nations especially in equatorial Africa for example in Sierra Leone, infant death rates are as high as 157 deaths per 1000 live births. Sierra Leone is plagued by drought and famine and the site of some of the highest mortality ever recorded for a human population.

Infant death rates are closely correlated with life expectancy. For example Japan is tied with Sweden for the honour of having the world's lowest rate of infant mortality at 3 deaths per 1000 live births. Canada's rate of 5 per 1000 put it in the top 20, whereas the United States has a rate of 7 per 1000 placing it in the top 30. Mexico's level is 28 per 1000 while the world average is 54 per 1000 (United Nations Population Division, 2001).

The basic question to ask at this juncture is "why do babies have higher death rates in some countries than others? According to Paul (1991), the answer is best summed up by mentioning the two characteristics common to people in places where infant death rates are low i.e. high levels of education and income. These are key ingredients at both the societal level and individual level. In general, those countries with highest levels of income and education are those with enough money to provide the population with clean water, adequate sanitation, food, and shelter, and, very importantly, access to health care services, especially oral rehydration therapy.

At the individual level education here can refer simply to knowledge of a few basic rule that would avoid unnecessary infant death. For example, Bouvier and Van der Tak (1976) have observed that the causes of infant deaths in rural India was due to the fact that umbilical cords were often cut with instruments such as unsanitary farm implements and the cord was dressed with ash from cow dung fire typical of that part of the country.

Income is important in order to provide babies with nutritious sanitary diet that prevents diarrhea, an important cause of death among infants. Nursing mothers can best provide this service if their diet is adequate in amount and quality. Income is also frequently associated with the ability of a nation to provide or in an individual to buy, adequate medical protection from disease. (Weeks, 2002). Thus, in places where infant death rates are high communicable diseases are a major cause of death and most of those deaths can be prevented with medical assistance.

In addition, resistance to disease is closely related to the overall health of the child, which in turn is associated with the health of the mother. Mothers who are healthy while pregnant and who maintain that good health after giving birth are more likely to have healthy babies. Since levels of health are generally higher in more advanced nation, infant mortality is generally lowest there.

Deriving from the above, UNICEF (1987), have noted that infant and child mortality remain disturbingly high in developing countries like Nigeria despite significant decline in most parts of the world. The state of the world's children indicated that about 12.9 million children die every year in the developing world. Furthermore, the Nigerian Demographic and Health Survey (NDHS), reported that 87 out of 1,000 infants born in Nigeria die before their first birth day. It is against this background that the present paper examines infant mortality rate and population growth in Ogwashi-uku area of Delta State.

The Study Area

The study area is Ogwashi-uku, the headquarters of Aniocha South local government area. It lies between latitudes 6^{o} and 7^{o}N of the equator and longitudes 7^{o} 7^{1} and 7^{o} 7^{1}E of the Greenwich meridian. It is bounded on the North by Aniocha North local government area; on the South by Ndokwa East, and West local government areas, on the East by Oshimili North and South local government areas and on the West by Ika South and North-East local government areas. Ogwashi-uku is made up of the following quarters, viz: Ogbe-Ofu, Ogbe-Ugbo, Ogbe-nta, Agediase Umudei, Azu-Ngwu, Ishekpe, and Ogbe-ani.

According to the 1991 census, Aniocha South has an area of 25,000 square kilometres and a total population of 112,398. It has one general hospital and number of clinics and maternity homes. Others are restaurants, supermarkets, filling stations, wielding, tailoring to mention but a few.

Hypothesis

The hypothesis tested in the study is that population growth is significantly related to death rate.

Methodology

The data for the study was collected from two major sources viz: primary and secondary sources.

The primary source was the administration of 210 questionnaires. The simple random sampling technique was used to select five (5) out of the ten (10) quarters that make up the Ogwashi-uku community. The systematic sampling technique was then used to select 42 houses per chosen quarter at an interval of 2 houses.

The questionnaire included questions on infant mortality and fertility levels of women in the study area.

The secondary sources included data from textbooks, journals, periodical and records from Ogwashi-uku General Hospital.

The data was analysed with the Spearman's rank correlation co-efficients with the following formular.

$$rs = \frac{1 - 6\sum d^2}{n^3 - n}$$

where rs = the index of correlation

d = Difference between the two ranked variables

$\sum$d2 = Sum of the values of d2

n = Number of cases being ranked.

1 and 6 are constants.

Discussion

The data on population growth and infant mortality are presented in table 1 below.

Table 1: Population Growth and Infant Mortality

Years	No. of Infant deaths (x)	Logrithm values of population (y)	Rx	Ry	d	d^2
1998	12	4.58	2	1	1	1
1999	17	4.57	4	2	2	4
2000	10	4.59	1	3	-2	4
2001	15	4.60	3	4	-1	1
2002	25	4.61	6	5	1	1
2003	19	4.63	5	6	-1	1
2004	38	4.64	7	7	0	0
						$\sum d^2 = 12$

Source: fieldwork 2005

Therefore

$$R^2 = \frac{1 - 6\sum d^2}{n^3 - n}$$

$$= \frac{1 - 6 \times 12}{7^3 - 7}$$

$$= \frac{1 - 72}{343 - 7}$$

$$= \frac{1 - 72}{336}$$

$$= 1 - 0.2143$$

$$\therefore r^2 = 0.7857$$

$$= 0.79$$

Significant at 0.05%

Thus, there is a high positive correlation of $r^2 = 0.79$ between population growth and infant mortality in the study area. Deriving from the above, the causes of infant mortality in the study area were examined in table 2.

Table 2: Causes of Infant Mortality

Diseases	No. of Respondents	% of Respondents
Miseales	98	46.7
Cholera	20	9.5
Whooping Cough	22	10.5
Influenza	17	8.1
Chicken pox	53	25.2%
Total	210	100%

Source: Fieldwork 2005.

It was observed from table 2 that the major cause of infant mortality in the study area was miseales represented by 46.7%; while chicken pox was 25.2%. These are followed by whooping cough 10.5%, cholera 9.5% and influenza 8.1%. The literature on infant mortality, is replete with these diseases as major causes of infant deaths especially in the developing countries like Nigeria. A total eradication of these killer diseases through immunization programmes as currently carried out by the federal and state governments and supported by the World Health Organization is a step in the right direction.

Conclusion

The paper examined the relationship between population growth and infant mortality and recorded a high correlation value of $r^2 = 0.786$. In addition, the infant killer diseases such as miseales, cholera, whooping cough, influenza and chicken pox were identified in the study area. A drastic reduction of these diseases through immunization programmes are recommended to the federal and state governments to preserve infant lives in Nigeria.

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Processing of Transparent Polycrystalline $Y_3Al_5O_{12}$ (YAG) Ceramics

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Abstract

Slip casting is one of the most common forming techniques used in the fabrication of ceramics. In YAG ceramics slurries, prepared with the proper stoichiometric ratios between alumina and yttria, with good rheological properties are necessary for successful casting. In this work, the rheological behaviour of aqueous YAG slurries prepared by milling alumina and yttria in the proper stoichiometric ratios was studied as a function of dispersant concentration. The effect of improper stoichiometry between Al_2O_3/Y_2O_3 as well as agglomeration on the transparency of the product was also studied. In general the dispersant concentration was found to have a great influence on the rheology of the slurries. Well dispersed slurries when cast gave very good transparent product whereas agglomerated slurries gave rise to porous products with poor transparency. Imbalance in the stoichiometric ratio between Y_2O_3 and Al_2O_3 also had negative effect on the transparency of the product.

Key words: Stoichiometric ratio, slip casting, transparency, polycrystalline ceramics, rheological properties.

Introduction

Since Maiman (Maiman, 1960; Maiman, 1960) discovered the ruby laser in 1960, the solid state laser has been rapidly developed. Although many kinds of solid state lasers exist (Moulton, 1986; Huber et al 1988; Fan et. al. 1988; Geusic et al, 1964) the Yttrium Aluminium Garnet ($Y_3Al_5O_{12}$) single crystal is the best laser host material. Attempts to synthesize solid state laser materials from polycrystalline ceramics, such as Nd-doped Y_2O_3-ThO_2 ceramics, have been reported (Greskovich, Wood, 1973; Greskovich, Chernoch, 1973; Greskovich, Chernoch, 1974).

In experiments conducted by some researchers (de With et al, 1984; Mudler et. al., 1985, Sekita et al, 1990) polycrystalline YAG proved inadequate for optical application and was unable to emit laser beam. As a result of this Czochralski technique for growing single crystals has been the major technique for producing YAG lasers. In recent years, application of Nd: YAG lasers has been widened to include use in several industrial fields such as medical operation (Daikuzano, 1993; Hofstetter et. al., 1984), metal processing (Daikuzano et al, 1985) and others(Goto et al, 1993; Ueda et al, 1993). In spite of its wide application Czochralski method remains the main technique for growing single crystals for the above mentioned applications. Single crystals grown by the Czochralski method have several disadvantages. It is extremely difficult to dope YAG with more than 1 at % neodymium(Nd)

homogeneously as a luminescence element in the single crystal, because the effective segregation coefficient of elemental Nd for the host material (YAG single crystal} is 0.2 as reported in previous papers (Shiroki et al, 1978). Further more only the homogeneous portion of the ingot is capable of being used in laser devices.

As a result of such limitations there has been a resurgence of interest in polycrystalline transparent ceramics. Transparent ceramics represent a unique challenge to the manufacturing community since they require exceptionally low pore concentration (<0.001%), clean grain boundaries and no second phases (Ikesue et. al, 1997). Even though there is an extensive literature on transparent ceramics including PLZT, AlON, $MgAl_2O_4$, Y_2O_3 and YAG there are virtually no publications on the processing conditions and production of high quality YAG ceramics by slip casting. This paper is an attempt to fill this gap for YAG ceramics, an important polycrystalline material in the laser industry.

Materials and Method

Submicron α-Al_2O_3 powder (AKP 3000, 0.4-0.7 μm) and relatively coasreY_2O_3 (NYC, 2-4μm) powders were used. Poly (acrylic acid) (PAA) (molecular weight 450,000, Sigma Aldrich, Inc., USA) with concentrations varying from 0.05 to o.4 weight % was used as a dispersant. Polyethylene glycol 4000 (J. T. Baker Chemical Company, Phillipsburg, N. J. USA) was used as a binder material. Tetraethyl orthosilicate (TEOS, 99.9999% Alfa, Ward Hill, MA, USA) was employed as a sintering aid. A constant amount of 0.6 wt % citric acid (Anhydrous, 99.5+ %, Aldrich Chemical Company, USA) was used as a pH modifier.

Weight loss of the yttria and alumina powders was determined using Thermogravimetric Analyser (TGA 2050, TA Instruments, Inc., New Castle, DE, USA). The weight losses were taken into account in the batching process to ensure that the amount of each powder used was in complete agreement with the material requirements dictated by the stoichiometry of the reaction between yttria and alumina. Alumina balls used as milling media were also accurately weighed before milling and after milling to ascertain the level of alumina going into the suspension.

Figure1: Flow diagram for the experimental procedure for preparing dispersed slurries and sintered YAG bodies.

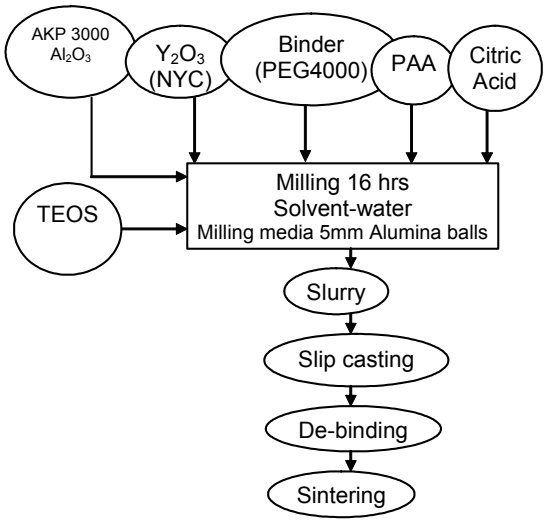


Table 1: Dispersant (PAA) concentrations (wt. % based on solids content)

Sample code	Y1	Y2	Y3	Y4	Y5	Y6
PAA wt %	0.1	0.15	0.20	0.25	0.30	0.35

Slurries were prepared as illustrated in the flow diagram in Fig. 1. Detailed information about the dispersant (PAA) concentrations used is as reported in Table 1. After drying the slip cast samples binder burn-out was carried out at 600^{o}C to remove all the organic additives. Sintering was carried out at temperatures in the range of 1750-1800^{o}C for periods ranging between 8-16 hours. The slurries or suspensions were tested to determine their rheological behaviour using rotational stress controlled rheometer
(Carimed CSL 100, New Castle, De, USA). All measurements were done at a constant temperature (25^{o}C) using the cone and plate configuration. Measurements were taken up to a shear rate of 500/s.

X-Ray diffraction analysis was carried out on the sintered sample using XRD(Sintag Inc, USA) at a current in-put of 30mA and a voltage of 35 kv. Microstructural analysis was carried out using scanning electron microscope.

Results

Figs. 2a and b show the SEM micrographs of the starting powders, AKP 3000 alumina and NYC yttria respectively. The Y_2O_3 was relatively coarser than the alumina hence the need for long milling to reduce the particle size. The results of TGA analysis for alumina and yttria are as shown in Figs. 3 and 4. Rheological behaviour of colloidal dispersion is among their most important properties. Rheological measurements monitor changes in flow behaviour in response to an applied stress or strain. Results of the shear stress vs. shear rate measurements are as illustrated in Fig. 5.

Figure 2a: SEM Micrograph of APK 3000 Alumina

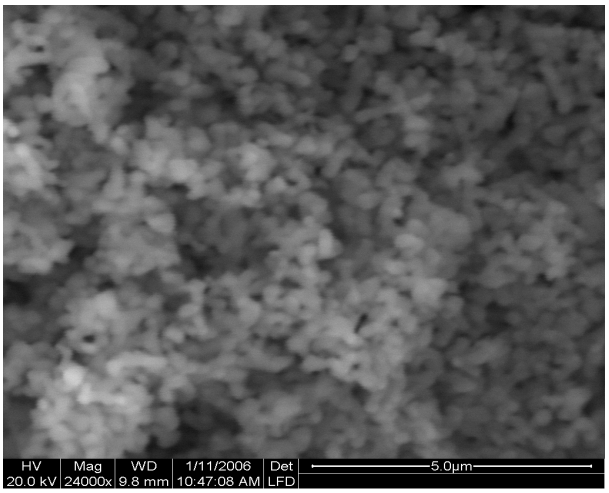


Figure 2b: SEM Micrograph NYC yttria

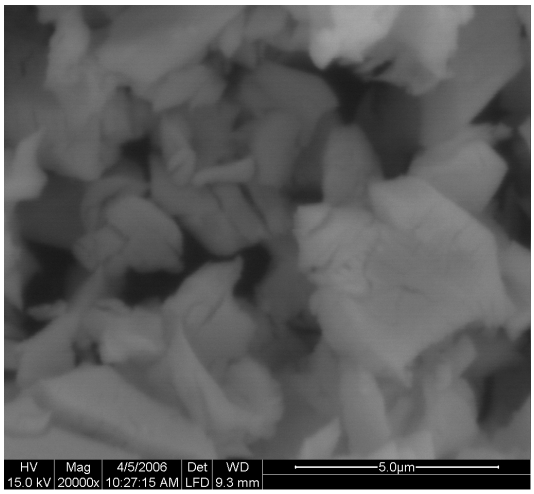


Figure 3: TGA of NYC Y_2O_3

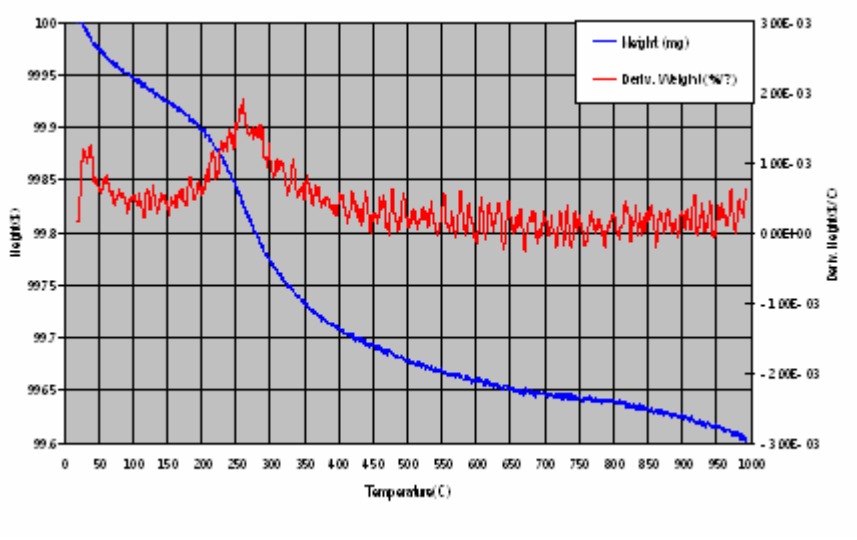


Figure 4: TGA of AKP 3000 Alumina

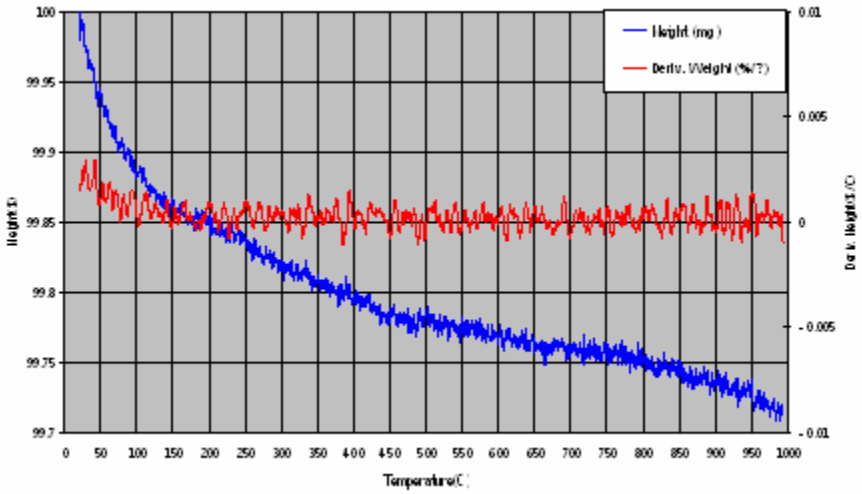


Fig. 6 shows the X-Ray diffraction of a YAG sintered sample. Fig. 7 is the SEM micrograph of a YAG sample showing the presence of a second phase. Fig. 8 is the energy dispersive analysis (EDAX Analysis) which indicates that the second phase was excess alumina. Figs. 9 and 10 show the SEM of samples made from agglomerated non-Newtonian slurry and that made from a Newtonian-like slurry respectively. The transparency of the sample made from Newtonian-like slurry is shown in Fig.11 and Fig.12 shows the transparency of a sample made from agglomerated non-Newtonian slurry.

Discussion

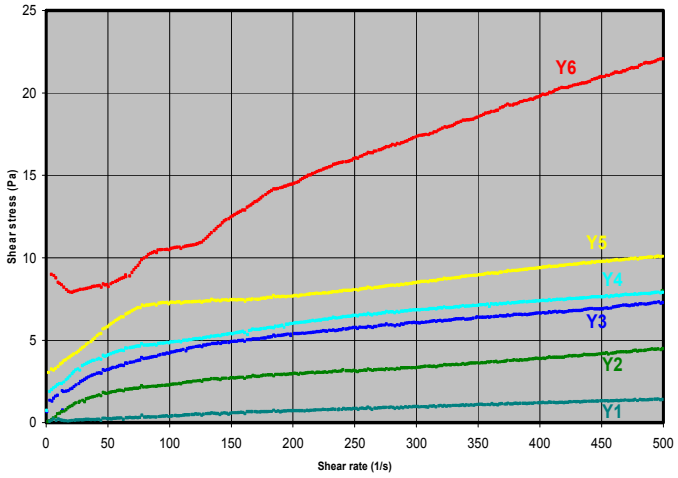
Weight changes during the TGA analysis are as shown in Figs. 3 and 4. The difference in the weight losses was taken into consideration during batching to avoid samples that are either alumina or yttria rich. Alumina or yttria rich samples did not give the expected transparency. The reaction between alumina and yttria to form yttrium aluminium garnet (YAG) proceeds according to the chemical equation:

$$3Y_2O_3 + 5\ Al_2O_3 \rightarrow 2Y_3Al_5O_{12} \quad (1)$$

From equation 1 the amount of yttria and alumina required for the reaction to proceed stoichiometrically is: 57.06% and 42.94% respectively. Deviations from this lead to bodies which have either alumina in excess or yttria in excess. A sample typical of alumina excess is as illustrated in Fig. 7. The excess material acts as a second phase and hence as a scattering center (19) which tends to

prevent the body from being transparent. Thus, during batching the difference in the weight losses illustrated by Figs. 3 and 4 must be compensated for to enhance a good stoichiometric balance. A weight change of the alumina milling media was determined and this was also compensated for during the batching to avoid any imbalance in the stoichiometric ratio.

Figure 5: The Effect of Dispersant Concentration on the Rheological Behaviour of YAG Suspensions.



Results showing the rheological behaviour of the slurries containing various levels of dispersant is as shown in Fig.5. The apparent viscosity η is related to the applied shear stress τ and the shear rate γ by the following expression:

$$\tau = \eta\gamma \quad (2)$$

Two types of flow behaviour can be observed under steady shear depending on suspension composition and stability as shown in Fig. 5. Newtonian-like behaviour, the simplest flow response, where viscosity is independent of shear rate is displayed in Fig. 5. With the exception of the slurry which contained 0.1 wt % PAA that exhibited Newtonian flow (Y1) all the rest showed pseudoplastic or shear thinning behaviour. Pseudoplastic or shear thinning behaviour occurs when the viscosity decreases with the shear rate.

Fig. 6 shows the XRD analysis of the sintered samples. All the peaks are YAG peaks indicating that there was a complete transformation of the bodies to the cubic YAG phase.

