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DATA MINING USING TEXT ANALYTICS

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Abstract

Text Mining refers to the process of extracting high quality information from text. High quality information is extracted through text categorization, text clustering, concept/entity extraction, sentiment analysis, document summarization and entity relation modelling. Text analysis also involves lexical analysis to study word frequency distribution, pattern recognition, tagging, information extraction and predictive analytics. The overarching goal is, essentially, to turn text into data for analysis, via application of natural language processing (NLP) and analytical methods.

INTRODUCTION

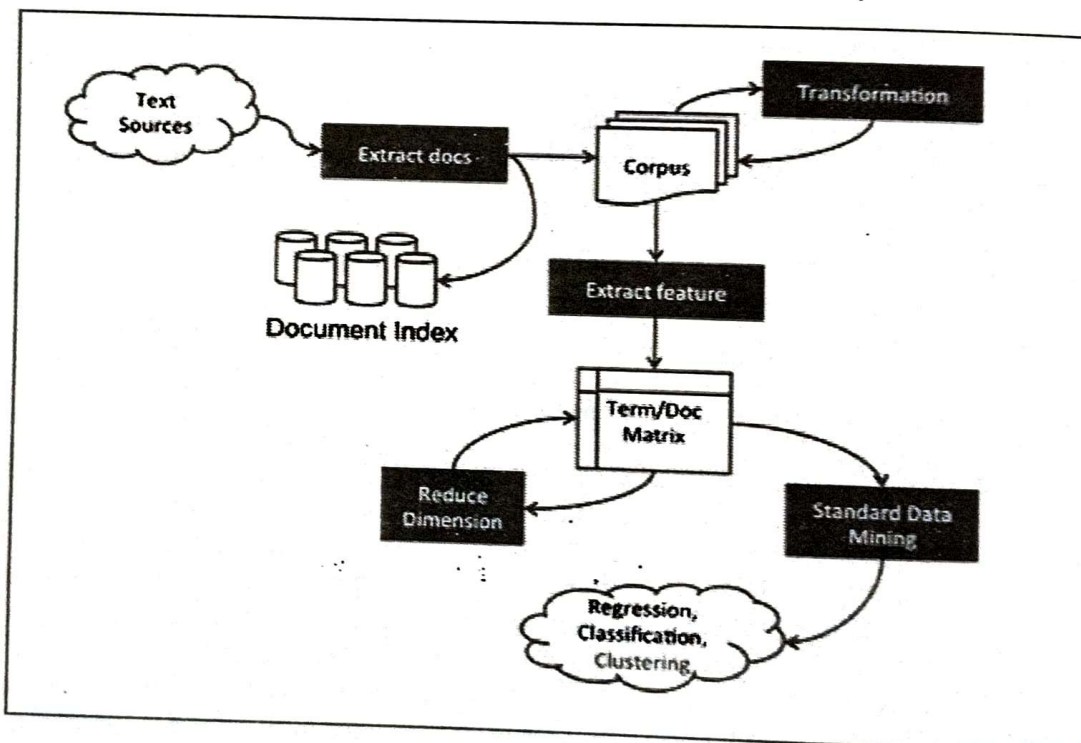
In communication “Speech” is considered to be vocalized form. It is based upon the syntactic combination of lexicals and names that are drawn from very large (usually about 1,000 different words vocabularies. Each spoken word is created out of the phonetic combination of a limited set of vowel and consonant speech sound units (phonemes). In history, the speech given by Martin Luther King is considered to be the greatest speech. In Washington before a crowd of 250,000 demonstrators, black and white, the Martin Luther King declared: "I have a dream that my four children will one day live in a nation where they will not be judged by the colour of their skin but by the content of their character".

The Speech of the King resonated in United States as well as throughout the world. This speech had an influential impact on Britain. A British press moved by the cadence and content of King's oration pointed out that it should not only stir the United States Congress but also Parliament to enact legislation promoting racial equality. The speech becomes great when the context is rightly addressed to the concerned stakeholders. There were many other great American speeches, of course. But for people in Britain, this speech undoubtedly had the greatest impact. This paper analyzes the speech delivered by our Honorable Prime Minister on Independence Day. Shri Narendra Modi is one among the politicians with great public speaking skills. His powerful speech delivery skills along with apt answering abilities are truly praiseworthy. If compared to his contemporaries, Modi's public speeches are commendable. Rarely does he carry a chit or paper for reference, his speeches are usually neatly crafted and delivered without any glitches or annoying pauses. Shri Narendra Modi speeches has always wooed crowd everywhere, no matter wherever he was and whatever he said. Netizens and citizens have equally been attracted by his talks which are quite visible from the sea of audiences

attending his speeches. It is not just in India, he has strong fan base in abroad too. His Madison Square Garden Speech had caught the fancy of the NRIs who got the glimpse of their favourite leader once in lifetime. Text mining is different in that it uses vocabulary term as key elements in feature engineering, otherwise it is quite similar to a statistical data mining project.

Following Are The Key Steps:

1. Determine the "object" that we are interested to analyze. In some cases, the text document itself is the object (e.g. an email). In other cases, the text document is providing information about the object (e.g. user comment of a product, tweaks about a company)
2. Determine the features of the object we are interested, and create the corresponding feature vector of the object.
3. Feed the data (each object and its corresponding set of features) to standard descriptive analytics and predictive analytics techniques.



(Source: <https://dzone.com>)

LOADING THE DATA INTO R

Loading the **tm** package requires loading of NLP(Natural Language Processing) which is done automatically. Now we require creating collection of the documents

in the R environment which is known as corpus. In short, corpus () function can trace the files from various sources including directories. A corpus is a container of documents. The main structure for managing documents in tm is a so-called Corpus.

```
> cname <- file.path("C:", "Speeches")
> cname
[1] "C:/Speeches"

> dir(cname)
[1] "66th Independence Day Speech.txt" "67th Independence Day
Speech.txt"
[3] "68th Independence Day Speech.txt" "69th Independence Day
Speech.txt"
[5] "70th Independence Day Speech.txt"

> docs <- Corpus(DirSource(cname)) #Loading texts into R
> summary(docs)
```

OPERATIONS ON CORPORA

After loading corpus into the R we want to carry out some operations such as removing numbers, capitalization, common words, punctuation, stemming and otherwise prepare your texts for analysis. In other words, a few preliminary clean-up steps are needed before we carry out powerful transformations. In tm, these entire functional requirements are part of the concept of a transformation. Transformations are done via the **tm_map()** function which applies (maps) a function to all elements of the corpus. Basically, all transformations work on single text documents and **tm_map()** just applies them to all documents in a corpus.

```
> docs <- tm_map(docs, removePunctuation) #Removing
Punctuation
> docs <- tm_map(docs, removeNumbers) #Removing Numbers
> docs <- tm_map(docs, tolower) #Converting to lower case
> docs <- tm_map(docs, removewords, stopwords("english"))
#Removing Stopwords
> docs <- tm_map(docs, removewords, c("brothers", "sisters"))
> install.packages("SnowballC")
> library(SnowballC)
> docs <- tm_map(docs, stemDocument) #Stemming the
Document
> docs <- tm_map(docs, stripwhitespace) #Stripping
Whitespace
> docs <- tm_map(docs, PlainTextDocument)
```

Document Term Matrix is a matrix that lists frequency of words in the corpus, by document. In the DTM, the documents are represented by rows and the terms (or words) by columns. If a word occurs in a particular document, then the matrix entry for corresponding to that row and column is 1, else it is 0 (multiple occurrences within a document are recorded – that is, if a word occurs twice in a document, it is recorded as “2” in the relevant matrix entry).


```
> dtm <- DocumentTermMatrix(docs)
> dtm
<<DocumentTermMatrix (documents: 5, terms: 3808)>>
Non-/sparse entries: 6460/12580
Sparsity           : 66%
Maximal term length: 24
Weighting           : term frequency (tf)
```

TEXT ANALYTICS

Once the frequencies are plotted we can check for *correlations* between some of these and other terms that occur in the corpus. In this context, correlation is a quantitative measure of the co-occurrence of words in multiple documents. To carry out such analysis R software is having *findAssocs()* function in tm package. If you have a term in mind that you have found to be particularly meaningful to your analysis, then you may find it helpful to identify the words that most highly correlate with that term. One needs to specify the DTM, the term of interest and the *correlation limit*. The latter is a number between 0 and 1 that serves as a lower bound for the strength of correlation between the search and result terms. For example, if the correlation limit is 1, *findAssocs()* will return only those words that *always* co-occur with the search term. A correlation limit of 0.9 will return terms that have a search term co-occurrence of at least 90% and so on.

```
# Association of country with other words
$country
new families ahead dreams every taken
0.96 0.95 0.92 0.92 0.91 0.91
# Association of government with other words
$government
fort red many made people will towards months see
0.97 0.97 0.96 0.95 0.94 0.94 0.93 0.92 0.92
happen
0.90
# Association of poor with other words
$poor
just development five employment areas place
0.99 0.98 0.98 0.97 0.96 0.96
since basis issue ten much strength
0.96 0.95 0.95 0.95 0.94 0.94
even job one
0.91 0.91 0.90
# Association of people with other words
$people
able government family
0.94 0.94 0.91
# Association of prime with other words
$prime
minister skill
0.99 0.94
# Association of india with other words
```


3. In the speech of honourable PM Shri Narendra Modi, there was a strong association between poor and development (0.98), employment(0.96), issue(0.95), strength (0.94), job(0.91).
4. In the speech of honourable PM Shri Narendra Modi, there was a strong association between India and dreams (0.97), new(0.94).
5. From the word cloud we can observe that our honourable PM Shri Narendra Modi focuses more on India, Government, People, Will, Poor, Freedom, Farmers and Development in his Speech.
6. By cluster analysis we can see that words like India, Government, People, Will, Poor, Freedom, Farmers and Development explains 96.38% of variance in the speech.

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A STUDY OF FINANCIAL PERFORMANCE INDICATORS AND CRITICAL EVALUATION OF REGIONAL RURAL WATER SUPPLY SCHEMES OF GUJARAT STATE

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INTRODUCTION

Water is one of the most important natural resources for the survival of life on the earth. There is plenty of water on the earth but it is not always in the right place, at the right time and of the right quality and in required quantity. The supply of water available for use by mankind is made limited by nature. Water is a renewable natural resource having multiple roles as consumption good, production good and an environmental amenity. It contributes significantly to economic growth and overall human development. However, water is a scarce resource which needs to be planned, developed, conserved and managed on integrated and environmentally sound basis, keeping in view the socio- economic aspects and needs.

REVIEW OF LITERATURE

As part of this research work, the researcher undertook a review of literature on Rural Water Supply Scheme on social and financial aspects. During the course of literature review, studies related to Water tariff, cost recovery and affordability of RRWSS are reviewed. The studies of Shah Binay¹, Azuma and Jayakaran², Mazumdar³, Raghupathi⁴, Misra Smita⁵⁻¹⁰, Landge Hemant C., *et.al.*¹¹, Karthic and Yohan¹², Dhanabalan M.¹³, Ahuwalia¹⁴ have concluded that the various tariff structures exist in different municipalities of India and abroad. The different studies offer suggestions on improvements required in the present tariff systems. An over view of the role of community or users related to the water supply services, is also given. As solutions to these studies of Tripathi and Lal¹⁵, Mhaisalkar and Gawalpanchi¹⁶, ORG Nielsen Report¹⁷, WASMO report¹⁸, Katpatal and Gupta¹⁹ and Patel²⁰ have suggested that the scheme has undergone tremendous changes and is suffering from technical, management and financial problems. Problems in each RRWSS should be tackled differently on the grass root level. However, identification and development of the indicators of evaluation of overall performance is common management practice, in rural water sector, despite large involvement of community and expenses occurred worldwide. With solutions to that, the studies of Dwivedi and Bhadauria²¹, The World Bank²², Yadav, Singh, and Shah²³ have suggested that all the indicators coverage of water supply, cost recovery in water supply services has good performance while efficiency in redressal of customer complaints, quality of water supplied and efficiency in collection of water supply related charges showed best performance.

Within the studies, financial aspects of RRWSS are a less ventured area. Based on literature review following remarks are made: The studies of Barot²⁴ addressed the challenges faced for water supply especially by rural India. By setting the example of

Gujarat, he explained what the available systems are, which are emerging ones and the conditions that need to be addressed. Nath²⁵ reported that the failure to provide safe drinking water and adequate sanitation services to all people is, perhaps, the greatest development failure of 20th century. Providing safe drinking water and sanitation to one billion unserved people in the next decade would be the most critical challenge for humanity as a whole, and more specifically, for the government in the developing countries. Jimenez & Perez-Forguet²⁶ discussed number of weaknesses viz, low quality of water services, lack of sustainability of constructed infrastructure, difficulties for targeting the poor and inadequate internal information systems that continue undermining strategies for poverty eradication. He also recommended including new paradigms for the provision of rural water supply such as adoption of water supply as a service that is monitored and supported by the government and need- based allocation of projects at community level.

During the course of literature review it is observed that various aspects of water supply schemes like its quality satisfaction, awareness, adequacy of water, impact on health and components of operation and maintenance cost of water have been analyzed through academic research. These research studies can be classified as relating to water tariff, cost recovery, affordability of water charges, and role of community or users in water supply services as well as developing the performance indicators. Various performance indicators are developed by different researchers. The study of World Bank with reference to India has divided performance indicators in to: Reliability and adequacy, Affordability, Environmental sustainability and financial sustainability. Realizing the high prospects and considering the vital role that RRWSS financial Performance Indicators can play in economic growth, present study is under taken. The operation and maintenance of RRWSS are from different agencies. The tariff recovery rates are also different and recovery also varies from 100% to almost nil. Thus, the need was felt for detailed study of RRWSS. The present study is related to a study of Financial Performance Indicators and critical evaluation of RRWSS of Gujarat. This study mainly focuses on the finance aspect and for this purpose the study is carried out of four schemes selected carefully from different geological status and sample also being selected from head, middle and tail regions of the schemes. The present study is done with the main intention of providing suggestions to the policy makers with respect to the functionality and sustainability of the RRWSS with the inclusion of financial aspects. In addition to the study based on primary data, the data published by NRDWP, regarding operational and financial aspects at national level and state level are also analysed as no detailed study could be located for the same during literature review.

The reviews are broadly presented in three parts viz. on water tariff, cost recovery and affordability, role of community or users in water supply services and the performance indicators. As the present study mainly focuses on the Performance Indicators, it is worth mentioning here that, for Indian and foreign studies following PIs are identified by the researchers: reliability and adequacy, affordability, environmental sustainability, financial sustainability, management, level of service, materials, parts and equipment, personnel, water quality, financial health and hygienic operation performance. It was very difficult to find scheme wise detailed analysis relating to water charges, water connection charges, satisfaction about the scheme as well as the affordability for water charges. In the context of above, the present study bridges this gap in literature by examining number of aspects of selected RRWSS.

RESEARCH METHODOLOGY

The research methodology adopted for the analysis of primary data and secondary data with the detailed discussion of the Sample selection, data collection and

methodology adopted for analysis of the data collected through the questionnaire related to the performance of Regional Rural Water Supply Schemes (RRWSS). It is divided into two sections: Section – I deals with research methodology used for analysis of secondary data to evaluate the overall performance of RRWSS in different states of India and different districts of Gujarat. The RRWSS supplies adequate and potable drinking water to villages, where local drinking water sources yield insufficient water or water that is not potable or where water is fetched from remote water sources. The RRWSS are based on reliable underground sources such as tube wells or surface water sources.

The data are collected from NRDWP and Gujarat Water Supply Sewerage Boards Administrative report. Section – II deals with the research methodology used for analysis of primary data to understand the various aspects of selected water supply schemes based on responses. This section intends to discuss the scope and coverage of the research study, research design, and collection of primary data through the questionnaire.

SOURCE OF DATA

The data are collected from NRDWP and Gujarat Water Supply Sewerage Boards Administrative report.

NRDWP publishes the financial and operational data from 2009-10 onwards. Government of India allocates the fund and the proportion of Centre and States share. The financial data are available for allocation of funds as well as release of funds during the year. It also provides the amount of expenditure incurred during the year. The information is available state wise for the whole nation and district wise for a given state. Operationally, it also provides the data about ongoing schemes, new schemes, achieved schemes, total habitations covered etc. All these data are available for each state separately. The data are available for a period of six years from 2009 to 2015. Prior to 2009 Government data were not available for the water supply schemes.

Based on the data collected, an analysis is carried out using percentage analysis. This is applied state wise for release as a percentage of allocation and expenditure as percentage of release. Moreover, to have an idea about the status of state in relative terms, the percentage allocation of funds, release and expenditure in comparison to total figures for India are also derived for each state for the six years. Further, taking all six years together, the average percentage of release to average funds allocation and average expenditure to average release are derived for each state. To have an idea about relative status of state, percentage of allocation, release and expenditure, in comparison to total for India are also derived for each state on an average for six years.

As part of analysis of the operational aspect, for a time span of six years, the percentage of ongoing schemes, new schemes, achieved schemes, habitations covered, cost per schemes and cost per habitation are derived for all states and union territories.

As part of analysis of the operational aspect, for a time span of six years, the ongoing, new and achieved schemes, habitations covered, cost per schemes and cost per habitations are derived for all districts of state of Gujarat.

In the second part of secondary data analysis, based on the information available in GWSSB administrative report, details are compiled for 3 years viz., 2011-12, 2012-2013 and 2013-14. The data is related to R_nWSS – General and Sardar Sarovar Canal. This was further divided into non-divisible expenditure, expenditure for tribal

development etc. Simple percentage analysis is applied to the same, to analyze structure of expenditure.

In addition to the above, the details were also gathered about number of schemes, habitations covered, estimated cost and total expenditure for the years 2012-13 and 2013-14 with breakup of type of schemes and completed schemes and schemes under program. Here also, percentage analysis is applied.

SAMPLE SELECTION

The state government initiated and promoted the concept of RRWSS in 1980 based on a reliable source of water to cater to the drinking water requirement of the rural community. Water is also sourced from distant places and transported to the villages.

1. The broad objectives of these RRWSS were²⁷:
2. Ensure adequate supply of water to the storage facility created in the villages.
3. Improve the accessibility of safe and adequate drinking water to all.
4. Ensure regular availability of water throughout the year.
5. Reduce the incidences of water borne diseases and improve quality of life.
6. The operation and maintenance of the in-village infrastructure created under the scheme by the *Gram Panchayat*.
7. The *Gram Panchayats* were required to ensure equitable distribution of water.
8. The *Gram Panchayats* were required to ensure collection of water tariff of ₹ 14/- per capita per year from the beneficiaries and deposit the same to the concerned authority.
9. Save precious time by providing safe water in the villages so that people can better utilize their time in economic activities.
10. To save public funds and precious time of Government machinery for various costly temporary measures to overcome the drinking water scarcity.

SAMPLING PROCEDURE

Selection of Schemes:

As the main objective of the study is to examine the performance of RRWSS, and as there are 4,306 RRWSS, in Gujarat²⁸, it was important to select RRWSS for study carefully. All attempts are made here to include, different geographic regions, different geological conditions and different levels of water availability.

To fix up the criteria of selection, various socio economic, geographical and climatic factors need to be considered. Looking into these, water scarce area, water available area, arid region and coastal region of four districts Amreli, Bhavnagar, Kutch and Surat are selected. Bhavnagar is a coastal region, Amreli is water scarce, Kutch is an arid region, and Surat is a water rich region. All these districts have wide range of variation in hydrological scenario that is in terms of annual rainfall. Further the rainfall is very much unevenly distributed.

The regions also have variations in geology. North Gujarat and Saurashtra regions consist of rocky strata. Considerable part of Saurashtra and some part of south Gujarat is coastline and Kutch is a desert area. The availability in terms of source of water also differs in a wide range. Dividing Gujarat in four parts the available river basins are mentioned in Table 1.1.

Table 1.1 Water Available Region wise

Name of Region	No. of River Basin
Kutch Region	97
Saurashtra Region	71
Central and South Gujarat Region	12
North Gujarat	5
Total	185

Still they face water problems. The reason for this is that majority of rivers in Saurashtra and Kutch are non-perennial or seasonal whereas the major perennial rivers like Narmada, Tapi, Mahi mainly flow towards south west or almost west and central side. The selected schemes also have a variety of population and populated area that is rural and urban area and also industrial area. All these different categories have different levels of demands in terms of quantity of water, both for domestic and industrial purpose. The above justification satisfies the selection of 4 schemes. The source of water may be situated at one place. Hence, some of the villages may be very near to source, whereas some may be at far off place. Thus, they are divided into Head, Middle and Tail, to have the representative sample.

Selection of village

The area selected for the purpose of study, Amreli, Bhavnagar, Kutch and Surat are the most popular districts in Gujarat state having total population of 8,85,237. The brief details of selected schemes and other relevant details are presented in Table 1.2.

Table 1.2 Population Coverage Under Scheme

Sr No	Name of Scheme	Total Taluk as	Total Villag es	Number of Villages Selected	Total Populati on
1	Iswariya Regional Rural Water Supply Scheme (Amreli)	11	49	11	79,665
2	Gadhada Regional Rural Water Supply Scheme (Bhavnagar)	11	67	12	1,27,516
3	Mandvi Regional Rural Water Supply Scheme (Kutch)	10	71	12	72,261
4	Variyav Regional Rural Water Supply Scheme (Surat)	10	156	20	6,11,795
	Total	42	345	55	8,85,237

Each scheme as mentioned above is a multi-village scheme. The representatives from among the residents of the head, middle and tail end of the water supply scheme were selected as respondents. The geographical coverage should be representative of the schemes. For this purpose for a given scheme the sample villages are selected based on geographic region on convenience basis. From the sample villages, households were selected with a predetermined sample size for each village which was arrived at

on the basis of the village population discussed below. The details about selected Talukas, Villages and respondents for each selected schemes are presented in Table 1.3, with the percentage of Taluka, village and respondents selected to total of the same. Thus, a total of 7 Talukas, 55 villages and 2,247 respondents are selected. The number of respondents in each of the villages is based on the population of the selected village. The basis of selection was as follows:

For population of village ≤ 1000 = 30 respondents
 For population of village between 1001 to 3000 = 40 respondents
 For population of village > 3000 = 50 respondents

Table: 1.3 Sample Selections: Critical Details

Sr. No.	Name of Scheme	No. of Sample Talukas % of S.T to T.T	No. of Sample Villages % of S.V to T.V	Population of Selected Villages	% of S.P to T.P	Respondents	% of Total Scheme		
1	Iswariya Regional Rural Water Supply Scheme (Amreli)	3	27.30	11	22.45	24,499	30.80	472	21.00
2	Gadhada Regional Rural Water Supply Scheme (Bhavnagar)	1	9.10	12	16.42	24,781	19.40	479	21.32
3	Mandvi Regional Rural Water Supply Scheme (Kutch)	2	20.00	12	16.90	21,085	29.20	433	19.27
4	Variyav Regional Rural Water Supply Scheme (Surat)	1	10.00	20	12.82	58,560	9.60	863	38.41
	Total	7		55		1,28,925		2,247	

(S.T. = Sample Taluka, T.T= Total Taluka, S.V= Sample Village, T.V= Total Village, S.P = Sample Population, T.P = Total Population.)

As per design, all these four schemes have variation in their benefited area composition and beneficiary. Variyav scheme²⁹ partly covers urban area. Gadhada scheme³⁰ is in the region of sea water intrusion and high total dissolved solids (TDS). Iswariya scheme³¹ high fluoride contamination and Mandvi scheme³² covers desert area as well as border area. Thus, they are provided in different characteristics area. Because of topography and other characteristics of area, cost of the scheme varies in a wide range.

Secondary data from various sources were also collected. Some secondary sources which were helpful in conducting the study are:

- Census of Gujarat
- Publication of GWSSB and its concerned field offices
- Laboratories of GWSSB

DATA COLLECTION

A detailed questionnaire for collection of data was developed.

Respondents were selected from the following categories:

- 1) Official of *Panchayat* i.e. Sarpanch and other officers.
- 2) Leading educated persons from the village like doctors, engineers and teachers.
- 3) Common villagers were asked questions related to personal experience as housewives.

Questionnaires were given directly to the *Panchayat* official and educated persons giving them brief description and they were requested to return it after filling it completely. To carry out survey among common village persons a "*Gram Sabha*" was called and rationale of the study and the questionnaire were explained to them. After that, the people who are higher secondary cleared or graduates were selected with the consultation of Sarpanch and they were given the task of making other villagers / respondents fill up the questionnaire.

HYPOTHESES

Based on classification and tabulation, the analysis is carried out. The analysis is mainly divided into two parts, viz. basic analysis through discrete statistics and testing of hypotheses.

For the discrete statistics, the collected data are classified based on geographic region, for the scheme, i.e. Head, Middle, Tail and the classified according to the economic activities and the frequency and percentage analysis is applied to the same. frequency and percentage analysis is applied to the same. Moreover, the data are also

DATA ANALYSIS TOOLS

Methodology adopted for testing of Hypotheses

For testing of hypotheses regarding responses received from the respondents, Z Test is applied. To know the difference between the proportions according to the scheme, geographic region as well as economic activities this test of difference in proportion is applied. To examine the similarity in opinion for the satisfaction for Government source of water, Spearman's Rank Correlation Coefficient was applied. To know the significance of the calculated Coefficient of Correlation of sample data *t*-test was applied.