Figure 6: XRD of YAG sintered sample

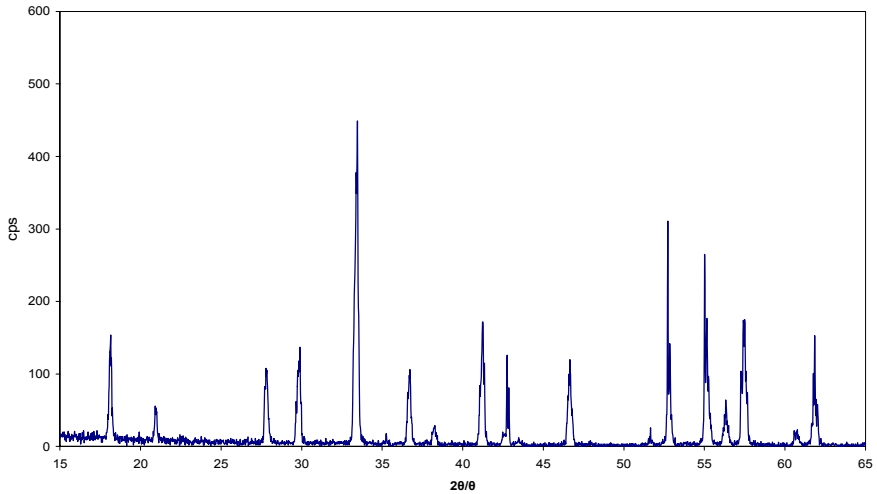


Figure 7: SEM Micrograph of YAG showing Alumina excess

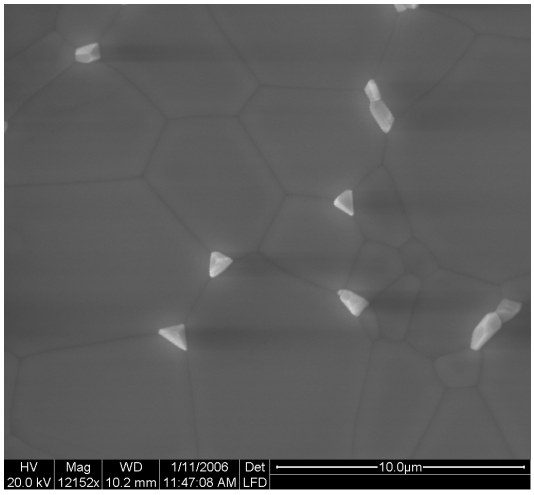


Figure 8: EDAX Analysis showing the analysis of bright spots in Fig. 7 above

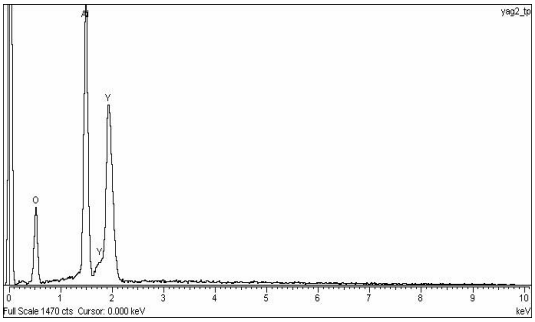


Figure 9: SEM Micrograph of a YAG sample made from agglomerated non-Newtonian slurry

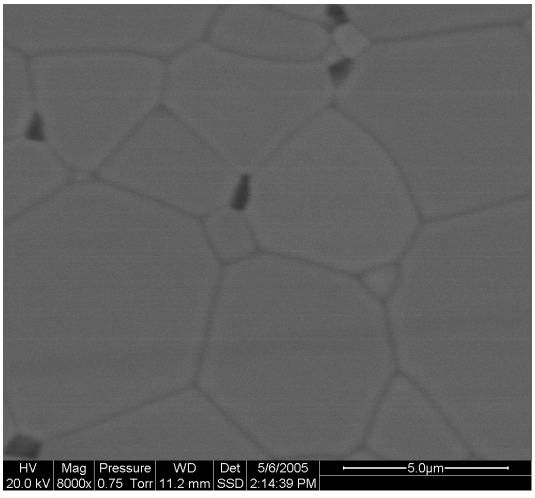


Figure. 10: SEM Micrograph of a YAG sample made from a Newtonian-like slurry.

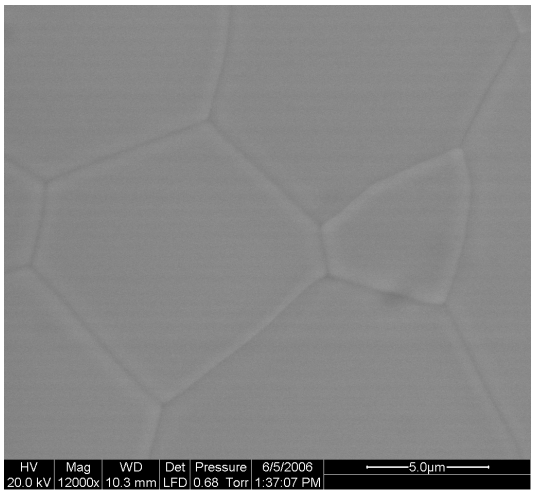


Fig. 8 shows the EDAX analysis of the bright spots (in Fig. 7) which were found to be very rich in alumina. The excess alumina acts as a second phase and therefore a scattering center thus making this sample poor in transparency (Ikesue et al, 1997). Fig. 9 is the SEM micrograph of a sample that was prepared from slurry with pseudo-plastic non-Newtonian characteristics. The density of this sample was very poor (<90%) because of the large pores that evolved as a result of the presence of large agglomerates in the slurry used for casting the sample.

Figure. 11: A picture showing the transparency of a sintered YAG body made from a well dispersed slurry.

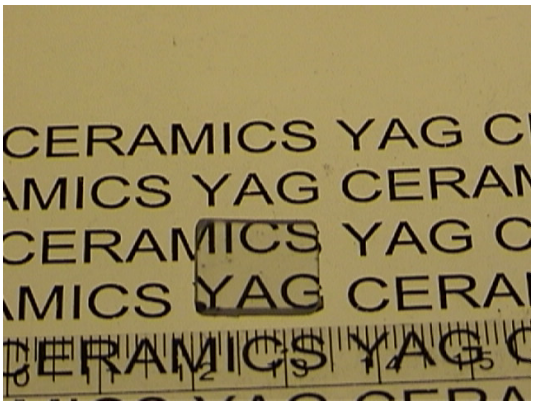


Figure 12: A picture showing the transparency of a sample made from a slurry that was not well dispersed.

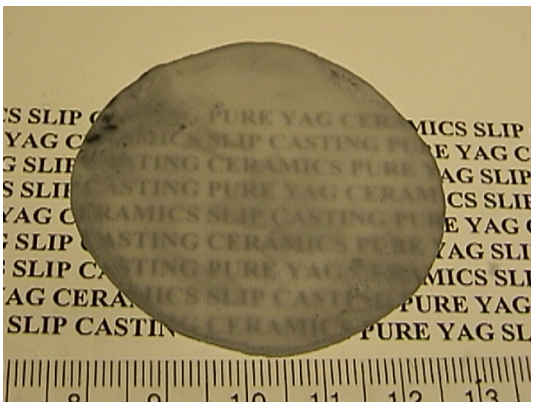


Fig.10 is the SEM micrograph of a sample that was prepared from homogeneous Newtonian-like slurry. This sample showed an excellent transparency as illustrated in Fig. 11. Slurries with stoichiometric imbalance and those that were non-Newtonian with agglomerates showed poor transparency as shown in Fig. 12.

From the foregoing it can be concluded that dispersant concentration has a lot of influence on the rheology of the aqueous YAG slurries which in turn influence the transparency of the final product. Well dispersed slurries tend to give transparent samples. Agglomerated slurries, however, tend to give porous samples with very poor transparency. Also samples with incorrect Al_2O_3/Y_2O_3 stoichiometric ratios tend to be rich in either alumina or yttria and such samples, irrespective of whether alumina or yttria is in excess, tend to be poor in transparency.

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A New Algorithm for Locating Tandem Repeats in a DNA Sequence

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Abstract

An algorithm for locating tandem repeats in DNA sequence is proposed based on string matching techniques to find the repetition of a tandem in a selected DNA sequence. The algorithm was implemented and compared with other algorithms like Boyer-Moore algorithm .Our results show that the proposed algorithm has a better performance in average and worst cases relative to others. Also, the results indicate that the proposed algorithm has less time complexity and decrease in computation time process.

Keywords: DNA, BM, TBM, CAT, and TAG

1. Introduction

Deoxyribonucleic Acid (DNA) is primary genetic material of all living organisms [1]. Its molecule usually consists of two nucleotide strands connected by base pairs, where the base of DNA is: Adenine (A), Cytosine (C), Guanine (G), and Thymine (T). A DNA sequence is represented by a string of four alphabets: A, C, G, and T as the above based. DNA of all living organisms are collected and kept in a database. A very well known DNA, developed by National center for Biotechnology Information is called Genbank [2], which contains huge information of various biological data. In the field of bioinformatics, similarity search is an important algorithm for analyzing biological data sequences. Basically, it is used to find sequences in a database that parts of it are similar to a query sequence. Design approaches of many matching algorithms, such as: Boyer-Moore (BM) algorithm , modified BM algorithm and Turbo Boyer-Moore algorithm(TBM) are based on dynamic programming [3,4], so, the execution time is proportional to number of comparisons, which depends on the sequence size(n) , and the pattern size (m) [5].

DNA typing, with its extremely high power is used to differentiate one human being from another, that is based on a large body of scientific principles and techniques that are universally

accepted. These newer molecular techniques permit the study of human variability at the most basic level, that of the genetic material itself, DNA. Standard techniques of population genetics and statistics can be used to interpret the results of forensic DNA typing. Because of the newness of the techniques and their exquisite discriminating power, the courts have subjected DNA evidence to extensive scrutiny.

If the array of DNA markers used for comparison is large enough, the chance that two different persons will share all of them becomes vanishing small. With appropriate DNA test systems, the uniqueness of any individual on the planet (except an identical twin) is likely to be demonstrable in the near future. In the meantime, the justification for an inference that two identical DNA profiles come from the same person rests on probability calculations that employ principles of population genetics. Such calculations are, of course, subject to uncertainty.

2. Basic Genetic Principles

Each human body contains an enormous number of cells, all descended by successive divisions from a single fertilized egg. The genetic material, DNA, is in the form of microscopic chromosomes, located in the inner part of the cell, the nucleus. A fertilized egg has 23 pairs of chromosomes; one member of each pair comes from the mother and the other from the father. The two members of a pair are said to be homologous. Before cell division, each chromosome splits into two. Because of the precision of chromosome distribution in the cell-division process, each daughter cell receives identical chromosomes, duplicates of the 46 in the parent cell. Thus, each cell in the body should have the same chromosome makeup [8]. This means that cells from various tissues, such as blood, hair, skin, and semen, have the same DNA content and therefore provide the same forensic information. There are some exceptions to the rule of identical chromosomes in every cell, but they do not affect the conclusion that diverse tissues provide the same information [9].

The most important exception occurs when sperm and eggs are formed. In this process, each reproductive cell receives at random one representative of each pair, or 23 in all. The double number, 46, is restored by fertilization. With the exception of the sex chromosomes, X and Y (the male-determining Y is smaller than the X); the two members of a pair are identical in size and shape. (It might seem puzzling that sperm cells, with only half of the chromosomes, can provide the same information as blood or saliva. The reason is that DNA from many sperm cells is analyzed at once, and collectively all the chromosomes are represented).

A chromosome is a very thin thread of DNA; surrounded by other materials, mainly protein (DNA stands for deoxyribonucleic acid). The DNA in a single chromosome, if stretched out, would be an inch or more in length. Remarkably, all that length is packed into a cell nucleus some 1/1,000 inch in diameter. The DNA is compacted by coils within coils.

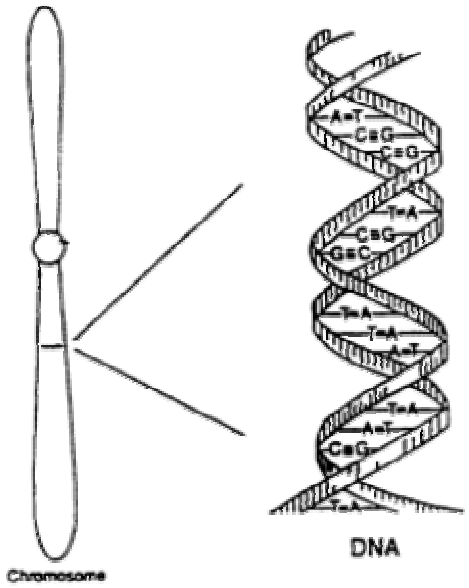
The DNA thread is actually double, consisting of two strands twisted to form a helix as shown in Fig.1. Each strand consists of a string of bases held together by a sugar-phosphate backbone. The four bases are abbreviated A, T, G, and C (these stand for Adenine, Thymine, Guanine, and Cytosine, but we shall employ only the abbreviations). In double-stranded DNA, the bases line up in pairs, an A opposite a T and a G opposite a C:

C A T T A G A C T G A T
G T A A T C T G A C T A

Thus, if the sequence of bases on one strand is known, the other is determined.

Prior to cell division, the double strand splits into two single strands, each containing a single base at each position. There are free-floating bases in the cell nucleus, and these attach to each single strand according to the A-T, G-C pairing rule. Then they are tied together and zipped up by enzymes.

Figure 1a: Chromosome sketch with a small region expanded to show the double-helical structure of DNA. The steps of the twisted ladder are four kinds of base pairs, AT, TA, GC, or CG.



In this way, each DNA double helix makes a copy of itself. There are then two identical double strands, each half old and half new, and one goes to each daughter cell. That accounts for the uniformity of DNA makeup throughout the body. The total number of base pairs in a set of 23 chromosomes is about 3 billion.

A gene is a stretch of DNA, ranging from a few thousand to tens of thousands of base pairs, that produces a specific product, usually a protein. The order of the four kinds of bases within the gene determines its function. The specific base sequence acts as an encoded message written in three-letter words, each specifying an amino acid (a protein building block). In the diagram above, CAT specifies one amino acid, TAG another, ACT a third, and so on. These amino acids are joined together to make a chain, which folds in various ways to make a three dimensional protein. The gene product may be detected by laboratory methods, as with blood groups, or by some visible manifestation, such as eye color.

The position that a gene occupies along the DNA thread is its locus. In chemical composition, a gene isn't different from the rest of the DNA in the chromosome. Only it's having a specific sequence of bases, enabling it to encode a specific protein, makes each gene unique. Genes are interspersed among the rest of the DNA and actually compose only a small fraction of the total. Most of the rest has no known function.

Alternative forms of a gene, for example those producing normal and sickle cell hemoglobin, are called alleles. The word genotype refers to the gene makeup. A person has two genes at each locus, one maternal, one paternal. If there are two alleles, A and a, at a locus, there are three genotypes, AA, Aa, and aa. The word genotype can be extended to any number of loci. In forensic work, the genotype for the group of analyzed loci is called the DNA profile. (We avoid the word fingerprint to prevent confusion with dermal fingerprints). If the same allele is present in both chromosomes of a pair, the person with that pair is homozygous. If the two are different, the person is heterozygous. (The corresponding nouns are homozygote and heterozygote.) Thus, genotypes AA and aa are homozygous and Aa is heterozygous.

Genes on the same chromosome are said to be linked, and they tend to be inherited together. They can become unlinked, however, by the process of crossing over, which involves breakage of two homologous chromosomes at corresponding sites and exchange of partners. Genes that are on no

homologous chromosomes are inherited independently, as are genes far apart on the same chromosome.

Occasionally, an allele may mutate; that is, it may suddenly change to another allele, with a changed or lost function. When the gene mutates, the new form is copied as faithfully as the original gene, so a mutant gene is as stable as the gene before it is mutated. Most genes mutate very rarely, typically only once in some 100,000 generations, but the rates for different genes differ greatly. Mutations can occur in any part of the body, but our concern is those that occur in the reproductive system and therefore can be transmitted to future generations.

3. Proposed Algorithm for Locating Tandem Repeats

In this paper, an algorithm is developed for locating repetitive regions within DNA sequences. Identifying and locating repeats will help biologists learn more about repetitive regions. In addition, computational analysis of DNA sequences becomes increasingly complex when repetitive DNA occurs in the sequences under analysis. Thus, identification of repetitive DNA is a first step towards enabling biologists to understand DNA sequences and computational biologists to solve more complex analysis problems involving DNA sequences [7].

Tandem repeats are one type of repetitive DNA. It is a string of characters which recur consecutively within a larger string. In biological terms, it is a concatenation of basic units within a DNA sequence where the DNA sequence and basic unit are composed of the bases: **A, C, G and T.**

A tandem repeat can occur at any position in the DNA sequence. It can start with any base in the basic unit but must continue the repeat with the next base in the basic unit. For example, the tandem repeat **CAGGCAGGCAGGCAG** has a basic unit of **GGCA**. The region begins with **C** and continues with **A**, the next base in the basic unit. (Note: the subsequent base is the first base in the basic unit. This is what is meant by a concatenation of basic units.) Practical issues.

3.1 Description of the Proposed Algorithm

The proposed algorithm requires the following steps to be implemented:-

1. Select the Tandem P with length (m) to be find in a DNA sequence.
2. Select the master DNA sequence F with length (n).
3. Find the locations of P (1) in F.
4. Find the locations of P (m) in F.
5. For each pair of locations P (1) and P (m) calculate the distant between the two locations.
6. Ignore all the distances which are less than m or greater than m.
7. Compare each subsequence of F (with distant = m) with the selected sequence P, if they are equal then save the position of P(1) as a starting index of the matched sequence.

Thus after running this algorithm, we can obtain valuable information which can be used for finding the similarity and to perform some analysis on DNA sequence.

3.2 Algorithm Implementation

The proposed algorithm uses dynamic programming to locate all tandem repeats which have a basic unit as specified in the input file. The output can be used in conjunction with a graphing program to identify plateaus. These plateaus represent tandem repeat regions. Dynamic Programming is a two - pass process which combines traditional dynamic programming with a second pass to wrap scores within a row. It is the second pass which is critical for identifying tandem repeats.

The following shows some results of detecting tandem in a DNA sequence. We have to notice that there are no modifications in the algorithm in order to perform the way of matching (using the direct match from beginning to end or using the reverse match from end to beginning)

sample sequence one

ttaaggaccccatgccctcgaataggcttgagcttgccaattaacgcgcacgggctggccgggcgtataagccaaggtgtagtgaggttgcattata
catgccggcttgtgattaacgcatgccataggacggttaggctcagaacccgcaaccaatacacgtgattttctcgtcccctg

Results for 180 residue sequence "sample sequence one" starting "ttaaggaccc"

>match number 1 to "ttaa" ends at position 4 on the direct strand
ttaa
>match number 2 to "ttaa" ends at position 44 on the direct strand
ttaa
>match number 3 to "ttaa" ends at position 116 on the direct strand
ttaa
>match number 4 to "ttaa" ends at position 68 on the reverse strand
ttaa
>match number 5 to "ttaa" ends at position 140 on the reverse strand
ttaa
>match number 6 to "ttaa" ends at position 180 on the reverse strand
ttaa

sample sequence two

aggcgtatgcgatcctgaccatgcaaaactccagcgtaaatacctagccatggcgacacaaggcgcaagacaggagatgacggcgtttagatcgg
cgaaatattaaagcaaacgacgatgacttcttcgggaaattagttccctactcgtgtactccaattagccataacactgttcgtcaagatatagggggtc
acccatgaatgtcctctaaccagaccatttcgttacacgaacgtatct

Results for 243 residue sequence "sample sequence two" starting "aggcgtatgc"

>match number 1 to "gat" ends at position 13 on the direct strand
gat
>match number 2 to "gat" ends at position 78 on the direct strand
gat
>match number 3 to "gat" ends at position 92 on the direct strand
gat
>match number 4 to "gat" ends at position 119 on the direct strand
gat
>match number 5 to "gat" ends at position 185 on the direct strand
gat
>match number 6 to "gat" ends at position 4 on the reverse strand
gat
>match number 7 to "gat" ends at position 153 on the reverse strand
gat
>match number 8 to "gat" ends at position 232 on the reverse strand
gat

sample sequence three

tactcagggctccagaggtacaagttggtaatcggttaggtgtatcgccgccaggggtgcgtcgtcatgactcggttaga

Results for 80 residue sequence "sample sequence three" starting "tactcagggc"

>match number 1 to "tcat" ends at position 68 on the direct strand
tcat
>match number 2 to "tcat" ends at position 14 on the reverse strand
tcat

3.3 Experimental Results

The proposed algorithm was implemented using different DNA sequences in size, and it was compared with TBM algorithm, which was also executed using the same files.

Tables (1-6) show the obtained results, (number of comparisons and CPB (Comparisons per Byte) which is equal the number of comparisons divided by the DNA sequence size).

Table 1.1: DNA sequence size=103337

P length(m)(Tandem)	TBM algorithm	TBM CPB	Developed algorithm	Developed CPB
1	206674	2	99004	0.96
2	162084	1.57	86892	0.84
3	119658	1.16	89232	0.86
4	107856	1.04	89132	0.86

Table 1.2: DNA sequence size=70182

P length(m)(Tandem)	TBM algorithm	TBM CPB	Developed algorithm	Developed CPB
1	140364	2	67468	0.96
2	110088	1.57	59034	0.84
3	81276	1.16	60444	0.86
4	73163	1.04	60438	0.86

Table 1.3 DNA sequence size=36578

P length(m)(Tandem)	TBM algorithm	TBM CPB	Developed algorithm	Developed CPB
1	73156	2	35248	0.96
2	57373	1.57	30814	0.84
3	42398	1.16	31470	0.86
4	38112	1.04	31588	0.86

Table 1.4: DNA sequence size=19900

P length(m)(Tandem)	TBM algorithm	TBM CPB	Developed algorithm	Developed CPB
1	39800	2	19516	0.98
2	31227	1.57	16913	0.85
3	23074	1.16	16996	0.85
4	20696	1.04	17161	0.86

Table 1.5: DNA sequence size=5578

P length(m)(Tandem)	TBM algorithm	TBM CPB	Developed algorithm	Developed CPB
1	11156	2	5436	0.97
2	8754	1.57	4791	0.86
3	6444	1.16	4756	0.85
4	5803	1.04	4990	0.89

Table 1.6: DNA sequence size=2480

P length(m)(Tandem)	TBM algorithm	TBM CPB	Developed algorithm	Developed CPB
1	4960	2	2436	0.97
2	3870	1.57	2121	0.86
3	2877	1.16	2137	0.85
4	2585	1.04	2219	0.89

4. Conclusions

A matching algorithm was proposed based on string matching for locating tandem repeats of DNA sequence. It was implemented and compared with other algorithms like TBM. Our algorithm has shown better performance, and valuable outputs which can be used later for analysis purposes.

The time complicity of the algorithm (worst case) is always less than O(n), and the proposed algorithm decreases the computation times from 1.7 to 2.06 times comparing with TBM algorithm.

Also we can see from the obtained results that the time complexity does not depend on the DNA sequence size, but it depends on the tandem size.

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Vibration Analysis using Conversion of Transfer Matrices

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Abstract

A matrix conversion method is proposed to calculate the new eigendata for parameter estimation procedure. The advantages of the method are the applicability to large complex structures, in particular, the concept of breaking up a complicated system into subsystems with simple elastic and dynamic properties, also it is useful one in rendering managible system whose solutions appear obscured in complexity. Since many engineering components are continuous in the way the mass and elasticity is distributed, it is useful to consider such method which involve solving such continuous systems. The objective of the study is to propose a method by which a fore mentioned difficulties can be alleviated. The method will be demonstrated on a realistically complex structural system.

Introduction

A common type of system occuring in engineering practic consists of a number of elements linked together end to end in the form of chain, well known examples are continuous beams, turbines, generator shafts, crank shafts, casings,etc. The transfer matrix method (1) is ideally suited to such system. Although the transfer matrix method is suitable for the treatment of branched and coupled system, its application is in advisable for system that lack a predominant chain topology (2). The transfer matrix method analysis has been greatly used by practicing engineers as fully documented in ref (3) to (10). The method becomes too cumbersome when there are too many mass stations or rotors have many bearings, Various schemes have been proposed to overcome the problems because multiplication of matrices makes the algebra grow quickly, so any loss of accuracy in subsequent matrix multiplication may becomes large for complete system. The effect of the loss of accuracy can be eliminated by certain methods (7). Another possibilities is to compute for the shaft separately and join it with bearings through impedance matchings (1,8) in which the shaft is divided into a number of equal lengths, and the mass of each length is concentrated at its centre. In addition, the matrix multiplication of the complete system includes the transfer matrix of the connection points.