CONCLUSION

The present study is a blend of secondary data and primary data analysis. The review of 5 year plans over a period of time indicates that good attempts are made at National level to improve the availability of the water to each corner of India. The initiative to convert ARWSP into NRDWP in 2009 is appreciable and NRDWP started publication of data from the year 2009-10 onwards itself, detailing operational and financial aspects. It is noticed from analysis of data that number of schemes taken up is increasing over a period of time. The study of 4 selected schemes of Gujarat through primary data reveals the ground realities about the payment of water

charges, water connection charges, affordability and satisfaction for 'water supply' and 'water charges'. Thus, the study is topical and it is felt that it will be useful to the policy framers.

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Measuring Awareness, Attitude, Intention and Buying Behaviour of Consumers towards Renewable Energy Sources: A Study with Special Reference to Solar Roof Top Plants

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Abstract

Energy is an important building block in human development. Energy conservation has emerged as one of the major issues in recent years. Conservation and efficient utilization of energy resources play a vital role in narrowing the gap between demand and supply of energy. Traditionally energy is obtained from non renewable sources like fossil fuels. However, they are exhaustible, causing pollution and lacking sufficient distribution network. Therefore, renewable energy sources and conservation of energy are good solutions. The Government of India and the State Governments have taken extensive measures to develop renewable sources including solar energy. The present paper tries to find out awareness, attitude, Intention and buying behaviour of house owners in Piplod, Surat area, towards renewable sources of energy with specific reference to solar energy product – Solar Roof Top Plant (SRTP) offered by GEDA.

KEY Words: Non renewable energy resources; Solar Roof Top Plant (SRTP); measuring consumer awareness, attitude, Intention and buying behaviour

INTRODUCTION

Energy is an important building block in human development, and, as such, acts as a key factor in determining the economic development of all countries. The International Energy Agency (IEA) forecasts that world primary energy demand between 2011 and 2030 will increase by 1.5% per year from just over 12,000 million tonnes of oil equivalent (Mtoe) to 16,800 Mtoe- an overall increase of 40%. Developing Asian countries are the main drivers of this growth, followed by Middle East.

According to Herman Scheer, the chair person of World Council for Renewable Energy, the current world cannot depend on fossil fuels for more than 40 years (Oliver, 2004). So, if no efforts are made to conserve energy or to search for alternative energy sources, the future generations may be deprived of energy to sustain life. So it is inevitable to develop renewable energy resources.

There has been a growing concern about energy security and climate change. One of the major cause is significant changes in how energy, especially electricity, is generated, transmitted and consumed. This requires low carbon technologies to

produce electricity from wind, sun, biomass, ocean resources etc. In the U.K., The Department of Trade and Industry, 2003; published The Energy White Paper containing a commitment to reduce carbon emission by 60% by 2050 in comparison to 1990 levels and to generate 20% of electricity from renewable sources by 2020.

India's substantial and sustained economic growth is placing enormous demand on its energy resources. The demand-supply imbalance in energy sources is pervasive, requiring serious efforts by Government of India to augment energy supplies as India faces possible severe energy supply constraints. While efforts are being made to improve availability of various energy sources, there is still a continuing gap between demand and supply of energy. Energy conservation thus has emerged as one of the major issues in recent years. Conservation and efficient utilization of energy resources play a vital role in narrowing the gap between demand and supply of energy.

Conventional energy generation has three major problems: Limited nature of resources, pollution and the distribution of energy. Pollution is created by using fossil fuels to produce energy. Sulphur content produces SO₂ & Nitrogen content produces NO₂ and both cause acid rain and pollute soil & water. Low calorific value of coal increases amount of ash in exhaust causing dust pollution. Unburnt carbon particles add to dust pollution. Insufficient O₂ supply produces CO which is toxic / hazardous. Concentration of CO₂ increases globally by 0.6 % every year. It results in green house effect i.e. the heating effect in atmosphere. The predicted rise of temperature is 1.4 to 5.8 degrees Celsius in twenty first century which is more than double of that in twentieth century (0.6 degrees). So the quality of life in cities greatly decreases. Discharge of coolant water into river or lake, by thermal power plants causes sudden rise in temperature of water and subsequent loss of O₂ holding capacity which affects aquaculture adversely.

The distribution of energy is a problem because many areas in India as well as in the world (e.g. 66% in South Africa) do not have access to main grid and there is very less possibility to be connected due high pressure of demand on existing grid. Therefore, decentralized generation by renewable resources can reduce the pressure on existing grid.

The role of new and renewable energy has been assuming increasing significance in recent times in India with the growing concern for the country's energy security. Energy self-sufficiency was identified as the major driver for new and renewable energy in the country in the wake of the two oil shocks of the 1970s.

As the non renewable energy resources are inexhaustible in nature, they can be a life line for human race and all living organisms in nature for the coming centuries. They offer viable option to address the energy security concerns of a country. Renewable energy technologies are ideally suited to distributed applications, and they have substantial potential to provide a reliable and secure energy supply as an alternative to grid extension or as a supplement to grid-provided power.

Today, India has one of the highest potential for the effective use of renewable energy. India is the world's fifth largest producer of wind power after Denmark, Germany, Spain, and the USA. The country has an estimated SHP (small-hydro power) potential of about 15 000 MW. Other renewable energy technologies, including solar photovoltaic, solar thermal, small hydro, and biomass power are also spreading. Greater reliance on renewable energy sources offers enormous economic,

social, and environmental benefits. The potential for power production from captive and field-based biomass resources, using technologies for distributed power generation, is currently assessed at 19 500 MW including 3500 MW of exportable surplus power from bagasse-based cogeneration in sugar mills (MNES 2005).

TYPES OF RENEWABLE ENERGY RESOURCES

Solar energy is the energy contained in the sun rays falling on the earth. It is more than 200 times the total annual consumption currently being used.

It can be used for direct heating with help of solar water heaters, solar cookers or solar reactors. Heat is produced by converging sun rays with the help of concave reflectors or convex lenses.

Indirectly it is used to produce electricity (DC) with the help of solar panels (photovoltaic panels). With development of new photosensitive materials, generation can be increased and the cost of solar plant is reduced. Governments of many countries of world adopt solar power generation and provide subsidies for the same.

Wind energy is the kinetic energy of the wind in the form of wind currents. It is converted into electrical energy by rotating fans of windmills which rotate wind turbines to produce electricity (AC). It works on cloudy days & in rainy season also.

Wind mills are set at the top of a tower (30 m. high). The turbines are separated by the distance 5-15 times of blades diameter to avoid turbulence from one turbine affecting the wind flow of others. The best desirable speed is 22 km. per hour. A typical wind mill has 15-30 m. diameter and capacity of 50-350 Kw. of electricity.

Windmills are usually used by farmers in the outskirts where ample space is available to install them.

Hydroelectric energy is harvested from the movement of water in streams, rivers or waves from seas and oceans. Hydroelectric power plants are also installed at dams to utilize the force of the water bodies. Specially designed turbines are placed under water to harvest the kinetic energy from the moving water. Hydroelectric energy can power larger units of electricity and is used in collaboration with energy produced from coal to reduce fossil fuel usage.

Biomass (i.e. biological waste such as garbage, animal excrete and biological by-products of industry) energy refers to the fuels made from plant and animal wastes. It is produced by decomposition or fermentation of organic chemicals present in the biomass. It produces fuels like biogas or biodiesel (ethanol).

The residual materials after decomposition and fermentation are rich in Nitrogen and Phosphorus which can be used as fertilisers. In a typical power plant, Daily 40 tons of vegetable waste can generate 4800 units of electricity per day.

Tidal power is the energy generated by using kinetic energy of waves. Oscillating water columns use the force of waves entering a fixed device to generate electricity.

The waves compress air in a vertical pipe. It is used to drive a turbine generator. However, the plant does not work during cyclones and severe storms.

Another way to use tidal energy is to create wall barriers with gates across the river or sea. During tide, water is accumulated on the upstream side by opening the gates and water level rises. Then just when water starts receding, gates are closed and water falls on the turbines kept on downstream side.

Geothermal energy is the heat energy available from the level below the earth surface.

Public acceptance is important for wide spread implementation of renewable energy technologies and achieving energy policy targets. For this, public attitudes need to be changed to make implementation feasible. Ways in which public responses are conceived and responded by stakeholders like local government, industry and interest groups need to be careful.

The need for research in the field of renewable energy resources arises from the facts that there is no intensive multi-fold research carried out so far, recent speculation about energy wars and resource sharing, very high levels of energy consumption, availability of renewable energy technology, the lack of legislation to enforce its use and global negative environmental effects etc.

There is ample international literature available on renewable energy resources and many companies and governments have come up with ingenious ideas for reduction of energy usage. But very little information on perception of use of renewable forms of energy is available.

REVIEW OF LITERATURE

Richard Semenik , Russell Belk & John Painter, (1982) studied the factors influencing energy conservation behaviour and suggested that greater understanding of conservers and non conservers can be achieved by multivariate analysis.

Gordon R. Foxall, Jorge M. Oliveira-Castro, Victoria K. James, M. Mirella Yanide-Soriano, Valdimar Sigurdsson et.al (2006) applied the Behavioural Perspective Model and suggested specific marketing strategies for different classes.

Birgitta Gatersleben, Linda Steg, & Charles Vlek (2002) studied the determinants of environmentally significant consumer behaviour and pointed out that pro-environmental behaviour is more strongly related to attitudinal variables.

Anja Tuohino studied a case of Sulkava Rowing Event to know the environmental awareness and environmentally friendly behaviour of tourists and concluded that they were aware of environment but not ready to transfer their beliefs into their consumer behaviour.

G. Davis, F. O'Callaghan and K. Knox (2009) studied the sustainable attitudes and behaviour of non academic staff of Information Services Department of Griffith University, Brisbane by using Theory of Planned Behaviour and identified barriers to pro-environmental behaviour.

Kamal Manaktola and Vinnie Jauhari (2007) explored the consumer attitude and behaviour towards green practices in lodging industry in India and concluded that

consumers are aware of green practices of hotels, prefer to stay in such hotels; but they are not ready to pay extra.

Peter Jones, Colin Clarke-Hill and Daphne Comfort & David Hillier (2008) tried to find out the relationship between marketing & sustainability and concluded that there was little consensus among experts.

Mathilda du Preez explored attitudes and perceived implications for quality of life of environmentalists with special focus on the domestic use of renewable energy sources. "How the UK public feels about renewable energy" is a paper that draws on a number of studies of public attitudes towards renewable energy. It suggested that a majority of people are in favour of renewable electricity generation.

Patrick Devine-Wright (2007) summarises existing social research on public understanding of, and attitudes towards renewable energy technologies, and provides a novel classification of personal, psychological and contextual factors explaining public acceptance.

Consumer Attitudes about Renewable Energy: Trends and Regional Differences, a report by National Renewable Energy Laboratory (2011) shows that Overall, consumers have a high degree of awareness and concern for renewable energy, but few are aware of their purchase options.

Siham H. Shoukry, Samia G. Saad, Ayman M. Eltemsahi and Mostafa A. Abolfotouh (2012) studied the awareness, attitude and concerns of Workers and Stakeholders of Alexandria Sanitary and Drainage Company (ASDCO) of Egypt, by using NEP (New Ecological Paradigm) scale containing 15 statements of environmental attitude.

Aizen A. (1991) has given the theory of planned behaviour (TPB). helps measure the attitude and behaviour of consumers towards socially desired behaviour. It tells that attitude, subjective norms and perceived behavioural control precede the intention which results in desired action.

Stone George, James H. Barnes and Camerron Montgomery (1995) have defined "Consumer Environmental Responsibility" as "a state in which a person expresses an intention to take action directed toward remediation of environmental problems, not as an individual consumer but through a citizen consumer concept of societal-environmental well being.

Md. Munjur E. Moula, Johanna Maula, Mohamed Hamdy, Tingting Fang, Nusrat Jung and Risto Lahdelma (2013) of Department of Energy Technology, Aalto University, Finland UNESCO Commission, Finland measured the social acceptance renewable energy technologies (RETs) in their research paper and suggested factors affecting acceptability.

Doug Mc Kenzie & Mohr (2000) presented Community Based Social Marketing to promote sustainable behaviour. They suggested to make psychological knowledge relevant and accessible to the designers of programs and a process for developing & delivering environmental programs based on psychological expertise.

David Hackston and Markus J. Milne (1996) have studied Corporate Social Disclosure (CSD) Practices by New Zealand Companies and pointed out that the factors of influence are size of the company, profitability and type of industry.

Michael Roarty (1997) explained the factors which influence corporate behaviour towards environment. Negative factors are environmental costs, economic policies of government, market prices, short term profitability, materialistic culture, lack of information to consumers etc. Favourable factors are growing trend towards green consumerism, environmental legislations, Influence from green groups, Pressure groups like Friends of Earth and Financial incentives to conserve.

Katherine D. Arbuthnott (2009) reviewed the correlation between attitude and behaviour change with help of factors responsible for changes in behaviour and suggests action plans for University education and ESD (programs; in the review paper titled as "Education for sustainable development).

Patrick Hartmann and Vanessa Apaolaza-Ibanez (2012) studied Consumer attitude and purchase intention towards green energy brands and explained the overall significance of psychological brand benefits.

Nada Kh. M. A. Alrikabi (2014) described various types of renewable energy with their benefits.

Ruben M. Mancha and Carol Y. Yoder (2015) studied the cultural antecedents of green behavioural intent by using an environmental theory of planned behaviour. They are behavioural beliefs, normative beliefs and control beliefs; perceived self control and self identity.

OBJECTIVES OF THE STUDY

1. To measure the awareness of the consumers related to renewal sources of energy and the products / ways / methods to utilise them
2. To find out the Awareness of the consumers related to the efforts of Government of Gujarat for encouraging domestic consumers to use Solar Roof Top Plant (SRTP) for producing solar electricity.
3. To find out the attitude of the consumers towards renewable energy sources and SRTP
4. To find out the intention to purchase and behaviour related to SRTP

RESEARCH DESIGN

The research design adopted for the study is exploratory. Both secondary and primary data was tapped for the study. For collecting the primary data survey method was adopted. The population for the study was house owners having independent roof top space i.e. house owners of row houses or bungalows. The sample size was 36 respondents. The Sampling procedure used was non probabilistic convenience sampling. The respondents were from the Piplod area of Surat city. The Instrument developed was a questionnaire including questions to measure their awareness, attitude, intention, and buying behaviour towards renewable resources. To measure the awareness related to SRTP the scales had the class intervals – "not aware, somewhat aware and aware"; For items to measure the attitude towards renewable energy sources and SRTP the scale categories were "disagree, neutral, agree" and the questions to measure the relative importance of various factors they consider for taking decision to install SRTP has scale categories "most important, more important, important, less important and least important". The questionnaire also included open ended questions for remarks / suggestions from respondents. The contact method was personal.

ANALYSIS AND FINDINGS

The findings relate to aspects like awareness of renewable resources and the products / ways / methods to utilise them; efforts of Government of Gujarat for encouraging domestic consumers to use Solar Roof Top Plant (SRTP) for producing solar electricity; and attitude towards renewal sources of energy and SRTP.

Table 1. Awareness about Renewable Resources and The Products / Ways / Methods to Utilise Them

		Not aware	Somewhat aware	Aware
Solar heater	Frequency	0	1	35
	%	0	2.8	97.2
Solar cooker	Frequency	2	4	30
	%	5.6	11.1	83.3
PV panels DC	Frequency	0	8	28
	%	0	22.2	77.8
PV panels AC	Frequency	0	8	28
	%	0	22.2	77.8
Windmills	Frequency	1	5	30
	%	2.8	13.9	83.3
Hydro power	Frequency	0	5	31
	%	0	13.9	86.1
Bio gas plant	Frequency	3	2	31
	%	8.3	5.6	86.1

As evident from table no. 1, house owners are mostly aware of renewable energy products / uses; minimum % of aware respondents is 77.8 and maximum % is 97.2

Table 2. Awareness of efforts of Government of Gujarat for Encouraging Consumers to Use Solar Roof Top Plant (SRTP)

		Not aware	Aware
SRTP Nodal Agency GEDA	Frequency	9	27
	%	25	75
SRTP target	Frequency	15	21
	%	41.7	58.3
SRTP eligibility	Frequency	3	33
	%	8.3	91.7
SRTP capacity allowed	Frequency	9	27
	%	25	75
SRTP space required	Frequency	12	24
	%	33.3	66.7
SRTP subsidy	Frequency	8	28
	%	22.2	77.8
SRTP net price	Frequency	8	28
	%	22.2	77.8
SRTP savings	Frequency	13	23
	%	36.1	63.9
SRTP net metering	Frequency	13	23
	%	36.1	63.9
SRTP on grid	Frequency	6	30
	%	16.7	83.3
SRTP dealers	Frequency	16	20
	%	44.4	55.6

As evident from the table no. 2, respondents are aware of most of the terms of SRTP of GEDA. The lower % of awareness is for SRTP target (58.3), space requirement (66.7) and probable savings & net metering (63.9). However, only half of the respondents know the authorized dealers. It implies that dealers should increase the contact of probable customers.

Table 3. Information Source Used by the Respondents

		No	Yes
Seminars	Frequency	32	4
	%	88.9	11.1
Open lectures	Frequency	31	5
	%	86.1	13.9
Websites	Frequency	27	9
	%	75	25
News papers	Frequency	8	28
	%	22.2	77.8
Television	Frequency	19	17
	%	52.8	47.2
Exhibitions	Frequency	28	8
	%	77.8	22.2
Information brochures	Frequency	26	10
	%	72.2	27.8
Family members	Frequency	31	5
	%	86.1	13.9
Relatives	Frequency	26	10
	%	72.2	27.8
Friends	Frequency	11	25
	%	30.6	69.4
Presentation by suppliers and dealers	Frequency	28	8
	%	77.8	22.2

As evident from table no. 3, respondents are not exposed to most of the sources, except that news papers, TV and friends are frequently used sources. It implies that other sources should be expanded for access and above sources should be frequently used.

Table 4. Attitude towards Renewable Energy Sources and SRTP
(The value assigned with the response "disagree" is -1, "neutral" is 0 and "agree" is 1).

Descriptive Statistics		
Statement	N	Mean
Approaching the limit of fossil fuels	36	.92
Fear of depletion of traditional resources	36	.89
Conservation of resources is a good solution	36	.97
Renewable energy sources are good substitutes	36	.97
Investment in renewable energy resources is justified as we invest in other amenities	36	.92
SRTP net price is comparable with that of traditional resources	36	.89

SRTP operational cost is nil	36	1.00
SRTP maintenance cost is almost nil	36	.86
SRTP does not interfere with life style of occupants	36	.94
SRTP causes no pollution	36	1.00
Adopting SRTP is service to nation also	36	1.00
Government efforts & investment should be enhanced	36	.97
Government and social institutes should launch awareness programmes	36	1.00

As evident from table 4., mean value is quite near to 1 which is assigned with response "agree". It implies that almost all respondents have positive attitude towards renewable energy sources and SRTP of GEDA.

Table 5. Intention and Buying Action of Respondents

Question		No	Yes
Have you installed SRTP in recent past?	Frequency	34	2
	%	94.4	5.6
Do you want to increase the capacity of existing SRTP?	Frequency	34	2
	%	94.4	5.6
Do you intend to be a customer?	Frequency	4	32
	%	11.1	88.9

This table shows that almost all respondents either intend to expand the existing SRTP or to install new SRTP.

Table 6. Perception of Problems / Obstacles / Barriers /Restrictions Faced by respondents

Question		No	Yes
Are you afraid of negative criticism by others?	Frequency	35	1
	%	97.2	2.8
Have you doubt for smooth & successful working of SRTP?	Frequency	21	15
	%	58.3	41.7
Do you doubt the claim of maintenance free working and savings accruing to you due to SRTP?	Frequency	16	20
	%	44.4	55.6
Do you feel that you may not be able to pay non subsidised amount Rs. 40000/- ?	Frequency	27	9
	%	75	25

It is evident that respondents are not afraid of negative criticism by other people. But, 55.6% of the respondents have doubts related to the functioning of the SRTP and savings they may have from the installation as also the claim that there would be virtually a nil maintenance.. Also, one fourth of the respondents (25%) feel that they may not be able to arrange non subsidized amount.

Table 7. Availability of technical and other information for SRTP

	Frequency	Percent	Cumulative Percent
most important	24	66.7	66.7
more important	4	11.1	77.8
important	8	22.2	100.0
Total	36	100.0	

It is evident that almost all respondents consider this factor as very much important.

Table 8. Cost of Installation of S RTP

	Frequency	Percent	Cumulative Percent
most important	16	44.4	44.4
more important	12	33.3	77.8
important	5	13.9	91.7
less important	3	8.3	100.0
Total	36	100.0	

This is also the important factor as considered by respondents with only 8.3% of the respondents considering it to be 'not important'.

Table 9. Cost of Operation of S RTP

	Frequency	Percent	Cumulative Percent
most important	12	33.3	33.3
more important	15	41.7	75.0
Important	4	11.1	86.1
less important	5	13.9	100.0
Total	36	100.0	

This table no. 9 shows that cost of operation is important. 13.9% of the respondents feel that the cost of operations is not important.

Table 10. Affordability to Bear the Cost of S RTP

	Frequency	Percent	Cumulative Percent
most important	12	33.3	33.3
more important	3	8.3	41.7
important	10	27.8	69.4
less important	8	22.2	91.7
least important	3	8.3	100.0
Total	36	100.0	

This table shows that 70% of respondents consider affordability as important and the rest think that it is necessity for which they should arrange money themselves.

Table 11. Maintenance Free Working due to S RTP

	Frequency	Percent	Cumulative Percent
most important	12	33.3	33.3
more important	18	50.0	83.3
important	6	16.7	100.0
Total	36	100.0	

All the respondents consider maintenance free working as an important factor.

Table 12. Advice from Family Members, Friends and Relatives to Install SRTP

	Frequency	Percent	Cumulative Percent
most important	6	16.7	16.7
more important	8	22.2	38.9
important	10	27.8	66.7
less important	7	19.4	86.1
least important	5	13.9	100.0
Total	36	100.0	

This table no. 12 shows that 66.7% respondents believe that social sources are important and advice need to be taken from friends, relatives and family members.

Table 13. Higher Social Status by Adopting SRTP

	Frequency	Percent	Cumulative Percent
important	1	2.8	2.8
less important	7	19.4	22.2
least important	28	77.8	100.0
Total	36	100.0	

97.2% of the respondents feel that installation of SRTP is not a status symbol.

Table 14. Green Effect on Environment

	Frequency	Percent	Cumulative Percent
most important	14	38.9	38.9
more important	7	19.4	58.3
important	10	27.8	86.1
less important	3	8.3	94.4
least important	2	5.6	100.0
Total	36	100.0	

Most of the respondents (86.1%) consider green effect on environment as an important factor.

Table 15. Any Legal Restriction to Install SRTP

	Frequency	Percent	Cumulative Percent
most important	2	5.6	5.6
more important	1	2.8	8.3
important	2	5.6	13.9
less important	2	5.6	19.4
least important	29	80.6	100.0
Total	36	100.0	

Most of the respondents (86.2%) do not consider any legal problem for installing SRTP as it is promoted by the government.

Table 16. Successful Installation of SRTP by Neighbours

	Frequency	Percent	Cumulative Percent
most important	6	16.7	16.7
more important	10	27.8	44.4
important	6	16.7	61.1
less important	5	13.9	75.0
least important	9	25.0	100.0
Total	36	100.0	

This factor is considered by 60% of respondents as important i.e. "seeing is believing" works well.

CONCLUSION

Most of the house owners are aware of renewable energy sources and scheme of GEDA for SRTP. News papers, Television and social sources are frequently used sources. As installing a Solar Roof Top Plant (SRTP) can be considered to be a high involvement decision personal sources play an important role in persuading the prospective customers. Mass media could be used for creating awareness.

Attitude towards renewable source and SRTP is quite positive. Almost all respondents intend to install SRTP. However, they still doubt the functioning and maintenance free claim made by GEDA. They are also unsure about the actual savings they would make due to the installation. One fourth of the respondents are hesitant to bear the un-subsidized amount of Rs. 40000/-. Some of the suggestions that have been received from the respondents are that awareness programmes should be increased, potential customers should be motivated through demonstrations and by making them aware about the installed SRTPs. and that installment payment facility for non subsidized amount can increase the number of customers to a considerable extent. The cost benefit analysis and loan facility available if communicated could help reduce the hesitation of shelling out the un-subsidized amount.