Numerical difficulties can arise in using the transfer matrix method when high frequencies are encountered or a large number of elements exist. The difficulty, in common with those found in other methods of analysis, occurs due to the solution depending upon the small difference in large numbers. These large numbers increase with each subsequent matrix multiplication. The transfer matrix method can be modified to overcome this contingency by assuming an initial state vector (9). This vector need not be close to the actual vector since, with one iteration, the vector is extremely near the actual value and if desired this corrected value can be used throughout a second iteration.

Unfortunately none of these methods are convenient for the problem which is to be tackled. This requires all the eigenvalues and eigenvectors of a particular component. The methods outlined above all give approximate values of eigenvalues and eigenvectors. For this reasons a version of transfer matrix technique which could be used in the matrices eigenproblem (10), $[A]\{W\}=\lambda[B]\{W\}$ was searched for. Fortunately such a version has been described in this paper where it demonstrates

how the transfer matrix method can be converted to mass-stiffness matrices and it is quite essential in this work were a specific problem is solved an this technique proved to be so efficient.

Development of Transfer Matrix to Produce Mass and Stiffness Matrices

To demonstrate this method let us consider the system shown in Fig 1., in which the bodies on beams are consider to have both mass and rotary inertia and it is assumed to be vibrating with frequency ω.

Consider the equations of Ref (1) page 55 to 58, for node 1 in Fig 1 and Fig (3-A). gives :-

$W_1^R = W_1{}^L = W_1 \; and \; \theta_1^R = \theta_1^L = \theta_1$

Since $V_1^L = 0$

The equation of inertia force is

$$M_1\omega^2 W_1 = -V_1^R \tag{1}$$

And Since $M_1^L = 0$

The equation of inertia couple is

$$I_1\omega^2\theta_1 = -M_1^R \tag{2}$$

Applying the equations of state vector to the mass less beam between node 1 and node 2 Fig 1 and Fig 3-B.

$$-W_2^L = -W_1^R + l\theta_1^R + \frac{l^2}{2EJ}M_1^R + \frac{l^3}{6EJ}V_1^R \tag{3}$$

$$\theta_2^L = \theta_1^R + \frac{l}{EJ}M_1^R + \frac{l^2}{2EJ}V_1^R \tag{4}$$

$$M_2^L = M_1^R + lV_1^R \tag{5}$$

$$V_2^L = V_1^R \tag{6}$$

Equations (3) and (4) can be manipulated to give :

$$V_1^R = \frac{12EJ}{l^3}W_2^L - \frac{12EJ}{l^3}w_1^R + \frac{6EJ}{l^2}\theta_2^L \tag{7}$$

$$M_1^R = \frac{6EJ}{l^2}W_2^L + \frac{6EJ}{l^2}W_1^R - \frac{4EJ}{l}\theta_1^R - \frac{2EJ}{l}\theta_2^L \tag{8}$$

Then equation (5) becomes

$$M_2^L = \frac{6EJ}{l_2}W_2^L - \frac{6EJ}{l^2}W_1^R + \frac{2EJ}{l}\theta_1^R + \frac{4EJ}{l}\theta_2^L \tag{9}$$

And equation (1) and (2) becomes

$$M_1\omega^2 W_1 = \frac{12EJ}{l^3}W_1^R - \frac{12EJ}{l^3}W_2^L - \frac{6EJ}{l^2}\theta_1^R - \frac{6EJ}{l^2}\theta_2^L \tag{10}$$

$$I_1\omega^2\theta_1 = \frac{6EJ}{l^2}W_2^L - \frac{6EJ}{l^2}W_1^R + \frac{4EJ}{l}\theta_1^R + \frac{2EJ}{l}\theta_2^L \tag{11}$$

In a Similar fashion the application of the equations to node 2 and the mass less beam between node 1 and node 3 produces

$$M_2\omega^2 W_2 = V_2^L - V_2^R \tag{12}$$

$$I_2\omega^2 \theta_2 = M_2^L - M_2^R \tag{13}$$

$$W_2^L = W_2^R \tag{14}$$

$$\theta_2^L = \theta_2^R \tag{15}$$

$$-W_3^L = -W_2^R + \theta_2^R + \frac{l^2}{2EJ}M_2^R + \frac{l^3}{6EJ}V_2^R \tag{16}$$

$$\theta_3^L = \theta_2^R + \frac{l}{EJ}M_2^R + \frac{l^2}{2EJ}V_2^R \tag{17}$$

$$M_3^L = M_2^R + lV_2^R \tag{18}$$

$$V_3^L = V_2^R \tag{19}$$

From these equations obtain the following

$$V_2^R = \frac{12EJ}{l^3}W_3^L - \frac{12EJ}{l^3}W_2^R + \frac{6EJ}{l^3}\theta_3^L + \frac{6EJ}{l^2}\theta_2^R \tag{20}$$

$$M_2^R = \frac{6EJ}{l^2}W_3^L + \frac{6EJ}{l^2}W_2^R - \frac{4EJ}{l}\theta_2^R + \frac{2EJ}{l}\theta_3^L \tag{21}$$

and

$$M_3^L = \frac{6EJ}{l^2}W_3^L - \frac{6EJ}{l^2}W_2^R + \frac{2EJ}{l}\theta_2^R + \frac{4EJ}{l}\theta_3^L \tag{22}$$

Substituting the relevant terms into equations (12) and (13) gives

$$M_2\omega^2 W_2 = \frac{12EJ}{l^3}W_3^L + \frac{24EJ}{l^3}W_2^R - \frac{12EJ}{l^3}W_1^R - \frac{6EJ}{l^2}\theta_3^L + \frac{6EJ}{l^2}\theta_1^R \tag{23}$$

and

$$I_2\omega^2 \theta_2 = \frac{6EJ}{l^2}W_3^L - \frac{6EJ}{l^2}W_1^R + \frac{8EJ}{l}\theta_2^R + \frac{2EJ}{l}\theta_3^L + \frac{2EJ}{l}\theta_1^R \tag{24}$$

Aplying equations above to node 3 is Similar to the way applied to node 1 because $M_3^R = 0$ and $V_3^R = 0$, then equations reduces to

$$M_3\omega^2 W_3 = \frac{12EJ}{l^3}W_3^L - \frac{12EJ}{l^3}W_2^R + \frac{6EJ}{l^2}\theta_3^L + \frac{6EJ}{l^2}\theta_3^R \tag{25}$$

$$I_3\omega^2 \theta_3 = \frac{6EJ}{l^2}W_3^L - \frac{6EJ}{l^2}W_2^R + \frac{4EJ}{l}\theta_2^R + \frac{4EJ}{l}\theta_3^L \tag{26}$$

In situation where the moments of inertia are not zero, then equations 10,11,13,24,25, and 26 are written directly in matrix form [A] {W} = λ [B] {W} as follows;

$$\begin{Bmatrix} \frac{12EJ}{l^3} & \frac{-12EJ}{l^3} & 0 & \frac{-6EJ}{l^2} & \frac{-6EJ}{l^2} & 0 \\ \frac{-12EJ}{l^3} & \frac{24EJ}{L^3} & \frac{-12EJ}{L^3} & \frac{6EJ}{L^2} & 0 & \frac{-6EJ}{l^2} \\ 0 & \frac{-12EJ}{l^3} & \frac{12EJ}{l^3} & 0 & \frac{6EJ}{l^2} & \frac{6EJ}{l^2} \\ \frac{-6EJ}{l^2} & \frac{6EJ}{l^2} & 0 & \frac{4EJ}{l} & \frac{2EJ}{l} & 0 \\ \frac{-6EJ}{l^2} & 0 & \frac{6EJ}{l^2} & \frac{2EJ}{l} & \frac{8EJ}{l} & \frac{2EJ}{l} \\ 0 & \frac{-6EJ}{l^2} & \frac{6EJ}{l^2} & 0 & \frac{2EJ}{l} & \frac{4EJ}{l} \end{Bmatrix} \begin{Bmatrix} W_1 \\ W_2 \\ W_3 \\ \theta_1 \\ \theta_2 \\ \theta_3 \end{Bmatrix}$$

$$\lambda \begin{pmatrix} M_1 & & & & & \\ & M_2 & & & 0 & \\ & & M_3 & & & \\ & 0 & & I_1 & & \\ & & & & I_2 & \\ & & & & & I_3 \end{pmatrix} \begin{Bmatrix} W_1 \\ W_2 \\ W_3 \\ \theta_1 \\ \theta_2 \\ \theta_3 \end{Bmatrix} = 0 \tag{27}$$

Where $\lambda = \omega^2$

Worked Problem

In the actual case in fig.2 moments of inertia are zero, M_1=M=100 kg, M_2 = 2M = 200 kg, M_3 = M = 100 kg, EJ = 10^9 N.m^2, L = 1 m

Equations 10,24 and 26 can be manipulated to give

$$\theta_1 = \frac{5}{4l}W_1 - \frac{3}{2l}W_2 + \frac{1}{4l}W_3 \tag{28}$$

$$\theta_2 = \frac{1}{2l}W_1 - \frac{1}{2l}W_3 \tag{29}$$

$$\theta_3 = \frac{3}{2l}W_2 - \frac{5}{4l}W_3 - \frac{1}{4l}W_1 \tag{30}$$

Substituting these equations into 10,23 and 25 obtaining the Simultaneous equations

$$M\omega^2 W_1 = \frac{3EJ}{2l^3}W_1 - \frac{3EJ}{l^3}W_2 + \frac{3EJ}{2l}W_3 \tag{31}$$

$$2M\omega^2 W_2 = -\frac{3EJ}{l^3}W_1 + \frac{6EJ}{l^3}W_2 - \frac{3EJ}{l^3}W_3 \tag{32}$$

$$M\omega^2 W_3 = \frac{3EJ}{2l^3}W_1 - \frac{3EJ}{l^3}W_2 + \frac{3EJ}{2l^3}W_3 \tag{33}$$

Setting up these equations in matrix form as (A) (W) = λ (B) (W),as where

$$\begin{pmatrix} \frac{12EJ}{2L^3} & -\frac{3EJ}{L^3} & \frac{3EJ}{2L^3} \\ -\frac{3EJ}{L^3} & \frac{6EJ}{L^3} & -\frac{3EJ}{L^3} \\ \frac{3EJ}{2L^3} & -\frac{3EJ}{L^3} & \frac{3EJ}{2L^3} \end{pmatrix} \begin{pmatrix} W_1 \\ W_2 \\ W_3 \end{pmatrix} = \lambda \begin{pmatrix} m & 0 & 0 & W_1 \\ 0 & 2m & 0 & W_2 \\ 0 & 0 & m & W_3 \end{pmatrix} \tag{34}$$

For the exit eigenvalues and corresponding eigenvectors, compare the eq.34 and eq.27, where the Solution of this matrix equation will give following eigenvalues and corresponding eigenvectors as follow:

$$\omega_1 = 0, \begin{Bmatrix} W_1 \\ W_2 \\ W_3 \end{Bmatrix} = \begin{Bmatrix} 1 \\ 3 \\ 5 \end{Bmatrix} \quad \omega_2 = 0 \begin{Bmatrix} W_1 \\ W_2 \\ W_3 \end{Bmatrix} = \begin{Bmatrix} 1 \\ 0.25 \\ -0.5 \end{Bmatrix} \quad \omega_3 = 7745.96 \text{ rad/sec}; \begin{Bmatrix} W \\ W \\ W \end{Bmatrix} = \begin{Bmatrix} 1 \\ -1 \\ +1 \end{Bmatrix}$$

The result obtained for eigenvalue is compared with that used by W. Thomson (11) when applying the principle of conservation of momentum, by applying the equation

$$\omega = \sqrt{\frac{6EJ}{Ml^3}\left(1+\frac{n}{2}\right)} \text{ ; Where } n = \frac{M}{m}$$

$$\therefore \omega = 7745.96 \text{ rad / sec}$$

Also same result is obtained by using the transfer matrix method ref (1)

Conclusions

The method of transfer matrices is thus shown capable of producing the relevant mass and stiffness matrices of a system which is vibrating in two or three dimensional. And by converting the transfer matrics to mass and stiffness matrices, as demonstrated, one able to calculate relatively easily the natural frequencies and mode shapes of the system.

This also provides for better storage and Simpler compilation in general and this technique is used for more complicated systems.

Figure 1: Free Ends Beam with concentrated masses and moment of inertia

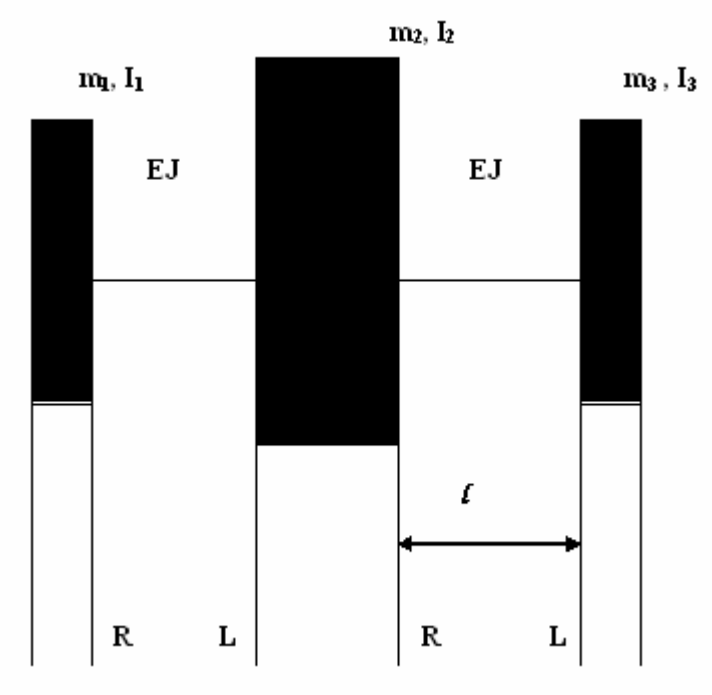


Figure 2: Free Ends Beam with concentrated masses

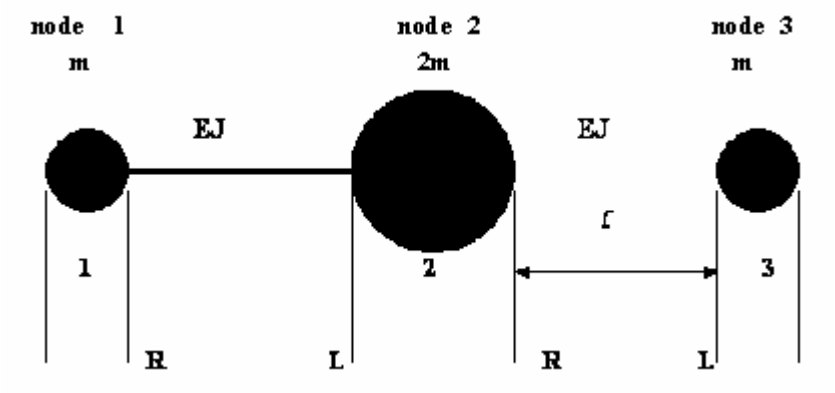


Figure (3-A): Finite element representation of pipe conveying fluid

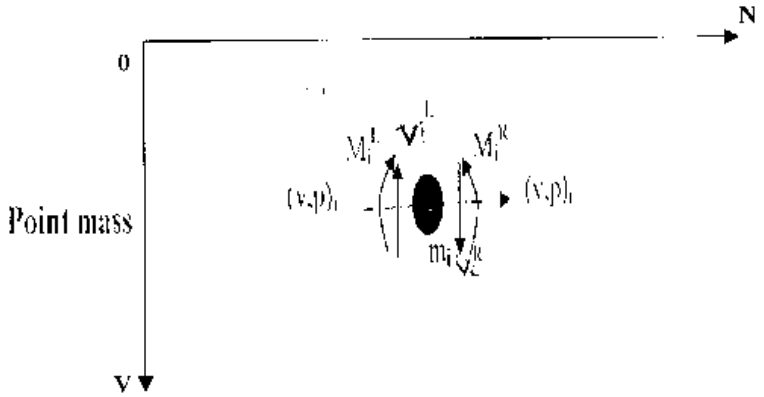
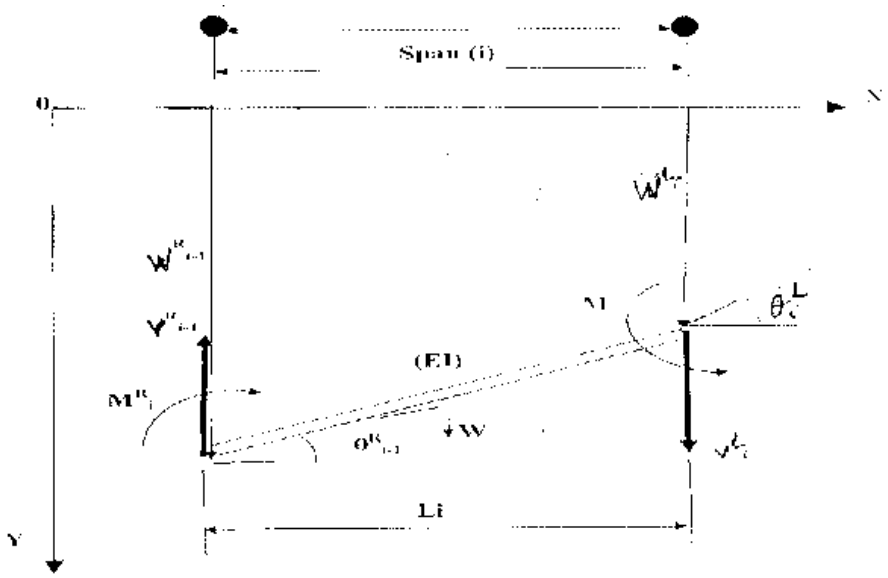


Figure (3-B): End forces and deflections for massless beam (Free-body sketch span)



Nomenclature:

[M]	Mass matrix
[K]	Stiffness matrix
{ q }	Displacement Vector
ω	Component natural frequency
I	Moment of inertia
EJ	Bending stiffness
Θ and β	Angular displacement
R	Right hand side
L	Left hand side
K	Spring stiffness
l	Length
W	Linear displacement

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Stigmatization of Leprosy and Epilepsy and the Implication for Sufferers

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Abstract

Supportive interaction is what the affected persons seek from spouse, relatives, friends and other members of society. Contrarily, leprosy and epilepsy are socially defined as disreputable whose sufferers possess discreditable attributes. On the basis of this social construction of illness, the experience of sufferers becomes increasingly traumatic, not due to pain, impairment and disfigurement only, but the social devaluation and rejection which find expression in an unbridgeable social gap between sufferers and previously intimate persons, role restrictions, loss of self respect, feelings of helplessness and despondency. The paper addresses the whole issue of stigmatization and its implication on symptom management and social functioning and proffers micro and macro options for coping with and ameliorating stigma and its ravaging effects.

Introduction

A large and growing body of literature presents detailed discussions of aetiology, symptomatology, treatment and regimens. This outpouring of information however generally ignores a basic aspect of illness especially those defined as chronic. The ignored aspect borders on how to deal with such ailments like leprosy and epilepsy in social terms.

Leprosy and epilepsy are major health problems that are mostly experienced in developing countries. Leprosy is a chronic disease caused by *Mycobacterium leprae*, an acid and alcohol fast bacillus. Its most common first symptom is a small but persistent area of impaired sensation or numbness. The bacterium affects the peripheral nerves, the skin and in rare cases, the mucous membrane of the respiratory tract. Infected persons have their nerves damaged causing obvious deformity and disability.

Modern medical conceptualisation of epilepsy sees it as a seizure produced by intermittent electron and chemical impulses to the brain (Govan et al, 1981). The causes of epilepsy are mainly idiopathic as medical investigation of patients with epilepsy reveals no cause in many cases (Cull and Will, 1995). Its classical signs are generalised convulsion and a loss of consciousness (Laidlaw et al, 1993), and according to Temkin (1971) and Pelman (1977), these convulsions, even though appear threatening, are not usually lethal. Common factors that precipitate seizures are sleep deprivation, emotional stress, physical and mental exhaustion, loud noise, flickering light, etc. Timble identifies a life threatening variant of epilepsy known as *status epilepticus*. It exists when seizure occurs without the patient regaining consciousness between attacks.

Though leprosy and epilepsy manifest symptom variation, they have certain elements in common. Both of them are diseases of ancient origin with causal linkage with disreputability, demonic possession, pernicious acts and necromantic attacks. Patients with both diseases are vulnerable to discreditable responses from family and other members of society, the reason for their classification as disreputable diseases.

What constitutes an issue of sociological attention is not the disfigurement, pains, loss of body mobility and the death trajectory associated with the diseases, but rather, from the alteration of the sufferers' social relationships and the implication of the alteration on symptom management and identity crisis.

Sick Role and Social Reproach

Illness generally has a potentially disruptive consequence on group or society. Parsons (1951) argues that in order to prevent this disruptive effect, there exists a set of shared cultural norms known as sick role. The essence of the sick role is to legitimize the deviation caused by the illness. Parsons identifies four components of the sick role in the society and these are,

i. i.The sick person is exempted from normal social responsibilities, at least to the extent it is necessary to get well.
ii. ii.The individual is not held responsible for his or her condition and cannot be expected to recover as an act of will.
iii. The person must recognize that being ill is undesirable and must want to recover.
iv. The sick person is obligated to seek and cooperate with expert advice, generally that of a physician. Sick people are not blamed for their illness but must work towards recovery (Parsons, 1960).

Illness experience reveals the inapplicability of the sick role to patients of leprosy and epilepsy in the Nigerian society. Instead of adhering to blame-free component of the sick role, certain negative impressions and evaluations are used on the lepers and epileptics. Consequently, people proceed to relate with them on the basis of expectations derived from these impressions and evaluations. This interaction mode signifies social reproach, a deviation from the normative principles of the sick role. Goffman (1963), sees this response as the root of stigmatization.

Stigmatization is a fundamental variant of symbolic interactionism. It is an act of negatively evaluating with attributes that differ from other members of society. The attributes (leprosy and epilepsy) per se are not the stigma; rather, it is the definition of the situation or the social perception of the attributes. Becker (1963), sees stigma as the way the significant others perceive and define the attributes. Thus upon diagnosis, the non sufferer perceives the afflicted persons as having scores to settle with preternatural (witches and wizards) and supernatural (ancestral, deity and God) forces, a perception that is deeply rooted in the belief system.

This perception and definition of the attributes significantly impair social relationship and interactions. It is in the light of this that Goffman refers to stigma as a language of relationship. Stigma interferes with what otherwise might have been a normal social relationship because of their undesired differences from what has been attributes.

The diagnosis and apparent manifestation of symptoms induce stigmatization from family and other members of society. At the initial stage of illness, family members and close friends try as much as possible to conceal it from public glare. As soon as the illness gets out of hands and symptoms become conspicuous, interaction becomes characterised by discreditable comments and avoidance.

Stigmatization and Coping with Crisis

Certain chronic diseases are fraught with a constant threat of grave medical crisis. Diabetics for instance can fall into insulin coma and die. Epileptics may go into convulsion and be killed in fire, pool of water, or traffic accident. The death arising from the crisis of epilepsy lies not in the convulsion but

in the scene of the convulsion. These crises need to be controlled so as to minimize their impacts on the patients. The onus lies with members of the family and friends to be organised around the sufferer. They must be prepared to read and understand the warning signals or signs that portend the crisis. It is fundamentally the first step in helping the sufferer to cope with the crisis.

Relevant to the issue of crisis is how far they can go before dying, how fast the crises appear, the clarity of the advance warning signals, the probability of recurrence, the complexity of the saving operations and the completeness of recovery from them. Granted that these critical issues are favourably disposed of, the sufferer still has a traumatic moment coping with the crisis.

Instead of getting the needed assistance from family members and friends, the epileptic is abandoned to manage or cope with the crisis alone. During convulsions, non sufferers stay far away from the victim or even ignore him or her. Apart from this unnecessary abandonment, people are also warned, out of ignorance, against touching the victim until he regains consciousness. This behaviour is derived from the cultural heritage which forbids touching the epileptic during crises or the leper for fear of contacting the disease.

Ordinarily, epileptics need not suffer physical deformities but for the crisis environment which makes the patient prone to fatal consequences resulting from convulsions. Epileptics are seen with wounds resulting from burns, cuts from sharp objects and water and traffic accidents due to lack of attention during convulsions. The negative social aspect of it is the embarrassment that may emanate from the crisis. Most epileptics regain consciousness only to discover their nudity in a crowd, the reason for epileptics opting for the back stage in life. In some cases, due to their inability to put up with life in the back stage or solitary life, epileptics contemplate suicide which they feel is a panacea to the mortifying moments in their lives.

The Burden of Symptom Management

The control of symptom, otherwise known as symptom management, extends beyond the frontiers of medical management and adherence to regimens. Most times, due to lack of proximity to medical facilities, the patient and his family members and friends rely upon their own ingenuity in the management of symptoms.

Central to the issue of symptom management is that the patient will be concerned primarily with whether the illness has any impairment on his functioning capacities or is evidencing disfigurement. Major symptoms may affect habits and subsequently call for the redesigning or reshaping of important aspects of the sufferer's life style. Reshaping activities could be made possible through the efforts of persons around him. A severely deformed and disabled leprosy patient may decide to carefully arrange every object he needs within arms reach. In the same vein, the epileptic, through the assistance of members of his family, has errands run for him, spends very little time in the kitchen to avoid fire accidents and is often in bed to cushion the effects of a fall.

The interference of the sufferers' lives with social relationships depends largely on a number of factors. The withdrawal of relatives and friends from sufferers may be due to the excessive demands by the patient in relation to symptom management and reshaping of activities. Also, whether the illness is terminal, publicly visible, unpredictable, degree of pain and the nature of regimen for the management of symptoms, are put into consideration. More importantly, the status or the social worth of the person before and during the illness determines how long relatives, spouse and friends get on with him. The moment the sufferer is not favourably disposed to these critical factors or conditions, the basic target of the patient is defeated. The fundamental aim of leprosy or epilepsy patient is not just to stay alive or to keep the symptoms of the disease under control, but to live as normally as possible in the face of the symptoms.

The Border Limits of Stigmatization and the Sufferers' Response

The collective definitional process in which the leprosy and epilepsy patients are described as possessing discreditable attributes does not leave the sufferer in a passive shape. Rather, the stigmatized actively learn the meaning of their attributes or performance through direct exposure to rejection and disapproval from non-sufferers in society.

The perception of stigma or what the putatively stigmatized think of others in relation to reaction inform their series of response to the reproach. The first response to the collective definition is the evaluation of the self or personal identity. The self concept is the totality of our beliefs and feelings about ourselves. Geca (1982) simply sees the self concept as our perception about who we are and this can only be established in our social encounter with others.

The social construction of self identity is derived from what Cooly (1998) refers to as the looking glass self – the way in which a person's sense of self is derived from the perception of others. The looking glass self of the sufferers is not who they actually are but rather their perception of how non sufferers see them. It is a three step process.

i. The sufferers' imagination of how their personalities and appearances will be judged by non sufferers or other members of society.
ii. The perception of how the sufferers think they are being judged. They are judged as possessing discreditable attributes.
iii. Based on the perceived judgement, the sufferers experience what Kendall (2001) refers to as social devaluation – the possession of less social value than others in a group or society. Social devaluation becomes acute as sufferers begin to exit roles that are central to their social identity. As a result of this unfavourable evaluation, the self concept begins to diminish.

In the face of social devaluation and diminishing self identity, the sufferers are left with no option but to eventually recreate their social lives on a daily basis in relation to the situation on ground. Central to the recreation of social life is tactical withdrawal from other members of society or social environment as a strategic measure of impression management. In the process of this situational withdrawal, according to Goffman (1968), an unbridgeable social gap between the sufferers and non sufferers is established.

In furtherance of the situational withdrawal, sufferers go in search of persons with similar health problems. The rational behind this action is for the sufferer to have the desired understanding and support that is lacking in the larger society. However, this experience is prevalent among leprosy patients who can afford to form leper colonies due to their numerical strength. It is in this colony that they adopt the beggarly life style as a survival strategy. Being alluded to severe loss of social contact, and by extension, great social isolation, sufferers of disreputable illness opt for speedy death. This is very common because they see an endless time ahead depending on people who are not readily available, increasing social isolation and a purposeless life. In other words, sufferers prefer suicide to staying alive in acute hopelessness.

Conclusion

The desire for lepers and epileptics to be normal and live conventional lives is hardly or never achieved even when the leprosy patient is already cured. This is due to the cultural context in which they find themselves. This social experience is as traumatic as the agony of pain, deformities and disabilities associated with leprosy and epilepsy.

Granted that leprosy and epilepsy are analytically similar to deviance because both represent threat to effective role performance, reaction from 'normals' ought to be different towards illness due to intentionality or wilfulness that is attributable to deviance and not illness. There is no doubt that the social functioning of the leprosy and epilepsy patient is severely jeopardized. The basic components of social functioning – satisfaction with roles in life, feeling of self worth and positive relationships with others, have been impaired due to stigmatization for faults that are unintentional. Considering the extent of stigma and its attendant impact on the sufferers or patients of leprosy and epilepsy, there are

two options at their disposal. The first option is to enable the sufferers manage the stigma and the second option is aimed at amelioration or eradication of stigma in society.

The stigmatized sufferers should devise a strategy to meet the problem of the social devaluation they suffer from other members of society. This option consists of two strategies. The first strategy is that sufferers should try as much as possible to avoid the 'normals' in society. In other words, they should identify with those who possess discreditable attributes who will not use derogatory comments on them. On the other hand, they can interact with normals who are sympathetic in approach.

The second strategy in the sufferers' solution to stigma is concealment of their identities. Beside the physical concealment of cloaking the symptoms, the sufferers should as well adjust to the role prescription of the non sufferers. The latter can be achieved through artful striving to play extra roles to demonstrate their normality. It should be noted however, that concealment is limited inter-alia by the extent and the frequency of the symptoms.

The second option is a macro level approach. It involves a major overhaul in the value structure of our society by creating re-socialisation avenues that will inculcate on the normals the need to empathise. People should understand that leprosy and epilepsy are like any other form of ill health that is independent of the sufferer's intention. Singling the lepers and epileptics out for blame and reproach is not a positive measure; rather, it is a conscience-soothing strategy of doing nothing about the problem of lepers and epileptics.

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Low-Power MP3 Decoder Implemented in a Xilinx Virtex-4 FPGA

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Abstract

A multi-processor architecture for MP3 decoder is presented which occupies 56% of a Virtex-4 LX15 FPGA from Xilinx. In order to reduce the power consumption of the decoder, the architecture of each block is customized to perform own special function using different parallel processing techniques. The estimated average power consumption of the MP3 decoder is only 11.17 mW for one mono sound channel and the decoding time of a complete frame is 20.8 ms at a chip clock frequency of 5 MHZ. The power consumption is much lower than the commercial single-chip MP3 decoder.

Keywords: MP3 decoder, FPGA, power consumption, multi-processors architecture

1. Introduction

The MPEG-1 layer-III (MP3) is a highly compressed digital audio format which can compress down a piece of music to approximately 90% of the original size with virtually indistinguishable quality. During the first years of mp3 usage, software decoders were used to decode the mp3 files, but during the last couple of years hardware decoders were employed to decode the mp3 files saved on a Flash memory and to play them. Power consumption is an essential issue in such systems and they are efforts [1-4] to design dedicated decoders in hardware with low power dissipation and less clock cycles.

In this paper, we purpose a multi-processor architecture for MP3 decoder in which each block is customized to perform own special function and the whole hardware including the block RAMs has been implemented in a Xilinx Virtex-4 FPGA to reduce the power consumption of the decoder.

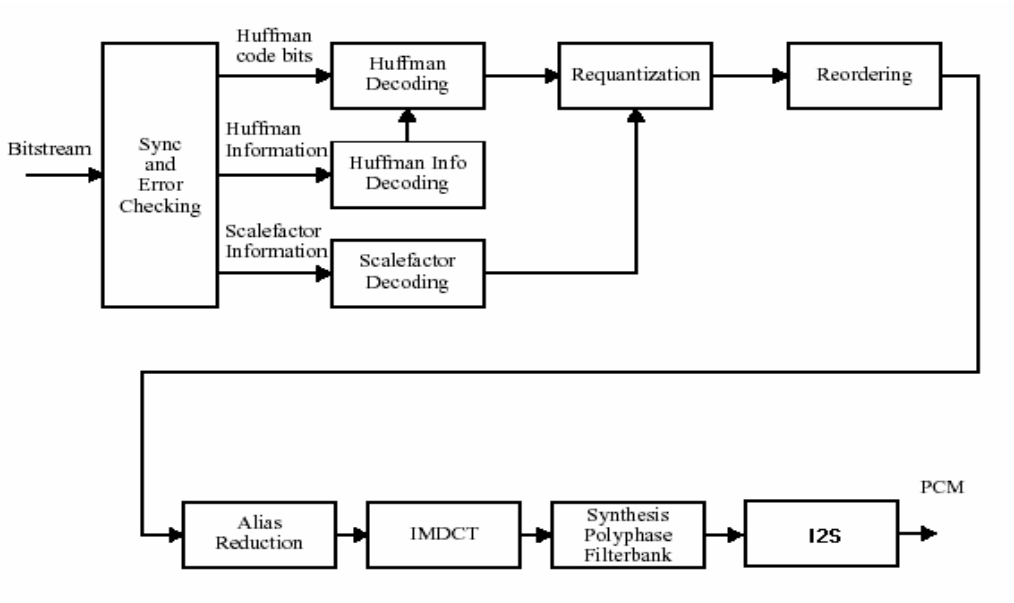
2. MP3 Decoding Process

In the MP3 decoding process during several stages an input bitstream is converted into PCM audio samples which can be sent to an external digital-to-analog converter (DAC) to be played. Each MP3 bitstream is divided into small packages, or frames, where each frame contains 26 ms of music data. A

frame contains compressed audio data as well as information about how it should be properly decoded. In the ISO/IEC 11172-3 (MPEG-1 audio) standard [5] audio information sampled from one (mono) or two (stereo) sound channels at 32 kHz, 44.1 kHz or 48 kHz frequencies can be encoded.

In this work, only sampling frequency of 44.1 kHz from one mono sound channel is supported. Extension to other sampling frequencies or multi channel sampling can be easily accommodated in this hardware. In the designed chip, an input bitstream is processed by eight blocks which are implemented independent of each other and the output PCM audio samples are formed at the sampling frequency of 44.1 kHz with the IS2 standard which is compatible with the most Digital to Analogue Converters (DACs). The block diagram of the MP3 decoder is shown in Figure 1. The function of each block and their implementation in hardware are described in the following sections.

Figure 1: The block diagram of the MP3 decoder



2.1. Synchronizer

This block accepts the input MP3 bitstream which consists of frames of 26 ms audio information. Each frame contains compressed audio data and some other information such as header, CRC, and side information with specific format. This information contains basic specifications of the main data, bitstream control, and the nformation which is necessary to decode the compressed data. Therefore, this block receives the input bitstream, partitions the different parts, and finally stores each part at the specific location of the chip main memory.

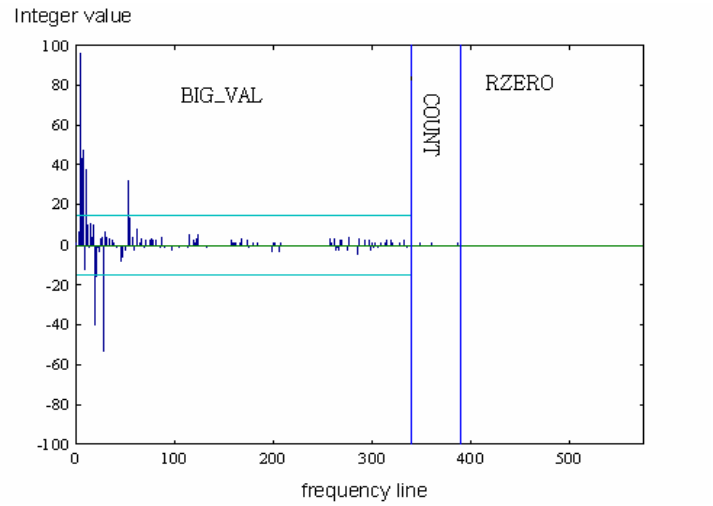
2.2. Huffman decoder

This block decodes the encoding main data according to Huffman decoding scheme [5]. In this technique for the data with more repetition number fewer bits are allocated. Moreover, the scalefactors used to quantize the audio information are extracted. These factors are used in the next block, requantizer, to rescale the original frequency lines (symbols) into 576 original non-scaled frequency lines. The outputs of this block are divided into three parts: *Big-values, Count,* and *Zeros*.

Since audio signals has higher amplitude in low frequencies thus in *Big-values* section, the levels of frequency lines are normally between -15 and +15. For the values higher than this range, encoded bits, called *linbits*, are included in input bitstream. In *Count* section which represents higher frequency lines, the levels of the frequency lines are 1, 0, and -1. The highest frequency lines are present in *Zero* section with zero level. Figure 2 illustrates the output of Huffman decoder block for

one frame. To decode information, 4 tables with constants and 32 additional Huffman tables are used in this block.

Figure 2: The output of Huffman decoder block



To design Huffman decoding block, 32 tables are implemented as Block Select RAM are used. Based on the side information of each frame, one of these tables is used and the whole block is controlled by a control unit. To store constant tables which are quite small, LUTs (Look Up Tables) configured as ROM are used on the chip. Since tables 16 to 23 and 24 to 31are the same, one table for each set of tables is stored. Moreover, with omitting one of the tables which inverts the input only, the number of stored tables is reduced from 32 to 17.

The output information in the form of 576 values of 32 bits is stored in the main memory and the scalefactores are put in a special small memory to be used by the requantiser block.

2.3. Requantiser

Requantiser is one of the MP3 building blocks and we are proposing a VLSI efficient implementation of this block to reduce power consumption. Its main function is to rescale the output samples of the Huffman decode block in order to reconstruct 576 original frequency lines. Two separate equations used to rescale the short and long blocks are as followings:

$$xr_i = sign(is_i) \cdot |is_i|^{\frac{4}{3}} \cdot 2^{\frac{A}{4}} \cdot 2^{-B} \quad (1)$$

for short block:

$$A = global\ \ gain - 210 - 8 \cdot subblockga\ in\,(window)$$

$$B = scalefacto\ r\_mutiplier\ \cdot scalfactor\ \_s\,(sf_b, win)$$

for long block:

$$A = global\ gain - 210$$

$$B = scalefactor\_mutiplier \cdot scalfactor\_l(sf_b) + preflag \cdot pretab\,(sfb)$$

where is_i is the value of the input to the requantiser block read from the main memory and xr_i is the rescaled value stored in the memory after calculation. The other parameters are obtained from the side information of each frame.

The datapath of the requantiser is controlled by a Moore-type Finite state machine (FSM) which is optimized in both timing and hardware resources. This has accomplished in this way that in each state, some parts of the quations are calculated and then buffered to the next state therefore each signal will be stable for a long period of time and consequently the power consumption will be reduced. Using this technique, execution time of this block increases slightly.

To reduce the calculation time of $|is_i|^{4/3}$, a search table calculated using the MATLAB has been formed. In order to reduce the table size to 1024 and consequently the size of the ROM implemented as a Block select RAM on the chip by a factor of 8, the following relation is used:

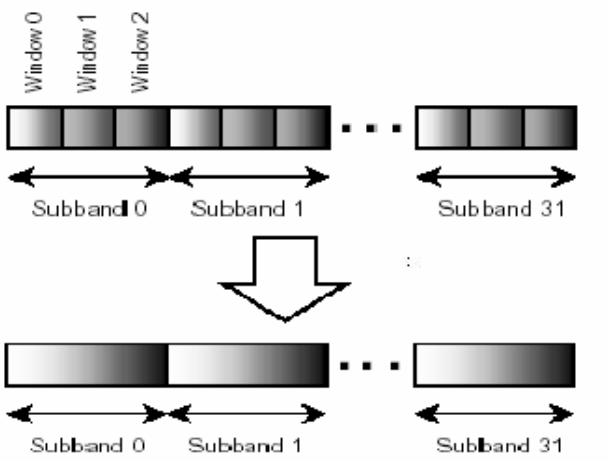
$$|is_i|^{4/3} = 16 \cdot \left|\frac{is_i}{8}\right|^{4/3} \quad (2)$$

In this way if the isi value is less than 1024, xri is directly obtained from the search table. Otherwise, isi is divided by 8 and then xri obtained from the table is multiplied by 16.

2.4. Reordering

In the stage MDCT of a decoding process, two types of windowing are used. When long windowing is used, 576 frequency lines are ordered in normal form in increasing order of sub-band frequency. When short windowing is used, three different windows are employed therefore in decoding process the frequency lines must be reordered in normal form in this block. The reordering procedure for short blocks is shown in Figure 3.

Figure 3: Reordering procedure for short blocks

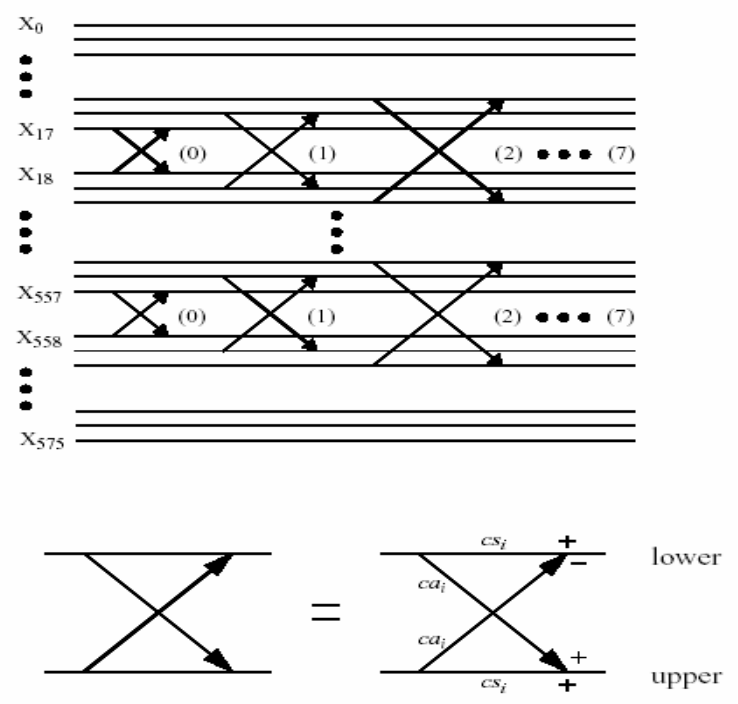


To implement this block, two internal memories are employed. One of these memories is used to store the data from the main memory and the other one includes the corrected addresses to restore the data in the main memory. Using this architecture, very short execution time can be achieved.

2.5. Alias-reduction

To compensate for the alias reduction occurs in encoding process due to non-ideal function of the bandpass filters, in this block adjacent frequency lines are mixed together in 8 butterfly filters and thus the values of all frequency lines except two middle lines are altered. Figure 4 illustrates clearly the alias reduction procedure.

Figure 4: Alias reduction procedure



To implement this block, a FSM, a butterfly, and several counters have been employed. One of the limitations of this block is multiplier unit for which a multiplier shared by the other blocks has been used on the chip. There is a trade-off between the execution time and the hardware resources and the parallel structures and buffering of the temporary values are employed. The butterfly coefficients are stored in LUTs configured as ROMs. In order to reduce the execution time of multiplication, operations such as fetching the next values are performed in parallel to multiplication process.

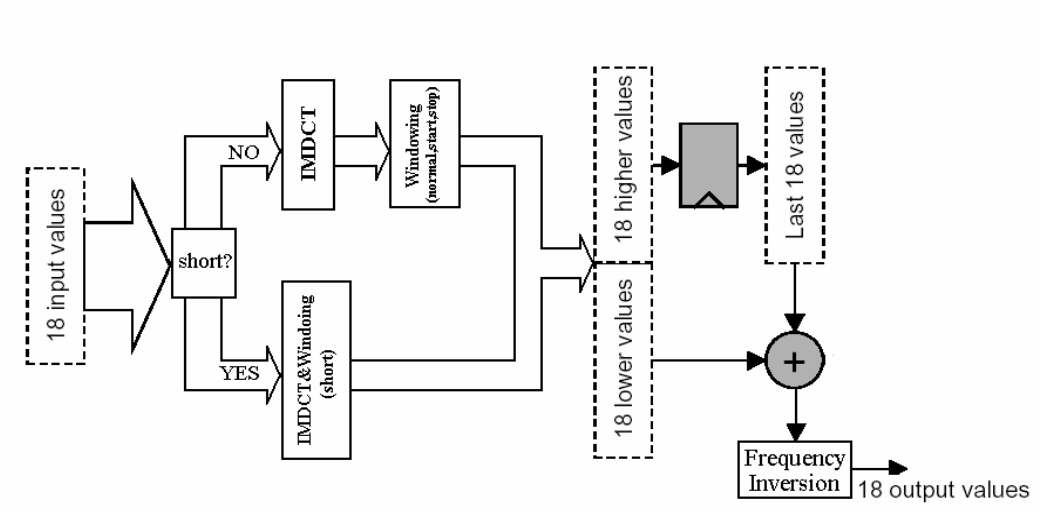
2.6. IMDCT

This block along the next block, polyphase filter Bank, reconstructs time domain samples from the 576 frequency lines. In MP3 process, IMDCT is an 18-point Direct Cosine Transform (DCT) which creates 36 polyphase filter sub-band samples (x_i) from 18 frequency lines (X_k) according to the following relation:

$$x_i = \sum_{k=0}^{n/2-1} X_k \cos\left[\frac{\pi}{2n}(2i+1+n/2)(2k+1)\right] \quad 0 \le i < n \quad , \; n = 36 \tag{3}$$

These 36 samples are multiplied to a 36-point window and then are passed to the next block. There are four windows (normal, short, start, and stop) and the window type is determined from the side information of each frame. Since 36 samples are created from 18 frequency lines, there is 50% overlapping of the output data therefore 18 lower samples of the current frame are added with 18 higher samples of the previous frame and the results are 18 output samples of this block. Figure 5 shows the IMDCT operation flow.