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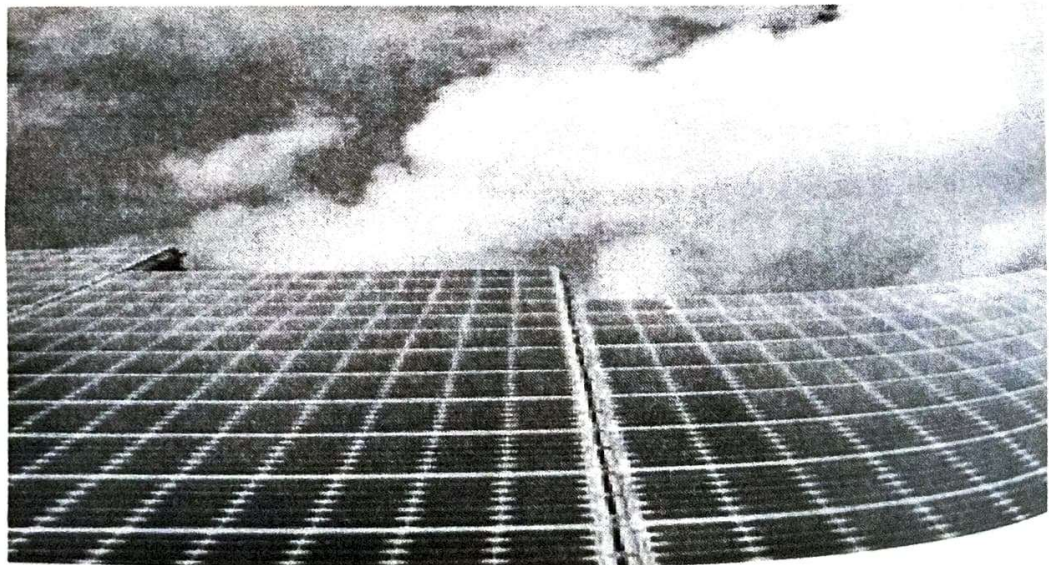


Figure 1: Solar panels

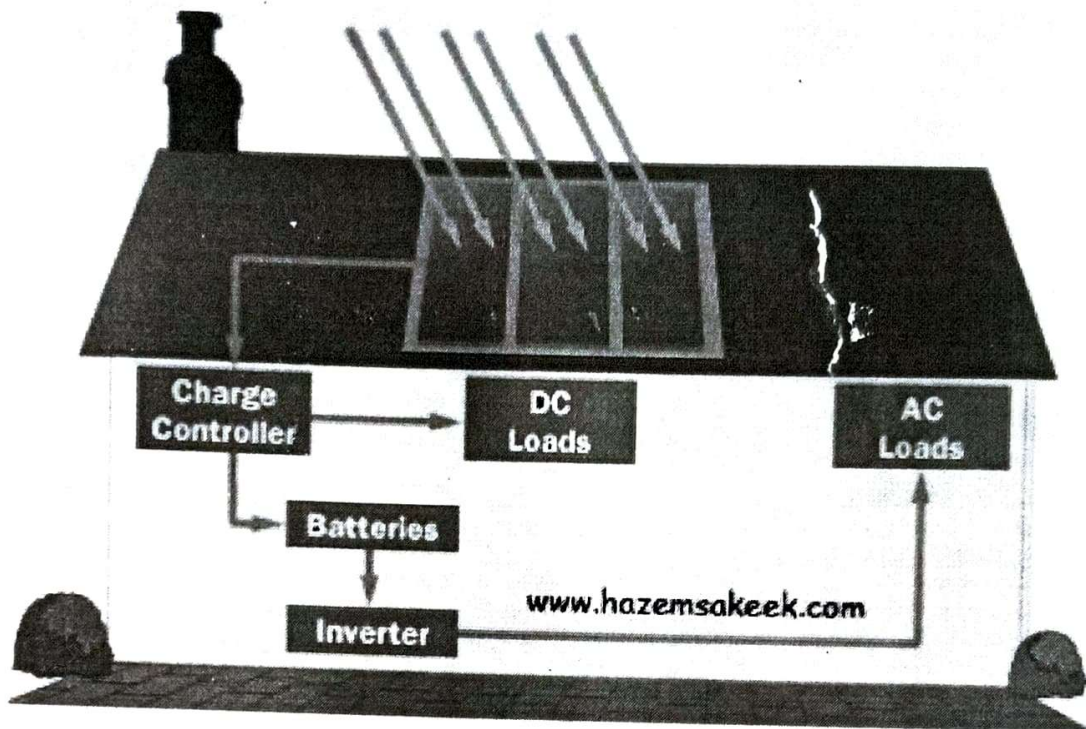


Figure 2: Solar energy mechanism at the unit

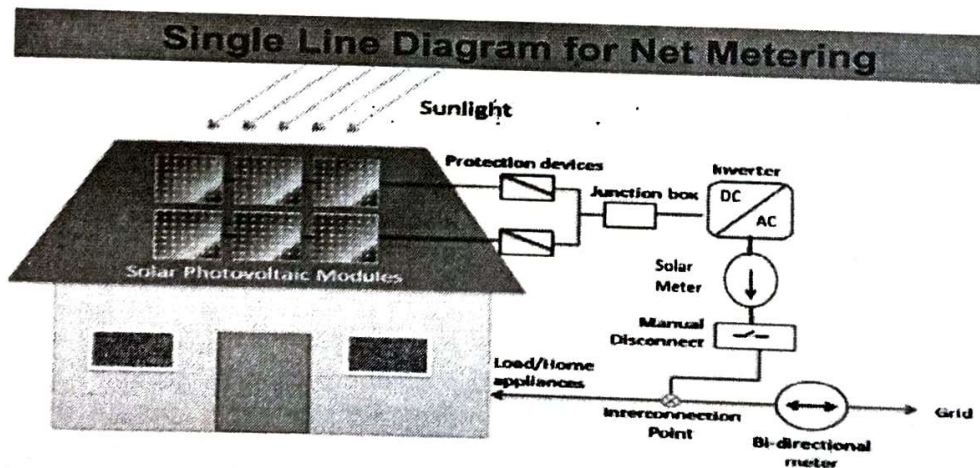


Figure 3: Diagram for Solar Roof Top Plant by GEDA



Figure 4: Windmills

AN EMPIRICAL ANALYSIS ON BEHAVIOURAL BIASES OF INDIAN EQUITY INVESTORS

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Abstract

Behavioural finance is an emerging field that combines the understanding of behavioural and cognitive psychology with financial decision making process. This paper examines the presence and relationship of behavioural factors on investment Performance and Reinvestment Intention of retail equity investors in India. From the existing literature, the study has identified broad behavioural factors such as Overconfidence, Representativeness, Anchoring, Mental Accounting, loss aversion, herd behaviour, Recency, self-attribution bias, Disposition effect, Ostrich Effect, Status quo effect that influence on investment decisions. The present paper conducted a Structural equation model (SEM) to confirm the presence of these factors on retail equity investors' decision in India and also find to what extent these behavioural factors have an impact on investment performance of retail equity investors. The study was conducted by using a structured questionnaire from a sample of 435 prospective retail equity investors of South Gujarat Region covering 4 major Districts i.e. Surat, Navsari, Bharuch, Valsad. The results of the study revealed that behavioural factors such as Mental accounting, Loss Aversion, Herding Bias, Overconfidence, self attribution, anchoring and Recency bias have high impact on disposition effect, status quo effect and ostrich effect on trading. Finally they have also significant effect on investment Performance and reinvestment intention. The findings of the study would be useful for the investors to have a better understanding of the common mistakes made in their decisions and to identify the behaviours which leads to better returns and also helpful to the financial planners and investment advisors to build suitable asset allocation policies for their clients.

The research paper implies that they ignore the importance of the fundamental analysis and to focus on recent upward price performance of the stock. The study clearly shows that investors are biased. These biases are the reflections of their personality traits.

Keywords : Overconfidence, Herding, Mental accounting, loss aversion, anchoring, representative bias, self-attribution bias, Recency bias, disposition effect, ostrich effect and status quo effect, Investment Performance

INTRODUCTION

Psychology plays an important role in explaining the financial behavior of investors and making the financial decision. As the psychology is involved in investment decision making, cognitive errors influence the financial decisions. When investors face uncertain conditions they make different decisions (Kahneman & Tversky, 1979). To make profit from the optimal investment decisions they may follow the professional investor's recommendation or collect the related information from other sources. According to Kahneman and Tversky (1979)'s prospect theory the psychological factors of investors are responsible for the deviation of actual decision making from rationality. Simon's (1957) argument of the bounded rationality also confirmed the prospect theory. Thus investors often tend to make systematic errors that lead toward acceptable investment choices but don't result in optimal decision.

According to standard financial theory, individual investors are perfectly rational. But the idea of fully rational investors that have perfect control on their decisions to maximize their utility is becoming less popular. In efficient markets investors are considered as rational, unbiased and consistent who make optimal investment decisions without the effects of psyche and emotions (Hayat, Bukhari, & Ghufuran, 2006). But actually sometimes emotions and psyche influence their decisions, causing them to behave in an irrational way. Behavioral Finance provides the explanation for these psyche and emotions. Behavioral finance is an emerging field that combines the Behavioral or say Psychological aspects with standard economic and financial theories. Behavioral finance explains the irrational behavior of

investors that can affect the stock market prices. It examines how cognitive and emotional errors influence investor's decision making process. The contribution of this field does not mean that it has completely neglected the importance of the fundamental work and the proponents of efficient market hypothesis. But it just tries to eliminate the unrealistic assumptions of traditional economic and financial theories in decision making process to make it more realistic.

LITERATURE REVIEW

Tversky and Kahneman (1973) introduced availability heuristic - a judgmental heuristic in which a person evaluates the probability of events by availability, that is, by the ease with which relevant instances come to mind. The reliance on the availability heuristic leads to systematic biases which make people think that what they have in mind to do is the most correct despite what the market indicators present. This means that people do not always act rationally nor do they fully utilize all the information available to them.

Kahneman and Tversky (1979) presented a critique of expected utility theory as a descriptive model of decision making under risk and developed an alternative model, known as prospect theory. Expected utility theory is unable to explain why people are often simultaneously attracted to both insurance and gambling. The paper found empirically that people under-weigh outcomes that are merely probable in comparison with outcomes that are obtained with certainty; also that people generally discard components that are shared by all prospects under consideration. Under the prospect theory, individual is risk-averse in relation to a known gain but risk-seeking in an effort to avoid a certain loss. Actual behaviour in a given situation depends on the sequence of events prior to that situation. For example, if an individual wins immediately prior to the time of the decision he/she is less likely to take a further gamble. However, if a loss has been incurred recently, then the individual is more likely to take a gamble in the hope of recouping such loss.

Bondt and Thaler (1985) effectively started what is today known as behavioural finance. They discovered that people systematically overreacting to unexpected and dramatic news events results in substantial weak-form inefficiencies in the stock market. This was both surprising and profound. In an attempt to find out why people decide to hold on to their views when there are obvious reasons to change, Samuelson and Zeckhauser (1988) performed a series of decision-making experiments and find evidence of status quo bias. This means that people would prefer to maintain their current position rather than move to a new position. In other words, they need to have a strong positive incentive to be persuaded to change a previous decision.

Loss Aversion is a pervasive phenomenon in human decision making under risk and uncertainty, according to which people are more sensitive to losses than gains. It plays a crucial role in prospect Theory (Tversky and Kahneman, 1974) (Tversky and Kahneman, 1992). A Typical financial example is in investor's difficulty to realize losses.

Mental accounting, a concept first named by Dr. Richard Thaler (1980) and developed by Tversky and Kahneman (1981), attempts to describe the process whereby individuals divide their current and future assets into separate, non-transferable accounts. Mental accounting as a bias plays an important role in decisions made about household budget (Thaler, 1985), transactions in stock exchanges (Shefrin & Statman, 1985) and consumption life cycle (Shefrin & Statman, 1985).

The concept of mental accounting was later developed by Thaler (1999) who identifies three components. The first captures how outcomes are perceived and experienced, and how decisions are made and subsequently evaluated. A second component involves the assignment of activities to specific accounts. The third component of mental accounting concerns the frequency with which accounts are evaluated (daily, weekly, yearly, and so on). Each of the components of mental accounting violates the economic principle of fungibility (money in one mental account is not a perfect substitute for money in another account). Applied to financial behavior the theory considers that individuals assign different levels of utility to each asset group, and this affects investor's investment decisions and other behaviors.

Herding in financial markets can be defined as mutual imitation leading to a convergence of action (Hirshleifer and Teoh, 2003). This is the most common mistake where investors tend to follow the investment decisions taken by the majority. That is why, in financial markets, when the best time to buy or sell is at hand, even the person who thinks he should take action experiences a strong psychological pressure refraining him to do so. The main reason for this is pressure from or influence by peers.

Chen et al. (2007) find that representativeness heuristic is only applicable to individual investors; institutional investors being unaffected by recent past return performance. Hence study hypothesizes that sophisticated investors are less prone to representativeness heuristic.

Anchoring makes investors to define a range for a share price or company's income based on the historical trends, resulting in under-reaction to unexpected changes. Anchoring has some connection

with representativeness as it also reflects that people often focus on recent experience and tend to be more optimistic when the market rises and more pessimistic when the market falls (Waweru et al., 2008).

Investors who suffer from self-attribution bias tend to attribute successful outcomes to their own actions and bad outcomes to external factors. They often exhibit this bias as a means of self-protection or self-enhancement. Investors afflicted with self-attribution bias may become overconfident, which can lead to overtrading and underperformance. Keeping track of personal mistakes and successes and developing accountability mechanisms such as seeking constructive feedback from others can help investors gain awareness of self-attribution bias. (Baker and Riccardi, 2014)

SIGNIFICANCE OF STUDY

This study has the significance for the individual investor, financial planners, financial managers and financial advisors. Investors with any personality trait will gain the knowledge about the respective bias that performs critical role while making financial decisions. By gaining the knowledge about the bias they can take steps so as to avoid the interruption of the biases while making financial decisions. Financial planners, financial managers and financial advisors by gaining the knowledge of the personality traits of the investor easily perceive types of investments that best suits the investor. Following are the objectives of the study.

OBJECTIVES

1. Identifying the effect of behavioral factors on the investment performance of individual investors at the Indian equity Market (i.e. BSE, NSE).
2. To identify the relationship between behavioural biases and behavioural effect on trading i.e. disposition effect, status quo effect and ostrich effect.
3. To explore the relationship between behavioural biases' effect on trading and investment performance as well as reinvestment intension

HYPOTHESES

Hypothesis 1:

Null hypothesis :Ho: There is no significant relationship between behavioural biases and Investment Performance.

Alternative hypothesis : H1 : There is significant relationship between behavioural biases and Investment Performance.

Hypothesis 2:

Null hypothesis :Ho: Behavioural Biases have no significant influence on effect of trading.

Alternative hypothesis : H1: Behavioural Biases have significant influence on effect of trading.

Hypothesis 3:

Null hypothesis :Ho: Behavioural Effect of trading have no significant influence on Investment Performance and Reinvestment Intention.

Alternative hypothesis : H1: Behavioural Effect of trading have significant influence on Investment Performance and Reinvestment Intention.

METHODOLOGY

Data Collection, Questionnaire Development and Sample

The present study is a descriptive survey in respect of its nature and because of its practical aim. This study performs a cross-section analysis via Structural Equation Modelling (SEM) that constructs a comprehensive path to link behavioural biases with three Investment Performance. Objective of the study is to find out the relation between the Behavioural Biases, effect of trading and Investment Performance as well as Reinvestment Intention. Structure Equation Modelling (SEM) that permit for the simultaneous estimation and testing of relationship between the two or more dependent and independent variables. Causal process is represented by a series of structural equations that can be modelled graphically to help in conceptualization of theoretical framework (Byrne, 2001). For analysis of data SPSS 16 and AMOS 20 are used. For the purpose of study a survey was conducted from clients and dealers of brokerage house in Surat city.

Our primary data set for this research was information through circulation of questionnaire to 435 clients of brokerage firms from South Gujarat Region, Gujarat, India on their investment behaviour. The investment and behavioural traits are assessed by 5-point Likert scales with end points labelled "strongly agree" and "strongly disagree". Therefore data from a total of 435 samples were included in construction of the Structural Equation Model[SEM]. Questionnaire was used as a data collection tool.

RESULTS OF THE STUDY

The present study has conducted Factor Analysis and Structural equation model (SEM) to identify and portray relationships among variables. This model is used to confirm which behavioural factors have an impact on investment decision of individual investors as well as estimate the regression weights among them to accept or reject hypothesis. Various fit indices were calculated to check the model fit. The exploratory factor analysis (EFA) is used for the behavioral variables to identify the factors which these variables belong to.

The requirements of factor analysis are satisfied to reduce the variables. After some rounds of removing the unsuitable variables, the analysis results that the remaining variables are grouped into 6 factors (six factors of behavioural variables), at the Eigenvalue = 1.14, KMO = 0.823 (sig. = 0.000), % of total variance explained = 54.73%, and all factors loadings are more than 0.5 These prove that factor analysis for these variables is totally suitable and accepted. The result is presented in the

Annexure (a) , (b) and (c)

Reliability of Data

Factors	No. of Item	Factor loading	Cronbach's Alpha
Mental accounting and Loss aversion	5	.596	0.701
		.600	
		.713	
		.840	
		.749	
Herdng	3	.740	0.750
		.858	
		.802	
Overconfidence _ self attribution Effect	6	.970	0.840
		.981	
		.878	
		.557	
		.977	
		.982	
Recency Bias	5	.672	0.642
		.706	
		.601	
		.560	
		.587	
Anchoring	5	.724	0.698
		.715	
		.683	
		.665	
		.649	
Representative Bias	3	.720	0.675
		.775	
		.641	
Disposition effect	2	.816	0.645
Status quo effect	2	.844	
Ostrich effect	2	.795	0.617
		.734	
Investment Performance	3	.799	0.701
		.782	
		.752	
Reinvestment Intention	3		0.646
	3		0.646

To check the reliability of data Cronbach Alpha is used and if its values are closer to 1 the questionnaire will be more reliable. As the average of Cronbach alpha values for all the variables is greater than the 0.6, it shows the reliability of the questionnaire. Mental accounting, Loss aversion, Herding, Overconfidence, Recency bias, self – attribution bias, anchoring and Representative bias and Investment Performance are reliable enough to follow further analysis: Structural Equation Modeling to explore the correlations among the factors.

In this study Structure Equation Modeling (SEM) was used to estimate and test how latent variables and their dimensions are related with each other. After extensive literature review, a hypothetical structure equation model was anticipated and analyzed with the software AMOS 20 version respectively.

The research investigated the relationship among Behavioural biases, Behavioural biases' effect on trading and investment performance as well as reinvestment intention. Factors were confirmed applying the factor confirmatory analysis on AMOS 20, all factors were confirmed.

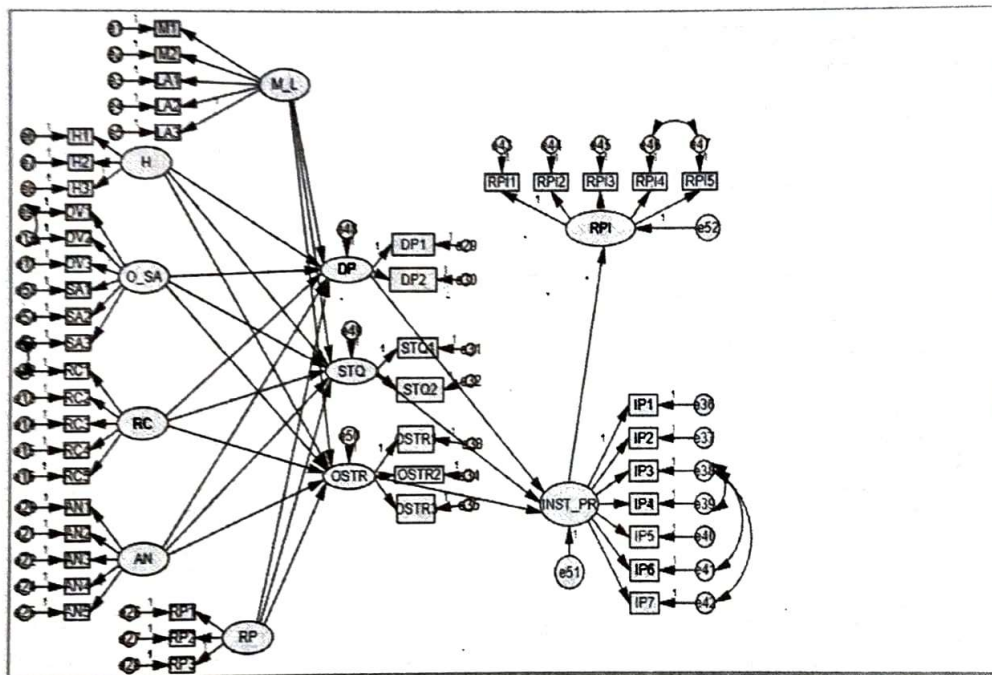


Figure 1- The Structure relationship among Investment behavioural Biases, its effect on trading, Investment performance as well as reinvestment intension

M_L = Mental accounting & Loss aversion, H= Herd Bias, O_SA= Overconfidence & self-attribution bias, RC= Recency Bias, AN= Anchoring bias, Rp= Representative bias

INT_pr= Investment performance, RPI = Reinvestment Intension

Table 7.2) Model Fit Parameters of the Relationship among Investment behavioural Biases, its effect on trading, Investment performance as well as reinvestment intension

Chi-square = 2546.219
Degrees of freedom = 961
Probability level = .000
Fitness Criteria

Sr. No.	Fitness Criteria	General rule acceptable fit – According to Criteria for an accepted SEM (Source: Schreiber, et al., 2006, p.330)	Result of Present study
1	CMIN/df	<= 2 or 3	2.650
2	GFI	>= 0.95	0.925
3	AGFI	>= 0.95	0.922
4	NFI	>= 0.95	0.929
5	IFI	>= 0.95	0.923
6	TLI	>= 0.95	0.910
7	CFI	>= 0.95	0.937
8	RMSEA	<0.06	0.046

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Significant
Disposition Effect	<---	Mental Accounting and Loss aversion	.569	.086	6.639	***	significant
Disposition Effect	<---	Herding bias	.220	.055	3.997	***	significant
Disposition Effect	<---	Overconfidence _Self Attribution bias	-.127	.044	-2.873	.004	significant
Disposition Effect	<---	Recency bias	.354	.089	3.964	***	significant
Disposition Effect	<---	Anchoring	.201	.086	2.335	.020	significant
Disposition Effect	<---	Representative bias	.253	.085	2.987	.003	significant
Status Quo Effect	<---	Mental Accounting and Loss aversion	.137	.050	2.763	.006	significant
Status Quo Effect	<---	Herding bias	.017	.028	.603	.547	
Status Quo Effect	<---	Overconfidence _Self Attribution bias	.073	.027	2.685	.007	significant
Status Quo Effect	<---	Recency bias	.126	.050	2.514	.012	significant
Status Quo Effect	<---	Anchoring	.065	.044	1.461	.044	significant
Status Quo Effect	<---	Representative bias	.121	.048	2.502	.012	significant
Ostrich Effect	<---	Mental Accounting and Loss aversion	.287	.059	4.840	***	significant
Ostrich Effect	<---	Herding bias	.179	.039	4.534	***	significant

			Estimate	S.E.	C.R.	P	Significant
Ostrich Effect	<---	Overconfidence _Self Attribution bias	-.117	.034	-2.863	.004	significant
Ostrich Effect	<---	Recency bias	.062	.058	1.078	.281	
Ostrich Effect	<---	Anchoring	.241	.062	3.870	***	significant
Ostrich Effect	<---	Representative bias	.180	.059	3.045	.002	significant
Investment Performance	<---	Disposition Effect	-.008	.033	-.254	.009	significant
Investment Performance	<---	Status Quo Effect	1.093	.303	3.602	***	significant
Investment Performance	<---	Ostrich Effect	.062	.018	2.381	.008	significant
Reinvestment Intention	<---	Investment Performance	.527	.057	9.240	***	significant

CONCLUSION

The conclusion of this study the values state that behavioural factors such as Mental Accounting & loss aversion (prospect theory), Overconfidence and self-attribution bias, Recency bias, Anchoring, Representative bias and herding factors were regressed significantly impact on the trading effects i.e. Disposition, status quo effect, ostrich effect . Mental accounting, herding, Recency biases have positive impact on Disposition. The overconfidence has negatively influence the disposition effect on trading . The mental accounting, overconfidence and representative bias has also positively influence status quo effect . The Mental Accounting, herding , representative bias and Anchoring bias have also positively influence the Ostrich effect. The overconfidence bias has negative influence on ostrich effect .The results revealed that null hypothesis can be rejected and conclude that there is a relationship between the Behavioural biases on trading effect and investment performance also. The values state that trading effects such as disposition effect, status quo effect and ostrich effect were regressed significantly but disposition effect and ostrich effect were regressed significantly and negatively impact on the investment performance . This result is consistent with Odean (1998, *Journal of Finance*) for disposition effect, but contrasts with Locke and Mann (2005, *Journal of Financial Economics*) .The Ostrich effect and Status quo effect has higher positive impact on investment performance . The Disposition 'as negatively influence the investment performance. The results conclude that There is relation between behavioural biases' effect on trading and investment performance as well as reinvestment decision also

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Annexure

(a) KMO and Bartlett's Test of Individual Investment Decisions

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.823
Bartlett's Test of Sphericity	Approx. Chi-Square	1.211E4
	df	378
	Sig.	.000

(b) Total Variance Explained

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.020	17.927	17.927	5.020	17.927	17.927	4.845	17.304	17.304
2	4.377	15.633	33.561	4.377	15.633	33.561	2.594	9.263	26.566
3	2.283	8.153	41.713	2.283	8.153	41.713	2.572	9.185	35.752
4	1.832	6.544	48.257	1.832	6.544	48.257	2.434	8.691	44.443
5	1.593	5.688	53.946	1.593	5.688	53.946	2.147	7.669	52.113
6	1.311	4.683	58.628	1.311	4.683	58.628	1.824	6.516	58.628

(c) Rotated Component Matrix

Rotated Component Matrix ^a		1	2	3	4	5	6
Component							
Mental accounting & Loss aversion (prospect Theory)	15. "I only consider return of individual share in portfolio((total investments) rather than return of entire portfolio "		.596				
	16.) "I feel dissatisfaction for return even though return of portfolio increases but done of share is in loss position' against that other one is in profit ." Agree?		.600				
	17.1)Take more risk after earning profit		.713				
	17.2)Avoid risk after getting loss		.840				
	17.3)Not invest in high volatile market		.749				
Herding Bias	17.4)Take investment decision by consulting advisor/ broker					.740	
	17.5)Choice of shares as per the choice of other investors					.858	
	17.6)Buy or sale the shares according to buy-sale decision of other investors					.802	
Overconfidence bias	17.7)confident to find out profit making share from stock market	.970					
	17.8)my skill & knowledge about stock market helps to perform well	.981					
	17.9)Go ahead with my calculation and prediction about shares rather than experts' views	.878					
Recency Bias	17.10)Avoid investing in companies with history of poor earning.				.672		
	17.11) "event" occurred in recent past is more important than in distant past				.706		
	17.12)How many and How fast information are passing in market is more important than what are sources of information?				.601		
	17.13)By hearing attractive launching news of one IPO of company for that have no or little knowledge. But I prefer to apply.				.560		
	17.14)keep on changing my portfolio according to the market scenario.				.587		
Self_attribution bias	17.16)My loss is due to unpredictable factors. Then What can I do?						
	17.17)Others seek information about shares or share market from me	.557					
	17.18)Have ability to access to lots of market information as they always readily available.	.977					
Anchoring Bias	17.19)Fix a target price for buying and selling in advance before starting of trading time	.982					
	17.20)Have ability to predict changes in share price by looking recent share price			.724			
	17.21)prefer to sale share once it crosses recent 52 week high price			.715			
	17.22)prefer to buy share at recent 52 week low price			.683			
Representative bias	17.23)Use past performance as indicator to buy or sale shares			.665			
	17.24)Use trend analysis for buying or selling shares						.720
	17.25)Prefer to buy " Hot favourite" shares						.775
Anchoring bias	18.)You wanted to buy share at RS. 500 as it is 52 week low price. But price in market is Rs.550. so you are waiting and now price is at Rs. 600.						.641
				.649			
Extraction Method: Principal Component Analysis.							
Rotation Method: Varimax with Kaiser Normalization.							