Figure 5: IMDCT operation flow



To implement the IMDCT block, a direct method or quick DCT techniques can be used. Since DCT is a matrix of multipliers, to realize it in direct method 18×36 multipliers and 17×35 adders are required. Therefore, the direct implementation does not seem a suitable method. On the other hand, the quick methods based on FFT are suitable for DCTs with a length of 2^k and for other lengths are quite complicated. Therefore we used some innovative techniques to implement this block.

In the first stage, some of IMDCT-value calculating and windowing for short blocks can be combined in a single multiplication stage thus some of calculation are omitted due to several multiplications to zero value. Moreover, According to relation (3), it is possible to obtained the half of output samples from the other half since

$$x_i = -x_{n/2-i-1} \quad , \; i = 0,...,n/4-1 \tag{4}$$

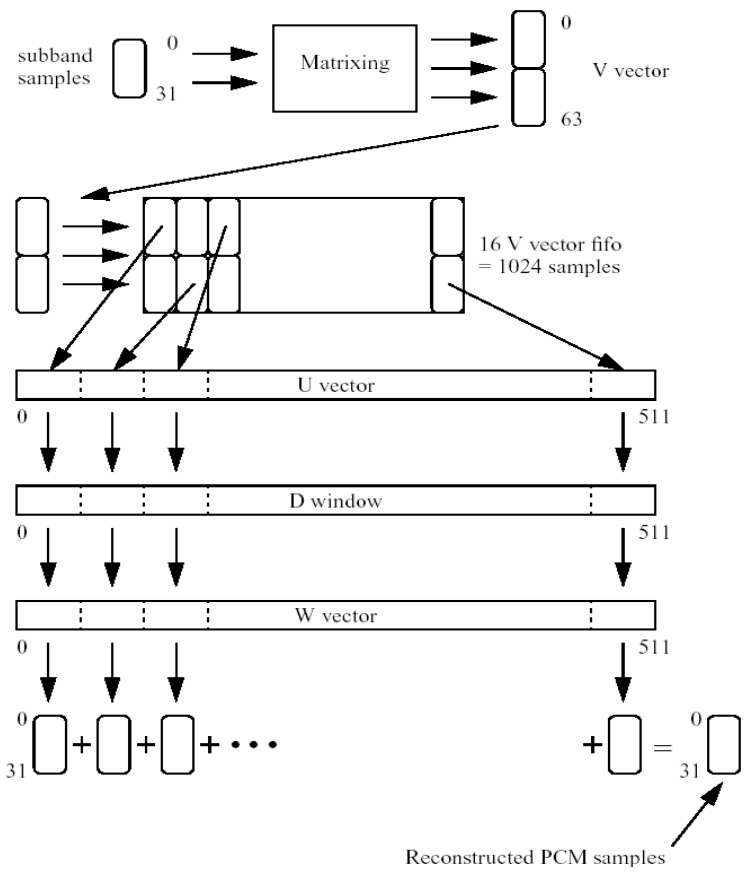
$$x_i = -x_{3n/2-i-1} \; , \; i = n/2,...,3n/4-1 \tag{5}$$

The shared multiplier to perform multiplication and an accumulator instead of the adders are used to implement this block. To reduce the execution time, all cosine and sine values used in IMDCT computation are calculated by the MATLAB and are stored in a Block select RAM.

2.7. Polyphase Filter Bank

This block is the final stage of a MP3 decoding process and generates 32 first output values from the first sub-sample of each sub-band, the next 32 from the second sub-sample and so forth. This operation is repeated 18 times until 576 PCM output for one granule of a frame are computed. Figure 6 shows the polyphase filter flow chart.

Figure 6: Polyphase filter flow chart



To implement this block, the polyphase structure is divided into two parts. For the MDCT part, the fast MDCT algorithm proposed by Lee [6] has been used in which a large DCT block is divided into smaller DCT blocks. Thus the multiplier number is reduced from 32×32 to only 80.

2.8. I2S Interface

The decoded data from the MP3 decoder to outside world is transferred serially based on the I2S protocol. The I2S block fetches the data from the main memory and generates the output serially with a format which is supported by many DACs.

According to the I2S standard, the output serial data is in form of 2's complement number and the MSB is transferred at first. The output serial bus consists of three lines: serial data, channel select, and clock. To realize this block, FIFO_buffer structures are employed. In order to have the output clock frequency of 44.1 kHz, the chip clock should be chosen to be an integer multiple of 44.1 kHz.

3. Synthesis

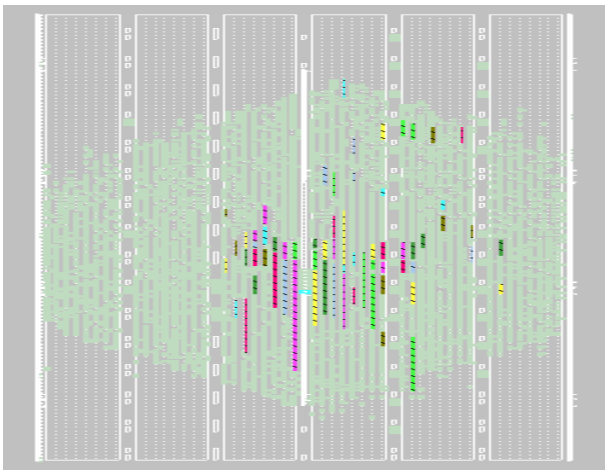
The target hardware of the project is a Virtex-4 LX15 FPGA manufactured by Xilinx. The FPGA features 6144 logic slices and 32 18×18-bit multipliers and 48 18Kb Block Select RAMs. The Xilinx ISE 7.1i has been used to implement and synthesis the MP3 decoder. Table 1 shows the utilization of hardware resources on the chip for each block.

Table 1: Utilization of hardware resources

Block	Flip Flops	4-input LUTs	Block RAMs	18x18 Multipliers
Synchronizer	298	359	0	0
Huffman	246	1165	4	0
Requantiser	134	995	3	0
Reorder	13	23	7	0
Alias-reduction	114	219	0	0
IMDCT	187	775	4	0
Filter Bank	157	641	4	0
I2S Interface	60	167	1	0
Main memory	107	380	5	0
Controller	257	398	0	0
Multiplier	110	399	0	4
MP3 decoder	1683	5521	28	4

The MP3 decoder chip floorplan is shown in Figure 7. The number of occupied slice is 3457 therefore the MP3 decoder design occupies only 56% of the FPGA.

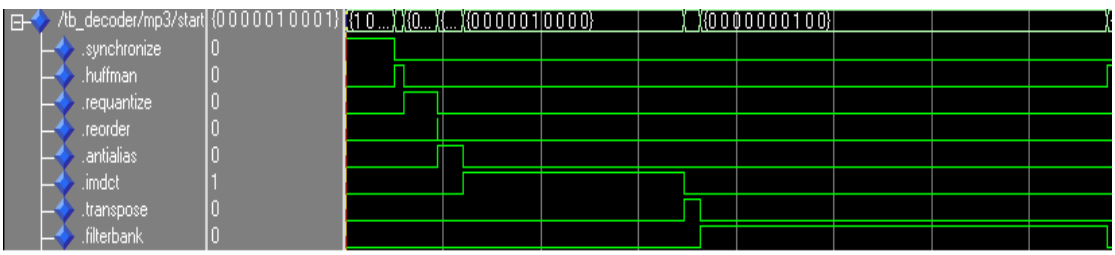
Figure 7: Floorplan of the MP3 decoder chip



4. Simulation

The whole chip has been simulated using ModelSim 6.0 and the execution time of each block is illustrated on Figure 8 and is given in Table 2. Some of the shared resources in the MP3 decoder such as the chip main memory and the shared multiplier are roughly active during the whole decoding time and therefore the execution time of them is overestimated in the Table 2. The total time to decode a complete frame, containing two granules, is 20.8 ms at a chip clock frequency of 5 MHZ. For an output clock frequency of 44.1 kHz, the chip should produce each output sample at 27 ms. It means that this chip can even clocked at a lower speed than 5 MHz.

Figure 8: Simulation results of the MP3 decoder



4.1. Power Estimation

As mentioned earlier, the objective of the implementation of a MP3 decoder on a FPGA is to reduce the power consumption. To calculate the power consumption of this design, we have used the XPower Estimator of Xilinx which works based on the clock frequency and the utilized hardware resources. Table 2 gives the power estimation of each block of the designed decoder with Xilinx XPower Estimator Tool [7]. The power consumption of the whole MP3 decoder core chip was calculated by dividing the sum of the energy used by each block to the total execution time.

Table 2: Power consumption and execution time of MP3 decoder blocks

Block	***Power consumption (mW)***	***Execution time (us)***
Synchronizer	2	400
Huffman	5	554
Requantiser	6	672
Reorder	4	230
Anti-alias	4	376
IMDCT	6	2873
Filter bank	5	5300
I2S	2	<10405
Main memory	2	<10405
controller	1	<10405
Multiplier	1	<10405
MP3 decoder	11.17	10405

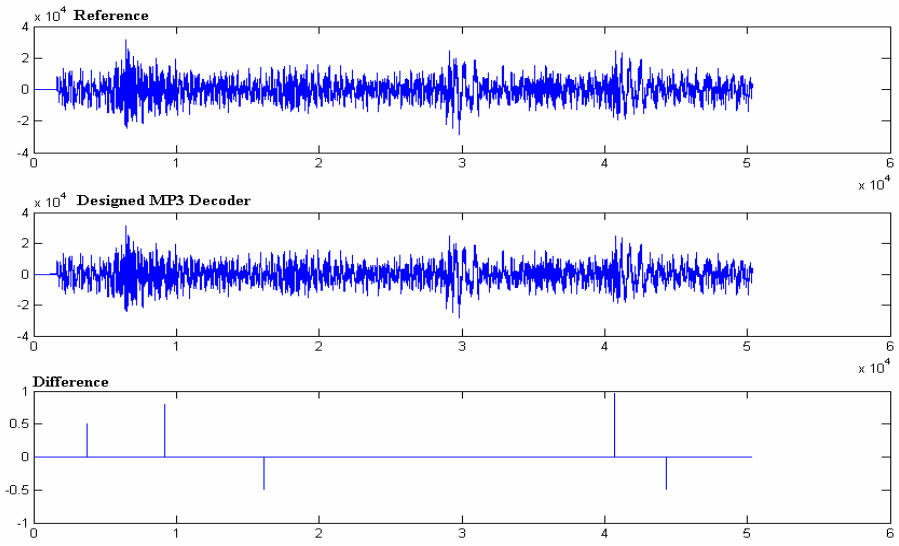
5. Sound Quality Assessment

Based on the ISO/IEC 11172-3 standard, in a standard MP3 decoder the root mean square of the difference between the samples of a reference sound and the decoder outputs must be less than

$$\sqrt{\frac{1}{N}\sum_{k=0}^{N-1}(x_k - y_k)^2} = 2^{-15}\Big/\sqrt{2} = 0/00000881$$

Figure 9 illustrates the reference samples and the output of the designed decoder as well as the difference between two sets. The root mean square of difference between two sets is 0.0000017 which is well below the permitted error value.

Figure 9: The original and decoded samples of a reference sound



6. Conclusions

A multi-processor architecture for MP3 decoder has been designed and implemented in a Xilinx Virtex-4 FPGA. In order to reduce the power consumption of the decoder, the architecture of each block is customized to perform own special function using different parallel processing techniques.

The MP3 decoder occupies 56% of a Virtex-4 LX15 FPGA and only 4 of 32 18×18-bit multipliers and 28 of 48 Block Select RAMs are used. The estimated average power consumption of the MP3 decoder is only 11.17 mW for one mono sound channel and the decoding time of a frame is 20.8 ms at a chip clock frequency of 5 MHZ. The average power consumption and the decoding time for two (stereo) sound channels could be roughly increased by a factor of 1.6 and 1.2, respectively. Therefore, the power consumption of our MP3 decoder is much lower than the commercial single-chip MP3 decoder chips [8].

In conclusion, the multi-processor architecture of a MP3 decoder implemented in a FPGA can significantly decrease the power consumption of the decoder that is essential in handheld devices.

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Acceptable Load Carriage for Primary School Girls

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Abstract

Randomized six primary school girls aged between 9 to 10 years old completed this study at the Motion Analysis Laboratory, Department of Biomedical Engineering, University of Malaya, Malaysia. Three different loads were used (10%, 15% and 20% of their body weight) and 0% was used as control during level walking. The data obtained, both kinetics and kinematics, were analyzed using the Peak Motus® 7.2.4 software from PEAK Performance Technologies® and SPSSÒ version 12.0 software. The results indicated that the peak ground reaction forces increased with increasing backpack loads. The hip and knee flexion/extension increased as the loads increased. The stride length and walking speed decreased, while the cadence showed no significant difference ($P>0.05$). If the trunk angle is taken as the criterion to determine acceptable backpack loads for children, these loads should not exceed 10% of the children's body weight.

Key words: Backpack; Gait; Kinetics; Kinematics; Ground Reaction Forces, Trunk

Introduction

The use of heavy backpacks is common among school children, resulting in complaints of back and shoulder pain reported by school children, parents, and educators. Medical experts advised that the maximum weight for a backpack should not exceed 15% of a child's total body weight because it can

cause back problem [1]. According to the Hong Kong Society for Child Health and Development [2], the mean ratio of backpack load was 20.2% of the body weight.

The purpose of this research was to investigate how the increase of backpack loads affects gait and posture among school children, thus to suggest the optimum weight that the primary school children should carry. Kinoshita [3] concluded that by increasing the backpack mass, it will proportionally increased the ground reaction forces (GRF), the gravitational force exerted on the backpack center of mass (COM) also increased, and consequently, the force the backpack is exerting on the lower and upper back during walking.

Goh et al. [4] studied the effects of varying backpack loads on peak forces in the lumbosacral spine during level walking. They found that the lumbosacral forces increased, but the mean trunk angle decreased as the loads increased. Li and Hong [5] and La Fiandra and Harman [6] studied the effect of backpack mass using treadmill. Li and Hong (2004) found the mean trunk inclination angle increased for the load of 15% of the body weight instead of 20% of the body weight backpack mass [7]. According to La Fiandra and Harman [6], the vertical forces and anterior-posterior forces exerted on upper and lower back increased by increasing the backpack mass.

The previous study by Chow et al. [8] investigated on the kinematics effects of increasing the backpack loads. The increment of loads would increase the double support time, but decreased the walking speed and cadence. However, Pascoe et al. [9] stated the cadence would increase, but decreased in stride length with increment of backpack mass. The effect of backpack mass on trunk range of motion was studied by Hong and Cheung [6] and they found that there was no significant effect. However, Li and Hong [5] concluded that the increment of loads would decrease the trunk range of motion.

Methods

Six female subjects of primary 3 and 4 students were selected to complete this study. Their age was limited to between 9 to 10 years old with their height 128.33±7.7 cm and their weight 26.7±5.1 kg. All the subjects were free from health disorders and physical disabilities. The consent forms with all the information necessary were given to the subjects and their parents to allow participation. The subjects were required to wear dark blue or black T-shirt and tights, wearing shoes and bringing their school bags to the Motion Analysis Laboratory, Department of Biomedical Engineering, University of Malaya, Malaysia.

The questionnaire was designed to gain information about the type of schoolbag used, the method used by the subject to carry her school bag, the means of transport to/from school, and the social background of the subject. The subjects were assigned to carry backpack load of 0, 10, 15, and 20% of their body weight and their anthropometrics measurement were taken. Each subject had to step her foot on the Kistler® Force Platform Type 9281C.

The three dimensional calibration was set up using PEAK Performance Technologies®. The 17 points calibration frame was placed on the Kistler® Force Platform Type 9281C while the global transformation frame (GTF) was put on the edge of the first force plate. The GTF was used to translate and rotate the origin to a position along the plane movement. The four set of 50 Hz shuttered CCTV cameras were ensured to be in a good positioning so that all the calibration points could be viewed by all the cameras.

Anthropometrics measurement was taken and markers placement was done after consent was obtained. In order to get good data, the subject was required to walk in their natural cadence comfortably. The experiment data was captured using four video tapes. Each of the subjects must complete at least five full gait cycles for each load in order to reach steady state. Then, a set of data was selected from these trials based on good force plate readings, gait pattern between trials, and clear marker positions [4]. Synchronization of each trials and digitization was processed using PEAK Performance Technologies® to obtain the kinetics and kinematics result from raw data.

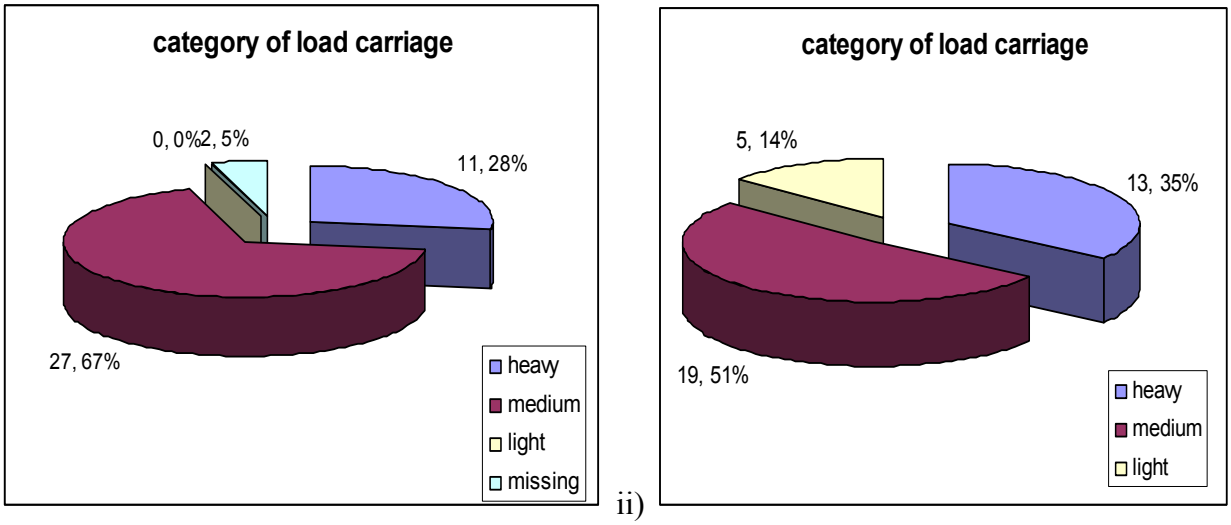
Single factor of Analysis of Variance (ANOVA) was used to examine the effect of the loads (10%, 15%, and 20% of the subjects' body weight) compared to no load. The statistical significance level of 0.05 was selected. The graphs obtained from the Peak Motus® 7.2.4 software system was filtered using 5 Hz low pass second-order Butterworth filter.

Results

Questionnaire

The feedback from the students of Brickfields (2) Primary School, Kuala Lumpur, Malaysia was impressing because from 80 primary students, there were 77 respondents. It was concluded that almost of the students went to school by bus, they liked to use double straps backpack, and 67% of primary 5 students and 51% of primary 3 students claimed their backpack as medium, not too heavy, (see Fig. 1). According to S. B. Mohd. Tamrin and R. Hamzah [10], a study was conducted in Seri Serdang in 2001 among 82 primary 2 and 5 students found that 95.2% of school children claimed their school bags as heavy.

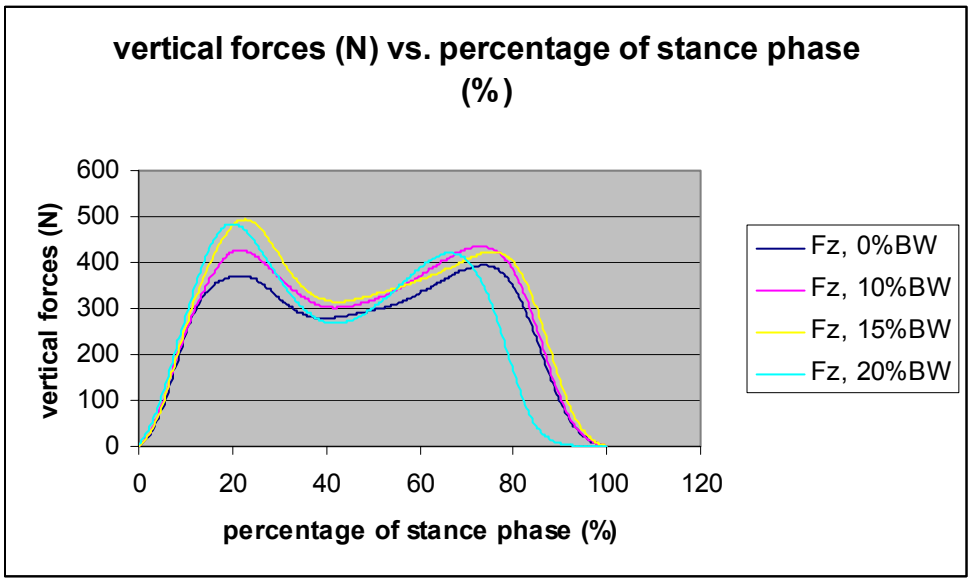
Figure 1: Category of Load Carriage among i) Primary 5 Students and ii) Primary 3 Students.



Kinetics

This study focused on the ground reaction forces (GRFs) that consisted of anterior/posterior forces (Fx), medial/lateral forces (Fy), and vertical forces (Fz). All the subjects present the same pattern of GRFs, but in different amplitude value. The result obtained from the Peak Motus® 7.2.4 software indicated that the peak ground reaction forces increased as the loads increased as shown in Fig. 2. The findings of this study showed that vertical forces, Fz increased almost two times when the loads increased up to 20% of the body weight compared to the loads of 10% of body weight, (see Table 1).

Figure 2: The vertical ground reaction forces (Fz) from sample F7.



Joint Kinematics

The majority of motion occurs in the sagittal plane during normal gait [11]. Joint kinematics in the sagittal plane consisted of the hip flexion/extension, knee flexion/extension, and ankle dorsiflexion/plantarflexion angle. Generally, the mean angle of hip flexion/extension increased as the loads increased, while the angle produced by each subject indicated that the knee flexion/extension angle increased as the loads increased. The mean angle of ankle during increasing loads showed insignificant changes ($P > 0.05$).

Table 1: The maximum value of the vertical GRF

Subjects	Backpack loads (% of the body weight)			
	0%	10%	15%	20%
F1	216.16	238.23	241.62	255.91
F3	318.04	363.24	402.12	418.07
F4	268.74	308.39	309.13	334.90
F5	235.97	264.49	246.72	246.07
F6	303.44	331.64	369.37	351.22
F7	394.09	435.08	493.51	483.88
Mean±SD	289.41±64.22	323.51±70.82	343.74±97.50	348.34±92.11

All the values are in Newtons

Temporal Parameters

It consisted of stride length, cadence, and velocity or walking speed. The mean stride length tended to decrease as the loads increased. The cadence is analyzed using single factor of ANOVA with significant value equals to 0.05. The preliminary data showed that there was no significant difference of cadence when increasing the loads since the F ratio was less than F critical. Only two subjects showed an increasing in cadence approximately 3% as the loads increased as shown in Table 2. The result of walking speed showed undistinguishable changes. The mean walking speed showed a decreasing speed as the loads increased up to 15% of the body weight.