MODELING AND ANALYSIS OF INVENTORY MODELS UNDER DIFFERENT DETERIORATION RATES WITH STOCK DEPENDENT DEMAND AND VARIABLE SELLING PRICE

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Abstract

Inventory models under different deterioration rates with stock dependent demand and variable selling price is developed. The models have been made without shortage and with shortage cases. To represent the models numerical cases are given. Affectability investigation is likewise done for parameters.

Key Words: Stock dependent demand, Inventory model, Varying Deterioration, Shortages, Variable selling price

INTRODUCTION

Deterioration of items is a general phenomenon in real life and effect of deterioration cannot be ignored in many inventory systems. EOQ models for deteriorating items are studied by many researchers. Research in the area of deteriorating items inventory model started with the work of Within [10] who considered fashion goods deteriorating at the end of prescribed storage period. Ghare and Schrader [1] considered inventory problem under constant demand and constant deterioration. Shah and Jaiswal [8] considered an order level inventory model for items deteriorating at a constant rate. Salameh and Jaber [7] developed a model to determine the total profit per unit of time and the economic order quantity for a product purchased from the supplier. Mukhopadhyay et al. [3] developed an inventory model for deteriorating items with a price-dependent demand rate. The rate of deterioration was taken to be time-proportional and a power law form of the price-dependence of demand was considered. Teng and Chang [9] considered the economic production quantity model for deteriorating items with stock level and selling price dependent demand. Mathew [4] developed an inventory model for deteriorating items with mixture of Weibull rate of decay and demand as function of both selling price and time. Other research work related to deteriorating items can be found in, for instance (Raafat [5], Goyal and Giri [2], Ruxian et al. [6]).

Many products are of the nature that there is no deterioration initially. After certain time deterioration starts and again after certain time the rate of deterioration increases with time. Here we have used such a concept and developed the deteriorating items inventory models.

In this paper we have developed two inventory models with different deterioration rates when shortages are allowed and shortages are not allowed.

Selling price is considered as function of demand. To illustrate the model numerical examples are given. Sensitivity analysis is also carried out for major parameters on optimal solution.

Model – I: (Without Shortage Case): Assumptions And Notations:

Notations:

The following notations are used for the development of the model:

- $D(t)$: Demand is a function of inventory level $I(t)$
 A : Ordering cost per order
 c : Unit purchasing cost per item
 S_0 : Unit selling price of the item ($p > c$)
 HC : Holding cost per unit time is a linear function of time t ($x + yt$, $x > 0$, $0 < y < 1$)
 DC : deterioration cost
 SR : Sales Revenue
 $I(t)$: Inventory level at any instant of time t , $0 \leq t \leq T$
 Q : Order quantity
 T : Cycle length
 θ : Deterioration rate during $\mu_1 \leq t \leq \mu_2$, $0 < \theta < 1$
 θt : Deterioration rate during $\mu_2 \leq t \leq T$, $0 < \theta < 1$
 π : Total relevant profit

Assumptions:

The following assumptions are considered for the development of the model.

- The demand of the product is declining as a function of inventory level $I(t)$.
- Replenishment rate is infinite and instantaneous.
- Lead time is zero.
- Shortages are not allowed.
- The deteriorated units can neither be repaired nor replaced during the cycle time.
- The variable selling price $S(t)$ is a function of inventory, i.e. $S(t) = S_0 - p \cdot D(t)$

The Mathematical Model And Analysis

Let $I(t)$ be the inventory at time t ($0 \leq t \leq T$) as shown in figure.

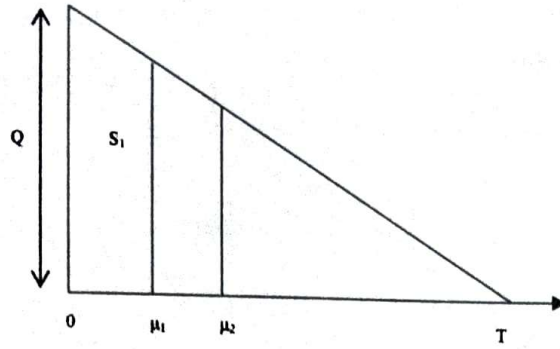


Figure 1

The differential equations which describes the instantaneous states of $I(t)$ over the period $(0, T)$ is given by

$$\frac{dI(t)}{dt} = -(a + bI(t)),$$

$$0 \leq t \leq \mu_1 \quad (1)$$

$$\frac{dI(t)}{dt} + \theta I(t) = -(a + bI(t)),$$

$$\mu_1 \leq t \leq \mu_2 \quad (2)$$

$$\frac{dI(t)}{dt} + \theta I(t) = -(a + bI(t)),$$

$$\mu_2 \leq t \leq T \quad (3)$$

with initial conditions $I(0) = Q$, $I(\mu_1) = S_1$ and $I(T) = 0$.

Solutions of these equations are given by

$$I(t) = Q(1 - bt) - a\left(t - \frac{1}{2}bt^2\right),$$

$$(4)$$

$$I(t) = a \left[(\mu_1 - t) + \frac{1}{2}(\theta + b)(\mu_1^2 - t^2) - (\theta + b)t(\mu_1 - t) - b\theta t(\mu_1^2 - t^2) \right] + S_1 [1 + (\theta + b)(\mu_1 - t)]$$

$$(5)$$

$$I(t) = a \left[(T - t) + \frac{1}{2}b(T^2 - t^2) + \frac{1}{6}\theta(T^3 - t^3) - bt(T - t) - \frac{1}{6}b\theta t(T^3 - t^3) - \frac{1}{2}\theta t^2(T - t) - \frac{1}{4}b\theta t^2(T^2 - t^2) \right]$$

$$(6)$$

(by neglecting higher powers of θ)

From equation (4), putting $t = \mu_1$, we have

$$Q = \frac{S_1}{(1 - b\mu_1)} + \frac{a}{(1 - b\mu_1)} \left(\mu_1 - \frac{1}{2}b\mu_1^2 \right).$$

$$(7)$$

From equations (5) and (6), putting $t = \mu_2$, we have

$$I(\mu_2) = a \left[\begin{array}{l} (\mu_1 - \mu_2) + \frac{1}{2}(\theta+b)(\mu_1^2 - \mu_2^2) \\ -(\theta+b)\mu_2(\mu_1 - \mu_2) - b\theta\mu_2(\mu_1^2 - \mu_2^2) \end{array} \right] + S_1 [1 + (\theta+b)(\mu_1 - \mu_2)]$$

$$I(\mu_2) = a \left[\begin{array}{l} (T - \mu_2) + \frac{1}{2}b(T^2 - \mu_2^2) + \frac{1}{6}\theta(T^3 - \mu_2^3) - b\mu_2(T - \mu_2) \\ - \frac{1}{6}b\theta\mu_2(T^3 - \mu_2^3) - \frac{1}{2}a\mu_2^2(T - \mu_2) - \frac{1}{4}b\theta\mu_2^2(T^2 - \mu_2^2) \end{array} \right] \quad (8)$$

So from equations (8) and (9), we get

$$S_1 = \frac{a}{[1 + (\theta+b)(\mu_1 - \mu_2)]} \left[\begin{array}{l} (T - \mu_2) + \frac{1}{2}b(T^2 - \mu_2^2) + \frac{1}{6}\theta(T^3 - \mu_2^3) - b\mu_2(T - \mu_2) \\ - \frac{1}{6}b\theta\mu_2(T^3 - \mu_2^3) - \frac{1}{2}a\mu_2^2(T - \mu_2) - \frac{1}{4}b\theta\mu_2^2(T^2 - \mu_2^2) \\ - (\mu_1 - \mu_2) - \frac{1}{2}(\theta+b)(\mu_1^2 - \mu_2^2) + (\theta+b)\mu_2(\mu_1 - \mu_2) + b\theta\mu_2(\mu_1^2 - \mu_2^2) \end{array} \right] \quad (10)$$

Putting value of S_1 from equation (10) into equation (7), we have

$$Q = \frac{a}{[1 + (\theta+b)(\mu_1 - \mu_2)](1 - b\mu_1)} \left[\begin{array}{l} (T - \mu_2) + \frac{1}{2}b(T^2 - \mu_2^2) + \frac{1}{6}\theta(T^3 - \mu_2^3) - b\mu_2(T - \mu_2) \\ - \frac{1}{6}b\theta\mu_2(T^3 - \mu_2^3) - \frac{1}{2}a\mu_2^2(T - \mu_2) - \frac{1}{4}b\theta\mu_2^2(T^2 - \mu_2^2) \\ - (\mu_1 - \mu_2) - \frac{1}{2}(\theta+b)(\mu_1^2 - \mu_2^2) + (\theta+b)\mu_2(\mu_1 - \mu_2) \\ + b\theta\mu_2(\mu_1^2 - \mu_2^2) \end{array} \right] + \frac{a}{(1 - b\mu_1)} \left(\mu_1 - \frac{1}{2}b\mu_1^2 \right) \quad (11)$$

Similarly putting value of Q from equation (11) in equation (4) we have

$$I(t) = \frac{a(1-bt)}{[1+(\theta+b)(\mu_1-\mu_2)](1-b\mu_1)} \left[\begin{aligned} & (T-\mu_2) + \frac{1}{2}b(T^2-\mu_2^2) + \frac{1}{6}\theta(T^3-\mu_2^3) - b\mu_2(T-\mu_2) \\ & - \frac{1}{6}b\theta\mu_2(T^3-\mu_2^3) - \frac{1}{2}a\mu_2^2(T-\mu_2) - \frac{1}{4}b\theta\mu_2^2(T^2-\mu_2^2) \\ & - (\mu_1-\mu_2) - \frac{1}{2}(\theta+b)(\mu_1^2-\mu_2^2) + (\theta+b)\mu_2(\mu_1-\mu_2) \\ & + b\theta\mu_2(\mu_1^2-\mu_2^2) \end{aligned} \right] \\ + \frac{a(1-bt)}{(1-b\mu_1)} \left(\mu_1 - \frac{1}{2}b\mu_1^2 \right) - a \left(t - \frac{1}{2}bt^2 \right). \quad (12)$$

Similarly putting value of S_1 from equation (10) in equation (5) we have

$$I(t) = \frac{a[1+(\theta+b)(\mu_1-t)]}{[1+(\theta+b)(\mu_1-\mu_2)]} \left[\begin{aligned} & (T-\mu_2) + \frac{1}{2}b(T^2-\mu_2^2) + \frac{1}{6}\theta(T^3-\mu_2^3) - b\mu_2(T-\mu_2) \\ & - \frac{1}{6}b\theta\mu_2(T^3-\mu_2^3) - \frac{1}{2}a\mu_2^2(T-\mu_2) - \frac{1}{4}b\theta\mu_2^2(T^2-\mu_2^2) \\ & - (\mu_1-\mu_2) - \frac{1}{2}(\theta+b)(\mu_1^2-\mu_2^2) + (\theta+b)\mu_2(\mu_1-\mu_2) + b\theta\mu_2(\mu_1^2-\mu_2^2) \end{aligned} \right] \\ + a \left[(\mu_1-t) + \frac{1}{2}(\theta+b)(\mu_1^2-t^2) - (\theta+b)t(\mu_1-t) - b\theta t(\mu_1^2-t^2) \right] \quad (13)$$

Based on the assumptions and descriptions of the model, the total annual relevant profit (π), include the following elements:

(i) Ordering cost (OC) = A

$$(ii) HC = \int_0^T (x+yt)I(t)dt \\ = \int_0^{\mu_1} (x+yt)I(t)dt + \int_{\mu_1}^{\mu_2} (x+yt)I(t)dt + \int_{\mu_2}^T (x+yt)I(t)dt \quad (14)$$

$$(iii) DC = c \left(\int_{\mu_1}^{\mu_2} \theta I(t)dt + \int_{\mu_2}^T \theta t I(t)dt \right) \quad (15)$$

$$(iv) SR = \left(\int_0^T S(t)D(t)dt \right) = \left(\int_0^T [S_0 - p(a+bI(t))](a+bI(t))dt \right) \\ = \left(\int_0^T [S_0 - p(a+bI(t))](a+bI(t))dt \right) \quad (16)$$

$$= \left(\int_0^{\mu_1} [S_0 - \rho(a + bI(t))](a + bI(t))dt + \int_{\mu_1}^{\mu_2} [S_0 - \rho(a + bI(t))](a + bI(t))dt + \int_{\mu_2}^T [S_0 - \rho(a + bI(t))](a + bI(t))dt \right) \quad (17)$$

The total profit during a cycle, π consisted of the following:

$$\pi = \frac{1}{T} [SR - OC - HC - DC] \quad (18)$$

Substituting values from equations (14) to (17) in equation (18) and $\mu_1 = 0.30T$, $\mu_2 = 0.50T$, we get total profit per unit.

The optimal value of $T = T^*$ (say), which maximizes profit π can be obtained by differentiating it with respect to T and equate it to zero

$$\text{i.e. } \frac{d\pi}{dT} = 0$$

provided it satisfies the condition

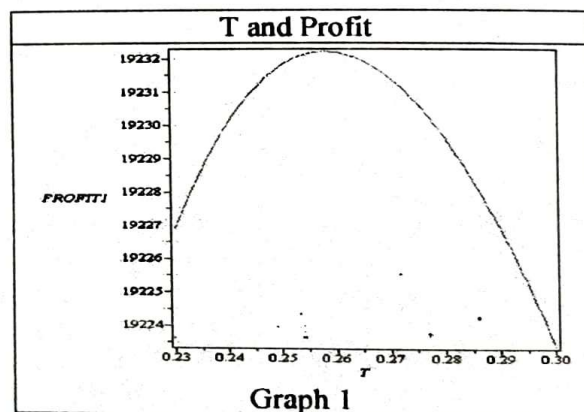
$$\frac{d^2\pi}{dT^2} < 0. \quad (19)$$

(20)

Numerical Example

Considering $A = \text{Rs. } 100$, $a = 500$, $b = 0.05$, $c = \text{Rs. } 25$, $S_0 = \text{Rs. } 40$, $\theta = 0.05$, $x = \text{Rs. } 5$, $y = 0.05$, $\rho = 0.05$, in appropriate units. The optimal value of $T^* = 0.2583$, Profit* = Rs. 19232.2210 and optimum order quantity $Q^* = 130.2251$.

The second order conditions given in equation (20) are also satisfied. The graphical representation of the concavity of the profit function is also given.



Sensitivity Analysis:

On the basis of the data given in example above we have studied the sensitivity analysis by changing the following parameters one at a time and keeping the rest fixed.

Table 1
Sensitivity Analysis

Parameter	%	<i>T</i>	<i>Profit</i>	<i>Q</i>
a	+20%	0.2269	23124.6219	137.1310
	+10%	0.2415	21178.1757	133.8563
	-10%	0.2779	17286.8724	126.1783
	-20%	0.3010	15342.2844	158.7786
θ	+20%	0.2566	19227.5239	129.4076
	+10%	0.2574	19229.8679	129.7911
	-10%	0.2593	19234.5834	130.7097
	-20%	0.2602	19236.9551	131.1431
x	+20%	0.2392	19169.7353	120.5194
	+10%	0.2482	19200.3736	125.0912
	-10%	0.2698	19265.4317	136.0750
	-20%	0.2829	19300.1949	142.7443
A	+20%	0.2826	19158.2855	142.5915
	+10%	0.2708	19194.4262	136.5839
	-10%	0.2453	19271.9255	123.6178
	-20%	0.2315	19313.8680	116.6102
ρ	+20%	0.2482	19200.3736	125.0912
	+10%	0.2532	19216.1373	127.6323
	-10%	0.2639	19248.6451	133.0732
	-20%	0.2698	19251.8531	136.0750

MODEL – II : (WITH SHORTAGE CASE)

Assumptions And Notations Notations:

The notations are same as in section 2.1 with additional notations for the development of the model:

c_2 : Shortage cost per unit

SC : Shortage cost

Q1 : Inventory level initially

Q2 : Shortage of inventory

Q : Order quantity

Assumptions:

- The demand of the product is declining as a function of inventory level $I(t)$.
- Replenishment rate is infinite and instantaneous.
- Lead time is zero.
- Shortages are allowed and completely backlogged.
- The deteriorated units can neither be repaired nor replaced during the cycle time.
- The variable selling price $S(t)$ is a function of inventory, i.e. $S(t) = S_0 - p(D(t))$

The Mathematical Model And Analysis:

Let $I(t)$ be the inventory at time t ($0 \leq t \leq T$) as shown in figure.

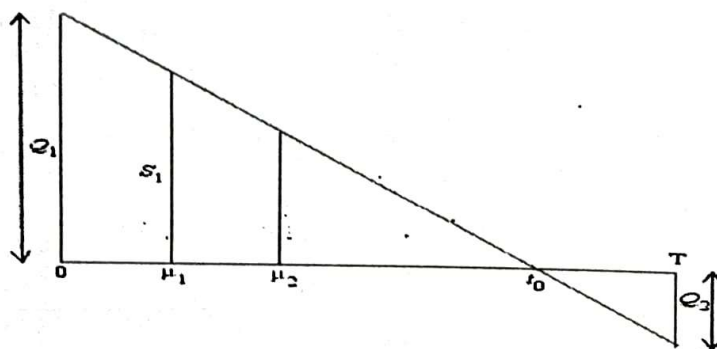


Figure 2

The differential equations which describes the instantaneous states of $I(t)$ over the period $(0, T)$ is given by

$$\frac{dI(t)}{dt} = -(a + bI(t)), \quad 0 \leq t \leq \mu_1 \quad (21)$$

$$\frac{dI(t)}{dt} + \theta I(t) = -(a + bI(t)), \quad \mu_1 \leq t \leq \mu_2 \quad (22)$$

$$\frac{dI(t)}{dt} + \theta I(t) = -(a + bI(t)), \quad \mu_2 \leq t \leq t_0 \quad (23)$$

$$\frac{dI(t)}{dt} = -(a + bI(t)), \quad t_0 \leq t \leq T \quad (24)$$

with initial conditions $I(0) = Q_1$, $I(\mu_1) = S_1$, $I(t_0) = 0$ and $I(T) = -Q_2$.
Solutions of these equations are given by

$$I(t) = Q_1(1 - bt) - a(t - \frac{1}{2}bt^2), \quad (25)$$

$$I(t) = a \left[(\mu_1 - t) + \frac{1}{2}(\theta + b)(\mu_1^2 - t^2) - (\theta + b)t(\mu_1 - t) - b\theta t(\mu_1^2 - t^2) \right] + S_1 [1 + (\theta + b)(\mu_1 - t)] \quad (26)$$

$$I(t) = a \left[(t_0 - t) + \frac{1}{2}b(t_0^2 - t^2) + \frac{1}{6}\theta(t_0^3 - t^3) - bt(t_0 - t) \right. \\ \left. - \frac{1}{6}b\theta t(t_0^3 - t^3) - \frac{1}{2}\theta t^2(t_0 - t) - \frac{1}{4}b\theta t^2(t_0^2 - t^2) \right] \quad (27)$$

$$I(t) = a \left[(t_0 - t) + \frac{1}{2}b(t_0^2 - t^2) - bt(t_0 - t) \right]. \quad (28)$$

(by neglecting higher powers of θ)

From equation (25), putting $t = \mu_1$, we have

$$Q_1 = \frac{S_1}{(1 - b\mu_1)} + \frac{a}{(1 - b\mu_1)} \left(\mu_1 - \frac{1}{2}b\mu_1^2 \right). \quad (29)$$

From equations (26) and (27), putting $t = \mu_2$, we have

$$I(\mu_2) = a \left[(\mu_1 - \mu_2) + \frac{1}{2}(\theta + b)(\mu_1^2 - \mu_2^2) \right. \\ \left. - (\theta + b)\mu_2(\mu_1 - \mu_2) - b\theta\mu_2(\mu_1^2 - \mu_2^2) \right] + S_1 [1 + (\theta + b)(\mu_1 - \mu_2)] \quad (30)$$

$$I(\mu_2) = a \left[(t_0 - \mu_2) + \frac{1}{2}b(t_0^2 - \mu_2^2) + \frac{1}{6}\theta(t_0^3 - \mu_2^3) - b\mu_2(t_0 - \mu_2) \right. \\ \left. - \frac{1}{6}b\theta\mu_2(t_0^3 - \mu_2^3) - \frac{1}{2}a\mu_2^2(t_0 - \mu_2) - \frac{1}{4}b\theta\mu_2^2(t_0^2 - \mu_2^2) \right] \quad (31)$$

So from equations (30) and (31), we get

$$S_1 = \frac{a}{[1 + (\theta + b)(\mu_1 - \mu_2)]} \left[\begin{aligned} & (t_0 - \mu_2) + \frac{1}{2}b(t_0^2 - \mu_2^2) + \frac{1}{6}\theta(t_0^3 - \mu_2^3) - b\mu_2(t_0 - \mu_2) \\ & - \frac{1}{6}b\theta\mu_2(t_0^3 - \mu_2^3) - \frac{1}{2}a\mu_2^2(t_0 - \mu_2) - \frac{1}{4}b\theta\mu_2^2(t_0^2 - \mu_2^2) \\ & - (\mu_1 - \mu_2) - \frac{1}{2}(\theta + b)(\mu_1^2 - \mu_2^2) + (\theta + b)\mu_2(\mu_1 - \mu_2) + b\theta\mu_2(\mu_1^2 - \mu_2^2) \end{aligned} \right] \quad (32)$$

Putting value of S_1 from equation (32) into equation (29), we have

$$Q_1 = \frac{a}{[1+(\theta+b)(\mu_1-\mu_2)](1-b\mu_1)} \left[\begin{aligned} & (t_0 - \mu_2) + \frac{1}{2}b(t_0^2 - \mu_2^2) + \frac{1}{6}\theta(t_0^3 - \mu_2^3) - b\mu_2(t_0 - \mu_2) \\ & - \frac{1}{6}b\theta\mu_2(t_0^3 - \mu_2^3) - \frac{1}{2}a\mu_2^2(t_0 - \mu_2) - \frac{1}{4}b\theta\mu_2^2(t_0^2 - \mu_2^2) \\ & - (\mu_1 - \mu_2) - \frac{1}{2}(\theta+b)(\mu_1^2 - \mu_2^2) + (\theta+b)\mu_2(\mu_1 - \mu_2) \\ & + b\theta\mu_2(\mu_1^2 - \mu_2^2) \end{aligned} \right] + \frac{a}{(1-b\mu_1)} \left(\mu_1 - \frac{1}{2}b\mu_1^2 \right). \quad (33)$$