Table 2: The mean of stride length and cadence

Subjects	Stride length (m)				Cadence (steps/min)			
	Backpack loads (% of the body weight)							
	0%	10%	15%	20%	0%	10%	15%	20%
F1	1.42	1.18	0.79	0.1	200	155.17	209.3	230.77
F3	0.1	0.07	0.28	0.02	209.3	166.67	138.46	272.73
F4	1.26	0.13	0.08	0.09	230.77	257.14	264.71	272.73
F5	0.18	0.41	0.25	0.39	272.73	272.73	281.25	290.32
F6	0.15	0.05	0.06	0.06	236.84	243.24	230.77	225
F7	0.02	0.03	0	0.01	281.25	264.71	264.71	272.73
Mean±SD	0.522±0.638	0.312±0.448	0.243±0.289	0.112±0.141	238.48	226.61	231.53	260.71

Trunk Posture

Trunk angle is defined as a segment-to-reference plane angle between shoulder point and Anterior Superior Iliac Spine (ASIS) point relative to XZ or horizontal plane. All the subjects presented the lower trunk flexion angle: four subjects produced 0º to 10º and two of the subjects produced 23º to 35º of trunk flexion angle. The trunk angle of each subject was analyzed using single factor of ANOVA with significant value of 0.05. There were four subjects who showed a significant difference ($P < 0.05$) at load of 10% of their body weight, while another two subjects at 15% of their body weight. The mean trunk angle decreased for 10% of the body weight load, but started increasing when the 15% of the body weight load was applied.

Discussion

Questionnaire

The backpack could be divided into three types; one strap, double straps backpack, and roller bags. The finding showed that most of the students preferred carrying their backpack with both shoulders. Legg et al. [12] found that double strap backpack was associated with less discomfort for pressure on the shoulders ($P< 0.01$), balance ($P< 0.05$), and ease of gait ($P < 0.05$). It is found that most of the students classified their backpack in the medium level of load carriage. However, this study proceeded in order to investigate the effect of the load carriage on the students backpack in gait and posture.

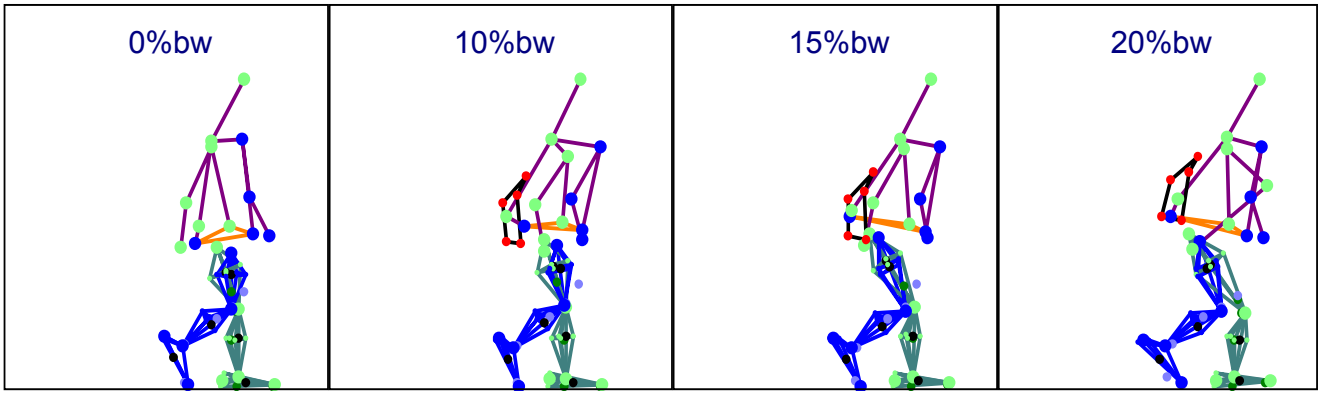
Kinetics

The anterior/posterior or horizontal ground reaction forces represent the naturalness of gait patterns by measuring the forces on a ground as the foot stepped onto the force plate (the braking phase) and as it stepped off it (the accelerating phase). The maximum 'braking' force showed in negative value of force and maximum propulsion force showed in positive value of force. The medial/lateral forces, Fy is related to the balances during walking, while the vertical forces reflect the accelerations due to gravity as well as the accelerations seen by the camera [13].The vertical forces, Fz showed an increase in value (Newtons) as the loads increased from 10% up to 20%. The first peak of vertical GRF of all the subjects without load represents their body weight in Newton.

Joint Kinematics

The angle produced by each subject indicated that the knee flexion/extension angle increased as the loads increased, (see Fig. 3). According to La Fiandra et al. [14], an increase in knee flexion would prevent floor contact during mid swing.

Figure 3: Stick Figure F7 for Different Loads during Toe Off.



Temporal Parameters

According to Kinoshita [3], Pascoe et al. [9], La Fiandra et al. [14], and Nottrodt and Manley [15], the stride length may shorten when the load is increased during fixed speed walking. From this study, the mean stride length tended to decrease as loads increased. This means the subjects tended to take shorter steps while balancing their body posture during carrying backpack. By increasing loads, the flight time will be decreased, thus decreasing the stride length.

The finding of this study showed that there was no significant difference of cadence ($P > 0.05$) when increasing the loads. However, Pascoe et al. [9] found that there was significant increase in cadence with respect to normal walking when the children walked over ground with backpack.s From preliminary data, only two subjects produced an increase in cadence as the loads increased.

The preferred walking speed was expected to decrease to compensate for the additional energy expenditure required for the load carrying as the weight of the load is increased. The mean walking speed showed a decreasing speed as loads increased up to 15% of the body weight as shown in Table 3. This was because the subjects are trying to minimize the oscillations of their foot while balancing the loads in order to avoid injury. According to Wang et al. [16], carrying a load of 15% of body weight will cause a decreasing in walking speed, since it is related to the need for stability when carrying the loads.

Table 3: The mean walking speed/velocity (m/s) of the subject

Subjects	Backpack loads (% of the body weight)			
	0%	10%	15%	20%
F1	0.98	0.54	0.21	0.05
F3	0.07	0.02	0.04	0.02
F4	0.63	0.21	0.07	0.18
F5	0.14	0.71	0.28	0.69
F6	0.15	0.07	0.08	0.16
F7	0.01	0.02	0.04	0.01
Mean speed ±SD	0.33±0.388	0.26±0.295	0.12±0.1	0.185±0.258

All values are in m/s

Trunk Posture

Most of the subjects gave a slightly lower trunk flexion angle, this means that they tended to lean forward in order to compensate for the additional energy expenditure required for load carrying and to avoid injury. The result found that the mean trunk angle started increasing when the 15% of the body weight load was applied and the different subjects might adjust their gaits to the loads in different ways, trying to balance the loads during over ground walking [16]. However, Hong et al. [17] found no significant difference in trunk posture with increasing load in carrying backpack during level walking,

but significant differences were found in stairs descent when the load was increased from 0% to 20% of body weight.

To be concluded, the result indicated that the peak ground reaction forces increases with an increasing backpack loads. This study showed that the vertical GRF, Fz increased almost two times when the loads increased up to 20% of body weight compared to the loads of 10% of body weight.The hip and knee flexion/extension increased as the loads increased to prevent floor contact during mid-swing. The stride length and walking speed decreased, while the cadence showed no significant difference ($P > 0.05$).

If trunk angle is taken as the requirement to determine acceptable backpack loads for children, these loads should not exceed 10% of their body weight as recommended by Sander [18]. This was because the subjects tended to lean forward and minimized the oscillations of their foot in order to compensate for the additional energy expenditure required for load carrying and to avoid injury.

Acknowledgements

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Performance Measurement of Various Modulation Formats in the Presence of Dispersion and Non Linear Effects for WDM Optical Systems

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Abstract

Increase in the data rate of fiber optic communication system is limited due to dispersive and nonlinear effects of the fiber medium. In this paper for the first time to the author's knowledge we have estimated the optimal length of dispersive compensating fiber which is determined by varying the DCF length to obtain high Q factor for various input power levels. Also we have simulated 16 and 32 DWDM channels for the data rate of 10 Gb/s and determined the Q factor for various modulation formats in the presence of dispersion and nonlinear effect.

Key words: Dispersion compensating fiber (DCF), Single mode fiber (SMF), Return to Zero (RZ), Non Return to Zero (NRZ), Q factor, spectral efficiency.

Introduction

As the need arouse to send the information over longer and longer distances, the fiber optic community developed additional wavelength windows that allowed longer transmission distance. However as the data rate increased and the fiber length increased, limitations due to dispersion in the fiber became impossible. Utilizing a wider bandwidth requires additional amplifiers and other optical components, so raising the spectral efficiency is often the more economical alternative. In an effort to improve spectral efficiency and robustness against transmission impairments, researchers have investigated a variety of binary and non binary modulation techniques in conjunction with various detection techniques like coherent and direct detection. In our earlier work we have analyzed eye opening penalty for various modulation techniques like RZ, NRZ, DPSK DQPSK and it was found that the eye opening penalty does not fluctuate in the case of DPSK and DQPSK scheme which is around and nearer to I dB when the propagation distance span is increased (Ramprasad and Meenakshi 2005).This DPSK detection technique uses an interferometer to convert phase modulation to intensity modulation. We know that increase in data rate causes the nonlinear dispersive effects to act and decreases the Q factor .In literatures we have seen that dispersion compensation unit is placed to compensate the

dispersion effects. In this paper we have taken some steps to determine the optimal length of DCF for improving the system performance of 32 channel DWDM system. Also in the second half of the paper we have estimated the Q factor of all the modulation formats in the presence of linear and nonlinear effects.The entire simulation work was done using MATLAB SIMULINK, communication and signal processing toolbox which is the major contribution of the author.

Non Linear Effects

Fiber nonlinearity limits the transmission distance and overall capacity of the DWDM systems .The major nonlinearities are the Kerr effect, Stimulated Raman scattering, stimulated Brillioun scattering (Agarwal 1995). The Kerr effect leads to Self phase modulation, Cross phase modulation and four wave mixing. In this effect the intensity of the aggregate optical signal perturbs the fiber refractive index, there by modulating the phase of the signal. In DWDM systems, SPM and XPM arise when the phase of the channel is modulated by its own intensity and by the intensity of other channels respectively. Fiber propagation with the kerr effect is modeled using NLSE for a single channel and coupled NLSE for the DWDM systems (Agarwal 1995).In fibers with non zero dispersion, XPM has greater impact than FWM. With constant intensity modulation such as frequency and phase modulation ideally both SPM and XPM cause only time invariant phase shift eliminating both intensity and phase distortion. The most significant negative effects of FWM are parametric gain and crosstalk in long haul multi channel WDM systems. FWM efficiency is maximized at the zero dispersion wavelength and for closely spaced input waves .In order to reduce the FWM effect researchers are utilizing the Non –zero dispersion shifted fiber which has low non-zero dispersion in the WDM operation of 1530 nm -1565 nm .There are various dispersion management schemes and by alternate sections of fiber with equal magnitude but opposite sign dispersion , the net chromatic dispersion of the system can be zero without having any section with zero local dispersion where FWM would occur efficiently. In this work for the first time the optimal length of the DCF is found by simulation and it is used in the DWDM system to improve the Q factor.

Simulation Model

Figure 1: Block diagram of N span an optical communication systems.

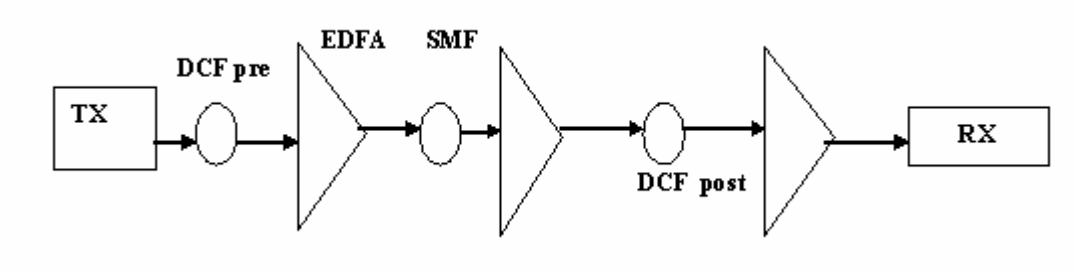


Figure 2: Q factor versus input power.

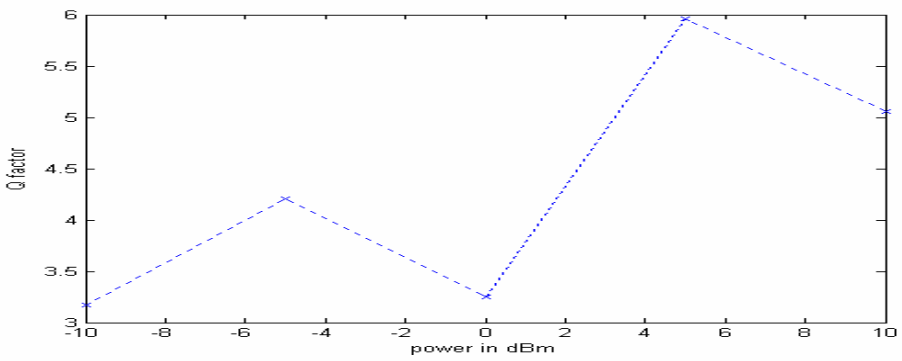


Fig1.shows the simulation model of N span optical communication systems .Fig 2.shows that when there is an increase in the input power the Q factor increases and then decreases due to the dispersion effect .In literatures (Sieben and conradi 1999) we have identified the Dispersion compensation unit for compensation the effect of dispersion and in this paper we have determined the optimal length of DCF in the presence of Four wave mixing effect to improve the Q factor. This dispersion effect can be compensated by the DCF fiber with the Pre and Post compensation .In this figure we have taken the readings for four input power levels of -10 dBm, -5 dBm , 0 dBm , 5 dBm Initially the single mode fiber (SMF) and dispersion compensating fiber (DCF) lengths are fixed as 80 Kms and 80 Kms respectively(Knudsen et al 2000) .The transmitter is a continuous wave Laser source at a frequency 193.1Thz and Pseudo Random bit sequence of bit rate 10 Gb/s. of modulation type NRZ The Q factor is observed as maximum for the input power level of 5 dBm. The dispersion compensating length is varied for the same length of SMF for determining its optimal length to get maximum transmission efficiency,

Table 1: Fiber parameters used in the simulation.

Parameters	**SMF**	**DCF**
Length	80 Kms	Variable
Attenuation	0.2 dB/km	0.25 Db/KM
GVD	16 ps/nm/km	-72 ps/nm/km
Slope	0.08 ps/nm^2	0.08 ps/nm^2
Effective Area	80 μ^2	30 μ^2

The Erbium doped fiber amplifier used in our simulation has gain of 20 dB and the noise figure of 4 dB. The optical Bessel filter prior to the receiver has the detecting frequency of 193.1Thz, Bandwidth of 160 GhZ. The optical receiver has the cut off frequency electrical filter 0.75 * bit rate Hz. In this paper DCF fiber length is varied for various power levels -10 dBm,-5dBm,5 dBm.

Figure 3:Q factor Versus Transmission distance for various power levels.

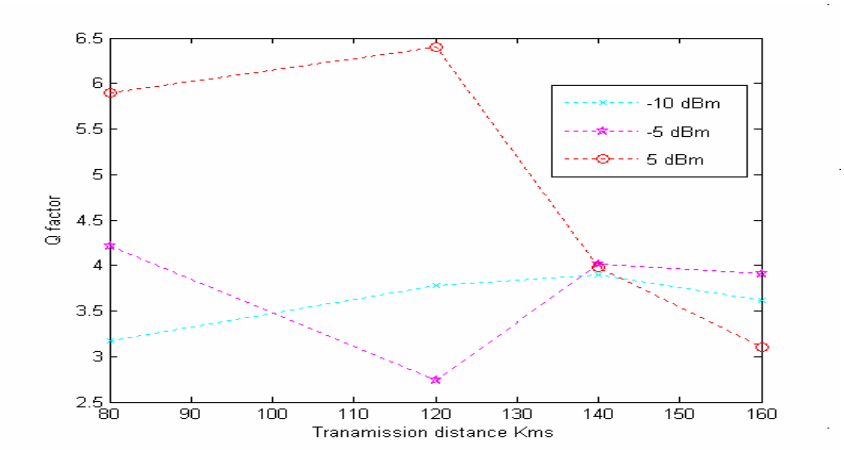
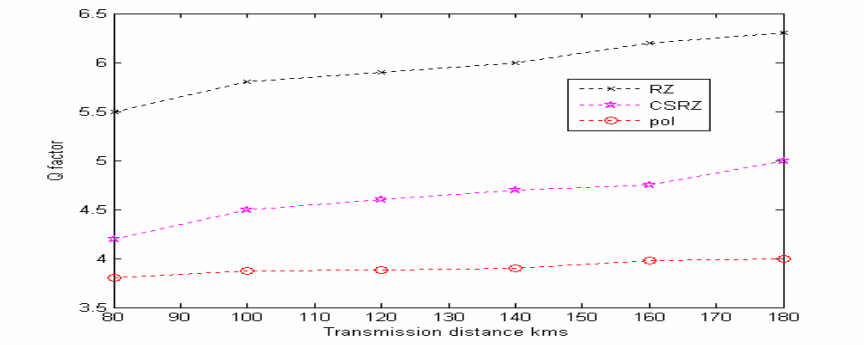


Fig 3.shows that the decrease in Q factor as the dispersion effect increases when the distance is increased for various power levels -10 dbm.-5dbm and 5 dbm. For the case of input power 5 dBm and the maximum Q factor level decreases after the distance of 120 Kms of DCF for a SMf of 80 Kms. For the same transmission distance of 120 Kms the Q factor values are 2.7, 3.8 and 6.5 for -10 dBm , -5 dBm and 5 dBm respectively. Hence comparatively in this work the optimal length of the dispersion compensation fiber to compensate the dispersion and to improve the Q factor is 120 Kms. We have taken in our work that optimal DCF length for a 32 multiplexed DWDM channels the lengths of the fiber are as follows SMF 80 Kms and DCF 120 Kms . Fig.4 shows that for the optimal Dispersion compensating fiber lengths the Q factor is measured and the results shows that the Q factor is not more fluctuated if the transmission distance is increased for an optimal distance of pre and post dispersion compensating fibers for the given length of Single mode fiber (Anderson and Lyle) ,

Figure 4: Q factor measurement for various modulations



Dense wavelength Division Multiplexed systems

The multiplexed system was simulated as same Fig1.and the Q factor was measured for the DWDM system 32 channels for various modulation formats the measured Eye diagrams are shown in the figures 5 and 6.

Figure 5: Eye diagram of 32 channel (NRZ Modulation for mat)

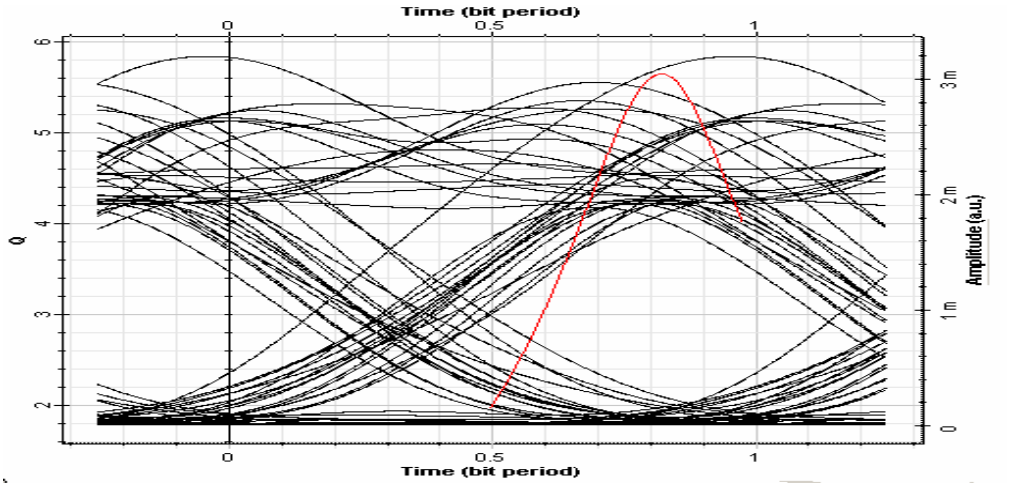
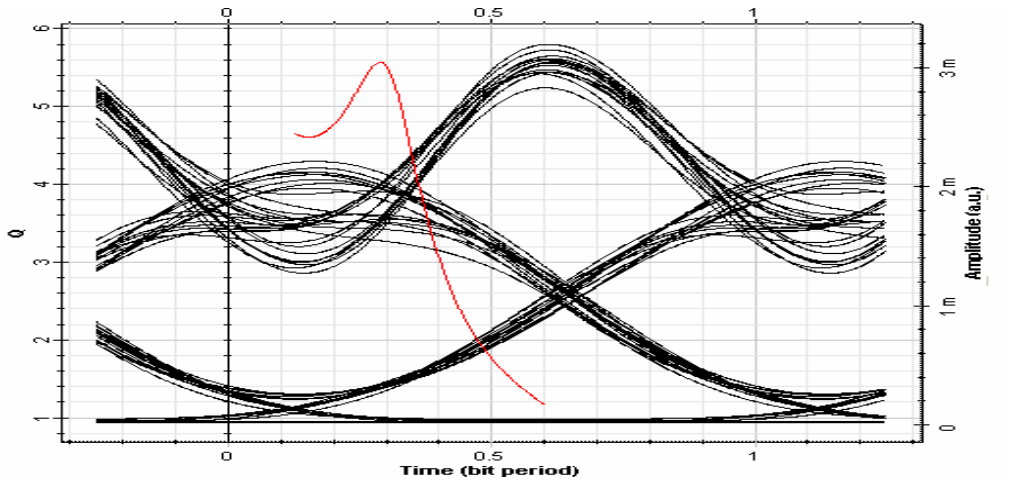


Figure 6: Eye diagram of 32 channel (RZ modulation)



Comparison of Various modulation formats

Various modulation formats can be compared in terms of the performance (Bosco and Carena 2002) for the nonlinear fiber

Figure 7: Schematic diagram to determine Q factor

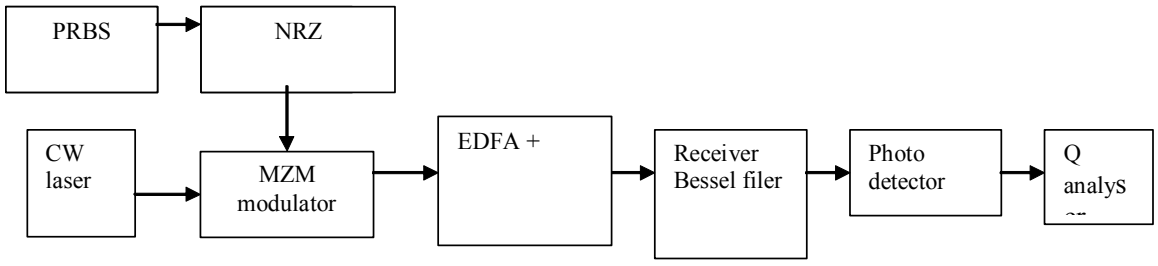


Figure 8: Q factor for nonlinear fiber (NRZ)

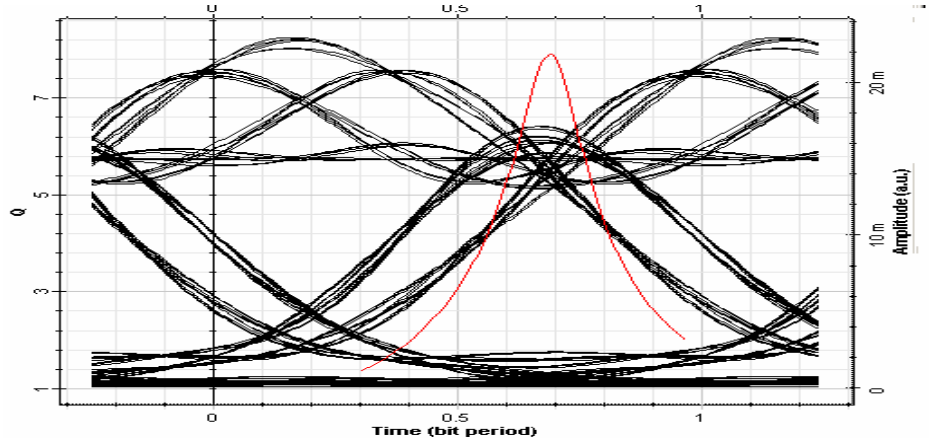


Figure 9: Q factor for nonlinear fiber (RZ).

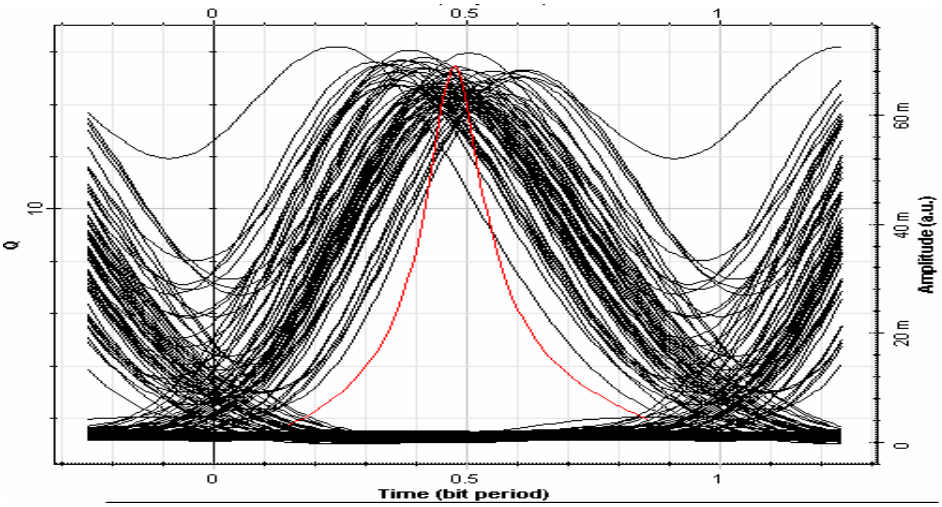


Table 2: Parameters used in the simulation model

S.N	Parameters	Values
1.	PRBS	10 Gb/s data rate, 128 lengths, 128 bits.
2.	Continuous wave Laser	1550nm 15 mw power
3.	Mechzender Modulator	100db ext ratio
4.	Nonlinear dispersive fiber	Dispersion16ps/nm,0.2dB/km attenuation, Effec Area 93 μ^2 Slope 0.08 ps/nm^2/km Length 25 Kms
5.	EDFA	Gain 5 dB Noise figure 6dB
6.	Number of loops	4 spans of EDFA and Nonlinear dispersive fiber
7.	Bessel optical filter	1550 nm with the band width of 4 * data rate Hz.
8.	Pin diode	Responsivity 1 A/w Dark current 10 nA.

Figs 8 and 9 shows the eye diagram where Q factor is measured for the nonlinear dispersive single more fiber with the data rate of 10 Gb/s with out dispersion compensation and approximately to a length of 100 Kms. are measured at the channel number eight in the DWDM system (Agarwal 2000)..

Results

Table 3: comparison of Q factor for RZ and NRZ modulation formats with dispersive and Nonlinear effects

S.N	Fiber Type	Modulation format	Channels	Q factor
1.	Dispersion compensating	NRZ	01	12.753
2.	Dispersion compensating	RZ	01	16.332
3.	Dispersion compensating	NRZ	16	7.06
4.	Dispersion compensating	RZ	16	8.92
5.	Dispersion compensating	NRZ	32	5.645
6.	Dispersion compensating	RZ	32	5.567
7.	Non linear fiber	NRZ	01	7.90
8.	Nonlinear fiber	RZ	01	15.47

A comparison of various modulation formats for 16 channels DWDM systems are done as

Table 4: Q factor for various modulation formats of Nonlinear fiber.

S.N	Modulation format	Spacings	Q factor
1.	Return to Zero	Equal	1.516
2.	Return to Zero	Unequal	14. 23
3.	Non return to Zero	Equal	1.923
4.	Non return to Zero	Unequal	11.921
5.	DPSK	Equal	3.15187
6.	DPSK	Un Equal	18.2323
7.	DQPSK	Equal	4.2323
8.	DQPSK	Un Equal	19.999
9.	Duobinary	Un Equal	20.32
10.	RZ duobinary	Un equal	22,85

Table 4.shows that Q factor is lower in the case of equal channel spacing this is due to the fact of FWM effect in the nonlinear dispersive fiber .

Discussions

In this paper it has been observed that the Q factor can be improved by the modulation scheme either by Return to Zero or Non Return to Zero with the dispersion factor of the transmission medium. Hence in the first half of the paper we have determined an optimal length of the Dispersion compensation fiber to be 120 Kms and for the fixed fiber length we have multiplexed 32 channels and the eye diagram is shown in Figs 5 and 6.Table 3. shows the comparison of RZ and NRZ modulations for two cases with dispersion and non linear effect. It is found that the Q factor for the nonlinear dispersive nature of the fiber for RZ modulation is slightly differed on comparing with the dispersion compensating fiber and conclude that RZ modulations sustain the nonlinearities and dispersive effects than the NRZ modulations Table 4. shows that in the case of equal channel spacing for all the modulation types the Q factor is lower than the Un equal channel spacing this is due to the Non linear effect like Four wave mixing can be suppressed.In the case of 16 DWDM multiplexed channels the modified Duo binary (RZ) format has the highest Q factor in the presence of Non linear effects.

Conclusions

It was found that the increase in the data rate causes the nonlinear dispersive effects which can be compensated by the compensating fibers and the optimal length of the dispersion compensating length was found and applied to improve the Q factor. It was also observed that by simulation the RZ modulation format can sustain the nonlinear effects at the data rate of 10 Gb/s .On comparing all the

major modulation formats it was observed that DPSK and RZ duobinary modulation performs well in the unequal channel spacing systems.

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Evaluating the Suitability of Groundcovers in the Arid Environments of Kuwait

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Abstract

Kuwait is an extremely hot, dry country. Kuwait is an arid country with high. The average daily temperature is about 33°C. Temperatures are even higher during the summer months between May and October, while the humidity is very low. It almost never rains during the summer. Temperatures are more moderate in winter. This is when Kuwait receives its annual rainfall of 25 to 175 millimeters. Sandstorms are common and can last several days. There is very little fresh water in Kuwait. Desalination plants, which distill fresh water from salt water, were built in order to provide the country with enough water. Groundcovers are low growing plants that spread quickly to from a dense cover. These groundcovers are used for reducing the loss of ground water through evaporation. This study was conducted on six ground covers and their performance in the climate of Kuwait was evaluated. It was observed that three out of the six selected ground covers could not withstand the varying temperatures in summer as well as in winter. The plant species like *Rhagodia spinescens* and *Furcraea gigantea* showed good growth rate and *Allamanda cathartica* showed a negative growth rate. The ground covers *Hardenbergia comptoniana, Duranta repens goldiana and Lonicera japonica* had 0 % survival percentage at the termination of the study.

Key Words: Groundcover, desalination, evapo-transpiration, survival percentage, growth rate

Introduction

In the arid land of Kuwait we have extreme climatic conditions accompanied by severe sandstorms due to loose structured, sandy nature of the soil. Simultaneously evaporation is very high in Kuwait particularly during summer. At the same time there is a good interest within Kuwait for soil and water conservation and greenery of the country to improve life and the environment (Suleiman and Abdal, 2002). Conservation of both water and soil is an essential concept for Kuwait's local environment, as water availability, in arid country as Kuwait, is limited and most soils are eroded and native plants are disappearing. Thus it is obvious to control the loss of soil as well as to conserve water. The ground cover plays an important role in conserving the soil and water. Moreover ground covers add beauty to the landscape.

Ground covers are low-growing plants that spread quickly to form a dense cover. They absorb heat, moisture, dust and control erosion. Ground covers vary in form leaf size, color and in texture.

Ground covers can provide a change in foliage structure or add color to landscaped beds. By covering the ground with a carpet of vegetation the ground cover prevents the germination of weeds (Khalil et al., 2006). It acts as an insulating cover for the soil, keeping it cooler in the summer and warmer in the winter. The ground cover is living mulch that helps to build up humus level in the soil. Grass is the best known ground cover, but grass is not suited to all conditions. Other ground cover plants should be used where grass is difficult to grow and maintain. When planted under trees, ground covers reduce the possibility of mower damage to the base of the tree (Relf and Appleton, 1999). Soil erosion models stimulate the reduction in soil loss by incorporating the effect of above ground biomass. But in reality the reduction in soil loss is due to the combined effect of both roots and above ground biomass (Gyssels and Poesen, 2003).

For this study six ground cover species were selected and they were planted in two sites namely, inland site which is away from the vicinity of sea and coastal site near to the sea as the name indicates. They were tested for their growth performance under the harsh climates of Kuwait.

Materials and methods

Six ground cover species namely *Rhagodia spinescens, Allamanda catharicta, Hardenbergia comptoniana, Duranta repens goldiana, Furcraea gigantea* and *Lonicera japonica* were selected for screening for their suitability to Kuwait's climatic conditions. The land was thoroughly prepared before planting. All weeds, trash, rocks and other debris were cleared and removed from the sites. Chemical analysis of water was also done prior to planting. In both the sites 30 cm of the top layer was back filled with agricultural soil and peat moss. The sites were fine graded and leveled. Soil was disinfected and weed treated. Soil was irrigated before planting to leach salts from the soil and was followed by a drying period of two days. The hardened plants were then transplanted in the field and a complete randomized block design was used. The transplanted plants were medium in size and had a healthy green appearance.

A complete randomized block design with five replications of all experimental plant species in both sites was used. Optimum cultural practices were carried out for the transplanted plants. Ground covers were fertilized with complex fertilizer at the rate of four teaspoons full per square meter area, raked and covered with soil. The lawn area is being maintained by cutting the grass using a lawn mower. The lawn grass is being irrigated with treated-waste-water using the sprinkler irrigation system. Experimental plant species were covered with shade net to protect the plants from high temperature and hot winds. Irrigation water amounts were regulated to meet the plants requirements according to the season. Data on survival, plant height, stem diameter and visual observations were documented on bi-monthly basis.

Results and Discussion

The means, standard deviation, survival percentages and growth rates were calculated data for the data collected. Table1 shows the survival percentages of the plants in both inland and coastal site, and Fig. 1 is the graphical representation of the same. It was observed that the plant species *Hardenbergia comptoniana, Duranta repens goldiana* and *Lonicera japonica* died in the inland site depicting its unsuitability to the harsh weather in Kuwait. Though some of these plants survived in the coastal site, they had very low survival percentages ranging from 20 to 60 %. *Rhagodia spinescens* and *Furcraea gigantea* exhibited good survival percentages of 100 % in both the sites. *Allamanda cathartica* **was** found to be moderately tolerant to the hot season.

The growth rates of the groundcovers in Table 2 indicate that *Rhagodia spinescens* had a good growth rates both in the inland and coastal site. In the Coastal site this plant exhibited a growth rate of 272.83 % (Fig. 2). This plant is well adapted for the dry weather condition in prevailing in Kuwait. The growth rate ranged between 40.66-54.61% for the groundcover *Furcraea gigantea*. Although the plant

Lonicera japonica survived in the coastal site it had a very low growth rate showing its unsuitability for adaptation in the desert conditions. Table 3 represents the plant caliper of the ground covers. It was observed that among the ground covers the plant *Furcraea gigantea* has the thickest caliper. It was evident from the Table 4 that *Rhagodia spinescens* plant exhibited a good plant spread. Table 1 indicates that during the hot season only the plants *Rhagodia spinescens* and *Furcraea gigantean* showed excellent growth. During summer the plant *Duranta repens goldiana* showed drying and burning of the plants. But in winter (Table 6) the plant started developing new shoots and leaves. All these results indicated that the best selected plant for the arid condition is *Rhagodia spinescens* followed by *Furcraea gigantea.*

Figure 1: The survival percentages of groundcover plants in the inland and coastal site.

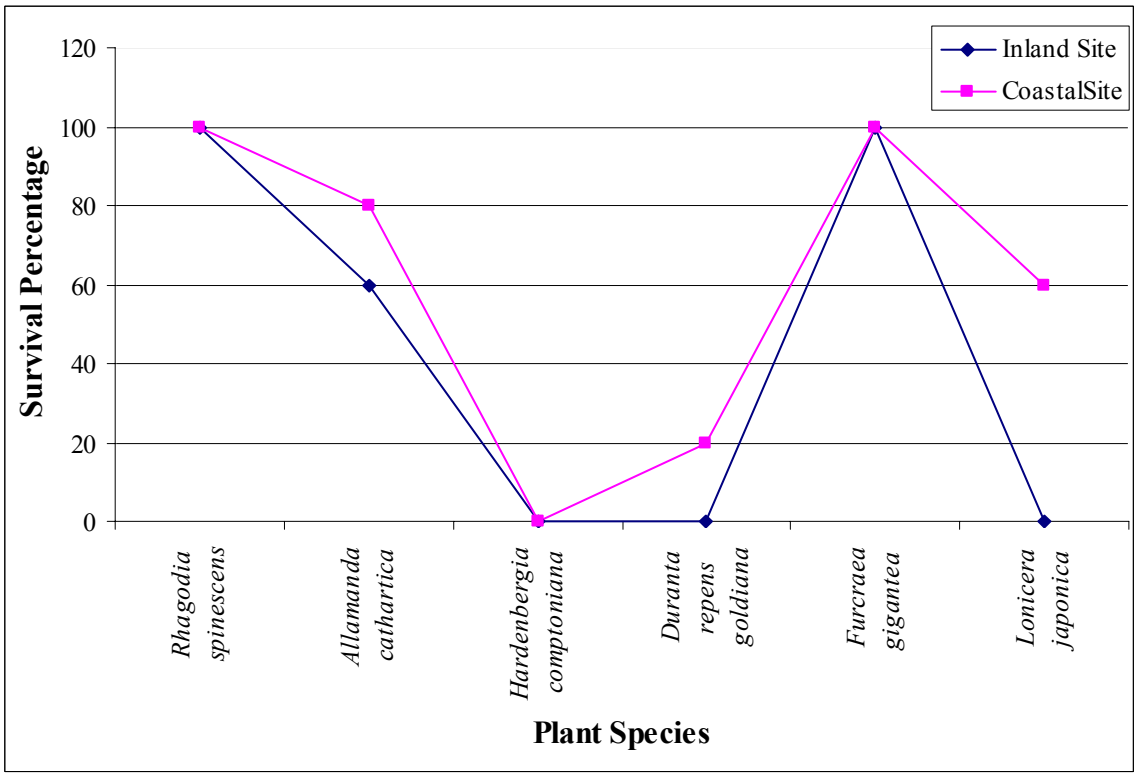

Figure 2: The growth rate of groundcovers in the inland and coastal site.

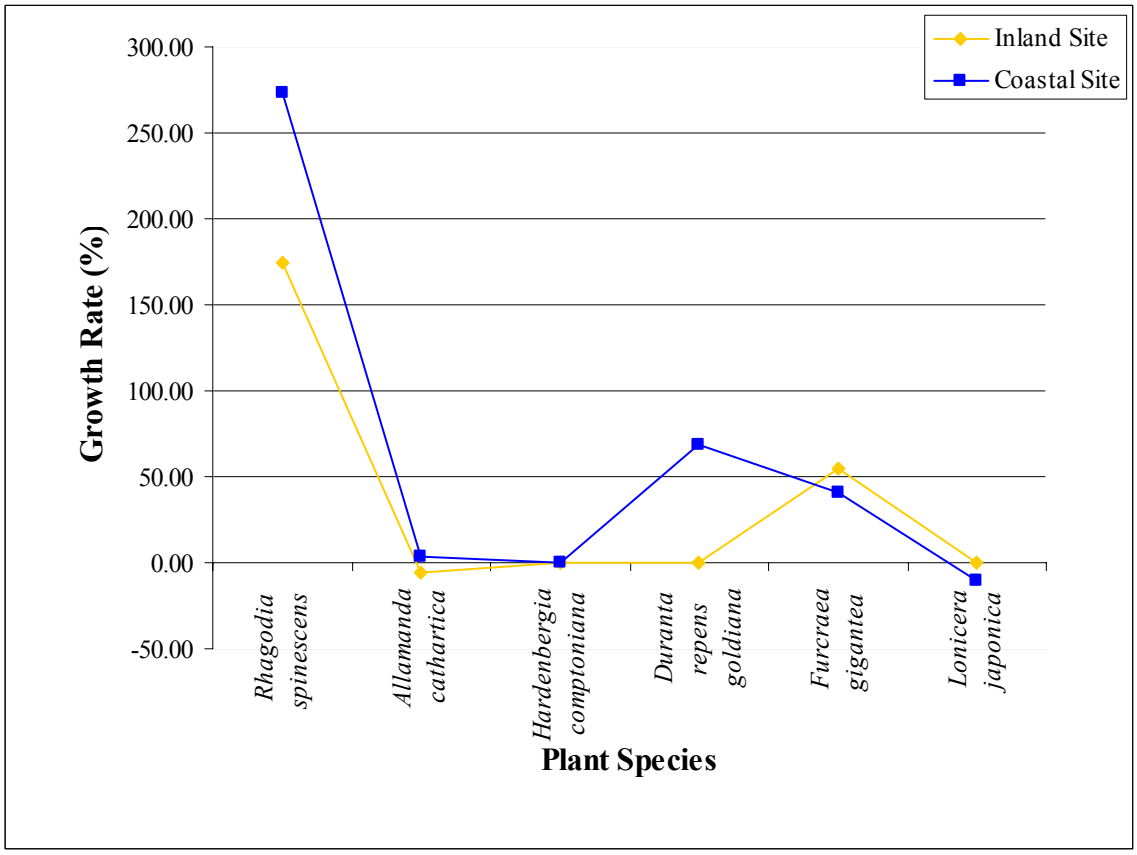

Table 1: The Plant Survival of the Groundcovers both in the Inland and Coastal Site

Plant Species	Survival (%)	
	Inland	Coastal
Rhagodia spinescens	100	100
Allamanda cathartica	60	80
Hardenbergia comptoniana	0	0
Duranta repens goldiana	0	20
Furcraea gigantea	100	100
Lonicera japonica	0	60

Table 2: Mean, Standard Deviation and Growth Rate of Groundcovers in both Inland and Coastal Site

Latin Name	Initial		120 DAP		240 DAP		360 DAP		420 DAP		Growth rate
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	Mean	SD	Mean	SD	
Inland											
Rhagodia spinescens	37.20	8.29	78.80	5.81	100.80	6.83	102.00	8.12	100.80	6.83	173.91
Allamanda cathartica	66.80	22.10	62.20	24.43	58.00	42.23	65.67	42.45	58.00	42.23	-6.15
Hardenbergia comptoniana	17.67	7.46	Dead	Dead	Dead	Dead	Dead	Dead	Dead	Dead	Dead
Duranta repens goldiana	18.80	6.30	Dead	Dead	Dead	Dead	Dead	Dead	Dead	Dead	Dead
Furcraea gigantea	31.80	8.23	39.40	5.90	43.60	3.85	42.60	3.78	43.60	3.85	54.61
Lonicera japonica	21.60	5.41	11.00	1.41	Dead	Dead	Dead	Dead	Dead	Dead	Dead
Coastal											
Rhagodia spinescens	36.80	3.70	59.80	4.76	177.80	14.34	135.80	8.11	137.20	6.83	272.83
Allamanda cathartica	61.80	23.85	59.80	26.75	68.25	18.55	74.00	14.12	63.75	15.59	3.16
Hardenbergia comptoniana	7.00	2.00	58.00	39.50	Dead	Dead	Dead	Dead	Dead	Dead	Dead
Duranta repens goldiana	18.40	3.65	14.50	3.54	Dead	Dead	26.50	3.54	31.00	2.83	68.48
Furcraea gigantea	28.20	0.84	26.80	1.48	32.20	7.73	39.00	5.79	39.67	7.02	40.66
Lonicera japonica	22.60	5.46	24.60	5.55	27.40	4.45	21.67	2.08	20.33	0.58	-10.03

DAP= Days after Planting

Table 3: Mean and Standard Deviation of Plant Caliper of the Groundcovers in both Inland and Coastal Site

Latin Name	Initial		120 DAP		240 DAP		360 DAP		420 DAP	
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	Mean	SD	Mean (mm)	SD
Inland										
Rhagodia spinescens	4.20	0.45	6.00	0.00	10.20	1.30	19.00	1.22	19.40	1.14
Allamanda cathartica	4.40	0.55	6.20	0.45	6.20	0.45	7.33	0.58	7.33	0.58
Hardenbergia comptoniana	2.00	0.00	2.33	0.58	Dead	Dead	Dead	Dead	Dead	Dead
Duranta repens goldiana	2.80	0.84	4.67	0.58	5.00	0.00	Dead	Dead	Dead	Dead
Furcraea gigantea	41.50	7.23	41.60	7.23	45.20	5.54	47.40	5.22	47.60	4.83
Lonicera japonica	3.20	0.45	4.20	0.45	6.20	0.84	Dead	Dead	Dead	Dead
Coastal										
Rhagodia spinescens	4.00	0.00	6.40	1.14	16.40	0.55	21.00	0.71	21.60	1.14
Allamanda cathartica	5.20	1.30	6.20	1.10	6.50	1.00	8.25	0.96	8.25	0.96
Hardenbergia comptoniana	2.00	0.00	2.00	0.00	Dead	Dead	Dead	Dead	Dead	Dead
Duranta repens goldiana	5.20	1.30	5.00	1.41	Dead	Dead	8.00	1.41	9.00	1.41
Furcraea gigantea	29.00	4.80	29.00	4.80	36.20	3.90	48.60	6.19	50.67	5.51
Lonicera japonica	4.20	1.79	4.60	1.34	22.20	32.35	8.33	1.53	8.33	1.53

DAP= Days after Planting

Table 4: Mean and Standard Deviation of Plant Cover of the Groundcovers in both Inland and Coastal Site

Latin Name	90 DAP		180 DAP		240 DAP		360 DAP		420 DAP	
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	Mean	SD	Mean	SD
Inland										
Rhagodia spinescens	22.40	2.30	65.40	6.11	70.20	6.98	117.60	12.42	119.80	12.79
Allamanda cathartica	12.00	1.22	9.40	4.98	16.60	13.94	21.00	24.76	17.33	24.85
Hardenbergia comptoniana	13.67	4.73	23.00	0.00	Dead	Dead	Dead	Dead	Dead	Dead
Duranta repens goldiana	9.67	4.93	10.00	0.00	14.00	0.00	Dead	Dead	Dead	Dead
Furcraea gigantea	35.80	5.07	37.40	4.83	35.00	3.87	43.60	2.88	45.40	2.30
Lonicera japonica	27.20	4.92	39.80	1.64	49.20	4.92	Dead	Dead	Dead	Dead
Coastal										
Rhagodia spinescens	63.40	7.27	137.80	137.80	199.20	12.44	180.40	8.08	180.60	8.65
Allamanda cathartica	12.80	3.90	15.20	15.20	33.25	17.50	40.75	16.42	32.00	10.74
Hardenbergia comptoniana	20.00	7.52	32.40	32.40	Dead	Dead	Dead	Dead	Dead	Dead
Duranta repens goldiana	18.00	4.24	14.00	14.00	Dead	Dead	35.50	3.54	36.00	5.66
Furcraea gigantea	34.20	3.05	34.20	34.20	37.60	7.02	49.00	7.97	54.00	8.72
Lonicera japonica	24.80	4.87	53.20	53.20	59.40	4.34	28.00	6.00	28.33	3.79

DAP= Days after Planting

Table 5: The effect of High Temperature on the Growth and Nature of the Experimental Plant

Name of plant	Effects of High Temperature
Rhagodia spinescens	Excellent growth. Increase in the size of the plant. Flowers still remain in the plant.
Allamanda cathartica	The tips of leaves dried. Leaves show acute chlorosis. The main stem turned to pale red. The leaves of the plant show curling towards inner side.
Harenbergia comptoniana	Total drying of plants. The tip of the branches first dried and later it spread to the base.
Duranta repens goldiana	Drying and burning of plants were noticed.
Furcraea gigantea	New healthy shoots are coming. Excellent growth. The increase in size of collar region shows its healthy nature.
Lonicera japonica	The tips of leaves were dried. The prostrate branches running in the ground were completely dried, leading to decrease in plant cover. Increase in size of leaves.