Putting $t = T$ in equation (28), we have

$$Q_2 = a \left[(T - t_0) + \frac{1}{2}b(T^2 - t_0^2) - bT(T - t_0) \right]. \quad (34)$$

Similarly putting value of Q_1 from equation (33) in equation (25) we have

$$I(t) = \frac{a(1-bt)}{[1+(\theta+b)(\mu_1-\mu_2)](1-b\mu_1)} \left[\begin{aligned} & (t_0 - \mu_2) + \frac{1}{2}b(t_0^2 - \mu_2^2) + \frac{1}{6}\theta(t_0^3 - \mu_2^3) - b\mu_2(t_0 - \mu_2) \\ & - \frac{1}{6}b\theta\mu_2(t_0^3 - \mu_2^3) - \frac{1}{2}a\mu_2^2(t_0 - \mu_2) - \frac{1}{4}b\theta\mu_2^2(t_0^2 - \mu_2^2) \\ & - (\mu_1 - \mu_2) - \frac{1}{2}(\theta+b)(\mu_1^2 - \mu_2^2) + (\theta+b)\mu_2(\mu_1 - \mu_2) \\ & + b\theta\mu_2(\mu_1^2 - \mu_2^2) \end{aligned} \right] + \frac{a(1-bt)}{(1-b\mu_1)} \left(\mu_1 - \frac{1}{2}b\mu_1^2 \right) - a \left(t - \frac{1}{2}bt^2 \right). \quad (35)$$

Similarly putting value of S_1 from equation (32) in equation (26) we have

$$I(t) = \frac{a[1+(\theta+b)(\mu_1-t)]}{[1+(\theta+b)(\mu_1-\mu_2)]} \left[\begin{aligned} & (t_0 - \mu_2) + \frac{1}{2}b(t_0^2 - \mu_2^2) + \frac{1}{6}\theta(t_0^3 - \mu_2^3) - b\mu_2(t_0 - \mu_2) \\ & - \frac{1}{6}b\theta\mu_2(t_0^3 - \mu_2^3) - \frac{1}{2}a\mu_2^2(t_0 - \mu_2) - \frac{1}{4}b\theta\mu_2^2(t_0^2 - \mu_2^2) \\ & - (\mu_1 - \mu_2) - \frac{1}{2}(\theta+b)(\mu_1^2 - \mu_2^2) + (\theta+b)\mu_2(\mu_1 - \mu_2) + b\theta\mu_2(\mu_1^2 - \mu_2^2) \end{aligned} \right] + a \left[(\mu_1 - t) + \frac{1}{2}(\theta+b)(\mu_1^2 - t^2) - (\theta+b)t(\mu_1 - t) - b\theta t(\mu_1^2 - t^2) \right] \quad (36)$$

Based on the assumptions and descriptions of the model, the total annual relevant profit (π), include the following elements:

(i) Ordering cost (OC) = A

(37)

$$(ii) \quad HC = \int_0^{t_0} (x+yt)I(t)dt = \int_0^{\mu_1} (x+yt)I(t)dt + \int_{\mu_1}^{\mu_2} (x+yt)I(t)dt + \int_{\mu_2}^{t_0} (x+yt)I(t)dt \quad (38)$$

$$(iii) \quad DC = c \left(\int_{\mu_1}^{\mu_2} \theta I(t)dt + \int_{\mu_2}^{t_0} \theta t I(t)dt \right) \quad (39)$$

$$(iv) \quad SC = -c_2 \left(\int_{t_0}^T I(t)dt \right) \quad (40)$$

$$(iv) \quad SR = \left(\int_0^T S(t)D(t)dt \right) = \left(\int_0^T [S_0 - p(a + bI(t))] (a + bI(t))dt \right) \\ = \left(\int_0^T [S_0 - p(a + bI(t))] (a + bI(t))dt \right) \quad (41)$$

The total profit during a cycle, π consisted of the following:

$$\pi = \frac{1}{T} [SR - OC - HC - DC - SC] \quad (42)$$

Substituting values from equations (37) to (41) in equation (42) and $\mu_1 = 0.30t_0$, $\mu_2 = 0.50t_0$, we get total profit per unit.

The optimal value of $t_0 = t_0^*$ and $T = T^*$ (say), which maximizes profit π can be obtained by differentiating it with respect to t_0 and T and equate it to zero

$$\text{i.e. } \frac{\partial \pi(t_0, T)}{\partial t_0} = 0, \quad \frac{\partial \pi(t_0, T)}{\partial T} = 0 \quad (43)$$

provided it satisfies the condition

$$\left| \begin{array}{cc} \frac{\partial^2 \pi(t_0, T)}{\partial t_0^2} & \frac{\partial^2 \pi(t_0, T)}{\partial t_0 \partial T} \\ \frac{\partial^2 \pi(t_0, T)}{\partial T \partial t_0} & \frac{\partial^2 \pi(t_0, T)}{\partial T^2} \end{array} \right| > 0. \quad (44)$$

Numerical Example:

Considering $A = \text{Rs. } 100$, $a = 500$, $b = 0.05$, $c = \text{Rs. } 25$, $S_0 = \text{Rs. } 40$, $\theta = 0.05$, $x = \text{Rs. } 5$, $y = 0.05$, $c_2 = \text{Rs. } 8$, $p = 0.05$, in appropriate units. The optimal value of $t_0^* = 0.1948$, $T^* = 0.3478$, Profit* = Rs. 19426.5102 and optimum order quantity $Q^* = 174.2071$.

The second order conditions given in equation (44) are also satisfied. The graphical representation of the concavity of the profit function is also given.

	- 20%	0.2095	0.3517	19433.3423	176.2994
	+20%	0.2021	0.3338	19402.8394	167.3359
	+10%	0.1984	0.3402	19413.8902	170.4774
c_2	-10%	0.1894	0.3569	19441.0704	178.6715
	- 20%	0.1837	0.3683	19458.0744	184.2619

From the tables 1 and 2, we observe that as parameter a increases/ decreases average total profit and optimum order quantity also increases/ decreases.

Also, we observe that with increase and decrease in the value of θ , ρ , x and c_2 , there is corresponding decrease/ increase in total profit and optimum order quantity.

From the table we observe that as parameter A increases/ decreases average total profit decreases/ increases and optimum order quantity increases/ decreases.

CONCLUSION

In this paper, we have developed an inventory model for deteriorating items with stock dependent demand with different deterioration rates. Sensitivity with respect to parameters have been carried out for both the models. The results show that with the increase/ decrease in the parameter values there is corresponding increase/ decrease in the value of profit.

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AN EPIGRAMMATIC REVIEW OF DIGITALIZATION OF THE RETAIL STORE ATTRIBUTES FOR BUILDING IN-STORE PATRONAGE INTENTIONS: A KEY TO SUCCEED IN THE ERA OF OMNI-CHANNEL RETAILING

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Abstract

The shopping journey of today's hyper connected shopper is fortified with technology and information which has necessarily changed the shopping paradigm. In such a scenario no single channel or touch point can provide the total customer experience. The retailers of Brick-and-mortar stores have already started facing the heat of the convergence of the online and off line channels. This embarks the new journey of rethinking the existing operational models and technology architectures; which will undergo the most radical transformation to satisfy demands of the new age shopper. Today's technology enabled shoppers have seemingly unlimited knowledge, power, and expectations and are also equipped to filter and prioritize where, how, and when they want to engage with retailers. How they interact with retailers continues to evolve quickly: not only are consumers changing how they shop across stores and online, even the digital component itself is changing as shoppers rapidly integrate smart phones and tablets into shopping. In a world where shoppers have ubiquitous broadband, active social networks, and multiple mobile devices, retailers must leverage technology as a competitive weapon and drive change further and faster. In today's retail reality, the store experience needs to meet the expectations of the savvy digital consumer. The digital consumer does a lot of research online before making a purchase. This additional knowledge raises expectations for in store service attributes with which the retailers are generally not equipped with. The retailers can raise the bar of shoppers' experience by giving a digital access of their products and by also enabling the service staff personnel so that they are digitally driven to provide holistic solutions to the ever connected shopper.

In this research article an attempt has been made to conceptualise and understand the key aspects of digitalisation of store attributes as one of the medium of Omni-channel retail for creating a seamless shopper experience.

Keywords: Digitalisation, Store Attributes, Omni-Channel Retail, Seamless Experience

INTRODUCTION

Digitisation is a step change even greater than the internet. Exponential technology advances, greater consumer power and increased competition mean all industries face the threat of commoditisation. The retailers will have to act now, and build a strategic advantage that leaves their counterparts wondering what happened. An imperative for digital innovation and engagement has emerged that compels to use digital channels to engage with their key stakeholders to maintain relevance and drive the conversation.

However, few realise how fast the change needs to happen, or how transformational it needs to be. The real imperative in a world where 'everything' is digitised is that businesses need to pursue innovation to disrupt their own business model before the competition does.

Without innovation strategies, modern day brick and mortar stores will lose their competitive advantage in an increasingly commoditised world. There is no time to lose for a retailer to grapple, as technology change accelerates exponentially and new digital platforms and devices are emerging.

The starting point is a structured approach to assessing your digital maturity based on an understanding not just of the technology, but of the 'big picture' of what digital engagement means to the business. To deal with this challenge, retailers must develop an end-to-end response. They need to develop a comprehensive digital strategy and rethink their business and operating models to deliver this. Such a strategy must go far beyond the Marketing department: it has to be about ubiquitous cross-channel connectivity, it must enable continuous engagement with customers, suppliers, employees and investors (Source: Ericsson, 'Vision 2020, February 2011).

Digitalization, together with globalization and urbanization, is dramatically transforming society, with many significant changes taking place. Within the retail industry, we are witnessing the emergence of what can be referred to as a seismic shift in retailing. However, the specifics of digitalization and its impacts on retailing are less clear. In recent years there has been an increase in Internet and mobile device usage in relation to shopping and retailing. E-commerce is growing and increasingly encompassing both large and small retailers, and the growth of e-commerce platforms such as Alibaba and Amazon are influencing the competitive environment. In addition, new mobile applications are developing rapidly and can be used by consumers to do price comparisons, evaluate products with health, environmental, and ethical considerations, and facilitate payment, among other things.

Despite these significant shifts induced by digitalization, the majority of retailing still takes place in physical stores, which will likely continue into the foreseeable future. However, these physical stores both impact and are impacted by the consequences of digitalization in retailing. Digitalization will challenge existing business models, many of which will then have to be revised. More specifically, digitalization will have consequences for many aspects of the physical stores, including how they attract and retain customers, how they are organised, and how the flow of goods is handled. The digitalization process will also create particular opportunities and challenges for retail firms and employees around knowledge sharing, sustainability performance, and ability to create value. While the link between digitalization and the physical store is pivotal, it has received limited scholarly attention to date. The aim of this research paper is to identify and analyze emerging trends and transformations that digitalization brings to the retail industry, with special emphasis on the physical store settings. The store retailers need to understand the retail digitalization and its implications for the physical store in order to explore the digitalization opportunities and ultimately create conditions for sustainable growth and profitability.

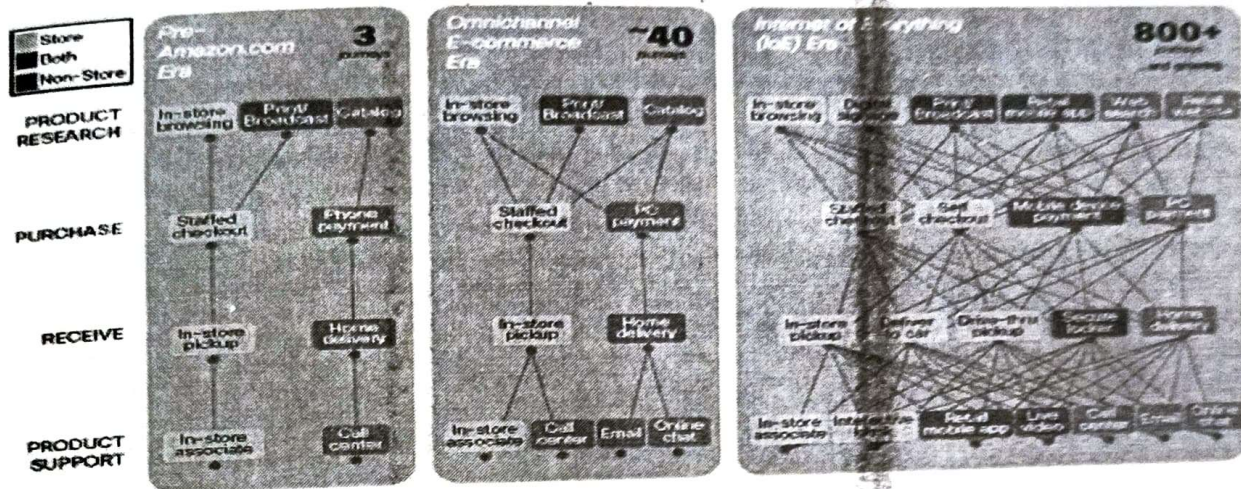
BACKGROUND OF THE STUDY- EXPONENTIAL CHANGE CREATES A MAZE OF SHOPPING JOURNEYS:

Nearly all consumers have been engaged in e-commerce for more than a decade, and a growing majority of American and British consumers now make smartphones an important part of their daily lives. Tablets are commonplace, and mobile apps are ubiquitous for mainstream users, not just early adopters. Today's digital consumers are more in control of their consumption than ever before, settling into technology-enabled behaviours such as deal seeking, so-called "showrooming" (examining a product in a store, then purchasing it online from another outlet), and social shopping. Mobility and apps now represent a disruption similar in scope to what we saw with e-commerce in the late 1990s and early 2000s, which brought about a tidal wave of industry change. With the number of channels and options growing exponentially, today's retailers face a wave of even larger complexity. New connections are creating unprecedented opportunities to innovate, as well as challenges. Expanding from 13 billion connections among people, process, data, and things today to 50 billion in 2020 will drive exponential change and complexity. But what does exponential change mean to a retailer? To illustrate the nature of the change impacting the industry, it is instructive to examine how the shopping journey (product research, purchasing the product, receiving the product, and obtaining support) has evolved from the pre-Amazon.com era through omnichannel e-commerce and on to the Internet of Everything [IOE] era.

Shopper interactions once added up to a total of three linear shopping-journey options: in-store, through a catalogue, or prompted by print or broadcast-media advertising.

The advent of e-commerce expanded this number to approximately 40. Now, Internet of Everything [IOE] promises more than 800 unique variations of possible shopping journeys. As technology innovations (such as wearable and augmented reality) increase and consumers' digital lifestyles evolve, these shopping journeys will multiply further.

Figure Number 01: Evolution of Shopper Journeys



Source: Cisco Consulting Services, 2015

Savvy retailers are leveraging mobile technologies to engage consumers as they shop in WI-FI enabled stores. This allows merchants to interact with customers who subscribe to digital promotions or opt in to loyalty programs, by pushing out time-limited offers or promoting items of particular interest on digital signage. Location and behaviour-based data analytics help retailers gather the right customer information for optimizing sales and generating revenue.

With the increasing availability of wireless connectivity and the growing list of new Smartphone capabilities, the connected consumer can explore products, availability, ratings, reviews and promotional offers with a tap on their wireless device while walking by or visiting a store. This data is almost limitless and is readily available across social media outlets, mobile-enabled websites and apps.

The convergence of mobile technologies and these customer engagement platforms provides many new ways for retailers to reach customers in-store. "Omni-channel retailing" enables customers to enjoy a consistent and integrated experience across all shopping channels in the mobile, digital and in-store environment.

Shoppers receive the same messages, source the same inventory and make purchases whether shopping in-store or online using a computer or mobile device (ibid).

RETAIL DIGITISATION OF PHYSICAL: THE NEW SHOPPING EXPERIENCE

Consumers enter the store more informed than ever before about the merchandise they seek, and turn to digital touch points to research products prior to and while visiting the store. While physical stores still claim over a sizeable portion of these are digitally influenced. E-commerce websites have given shoppers an endless assortment of products and product details; therefore, the physical store is not always the best place to help educate a consumer to make a purchase decision. By integrating digital technology into the stores, both store associates and consumers benefit from having access to a new level of product detail and an endless aisle of products that help better engage the store associate to serve the consumer.

In today's retail reality, the store experience needs to meet the expectations of the savvy digital consumer. The digital consumer does a lot of research online before making a purchase, and most of the time she has access to detailed information about products that is not typically made available to sales associates. This additional knowledge raises expectations for in store service as a result. And to compound the expectations gap, many retailers do not have the physical space to carry all products in all stores at all times.

However, by giving both store associates and consumers digital access to more products, more product inventory and more product detail retailers can, in essence, raise the bar in customer experience. Omni-channel initiatives, with the help of digital in the store, are quickly displacing formerly siloed retail channels and providing store associates and shoppers with a convenience factor like no other. Consumers can now shop when they want, where they want, and on whatever device they want.

Digital in the store can, for example, allow consumers to start a shopping experience via an e-commerce site, leave items in their basket, then retrieve the basket and complete their shopping trip in the store a single basket anywhere, anytime. Additional examples include buy online and pick-up in the store and ship from the store. There is no doubt that the face of retail is changing.

The research firm estimates cross-channel retail sales will reach \$1.8 Trillion by the year 2017 and direct e-commerce sales (including mobile and tablets) will top \$370 Billion by the same time. In short, for every \$1 that consumers spend online, they will spend nearly \$5 in the physical store.

By giving consumers access to a digital store and thus the ability to purchase products not in stock in the store while they are in the store, store associates can increase revenue, offer greater inventory efficiency, streamline business operations and enhance consumer loyalty (Forrester Report, 2011).

In this "Amazon Era" where instant gratification is king, consumers want it all, and they want it now. By giving them the digital store they've always dreamed of, these consumers will reward retailers who can provide them with best-in-class Omni-channel consumer experiences across the web, mobile and store (ibid): What if store associates had a better understanding of where and how the connected consumer decides to buy, as well as knowing what influences her to buy more in the store?

What if they had the power to quickly meet consumers' requests and exceed their expectations? They would have the power not only to cross- and up-sell more, but to make it harder for consumers to walk away.

Consumers want to feel like they are the most important person to walk through a retailer's door. They want store associates to "recognize" them within minutes of entering the store, and they want to know that there will be a product expert in the store should they have any questions or need guidance.

Clienteling capabilities should be developed by the retailers to allow store associates to have extensive and consistent product information that better equips them to provide relevant cross-selling suggestions to shoppers. With guided selling, store associates have access to a 360 degree view of the consumer across all retail touch points, including past purchases, consumer style and brand preferences, to make personalized recommendations and avoid missed sales.

Allowing store associates to become more knowledgeable about products, consumer reviews and preferences can result in a more personalized and engaging shopping experience for the consumer and a greater chance to convert the opportunity into a sale.

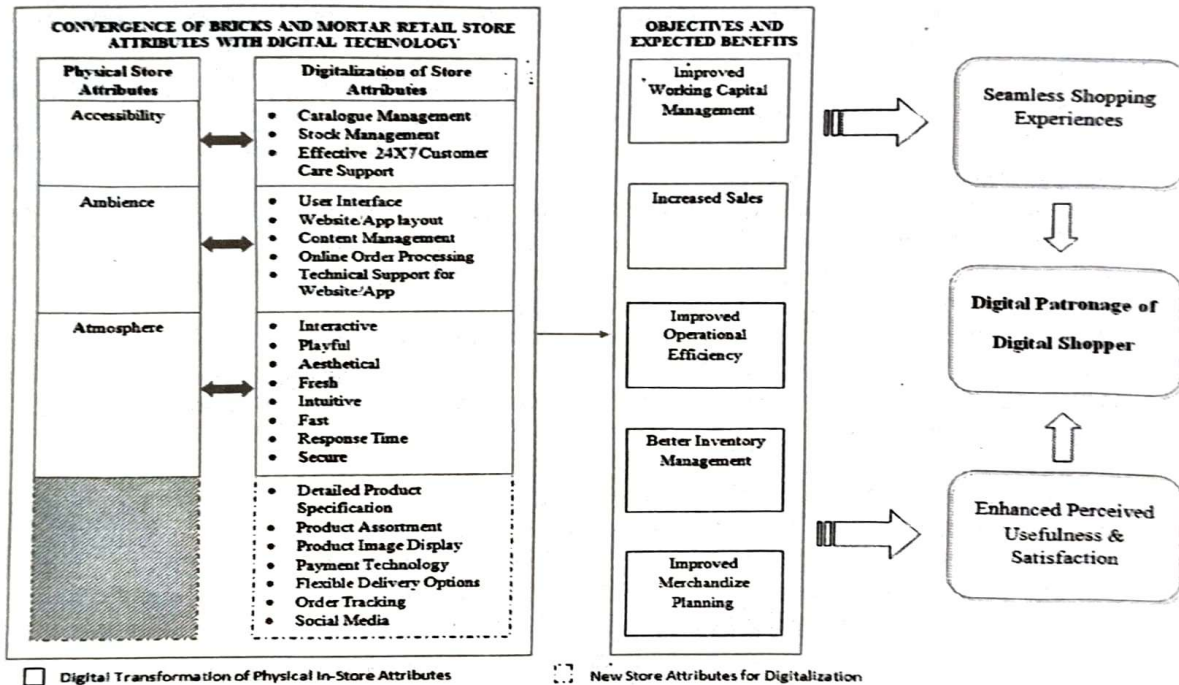


Figure Number 02: Conceptual Model showing the convergence of Bricks and Mortar Retail Store attributes with digital technology leading to Digital patronage

Source: Prepared by the Author from Review of Literature

THE CHIEF OBJECTIVE OF THE RESEARCH

The objective of this research is to study and investigate the underlying facets of the functionality along with the convergence across multiple retail channels and its impact on digitizing the retail store.

The focal theme of this research is to identify the role of the technology that can be intertwined to digitalize the physical store attributes which can enable the retailer to deliver a pleasing shopping experience across all the platforms of technology. This research aims to explore the best in class Omni-channel practices that can be leveraged by retailers that enable them to create a personalised shopper experience anywhere, anytime and on any device. The modern day shopper dictates and controls the shopping journey and it is not at all astonishing that the current level of technology, the infrastructure, architecture and applications have been unsuccessful to keep up the pace of growth. This is true particularly in the typical Indian retail scenario where the retailers are using the loosely coupled legacy systems without having a clear focus as to how the shoppers interact with them.

The retailers in India are successful in cultivating a pleasing in-store atmosphere by using the various store attributes.

But, the same is not the case when the framework turns digital. In this research a model for digitizing the store attributes by using the next level of technology so as to create value for the modern digital shopper has been developed. Further, a conceptual model of the convergence of Bricks and Mortar Retail Store Attributes with Digital Technology is also proposed in this research paper by conducting extensive review of literature so as to enhance the patronage of the Digital shopper by providing him/her with the seamless shopping experiences and enhancing the perceived usefulness for shopping [Please refer Figure Number 02 and 03].

The framework as shown in figure number 02 explains the Role of Digital Technology that can be leveraged by the retailers in order to usher in the next wave of Digital shopping by enhancing the store experience, using the mobile application platforms, increasing the shoppers' convenience and to promote store as a brand across all digital platforms. In brick and mortar stores the retailers can use digital technology to enhance the in-store shopping experiences. The retailers can also go online and enhance the online buying experiences of the shoppers'. This will enable the retailer to maintain a unique image in the minds of the shoppers'.

The conceptual framework in the research paper as depicted in the figure Number 03 explains how the traditional brick and mortar store retailer can translate the physical store attributes by digitalising which will help the retailers in not only attracting the digital shopper but also achieve the benefits of improved working capital management, increased store traffic etc. The result of the same will be creating a seamless shopping environment for the shopper.

KEY TERMS USED IN THE STUDY

- **Digitalisation:**

"Digitalization" is one of the greatest transformations of contemporary society. The on-going changes due to digitalization are not least important in the retail sector, which both affects and is affected by the development. The Internet's entry has resulted in new business opportunities (Quelch & Klein, 1996), new companies (Mols, 2000), business models (Sorescu et al., 2011) and forms of commerce (Gloor, 2000). So far in retailing, digitalization and the Internet has primarily been discussed in terms of an increased presence of e-commerce.

- **Omni-Channel Retail:**

Omni-channel retailing is a concept used to describe the increasing variety of access points between customers and retailers, brought on by the growth of online shopping and its integration with physical stores. For example, a customer can choose from a variety of methods to research (online, in-store, social media), buy (online, in-store), receive (in-store, home, post office, shopping centre) and return (in-store, supplier, home, post office) an item. The result has been retailers working to integrate these various digital and physical channels into their existing business and logistics operations (Yuen & Waters, 2014).

- **Seamless Experience:**

Shoppers interact with companies and retailers through many channels, including the web, mobile and tablet applications, email, kiosks, online chat, and by speaking with customer representatives in a physical location or over the phone. When users engage with an organization through a specific channel, they don't consider it to be the "email channel" or the "web channel" (as companies may internally talk about these touch points), they see it as one of the many interactions that make up their overall user experience with the company (<https://www.nngroup.com/articles/seamless-cross-channel/>).

- **Store Attributes:**

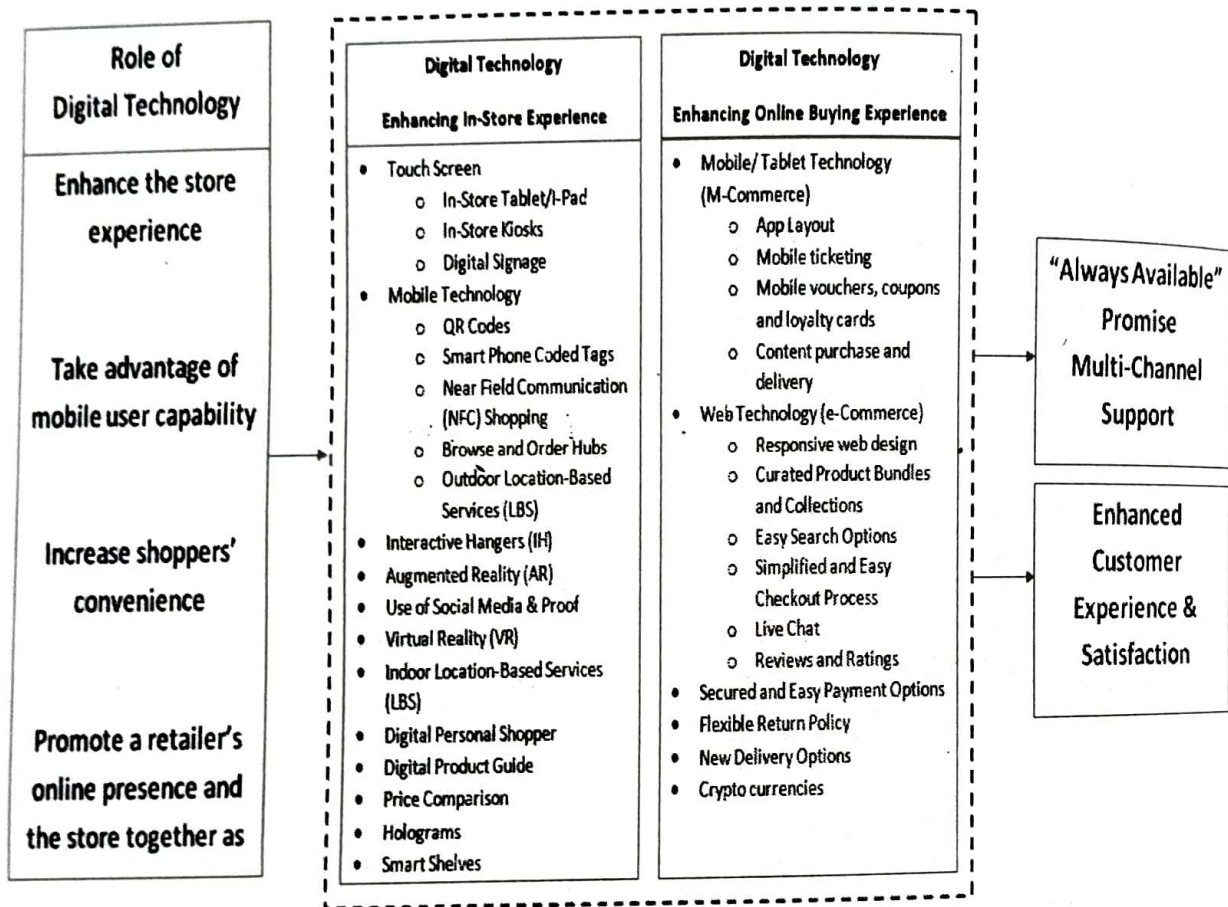
Store attributes refer to specific attributes grouped under each specific store image dimensions which includes, Atmosphere (décor, smell, sound, store atmosphere), Convenience (check-out, travel, location, parking, shopping ease, store hours, transportation), Facilities, Institutional

(clientele, overall impression, store reputation, store association), Merchandise (merchandise assortment, merchandise style, merchandise price merchandise quality), Promotion, Sales personnel and Service (after-sales service, payment options, in-store service, delivery options) (Janse van Noordwyk, 2003).

DIGITAL TECHNOLOGIES THAT ENHANCE THE STORE EXPERIENCE: AN OVERVIEW

Some of the In-Store Digital Technologies that can be leveraged by the retailers include tablet technology, video screens and in-store kiosks, digital signage, interactive hangers, augmented reality, use of social proof, and virtual reality

Number 03: Framework depicting the role of digital technology to enhance shopper satisfaction in the retail store



Source: Prepared by the Author from review of Literature

Tablet Technology:

Touch screens have become key components to the in-store experience. They come in two forms: kiosks and digital signage. Touch screens encourage interactivity and engagement on the part of the user. Some retailers have used tablets to remove checkout desks. Tablets can turn an ordinary dressing room into a place where customers try on new clothes and then capture and share experiences through their social networks.

Giant touch screens on showroom floors could become interactive mirrors people use to assess the potential for new purchases. At some retailers, tablets are made available inside stores in order to capture customers' interest and then lead them to the right product at the right price. Retailers are learning to adapt to shoppers using personal devices before, during, and after purchases.

VIDEO SCREENS AND IN-STORE KIOSKS: TWO FORMS OF TOUCH SCREENS

Retailers such as Tesco and John Lewis have "kiosks" that allow customers to browse product ranges and order items while in store, while brands like Oasis have been using iPads for the same purpose, as have a number of other retailers.

Digital Signage:

Digital Signage promotes engagement in store and encourages customers to take the retail experience with them when they leave the store. Digital signage can connect with content management systems to allow for quick and seamless updates, as well as the ability to either broadcast updates once to any number of devices or custom update each device with localized content.

Interactive Hangers (IH):

IH works when the hanger is picked up by a shopper and triggers pre-programmed visual media to be played on a nearby screen. IH also can be programmed to change lighting, background music, and other media around the store.

Augmented Reality (AR):

AR allows for a digitally enhanced view of the real world. AR can add layers of digital information on top of items in the world around us. It also can be used for reading product reviews, watching videos, and ordering online.

Near Field Communication (NFC) Shopping:

Customers use their smart phones to access information on products and pricing, access loyalty programs, and share content on social media via NFC-enabled shelf edge labels, and scan items added to their basket. When they're done shopping, they can quickly pay for their items by tapping their phone on a reader attached to the cash register.

KEY DISCUSSIONS

As customer demands are evolving ever faster, businesses, and retailers in particular, need to stay abreast in order to remain relevant to shoppers by providing them with seamless, engaging, reliable and trustworthy shopping experiences across several shopping channels and at each customer touch point. Combining different shopping channels and selling across channels is no longer a question of whether or not retailers should do it. Being active across several shopping channels has been identified as an absolute necessity in order to satisfy existing customers, attract new customers while, simultaneously, gaining and maintaining lasting competitive advantage (Ebeltoft Group, 2012). The complexity of the retail marketplace itself forces retailers to adopt a multi-channel stand in order to improve on the products and services they offer.

The approach of cross channel retail strategy has been termed **multichannel retailing** (Berman & Thelen, 2004) with **Omni-channel retailing** that builds upon it. Berman and Thelen (2004) argue that retailers can benefit from multi-channel retailing by growing their customer base, market share, and total sales. On the other hand, each retail channel creates competitive opportunities, challenges and different cross channel priorities. This means that being a multi-channel retailer is a strategically and operationally demanding undertaking that requires substantial planning and a wise allocation of resources and investments.

Thus, each channel requires different strategy, approach and infrastructure that must all unite in one integrated system that can answer and deliver on customers' demands along with the required development of new services, applications and business models.

Retailers need to break down internal barriers in the form of a siloed approach to each channel and customer segment and create a unified consumer strategy across all channels to start integrated customer interactions and to avoid customer confusion. Shared departmental goals focused around enhancing the customer experience and the customer lifetime value will produce more consistent brand messaging and enhanced shopping experience across multiple touch points and channels.

In order to architect dynamic experiences, retailers will need to revolutionize their business models. In fact, every company must be a technology company. If retailers are to meet the demands of the new digital consumer, they will need to innovate faster and better. We have explored the surging number of potential shopping journeys and the kinds of experiences that consumers expect. Given this complexity, most retailers will not be able to transform alone.

Cultivating an ecosystem of partners to help support and guide their transformation journey will be critical, especially as disruption and change continue to accelerate in the Internet of Things [IOE] era. Those retailers that have made significant investments toward hyper-relevance with their existing e-commerce and omnichannel strategies will be in the best position to move forward on this transformation journey. However, complexity will only increase, and retailers must ensure that they have the right partner ecosystem in place in order to accelerate and further evolve their business models.

MANAGERIAL IMPLICATIONS AND CONCLUDING REMARKS

By architecting the dynamic infrastructure and process changes outlined above, retailers can begin to transform their business models and their customer experiences. The resulting innovation at speed and scale will be the key that sets them apart from their competition, and ultimately enables them to win in a challenging new environment.

To get their strategy right, retailers must understand evolving customer behaviours and heed the shoppers of all ages and levels of technology adoption want and do not want. Retail organizations often fail to realize their full return on investment for digital projects. That is because they are implemented in a piecemeal fashion rather than addressed from the top down as a business transformation effort.

Physical stores are not going to disappear. Customers will always have different motivations to shop and hence will be looking for different purchase environments. Retailers need to understand how to address these shopping motivations online and offline. Convenience and comfort are certainly two of the major advantages of the online channel. The online environment also offers a good opportunity to talk to customers about personalised offers and individual recommendations – provided the algorithms are correct and the recommendations are customer-relevant. In this respect, it is important for technology to be seamlessly integrated with human contact in the retail space; otherwise, the social component of the shopping experience will be lost.

This requires the development of strategies prioritising experience oriented elements and promoting shopping as a leisure pursuit, as well as creating a profile that contrasts with the strongly information- and transaction-driven online business. Although retail stores are currently cautious about the significance of personalised offers on the internet, customers have long been accustomed to online retailers knowing their preferences. This leads to an expectation for getting the same personalised service in physical retail stores.

Advice and services should not be limited to the services and products offered in the store, but should actively incorporate omnichannel (service) advice. A good range, excellent sales advice, sales staff boasting cross-channel knowledge and adaptation to special requests of the (online) customer will be success factors for physical stores. A good range, excellent sales advice, sales staff boasting cross-channel knowledge and adaptation to special requests of the (online) customer will be success factors for physical stores.

What are the consequences of the future roles of online transactions and physical stores in an omnichannel retail world and its core services? What do the changes mean for product assortments, staff and marketing, and, ultimately, for the physical store and its retail location?

Assortments will be more focused and specifically tailored to local customer preferences. Demands on staff will increase, in terms of both expertise and cross-channel competency.

In-store marketing must be personalised, digitised, localised and better integrated across all channels. Store formats within a retail network will be more diverse and smaller. The store management will undergo a radical shift. On the other hand, the retail trade has recognised that e-commerce and omnichannel offer the chance to vary and rethink retail concepts

(location, store formats, service offering) and that omnichannel is not necessarily a danger to physical retail, but rather offers a chance to reconfigure. However, to maximise this opportunity the retail trade must undertake extensive change, including its in-store business. The focus is on new processes, management systems, IT infrastructure and even staffing requirements.

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THE IMPACT OF INTERNATIONAL TRADE ON ECONOMIC GROWTH OF RWANDA:

IMPORTS & EXPORTS REVENUE REGRESSION ANALYSIS (1996 TO 2010)

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Abstract

study provides an empirical analysis of international trade represented by exports This revenue and Imports time series that could potentially affect Economic growth in Rwanda in a short as well as in long run perspective. Both the theory and the empirical studies were viewed in order to identify behavior of Economic growth regression model for the period (1996-2010) in terms of the factors described above.

The study used regression analysis as the method of analysis using Johansen cointegration method to find out long run relationship between variables. The estimation of results from cointegration provide evidence of the complex dynamics and relatively run effects between Economic growth and its determinants in this study along with their signs which are consistent with theoretical postulates in long-run. Exports revenue and Imports showed positive effect on Economic growth of Rwanda in the long run.

Keywords: International trade, Import, Export revenue, Economic growth, Time series data and Cointegration

INTRODUCTION

Economic growth is the primary focus of the policymakers especially in the developing countries and the export led growth hypothesis is one of the most highlighted strategies for them. The hypothesis is true in developing countries (Ahumada & Sanguinetti, 1995; Ibrahim, 2002; Awokuse, 2003; Shirazi & Manap, 2005; Dreger & Herzer, 2011; Palley, 2011; Araujo & cz Soares, 2011; Abbas, 2012) and rejected in developed countries (Ibrahim, 2002; Afzal et al., 2009; Kubo, 2011).

Exports are not only important for earning foreign exchange and boost the economic growth (Munemo, 2011) but also influence government revenue, investment, import capacity and producer revenue (Ferreira, 2009).

Exports are not only important for earning foreign exchange and boost the economic growth (Munemo, 2011) but also influence government revenue, investment, import capacity and producer revenue (Ferreira, 2009).

The Rwandan trade policy proposes the objective of strengthening participation in international trade through seeking greater market access and entry opportunities by developing a National Export Strategy; supporting enterprises in finding new markets for exports of Rwanda, especially in Africa, in the EU under EPAs, in Asia and in transition economies; building up and disseminating data and information on tariff and non-tariff measures affecting exports of Rwanda. (MINICOM, 2010)

OBJECTIVE

To see the impact of International trade case of exports and imports on economic growth of Rwanda (1996-2010).

REVIEW OF LITERATURE

The impact of trade on the economic performance of a country is a highly discussed issue in the political debate of both developing and advanced economies. Here we are going to see the contributions of other researchers and their findings.

The openness increases the market for local producers and improves the economic efficiency. Then, it causes the specializing of country in knowledge oriented and research-based production (Harrison 1996).

Krueger (1978), Balassa (1982) and Michaely et al. (1989) used the data of individual country studies to test whether trade has a positive impact on output growth or not. Each of them found a positive impact of trade on growth. (Marius Dominik Osterfeld, 2007:4)

Maizels (1963) discussed the positive relationship between international trade and economic development by a rank correlation analysis among 7 developed countries and He found a positive impact of trade on economic growth. (Ibid)

Coe and Helpman (1995) studied the international R&D diffusion among 21 OECD countries and Israel over the period of 1971-1990, and found that international trade is an important channel of transferring technology.

Balaguer (2002) investigated the empirical linkages between exports and economic growth. The analysis show that more export oriented countries like middle-income countries grow faster than the relatively less export oriented countries. The study also showed that export promotion does not have any significant impact on economic growth for low and high income countries. (Adeleye J. O., 2015)

Kavoussi (1984), after studying 73 middle and low-income developing countries, found out that higher rates of economic growth were strongly correlated with higher rates of export growth. He showed that the positive correlation between exports and growth holds for both middle- and low-income countries, but the effects tend to diminish according to the level of development.

Methodology

This study investigates the Impact of International trade on Economic growth in long-run and in short-run for the case of Rwanda. The following econometric approaches are

Method of Evaluation

We used the following three criteria to evaluate the results obtained from the regression analysis.

Evaluation based on economic criteria (Signs Expectation)

Many theoretical models and theories suppose international trade to enhance economic growth. They suggest several chains through which higher trade share positively influence income per capita.

Evaluation based on statistical criteria

According to GUJARATI, D.N (2006:126) there is two mutually complementary approaches of hypothesis testing which is concerned with developing rules or procedures for deciding whether to reject or not the null hypothesis, namely confidence interval and test of significance.

• The coefficient of determination (R^2)

The (R^2) is a summary measure that tells us if the sample regression line fits the data (Gujarat: 2007:83). It is also known as goodness of fit. It tells us by what percentage the variation in the dependent variable is explained by the independent variable of the model.

• The T-Test

The test is carried out to ascertain whether the individual variables are statistical significant or not to determine investment decisions.

• The F-Test

This is used to test the overall statistical significance of the variables.

Evaluation based on Econometrics criteria

• Cointegration test

The cointegration test measures relationships between Impact of International trade on Economic growth in the long run while the VECM is utilized to examine the short-run aspects. If cointegration is found, it means that between set of variables there is long run relationship.

• Stability test

Stability diagnostics to measure parameter constancy is a critical issue for investment equations. The CUSUM test statistics is adopted in the study.

• Normality Test

This test is carried out to check whether the error term follows normal distributions. The normality test we have opted for is the Jarque Bera (JB) statistic, which follows the Chi-Square distribution.

• Serial correlation test

This test is carried out to check whether the errors corresponding to different observations are serially correlated or not.

• Heteroscedasticity Test

This test is used to test whether the error term in the regression model have a common or constant variance. The ARCH heteroscedasticity test is adopted.

Presentation, Analysis And Interpretation Of Results

The analysis has been done with the stated software and their interpretation has its roots on statistical notions and criteria.

All these were to try to find out the relationship between variables whether it is positive or negative, the model and parameters (its coefficients) estimated are statistically significant.

Data Presentation

A time series is a set of observations on the values that a variable takes at different times. Time series is stationary if its mean and variance do not vary systematically over time. (GUJARATI N.D, 2006)

This research used the time series data of GDP (current price US\$), Export (current US\$) and Import (Current US\$) from 1996 to 2010 from World Development Indicators (WDI).

Presentation Of Results

Specification of the model

The long-run GDP function is stated as follows:

$$LGDP = \beta_0 + \beta_1 LEXP_t + \beta_2 LIMP_t + \varepsilon_t$$

Where:

LGDP: Is Gross domestic product in logarithmic form as dependent variable

LEXP_t: Exports in logarithmic form at period t.

LIMP_t: Imports in logarithmic form at period t.

β_0 , β_1 and β_2 are coefficients and ε_t represents an error term which is assumed to be a white noise error.

<i>Variable</i>	<i>Description</i>	<i>Expected sign</i>
Lgdp	Gross domestic product	
Lexp	Exports	Positive
Limp	Imports	Positive

Source: Author's Design from economic theories

Table 4.1: Expected sign

Method Applications, Results And Discussion

In the first step, the variables are tested for stationarity using Augmented Dickey-Fuller (ADF) tests. The second step involves testing for cointegration among the integrated variables. In this paper, the Johansen (1991) maximum likelihood procedure is used. Provided that one or more cointegrating relationships exist, the third step of the standard procedure involves the estimation of a VEC specification containing the cointegrating relationship(s), lagged first differences of the variables in the cointegrating relationship(s), and any stationary variables thought to influence Gross domestic product

Testing for stationarity

At the first step, the Augmented Dickey –Fuller (ADF) (Dickey and Fuller, 1981) unit root test is applied to all the variables to test for their stationarity. The test is applied to both the original series (in log form) and to the first differences. Results of this test are reported below.

a) Augmented Dickey-Fuller (ADF) test for variables in levels.

The results indicated that the series are non-stationary at their level when including trend and intercept, only included intercept and none of them.

Variable	Trend and intercept		Intercept		None	
	<i>t-test statistics</i>	<i>Lag Length</i>	<i>t-test statistics</i>	<i>Lag Length</i>	<i>t-test statistics</i>	<i>Lag Length</i>
ΔLGDP	-0.63	3	-2.84*	3	-2.09**	3
ΔLEXP	-3.60*	3	-4.42***	3	-	-
ΔLIMP	0.22	3	-1.88	3	2.19**	3

Source: E-views 7, from the data entered by Researcher

b) Table 4.2: Augmented Dickey-Fuller (ADF) test for variables in first difference.

*, ** and *** indicates rejection of the null hypothesis of unit root at 10%, 5% and 1% significant level, respectively.

When taking the first difference of the variables, the above table shows that the variables become stationary which mean that, these series are integrated of order one, I(1).

Cointegration test

Unrestricted Cointegration Rank Test (Trace)

<i>Hypothesized No. of CE(s)</i>	<i>Eigenvalue</i>	<i>Trace Statistic</i>	<i>0.05 Critical Value</i>	<i>Prob. **</i>
None *	0.908837	56.60188	35.01090	0.0001
At most 1 *	0.666663	25.46550	18.39771	0.0044
At most 2 *	0.576958	11.18370	3.841466	0.0008

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: E-views 7, from the data entered by Researcher

This test shows that there is cointegration, meaning that there is long run relationship between variables.

Normalized Cointegrating Equations

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LEXP	LIMP
1.000000	-0.654253	-0.435960
	(0.10297)	(0.09702)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	0.181226
	(0.35656)
D(LEXP)	2.790058
	(0.42431)
D(LIMP)	0.747269
	(0.52087)

Based on the results shown above, the cointegrating vector representing the long-run function is as follows:

$$LGDP_t = 0.63 + 0.65 LEXP_t + 0.43 LIMP_t + \varepsilon_t$$

In this equation, all the estimates of the coefficients of the variables have the correct sign and are statistically significant.

The slope of exports suggests that 1 unit increase in exports leads to 0.65 units boost in GDP in long-run, ceteris paribus.

The slope of import has also positive relationship with GDP growth. Its coefficient indicates that 1 unit increase in imports of raw materials leads to 0.43 units increase in GDP growth.

The value of R^2 is 0.65 which shows that about 65 % variation in GDP growth is explained by the exports, imports ceteris Paribus.

Dynamic error correction model

After the determination of cointegrating relationship, the next step is to estimate the short-run GDP using Vector error correction model (VECM). The short-run model coefficients measure the dynamics of the model, VECM measures the speed of adjustment to the long run equilibrium which is taking place.

Variable	Coefficient	Probability
CONSTANT	0.01	0.10
$\Delta LEXP_{t-1}$	0.16	0.37
$\Delta LIMP_{t-1}$	0.30	0.61
$VECM_{t-1}$	-0.18	0.62
R-squared: 0.65		

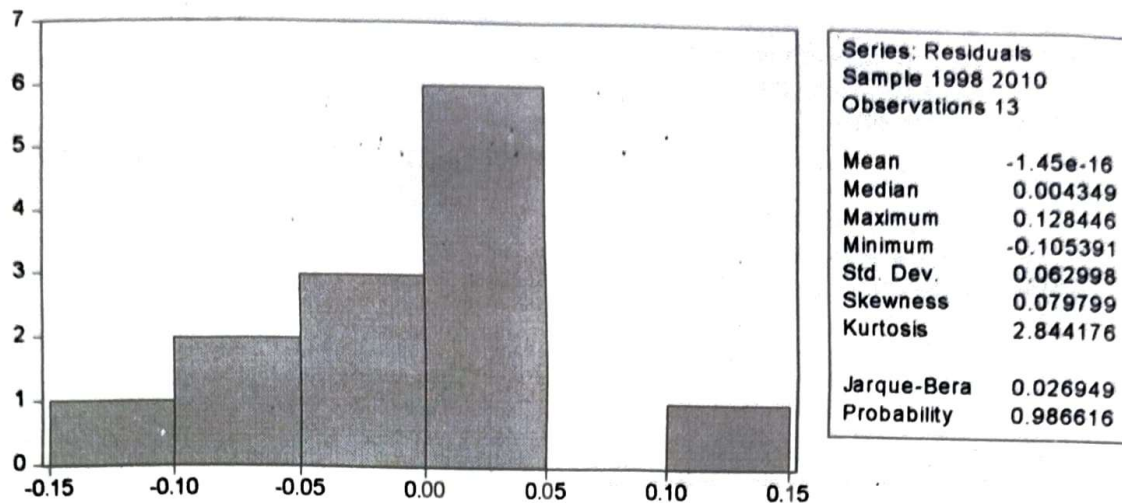
Source: E-view 7

Table 4.3: Short-run model of the International Trade

*, ** and *** indicates rejection of the null hypothesis at 10%, 5% and 1% significant level, respectively.

All estimated coefficients of included variables are consistent with economic theory, but they are not significant in short run.

2.2.4 Diagnostic test
After testing the VEC equation, the supplementary tests are necessary to verify if the hypothesis of classical regression are confirmed.



Source: E-view 7

Figure 4.1: Jarque-bera test (normality test)

The assumptions of this test are as follows:

H_0 (Null hypothesis): The residuals are normally distributed.

H_1 : The residuals are not normally distributed.

The null hypothesis is rejected when the probability is less than 10%.

The null hypothesis is not rejected means that residuals are normally distributed because the probability of 98 % is greater than the significant level of 10%. This means that the error of the previous year can not affect the next.

Heteroskedasticity Test: ARCH

F-statistic	1.189031	Prob. F(1,10)	0.3011
Obs*R-squared	1.275211	Prob. Chi-Square(1)	0.2588

Source: E-view 7

Table 4.4: ARCH heteroscedasticity test

H_0 = the model is homocedastic.

H_1 = the model is heteroscedastic.

White heteroscedasticity proves that there is no heteroscedasticity as the probability of obs*R-squared (25.8%) is greater than 10% level of significance. This means that our model is homoscedastic and model is fit for analysis.