Table 6: The effect of Low Temperature on the Growth and Nature of the Experimental Plant

Name of plant	Effects of High Temperature
Rhagodia spinescens	Excellent growth. Good, extensive growth of foliage gives the plant a bushy appearance. The plants produced flowers.
Allamanda cathariсta	Plants showed loss of vigor. The growing part was dried from top downwards. Leaves from the upper part were dried and shredded.
Hardenbergia comptoniana	Total loss due to high temperature in summer.
Duranta repens goldiana	Excellent growth. The leaves were well developed and showed characteristic golden yellow color. Formations of lateral branches lead to development of more luxurious leaves.
Furcraea gigantea	Very good growth. No effect of cold on the growth and development. Increase in size of the collar region as well as the size of leaves were noticed.
Lonicera japonica	Dried lateral branches. As the season progressed, the newly formed leaves showed drying and shredding.

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Evaluation and Screening of Suitable Vines for the Arid Conditions of Kuwait

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Abstract

Vines offer an interesting variation in plant form. They are valuable in the landscape for their practical and aesthetic qualities. If vines are to be satisfactory in the landscape, they must be well adapted to the environment in which they are to be grown. Especially in Kuwait, where the atmospheric temperature is too high during the months of June to August and frost and cold winds during the winter months, it is important to adapt the suitable vines that are compatible with other components of landscapes. With this view in mind a study was initiated on eight species of vines namely, *Clematis microphylla, Clerodendrum thomsoniae, Cryptostegia grandiflora, Ficus pumila, Hardenbergia violacea, Ipomoea horsfalliae, Pandorea jasminoides*, and *Petrea volubilis* were tested in the inland and coastal sites. These vines were subjected to the arid climates of Kuwait and evaluated for their suitability. It was observed that the except *Cryptostegia grandiflora*, all other vines species were susceptible to the harsh weather prevailed during the summer in Kuwait. Four vine species had 0 % survival percentage. *Ipomoea horsfalliae* and *Petrea volubilis* exhibited a negative growth rate and *Pandorea jasminoides* was found to have a slow growth rate.

Keywords: Vines, landscape, aesthetic quality, frost, harsh weather, survival percentage, growth rate.

Introduction

Kuwait is an arid country with harsh climate, where the temperature means range from 8o to 44o in January and July respectively. The soil is sandy in texture. To ensure successful landscape, one should consider the type of soil, water quality and availability. Desert soil in general are short of organic matter, sandy with sparse vegetation, low in nitrogen, low in phosphorus, alkaline due to high content of calcium and often contains sodium (Khalil et al, 2003). The selection of plants best suited to these types of soils and climate is an important criteria. Along with trees, shrubs and ground cover, vine is also an important component of landscape gardening.

Vines include all plants, whether woody or herbaceous, that requires some support for their development. Vines are versatile and can grow quickly as a groundcover, a screen in trellis, a cascade of foliage and flowers against a wall, a leafy cover on an arbor, or a climber on a wall or a tree (Harris, 1992). Vines can form excellent screen plants for fences, and add appeal when grown on trees or shrubs. Combined with overhead structure, vines can provide delightful shade areas. They also perform

well as windbreaks. There are annual and perennial vines, woody and herbaceous vines, evergreen and deciduous vine, flowering vines and vines grown primarily for their foliage. We may use vines in several ways. They include using on walls or other overhead structures and as groundcovers. The trees, shrubs and vines have some effects on the space cooling requirements of a building in a warm humid environment (Parker, 1981).

The study was conducted in the urban demonstration garden in Kuwait (coastal site) and in a commercial garden (inland site). The eight species of vines listed in Table 1 were tested for their suitability to the harsh climates of Kuwait was evaluated. These plants were imported from Australia and India. The plant species were known to survive under similar climatic conditions in their respective countries.

Materials and Methods

Eight vines namely, *Clematis microphylla, Clerodendrum thomsoniae, Cryptostegia grandiflora, Ficus pumila, Hardenbergia violacea, Ipomoea horsfalliae, Pandorea jasminoides,* and *Petrea volubilis* were selected for screening for their suitability to Kuwait's climatic conditions. The land was thoroughly prepared before planting. All weeds, trash, rocks and other debris were cleared and removed from the sites. Chemical analysis of water was also done prior to planting. 30 cm of the top layer was back filled with agricultural soil and peat moss. The sites were fine graded and leveled. Soil was disinfected and weed treated. Soil was irrigated before planting to leach salts from the soil and was followed by a drying period of two days. The plants after were allowed to harden in the greenhouses before planting in the field. The hardened plants were then transplanted in the field and a complete randomized block design was used. The transplanted plants were medium in size and had a healthy green appearance.

A complete randomized block design with five replications of all experimental plant species in both sites was used. Optimum cultural practices were carried out for the transplanted plants. The vines were trailed on the supports such as fence, bamboo stalks and tied. The unwanted and dried branches were removed. Experimental plant species were covered with shade net to protect the plants from high temperature and hot winds. Irrigation water amounts were regulated to meet the plants requirements according to the season. Data on survival, plant height, stem diameter and visual observations were documented on bi-monthly basis.

Results and Discussion

The data on plant height, plant girth, plant canopy and other visual observations were tabulated and their mean and standard deviation were calculated. It was observed that the vine *Cryptostegia grandiflora* showed hundred percent survivals both in the inland and coastal site (Table 1). *Ipomea horsfalliae* also showed about 40 % survival in the inland site. All other plant species died indicating their unsuitability to Kuwait's weather. In the coastal site the plants Ipomea horsfalliae and Pandorea jasminoides showed cent percent survival. *Clematis microphylla, Clerodendrum thomsoniae* and *Hardenbergia violacea* died in the coastal site. A graphical representation of the survival percentages of the vines are presented in Fig 1.

Table 2 indicates the mean plant height, standard deviation and growth rate of the vines in the inland and in the coastal site. The vine *Cryptostegia grandiflora* exhibited the highest growth rate of 178.90% and 213.76% in the inland and coastal site respectively (Fig 2).In the inland site the species *Ipomea horsfalliae* showed negative growth rate. All other plants died in this site due to the extreme heat in summer.The vine species *Ipomoea horsfalliae* and *Petrea volubilis* exhibited negative growth rate in the costal site. *Pandorea jasminoides* showed very slow growth rate in summer. Table 3 represents the plant caliper and table 4 is the plant canopy of the experimental plants in both sites. The effect of temperature on the growth and development of the vines are indicated in Table 5 and 6.

Table 1: The Survival Percentages of Vines in the Coastal Site and Inland Site

Plant Species	Inland Site	Coastal Site
Clematis microphylla	0	0
Clerodendrum thomsoniae	0	0
Cryptostegia grandiflora	100	100
Ficus pumila	0	40
Hardenbergia violacea	0	0
Ipomea horsfalliae	40	100
Pandorea jasminoides	0	100
Petrea volubilis	0	40

Table 2: Mean, Standard Deviation and Growth Rate of Vines in the Inland and Coastal Site

	Initial		120 DAP		240 DAP		360 DAP		420 DAP		Growth rate
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Inland Site											
Clematis microphylla	13.40	4.67	17.00	14.28	Dead	Dead	Dead	Dead	Dead	Dead	Dead
Clerodendrum thomsoniae	27.80	12.54	33.20	9.44	17.50	7.78	Dead	Dead	Dead	Dead	Dead
Cryptostegia grandiflora	79.20	10.57	85.40	10.57	162.20	41.17	182.80	25.81	182.40	25.24	178.90
Ficus pumila	15.00	9.27	32.50	17.68	40.00	0.00	Dead	Dead	Dead	Dead	Dead
Hardenbergia violacea	26.40	10.88	43.60	10.01	Dead	Dead	Dead	Dead	Dead	Dead	Dead
Ipomea horsfalliae	60.60	36.15	48.60	37.13	76.75	78.64	Dead	Dead	22.00	1.41	-46.60
Pandorea jasminoides	14.20	5.50	24.50	23.33	62.50	43.13	Dead	Dead	Dead	Dead	Dead
Petrea volubilis	40.60	6.88	46.67	14.22	50.50	13.44	Dead	Dead	Dead	Dead	Dead
Coastal Site											
Clematis microphylla	17.60	9.32	138.20	48.39	10.80	4.60	Dead	Dead	*Dead*	*Dead*	Dead
Clerodendrum thomsoniae	22.40	9.71	27.20	10.83	Dead	Dead	Dead	Dead	*Dead*	*Dead*	Dead
Cryptostegia grandiflora	65.40	7.13	91.80	11.34	191.20	71.91	231.20	65.17	205.20	59.81	213.76
Ficus pumila	7.00	1.41	14.80	4.97	19.00	4.64	Dead	Dead	Dead	Dead	Dead
Hardenbergia violacea	39.60	16.74	63.80	22.08	Dead	Dead	Dead	Dead	Dead	Dead	Dead
Ipomoea horsfalliae	41.20	65.34	17.40	5.32	105.40	64.64	17.00	7.81	14.50	7.78	-64.81
Pandorea jasminoides	42.40	21.52	44.40	13.90	70.40	59.63	52.60	15.50	56.25	8.10	32.67
Petrea volubilis	43.20	15.17	48.60	18.51	46.00	17.05	32.00	19.80	31.50	21.92	-27.08

DAP= Days after Planting, SD= Standard Deviation, Growth rate= $\frac{\text{Final Height-Initial Height}}{\text{Initial Height}} \times 100$

Table 3: Mean and Standard Deviation of Plant Caliper of the Vines in the Inland and Coastal Site

Plant Species	Initial		240 DAP		360 DAP		120 DAP		420 DAP	
	Mean	SD	SD	Mean	Mean	SD	Mean	SD	Mean	SD
Inland Site										
Clematis microphylla	_		0.89	2.40	Dead	Dead	Dead	Dead	Dead	Dead
Clerodendrum thomsoniae	2.80	0.45	0.55	5.40	5.50	0.71	Dead	Dead	Dead	Dead
Cryptostegia grandiflora	7.40	0.89	0.89	9.40	12.00	0.71	14.80	1.30	15.00	1.00
Ficus pumila	2.60	2.19	0.71	5.50	5.00	0.00	Dead	Dead	Dead	Dead
Hardenbergia violacea	2.00	0.71	1.00	4.00	Dead	Dead	Dead	Dead	Dead	Dead
Ipomea horsfalliae	3.20	0.84	1.73	4.00	5.00	0.82	Dead	Dead	6.50	0.71
Pandorea jasminoides	2.00	0.71	2.12	3.50	4.00	1.41	Dead	Dead	Dead	Dead
Petrea volubilis	5.80	2.68	1.73	9.00	10.00	0.00	Dead	Dead	Dead	Dead
Coastal Site										
Clematis microphylla	1.40	0.55	0.00	3.00	4.00	0.00	Dead	Dead	Dead	Dead
Clerodendrum thomsoniae	3.60	0.55	0.84	3.80	Dead	Dead	Dead	Dead	Dead	Dead
Cryptostegia grandiflora	8.00	0.71	0.84	8.20	11.20	1.30	14.40	1.14	14.40	1.14
Ficus pumila	1.80	0.84	0.00	2.00	3.80	0.45	Dead	Dead	Dead	Dead
Hardenbergia violacea	3.00	1.00	3.03	6.80	Dead	Dead	Dead	Dead	Dead	Dead
Ipomoea horsfalliae	3.40	0.55	0.45	4.80	6.00	1.00	6.00	1.00	7.00	0.00
Pandorea jasminoides	3.40	0.55	0.55	3.40	4.40	1.14	4.80	0.84	4.75	0.96
Petrea volubilis	6.40	2.30	2.17	7.20	7.75	0.96	8.00	1.41	8.00	1.41

DAP= Days after Planting, SD= Standard Deviation

Table 4: Mean and Standard Deviation of Plant Cover of the Groundcovers in both Inland and Coastal Site

Plant Species	120 DAP		240 DAP		360 DAP		420 DAP	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Inland Site								
Clematis microphylla	9.00	Dead	Dead	Dead	Dead	Dead	Dead	Dead
Clerodendrum thomsoniae	11.60	4.56	4.50	3.54	Dead	Dead	Dead	Dead
Cryptostegia grandiflora	25.20	5.26	56.60	16.92	82.20	6.02	83.80	4.92
Ficus pumila	18.00	0.00	28.00	0.00	Dead	Dead	Dead	Dead
Hardenbergia violacea	24.40	7.38	Dead	Dead	Dead	Dead	Dead	Dead
Ipomea horsfalliae	12.60	6.22	2.00	0.00	Dead	Dead	8.00	0.00
Pandorea jasminoides	15.50	9.90	17.00	5.66	Dead	Dead	Dead	Dead
Petrea volubilis	25.33	0.71	28.00	9.90	Dead	Dead	Dead	Dead
Coastal Site								
Clematis microphylla	47.60	41.73	8.00	8.25	Dead	Dead	*Dead*	*Dead*
Clerodendrum thomsoniae	7.20	12.73	Dead	Dead	Dead	Dead	*Dead*	*Dead*
Cryptostegia grandiflora	30.40	11.67	77.40	7.54	94.40	10.90	89.80	7.12
Ficus pumila	15.40	2.88	18.40	2.30	Dead	Dead	Dead	Dead
Hardenbergia violacea	53.40	22.43	Dead	Dead	Dead	Dead	Dead	Dead
Ipomea horsfalliae	17.20	3.51	15.60	5.03	6.40	5.22	6.50	6.36
Pandorea jasminoides	14.20	3.11	16.00	4.58	22.40	5.32	21.00	3.83
Petrea volubilis	8.00	3.78	17.50	3.42	18.00	2.83	20.00	5.66

DAP= Days after Planting, SD= Standard Deviation

Figure 1: The survival percentages of groundcover plants in the inland and coastal site.

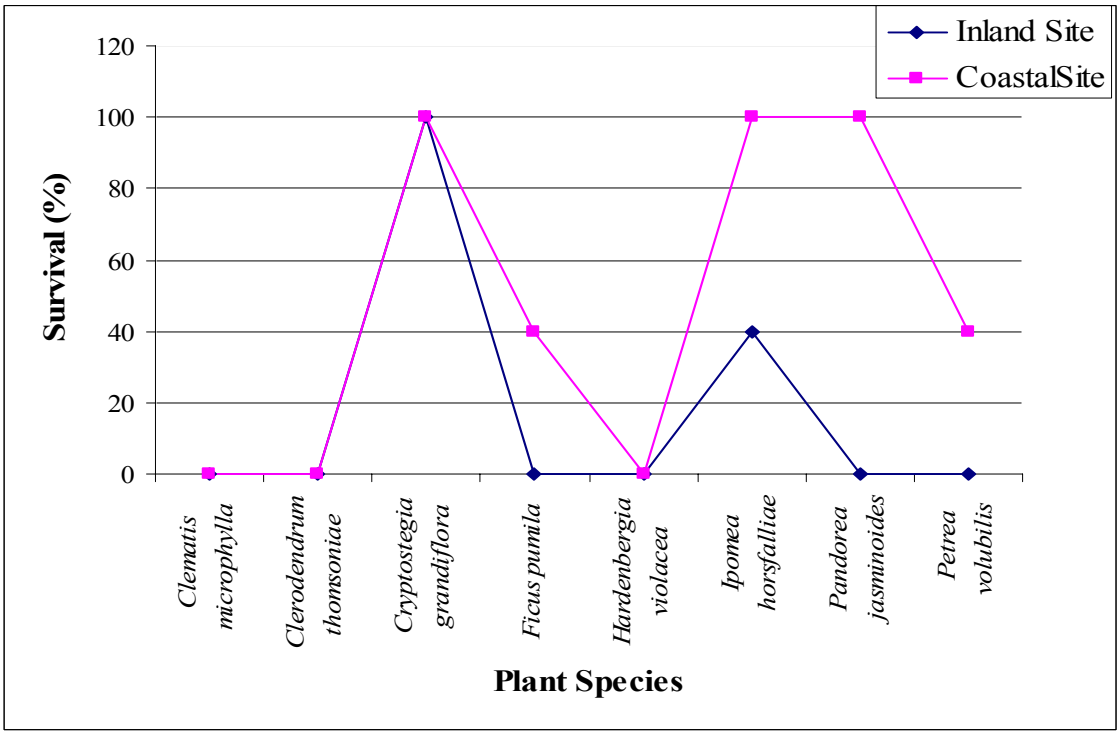

Figure 2: The growth rate of groundcovers in the inland and coastal site.

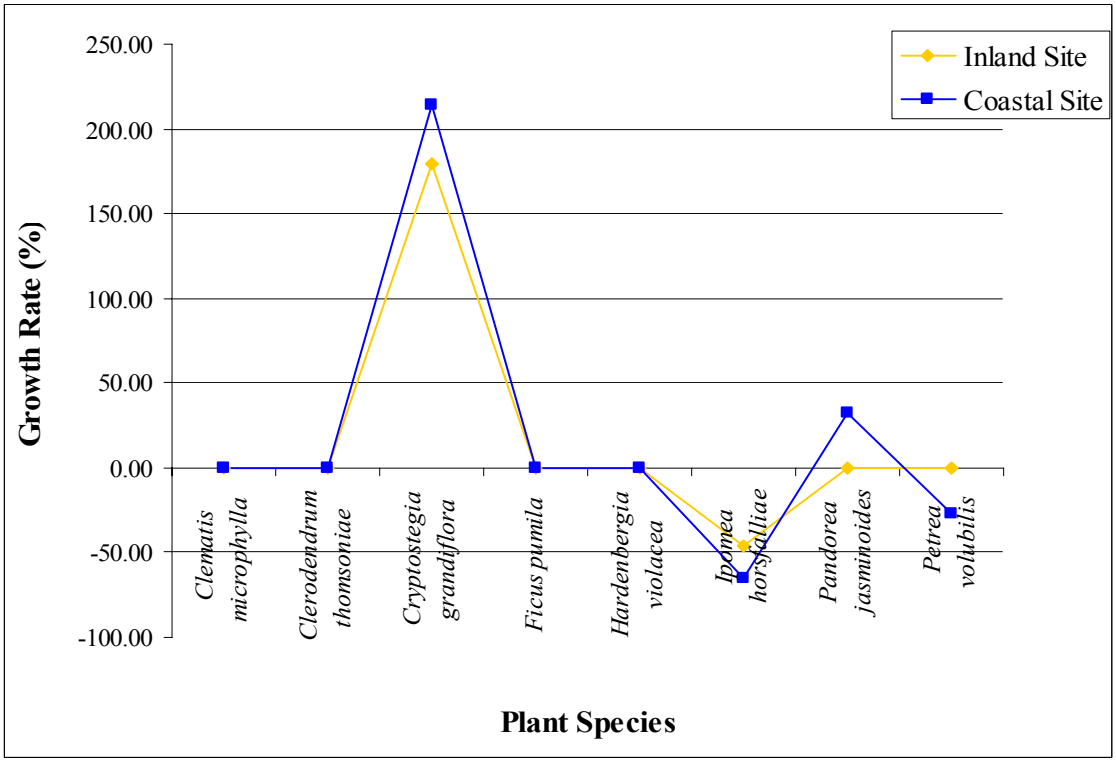

Table 5: Effect of High Temperature on the Growth and Nature of Original Experimental Plants

Plant Species	Effects of Low Temperature
Clematis microphylla	Total drying of plants due to excess heat. Could not with stand high temperature for continuous periods.
Clerodendrum thomsoniae	Total loss of plants.
Cryptostegia grandiflora	Excellent growth. More branches from all parts of main stem, which are trailing actively. Elongation of the inter-nodal region leads to increase in height of plants. The branches were growing at a faster rate than the main stem.
Ficus pumila	No growth. Total drying of leaves and branches.
Hardenbergia violacea	After a luxurious growth, plants were dead due to high temperature. The leaves first turn to pale green and then complete drying.
Ipomoea horsfalliae	Total drying of the leaves, but the vines remained healthy. The drying of vines starts from the tips leading to decrease in plant cover. But new growths can be seen from leaf axils.
Pandorea jasminoides	Not much effect. Drying of leaves can be seen.
Petrea volubilis	Drying can be seen on the margins of the leaves. New growth can be seen on stem axils. The plants lost their vigor and health.

Table 6: Effect of Low Temperature on the Growth and Nature of Original Experimental Plants

Plant Species	Effects of Low Temperature
Clematis microphylla	Total loss during summer.
Clerodendrum thomsoniae	Total loss of plants.
Cryptostegia grandiflora	Shredding of leaves from main stem. Healthy shoots were coming from the base. Upper part of the main stem was dried. New leaves were very healthy.
Ficus pumila	Total loss during summer.
Hardenbergia violacea	Total loss during summer due to high temperature.
Ipomoea horsfalliae	The wine length was reduced substantially due to the drying of wines. The leaves were dried.
Pandorea jasminoides	Almost retarded growth. The leaves showed chlorosis. The wine length was reduced.
Petrea volubilis	Good growth. New leaves were coming.

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