Table 5: Serial correlation test: CORROLEGRAM Q-STAT

Date: 15/10/16 Time: 00:15

Sample: 1996 2010

Included observations: 13

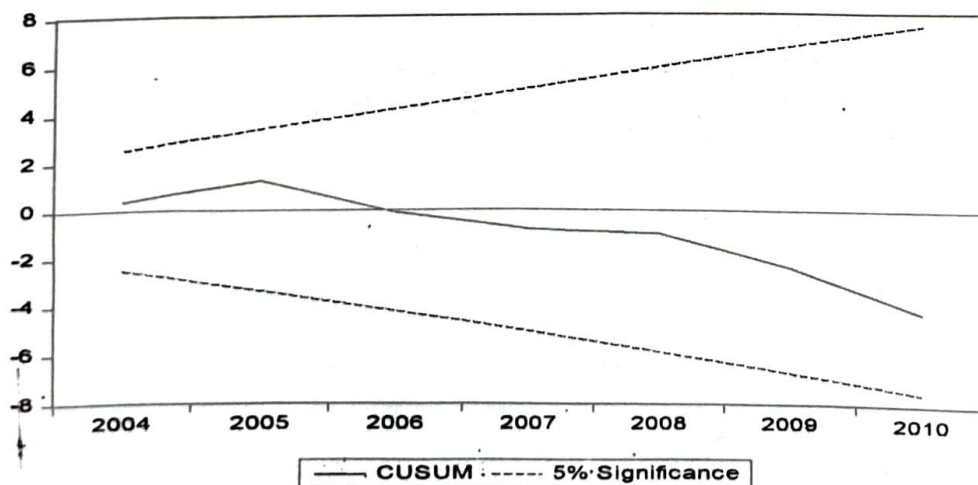
Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
. * .	. * .	1	0.171	0.171	0.4748	0.491
. * .	. * .	2	0.129	0.103	0.7691	0.681
** .	** .	3	-0.235	-0.284	1.8476	0.605
* .	. .	4	-0.129	-0.063	2.2057	0.698
* .	. .	5	-0.108	-0.005	2.4903	0.778
** .	*** .	6	-0.297	-0.357	4.9487	0.550
** .	** .	7	-0.312	-0.318	8.1048	0.323
* .	. .	8	-0.114	0.008	8.6103	0.376
. * .	. .	9	0.106	0.022	9.1552	0.423
. ** .	. .	10	0.217	-0.043	12.208	0.271
. .	. * .	11	0.051	-0.146	12.464	0.330
. .	. * .	12	0.021	-0.101	12.549	0.403

Ho: No serial correlation (errors are not correlated).

H1: There is serial correlation.

The null hypothesis is rejected when the probability is less than 10%.

The results show that there is no serial correlation up to the 12th lag, because all probabilities are greater than 10% level of significance.

Figure 2: STABILITY TEST: CUSUM TEST

As the plots of these two tests are within the critical value line, it shows parameters are stable.

CONCLUSIONS & RECOMMENDATIONS

At the end of this paper whose topic: "The impact of International trade (exports revenue and Import duties) on Economic growth of Rwanda (1996-2010), the main objective was to analyze econometrically the impact of International trade on economic growth of Rwanda.

The coefficient of exports (0.65) shows that one percent increase in exports leads to 0.65 rate change (slope) in GDP in long-run, *ceteris paribus*.

The coefficient of imports (0.43) indicates that, *ceteris paribus*, one percent increase in imports leads to 0.43 rate of change (slope) in GDP.

And only 65% of Rwandan Economic growth is explained by International trade and 35% of Economic growth is explained by other factors.

Using Eview 7 software, we determined the long run impact of international trade on Rwandan Economic growth using the Data collected from WDI, MINECOFFIN and BNR based on the result of Cointegration test and on STABILITY TEST: CUSUM TEST testing the stability of coefficients we found out that the plots of these two tests are within the critical value line, it shows parameters are stable.

And we realized that both exports revenue and imports as indicators of International trade and economic growth of Rwanda; GDP as indicator varies in the same direction other things remain constant (*Ceteris paribus*).

In this direction of econometric analysis, we accepted and confirmed the alternative hypothesis which stated that the international trade has a positive and significant impact on economic growth of Rwanda in the period of 1996-2010.

In nut shell, international trade has positive impact on the economy of Rwanda. The Rwandan economy can be better if Government should adopt multipurpose strategies such as export promotion policy as targeted in EDPRS 2, improving fiscal policy, monetary policies and eradicate anticompetitive market practices. Moreover, Government should decrease the imports of costly products with suitable policies and prefer to prepare all required things inside the country.

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A STUDY OF THE AQUACULTURE PRODUCTION (SHRIMPS) IN INDIA WITH SPECIAL REFERENCE TO GUJARAT STATE

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Abstract

'High risk – High return': this sum up the whole shrimp aquaculture farming industry. Even though the industry has experienced a transformation in terms of adoption of scientific and modern techniques of farming, shrimp farming has not become any less risky. Weather it is small rural farmer or a corporate farmer, the level of risk does not change as it originates from the species cultivated and it's grow out phase operations.

Shrimp farming in India is influenced by cultivation of two major species. P Monodon and L. Vannamei. P monodon was extensively cultured throughout India by shrimp farmers owing to its large size and higher prices. With passage of time, P monodon species of shrimp started to lose its popularity among shrimp farmers, and under such circumstances L Vannamei species of shrimp entered the Indian shrimp aquaculture industry and was instantly adopted by the farmers as the most cultivated shrimp species in India.

Vannamei species due to its higher resistance and availability of SPF and SPR seeds allows higher stocking density in culture ponds and thereby obtaining higher production of shrimps. After 2009-10 Indian shrimp industry has witnessed a big growth in the total shrimp production in the country, which came from a relatively new species L. Vannamei that was on its way to become the most cultured shrimp species in India.

This paper is an effort to study the production trend and productivity along with the reasons and circumstances that led to a shift from tiger to vannamei among the shrimp farmers in India and studies the pattern of Shrimp aquaculture production in India with reference to Gujarat state.

ABOUT AQUACULTURE

Aquaculture has been defined by the Japanese Resource Council, Science and Technology Agency as under:

"Aquaculture is an industrial process of raising aquatic organisms up to final commercial production within properly partitioned aquatic areas, controlling the environmental factors and administering the life history of the organism positively and it has to be considered as an independent industry from the fisheries hitherto."

The two essential factors that together distinguish aquaculture from capture fisheries are:

- Intervention to enhance the stock
- Ownership of the stock.

Aquaculture remains one of the fastest growing food producing sectors by setting another all time production high and now provides almost half of all fish for human food. Asia accounts for about 88% of world aquaculture production by volume.

Aquaculture in India has a long history; there are references to fish culture in Kautilya's Arthashastra (321 – 300 B.C.) and King Someswara's Manasoltara (1127 A.D.). Indian aquaculture has demonstrated a six and half fold growth over the last two decades, with freshwater aquaculture contributing over 95% of the total aquaculture production.

India's aquaculture production basically can be classified into freshwater and brackish water production. Shrimp farming in India took a negative turn in 1995 with the occurrence of WSSV (white spot syndrome virus) disease outbreak. Simultaneously environmental and legal issues also surfaced.

About The Species:

Term 'shrimp' originated in around 14th century with middle English 'shrimpe' and also to middle low german 'schrempen' meaning to contract or wrinkle. The term shrimps and prawns are common English names used synonymously due to the absence of systematic basis to mark a distinction.

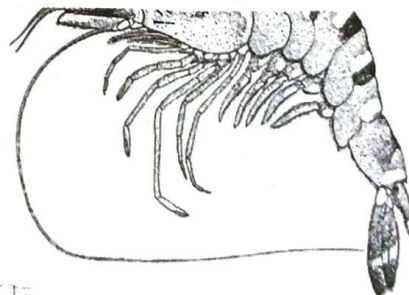
According to the English oxford dictionary shrimp and prawns are defined as follows:

Shrimp: "a small free swimming crustacean with an elongated body, typically marine and frequently of commercial importance as food"

Penaeus Monodon Fabricius, (Giant Tiger Prawn / Black Tiger Prawn)

Named for its huge size and banded tail, *P. monodon* accounted for most of the farmed shrimp coming out of Asia, but it's now been taken over by *P. vannamei* over the past couple of years. Native to the Indian Ocean and the southwestern Pacific Ocean from Japan to Australia, "tigers" are the largest

Fig: 1 – Giant Tiger Prawn

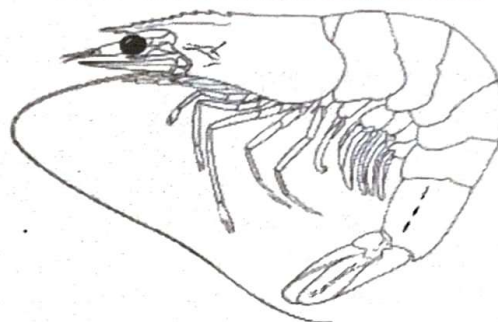


(maximum length 363 millimeters) and fastest growing of the farmed shrimp. They tolerate a wide range of salinities, but shortages of wild broodstock often exist, captive breeding is difficult and hatchery survivals are low (20 to 30%). Tigers are very susceptible to two of the most lethal shrimp viruses: yellowhead and whitespot. The giant tiger prawn inhabits the coasts of Australia, South East Asia, South Asia and East Africa. It can achieve a maximum size (TL): females, 35cm and males 26.8 cm

Penaeus (Litopenaeus) Vannamei (Pacific White Shrimp)

Native to the Pacific coast of Central and South America (from Mexico to Peru), this is the leading farm raised species in the Western Hemisphere, representing more than 95% of production. Because vannamei feeds on organisms which grow naturally in the pond, it is cheaper to feed than monodon.

Fig: 2 - penaeus (litopenaeus) vannamei



White shrimp can be stocked at small sizes, have a uniform growth rate and reach a maximum length of 230 millimeters. It is mainly found on mud bottoms, down to a depth of 75 m. It is greyish white in color. The maximum weight of females in the wild is about 120 g. The males are smaller at 60-80g. Its Maximum size is about 23 cm.

CHANGING PRODUCTION PATTERN IN INDIAN SHRIMP AQUACULTURE INDUSTRY

India is the second largest producer of fish in the world contributing to 5.68% of global fish production. The fisheries sector is a source of livelihood for over 14.49 million people engaged fully, partially or in subsidiary activities pertaining to the sector. Over the years Indian Shrimp aquaculture industry has seen a shift in its production pattern. While the total quantity of shrimp produced in country has increased on a yearly basis, the species of shrimp cultivated has seen a sudden shift.

Table: 1 Total shrimp & Scampi production

(AUC: ha) (EP: MT)

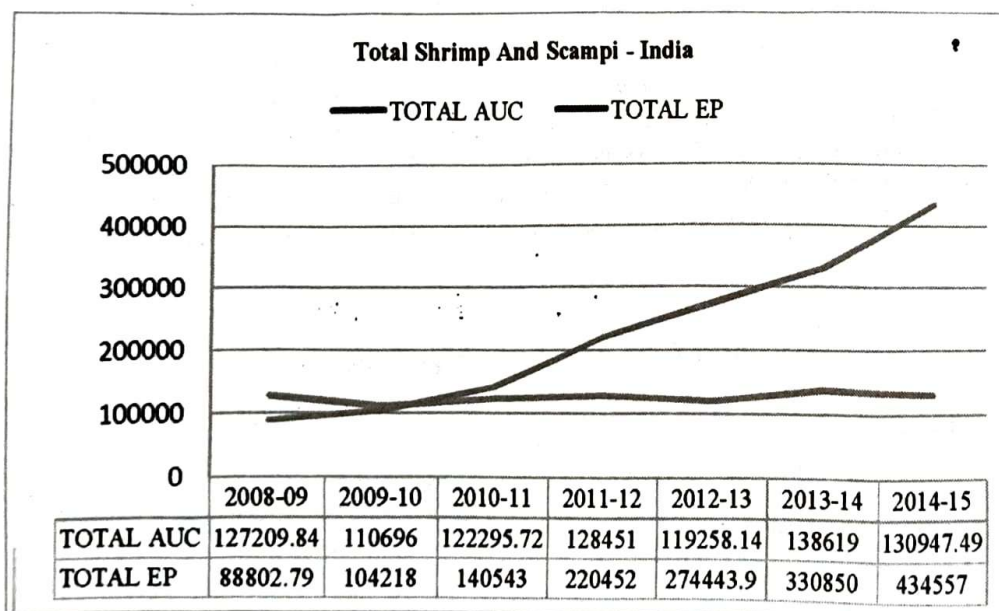
Total Shrimp & Scampi Production								
Species		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Tiger Shrimp	AU	108788.	1022	113853	1143	93110.4	7217	71400
	C	7	59		70	3	7	
	EP	75996.5	9591	118575	1354	123302.	7679	73155
		4	9		66	7	8	
L Vanna mei	AU	0	283	2931	7837	22715.7	5726	50240
	C					1	7	

	EP	0	1731	18247	8071 7	147516. 2	2505 07	353413
Scampi	AU C	18421.1 4	8154	5511.72	6244	3432	9175	9307.49
	EP	12806.2 5	6568	3721	4269	3625	3545	7989
Total	AU C	127209. 84	1106 96	122295. 72	1284 51	119258. 14	1386 19	130947. 49
	EP	88802.7 9	1042 18	140543	2204 52	274443. 9	3308 50	434557

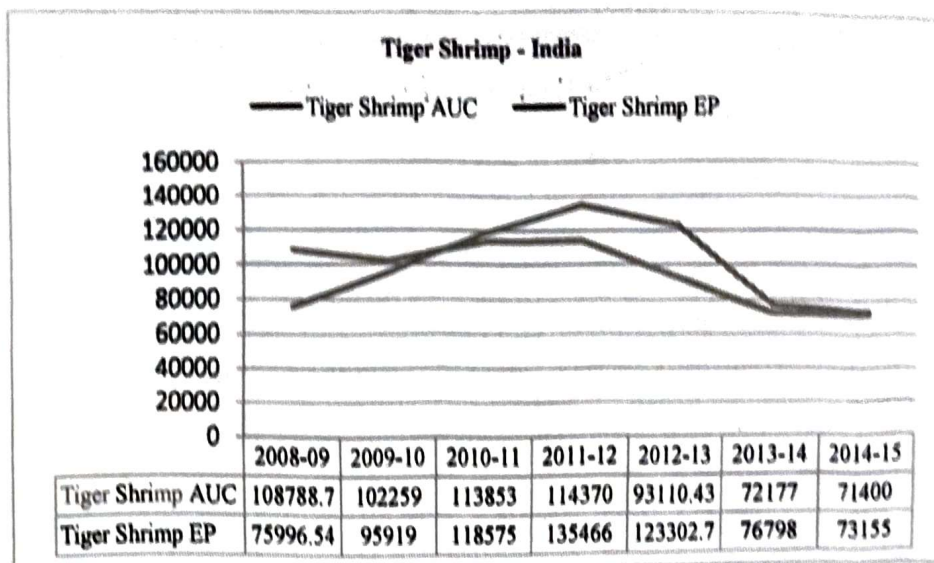
(Source: mpeda, 2016)

Indian shrimp aquaculture industry mainly comprises of three species: *P. Monodon* commonly known as tiger shrimp, *L. Vannamei* commonly known as Pacific white shrimp and Scampi. The total shrimp and scampi production in 2014-15 reached a record level at 434557 MT. This production came from nearly 130947 ha of culture area spread across nine states resulting in an overall productivity of more than 3 MT/ha/year. This increased productivity largely came from the recent switch from Tiger shrimp to the use of vannamei shrimps which achieved a productivity of over 7 MT/ha/year in the same period.

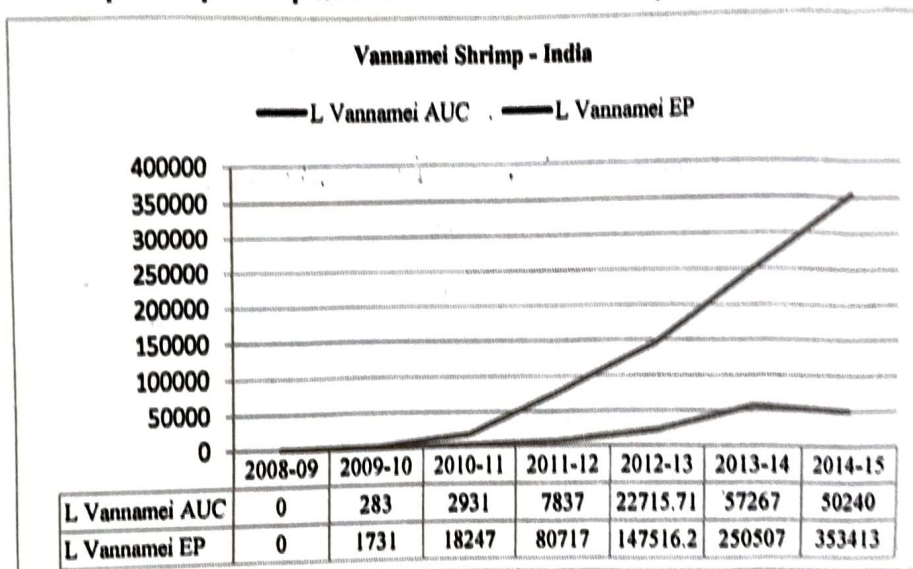
Graph: 1 Graphical Representation of Total Shrimp and Scampi Production In India



Graph: 2 Graphical Representation of Total Tiger Shrimp In India



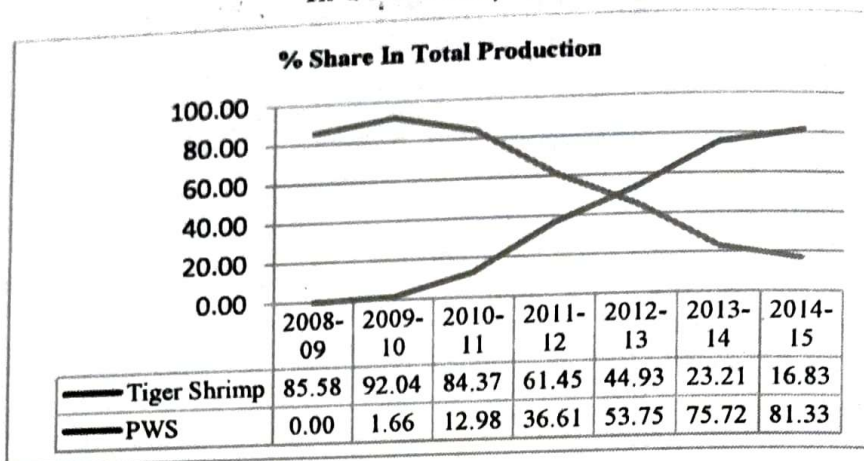
Graph: 3 Graphical Representation of Total Vannamei Shrimp Production In India



FROM THE ABOVE DATA FOLLOWING OBSERVATION WERE DRAWN

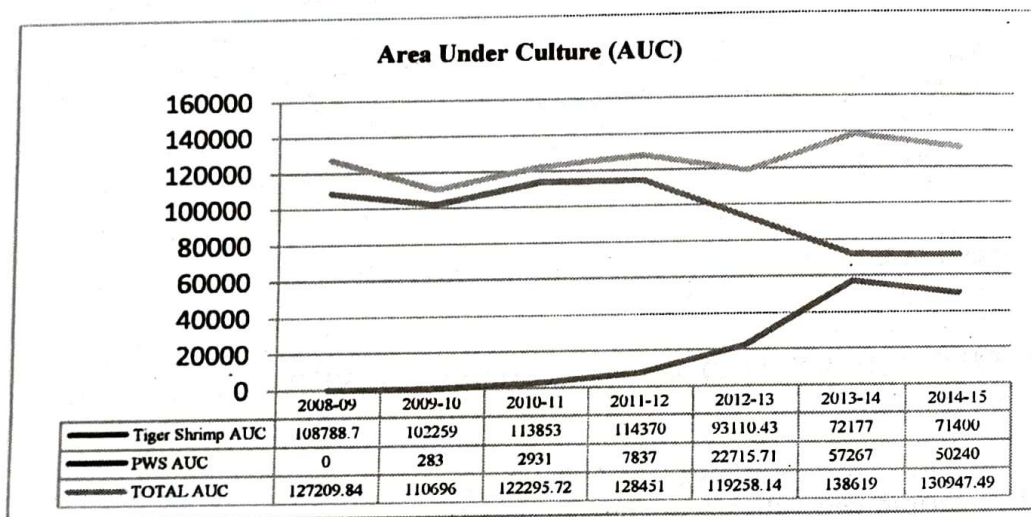
- Cultivation of PWS began in India during the period of 2009-10. Before that shrimp cultivation was mainly carried out using *P monodon* species. In 2008-09 *P monodon* contributed nearly 85% of the total production in the country. Remaining 15% came from scampi.
- In 2014-15 the total shrimp and scampi production in India grew by around 31% as compared to 2013-14 to nearly 434557 MT. *P monodon* contributed almost 17%, while PWS contributed 81%, the remaining came from scampi.
- Production of vannamei shrimps in 2014-15 grew by nearly 41% yoy as compared to previous year i.e. 2013-14, while the area under culture for vannamei shrimps was reduced by more than 12% for the same period.
- Production of tiger shrimps witnessed a sharp decline from 2009-10 and the trend continues till date.

Graph: 4 Graphical Representation of % Share of Tiger & Vannamei Shrimp In Total Production



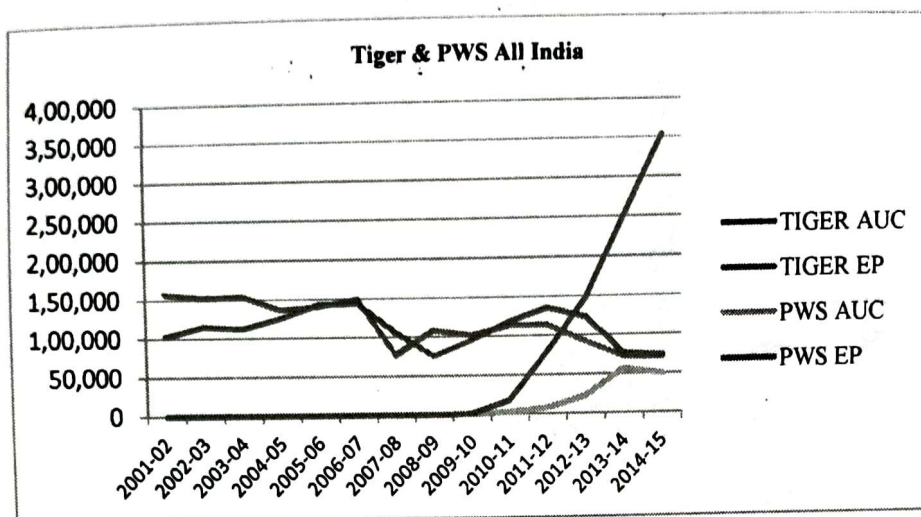
- Area under culture for total shrimp cultivation remained stable. The decrease in AUC for P monodon was compensated for an increase in the AUC for PWS culture.

Graph: 5 Graphical Representation of Total Area Under Culture In India



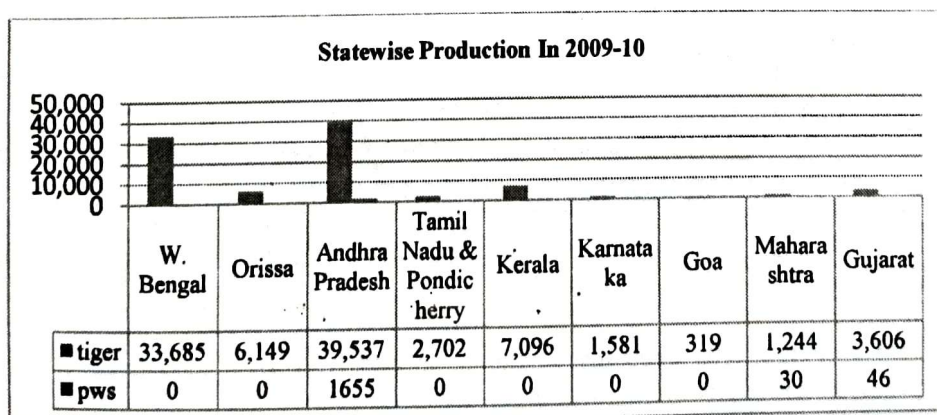
- Indian shrimp aquaculture based on higher growth potential witnesses a continuous increase in the total area under culture for shrimp farming.
- After 2009-10, the production of vannamei was rising manifolds, production of Tiger shrimps was witnessing constant drop. This growth in vannamei shrimps came at an overall lesser area under culture for vannamei shrimps as compared to tiger shrimps in the country.
- One of the driving force behind the shift in the choice for culture species came from the fact that vannamei offered considerably higher productivity per ha/year as compared to tiger shrimps.

Graph: 6 Graphical Representation of Total Shrimp Production And AUC In India



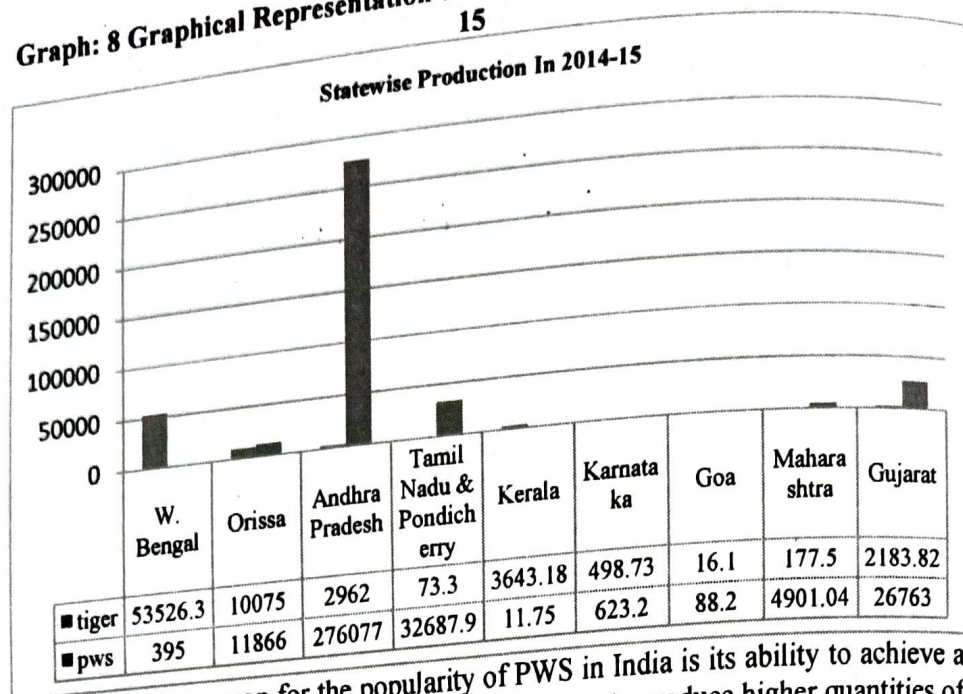
- Around 2006-07 Aquaculture farmers experienced major setbacks and problems due to the species characteristics and resulted in production loss. Since then Production of *P. Monodon* species of shrimp experienced a steady decline in India.
- In the year 2009-10 when the vannamei shrimp were first introduced, only three states out of the 9 aquaculture producing states in India cultured vannamei. In that year the total tiger shrimp produced were 95919 MT as compared to 1731 MT of vannamei shrimps. The production of tiger shrimps was more than 55 times to that of vannamei shrimps.
- In 2009-10 production of vannamei in Andhra Pradesh amounted to 1655 MT, Maharashtra produced 30 MT and Gujarat produced 46 MT.
- In terms of Tiger shrimp West Bengal and Andhra Pradesh were the major producing states in 2009-10

Graph: 7 Graphical Representation of State Wise Shrimp Production in 2009-10



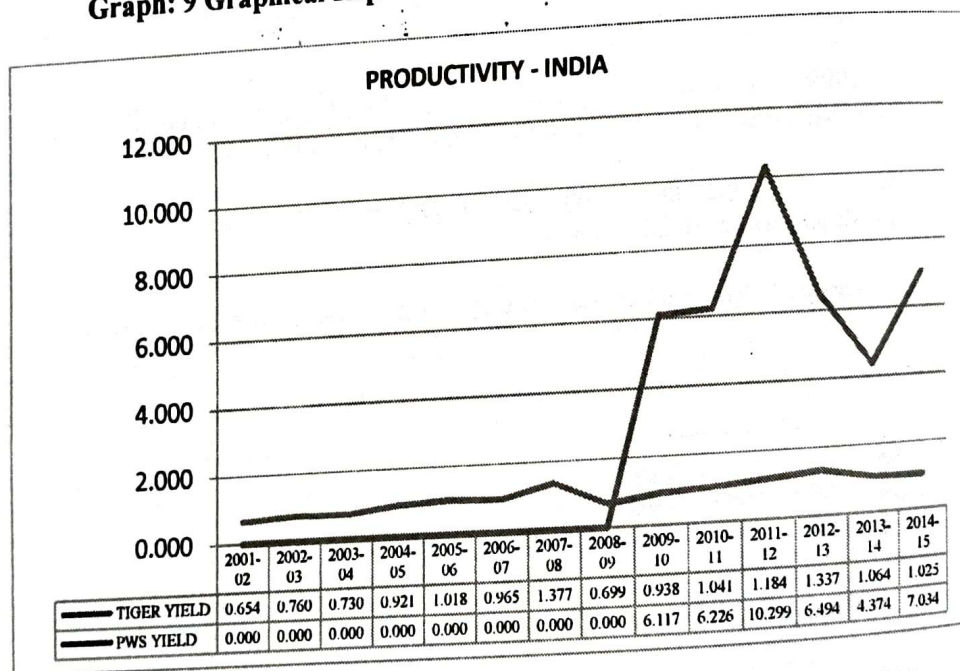
- Production of vannamei shrimps were nearly 5 times to that of tiger shrimps during that year. West Bengal produced nearly 73% of the total tiger shrimps produced, while AP contributed 78% of the total Vannamei Shrimps produced in the country.

Graph: 8 Graphical Representation of State Wise Shrimp Production in 2014.
15



- A major reason for the popularity of PWS in India is its ability to achieve a better yield and thereby allowing the farmers to produce higher quantities of farmed shrimps. Higher resistance to diseases and availability of SPF and SPR seeds of vannamei shrimps results in higher growth rate and better culture of vannamei shrimps as compared to tiger shrimps.

Graph: 9 Graphical Representation Productivity In India

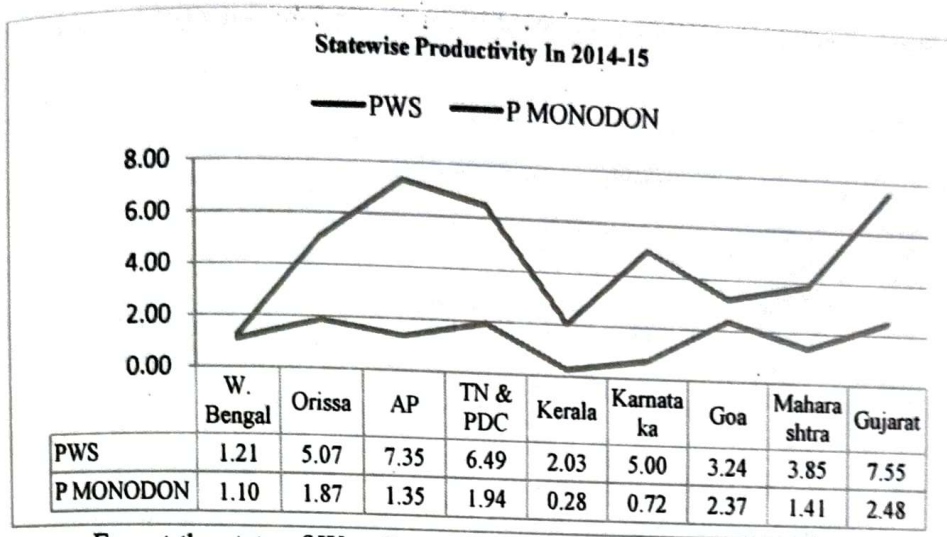


- In the year 2009-10, when the vannamei shrimp were first introduced, it achieved a productivity of more than 6 MT/ha/year as compared to 0.9 MT/ha/year for tiger shrimps, which had been cultivated from a very long time in India.
- Since the beginning of culture operations in India, vannamei shrimp recorded a constant rise in its yield until 2011-12 where in disease and other

external threats caused production losses for the vannamei farmers across the country. Even during these period of risks and diseases, the yield for vannamei shrimps were still considerably higher than that of tiger shrimps.

- In 2014-15 the productivity of vannamei reached over 7 MT/ha/year, while tiger shrimps managed a little over 1 MT/ha/year.

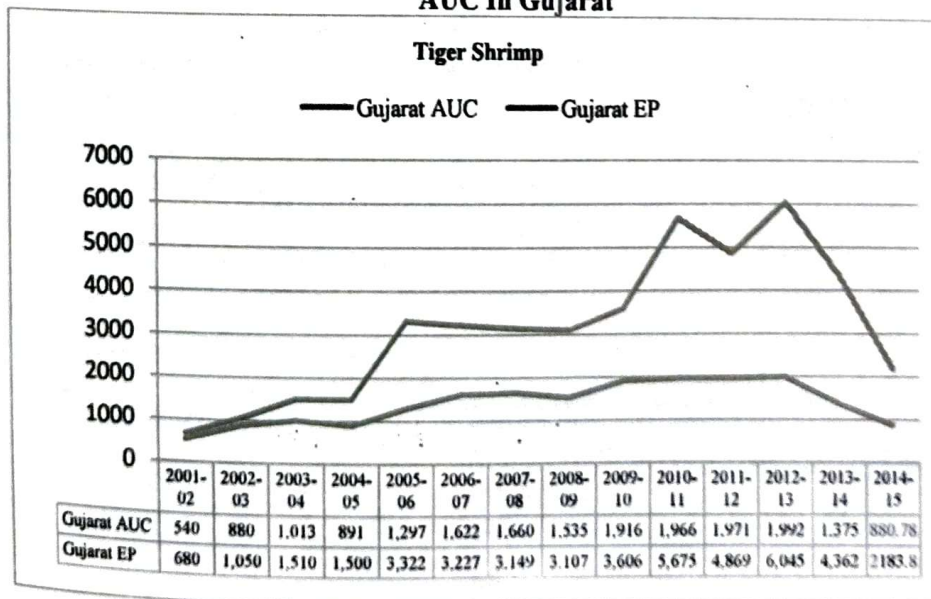
Graph: 10 Graphical Representation of State Wise Productivity in 2014-15



- Except the state of West Bengal every other aquaculture shrimp producing state in India showed a considerably gap between the productivity levels of Tiger and vannamei Shrimps.
- During 2014-15 Gujarat state recorded the highest yield, both for vannamei (7.55 MT/ha/year) and tiger shrimps (2.48 MT/ha/year). However the yield for vannamei was 3 times more that of tiger shrimps.

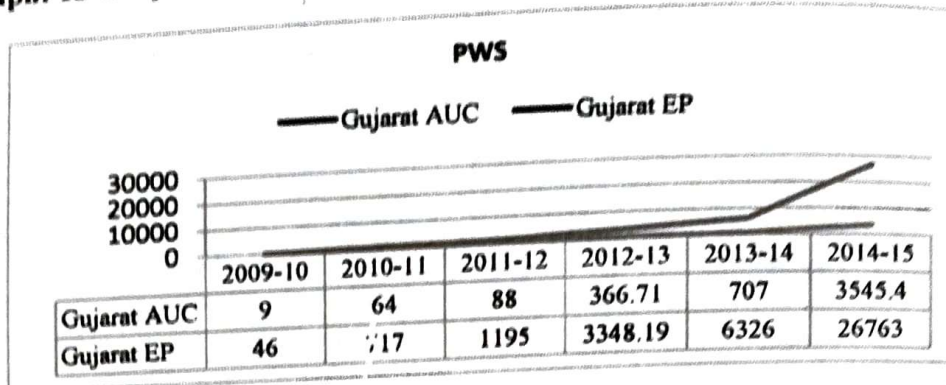
GUJARAT

Graph: 11 Graphical Representation of Tiger Shrimp Production And AUC In Gujarat



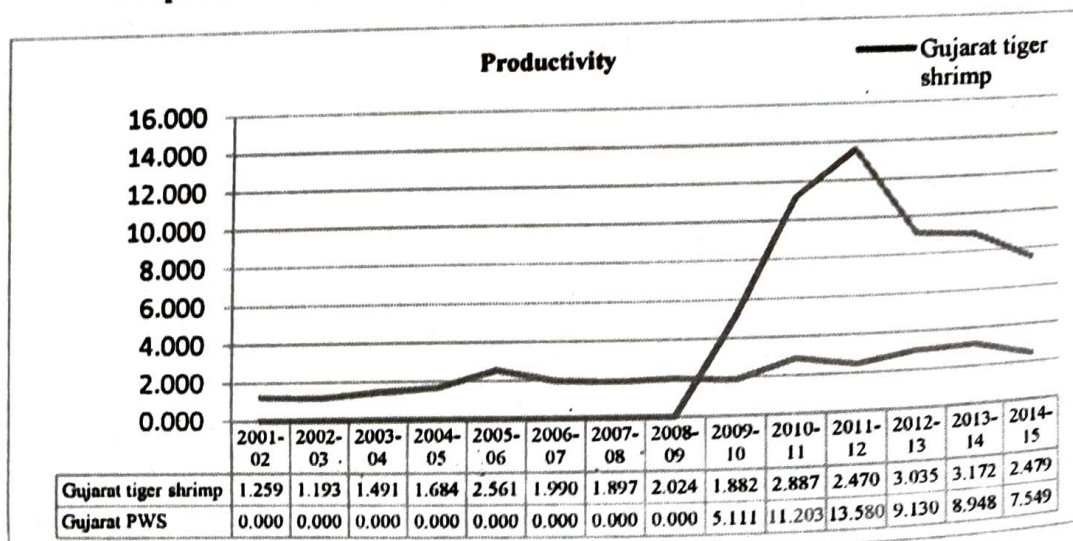
- Gujarat witnessed a booming growth in shrimp aquaculture production with 680MT in 2001-02 to 6045MT in 2012-13. Area under culture also continuously rose during this period.
- 2012-13 witnessed problems in tiger shrimp cultivation in terms of diseases and other external pressures, which lead to downfall in its production. The Shrimp farmers now started adopting Vannamei species with an expectation of lower risks exposure as compared to tiger shrimps.

Graph: 12 Graphical Representation of PWS Production And AUC In Gujarat



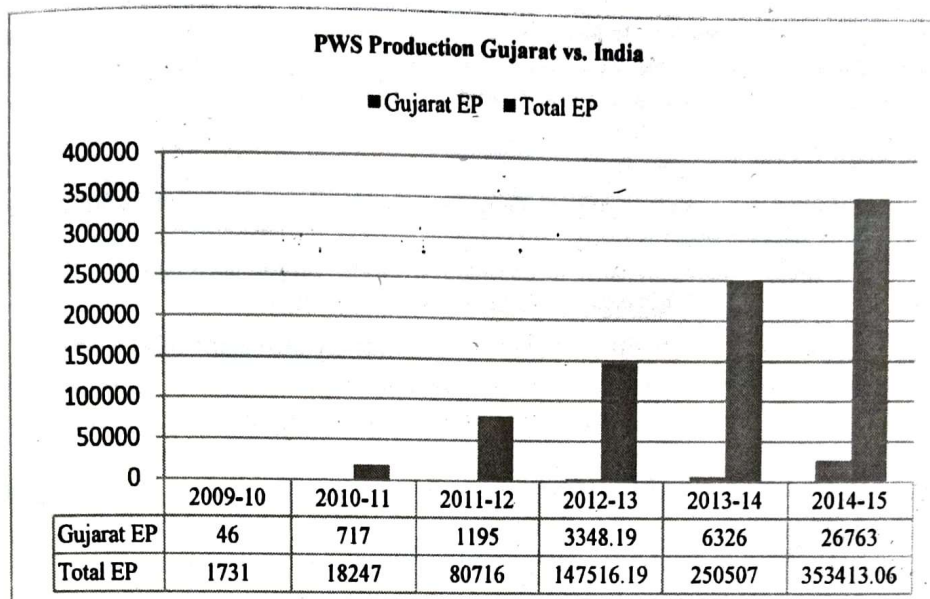
- Vannamei shrimp production in Gujarat experienced a compounding since the year it was introduced till 2014-15. The production as well as the area under culture for vannamei shrimps witnessed a continuous growth during this period.
- In 2009-10 the area under culture for vannamei shrimps in Gujarat was 9ha which produced a total quantity of 46MT.
- In 2014-15 the area under culture of vannamei shrimps in Gujarat was more than 3545 ha which produced a total of 26763 MT. In an absolute measure the increase was 581 times as compared to 2009-10

Graph: 13 Graphical Representation of Productivity In Gujarat



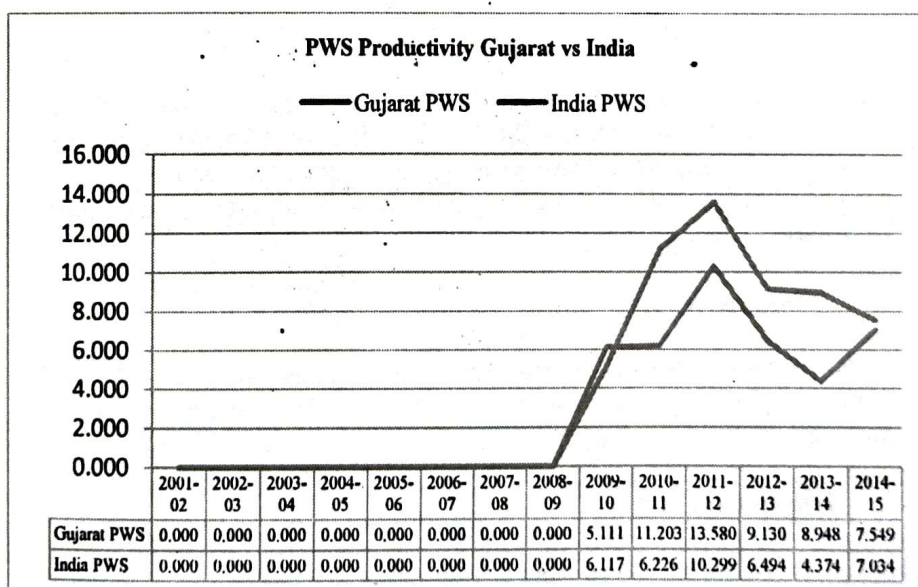
Gujarat possesses more than 89340 ha of brackishwater land which is suitable for shrimp farming, out of which nearly 5000 ha is used for shrimp aquaculture. Suitable Brackishwater Aquaculture Land Available And Alloted In State

Graph: 14 Graphical Representation of PWS Production In Gujarat As Compared To India



- In 2014-15 Gujarat produced 26763 MT of vannamei shrimps, but it contributed only 13% to the overall production of the country. This ratio has been steadily rising over the years but still there lies a huge growth potential.

Graph: 15 Graphical Representation of PWS Productivity In Gujarat As Compared to India



- In terms of Productivity Gujarat outperforms every other aquaculture shrimp producing state in India.
- In 2009-10 Gujarat had a productivity of a 5.11 MT/ha/year which was lower than the country average of 6.11 MT/ha.

- In 2014-15 the productivity of vannamei shrimp culture in Gujarat was 7.55 MT/ha/year as compared to country average of 7.03 MT/ha/year.

CONTRIBUTING FACTORS TOWARDS THE GROWING POPULARITY OF L.VANNAMEI SHRIMPS

The main reason behind the success of *P. vannamei* has been the perceived poor performance, slow growth rate and disease susceptibility of *P. monodon*. Lower resistance towards diseases and non availability of SPF seeds are some of the major disadvantages of *P. Monodon*.

- There is a sparse supply of wild seed for stocking; as a result wild fry are usually expensive.
- Gravid females are difficult to obtain from the wild in sufficient numbers to support a large hatchery.
- Females are more difficult to mature in captivity than many other species.
- It takes a long growing period to reach the large size which commands the best price. This increases risk of heavy losses from typhoons and other natural disasters.
- It is difficult to harvest because it does not have a pond with discharged water as readily as other species.
- The head to tail ratio is not as good as that of some other species.

Advantages Of Vannamei Shrimps:

- ***Growth rate***

L. Vannamei has the potential to grow as fast as *P. Monodon* (at up to 3 g/wk) up to 20 g (the maximum size of *P. Vannamei* usually cultured) under intensive culture conditions (up to 150/m²).

- ***Stocking density***

L. Vannamei are open to culture at very high stocking densities of up to 150/m² in pond culture, and even as high as 400/m² in controlled recirculated tank culture. *P. Monodon* can be aggressive, have high protein requirements, and may be more demanding of high water quality, making them difficult to culture as intensively as *P. Vannamei*.

- ***Salinity tolerance***

Penaeus vannamei tolerates a wide range of salinities, from 0.5-45 ppt., is comfortable at 7-34 ppt., but grows particularly well at low salinities of around 10-15 ppt. This ability makes it a good candidate for the newer inland farms

- ***Temperature tolerance***

Although *P. Vannamei* will tolerate a wide range of temperatures, it grows best between 23-30°C with the optimum for growth being 30°C for small (1 g) and 27°C for larger (12-18 g) shrimp. This greater temperature tolerance of *P. Vannamei* may also be a reason why farmers have perceived this species to be more resistant to WSSV relative to *P. Monodon*.

- ***Dietary protein requirement***

Compared with other species, *P. Vannamei* requires a lower protein (and hence cheaper) diet (20-35%) during culture than *P. Monodon*, and are more able to utilize the natural productivity of shrimp ponds, even under intensive culture conditions. Additionally, feeding efficiency is better with *P. Vannamei*, which yields an average FCR of 1.2, compared to 1.6 for *P. Monodon*.

- ***Ease of breeding and domestication***

P. Vannamei can be induced to mate and spawn easily in captivity which enables the culturist to close the life cycle of the shrimp, facilitating genetic selection and domestication programmes. This feature permits much more control and enhancement of the cultured stock and allows the development of SPF and SPR stocks, which are already commercially available. This in turn relieves the expense, disease implications, environmental concerns, unpredictability and waste of relying on wild broodstock.

- ***Disease resistance***

Penaeus vannamei is generally considered to be more disease resistant than other white shrimp, although it is in fact highly susceptible to WSSV and TSV (can cause high mortality) and a carrier of IHHNV and Lymphoid Organ Vacuolization Virus (LOVV). Mostly owing to its perceived disease tolerance, it is replacing the less virus tolerant species in the country.

- ***Specific Pathogen Free (SPF) and Specific Pathogen Resistant (SPR) shrimp***

One of the main advantages of culturing the shrimp species *P. Vannamei* is that this species is commercially available as high health animals from SPF stocks. *Penaeus monodon* have very limited availability from SPF stocks. SPR shrimp usually result from a specific breeding programme designed to increase resistance to a particular virus.

- ***Post harvest characteristics***

After harvest, if well treated with plenty of ice, *P. Vannamei* are particularly resistant to melanosis and keep a good appearance three to four days after defrosting. However, *P. Monodon* tend to have a longer shelf life and are easier to handle, transport and process than *P. Vannamei*.

CONCLUSION

With higher disease resistance and higher productivity, *L. Vannamei* has taken over the most favored shrimp species for cultivation in India; achieving an overall productivity of more than 7 MT/ha/year it has surpassed tiger shrimp production in a significant manner. India with its abundant water resources possesses a vast potential for a further expansion in shrimp aquaculture. Currently India ranks 2nd in the world in terms of the aquaculture production behind China, however Indian production accounts for just 1/20th of what China Produces.

In India the total production of vannamei shrimps is almost 5 times higher than tiger shrimps. Among the nine states with aquaculture shrimp production in the country

nearly 78% of the total production comes from Andhra Pradesh alone. Gujarat Currently produces only 1/10th of the total vannamei production of Andhra Pradesh, but in terms of the productivity with more than 7.55 MT/ha/year Gujarat outperforms every other state in India.

Until 2009-10 Shrimp Farmers in India had to culture *P monodon*, regardless of the high risks and its exposure to diseases farmers cultured tiger shrimp, due to lack of alternative shrimp species which was commercially accepted. Introduction of Vannamei Shrimps in Indian aquaculture industry eradicated the disadvantages of tiger shrimps and offered a more sustainable and culture friendly species.

As the years go by the area under culture (AUC) for Indian Shrimp aquaculture is expected to increase and with the adoption of better management practices for shrimp farming in India the productivity of Vannamei shrimp species will continue to improve thereby expanding the total production in the country.

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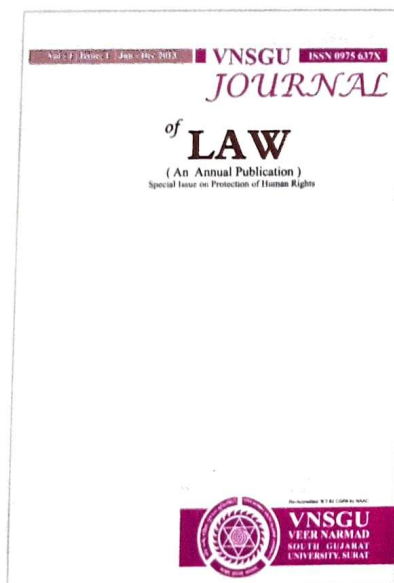


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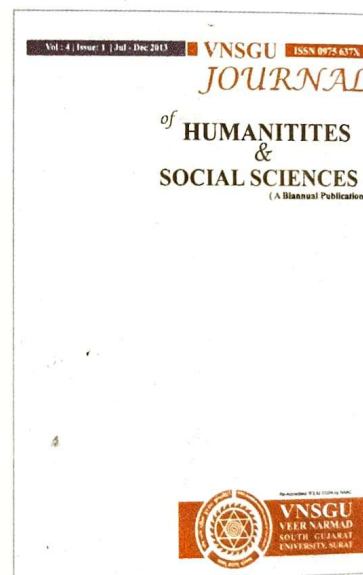
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