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PERCEPTION OF CUSTOMER TOWARDS GREEN PRODUCTS WITH REFERENCE TO KOTTAYAM DISTRICT

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ABSTRACT

This study attempts to describe the initiatives taken by selected durable goods manufacturing companies for making the environment clean and green with its objective of establishing low carbon society, establishing a reprocessing-based society, providing environmental protection and establishing a society in harmony with nature[1]. But some of the occasions, it has been noticed that companies are involved in claiming themselves as eco-friendly whereas they are not involved in green activities, hence involving in green washing[2]. The conclusion is that, the complex and erratic behaviour of consumers pose challenges to the government and producers in addressing their issues and fulfilling their needs. Each and every organization of today have better knowledge about their environmental responsibility. They have realized that the mere importance of their responsibility towards the society and the environment is not sufficient. Many top companies around the globe have launched its footstep towards environmental responsibility. Environmental degradation taken into consideration by companies leads to the production of new green products. This helps the company to gain a sufficient reputation from the public. In turn this will increase its sales volume and profit. Hence, if all the companies make an effort to increase their responsibility towards the environment, it can surely help prevent environmental degradation and conserve ecology.

Keywords: Green products, Eco-friendly

1. INTRODUCTION

Consumers are the main factors that boost a country's economy. Each and every consumer has their very own perspective and preference towards what they consume.

Consumers have become environmental conscious; this is because of the initiatives of the environmentalists, and government. Environmental concerns have been growing, the reason being global warming and climate change [3]. Natural events and human activities such as garbage burning, contribute to an increase in average global temperatures. This is caused primarily by increases in "green-house" gases such as Carbon-Dioxide. The green-house effect keeps the earth warm when functioning normally [4]. According to Jack, (2010), in less than 2 centuries, humans have increased the total amount of carbon dioxide in the atmosphere by 25 per cent from the burning of the fossil fuels and the destruction of forests, etc.

Green products are defined as products that produce limited carbon footprints; they require fewer resources to produce, consume less energy or emit fewer hazardous emissions [5]. Green products are also a product that is non-toxic, water efficient, and also recyclable and bio-degradable. There are many green products that have been produced for the consumers in the market. The rationale for going green is two-fold; clearly, the positive effects on the environment are the key driver for purchasing green products [6]. Green products provide myriad environmental benefits. They can replace toxic materials that may be harmful to people, animals, and the earth. Some products save energy and water, while others limit solid waste and manufacturing releases [7]. Green products create a healthier environment for people through reduced exposure to cleaners, solvents, paints and other hazardous substances. Green products also reduce allergies. Green products are formed from recycled components, be manufactured in a more energy-conservative way, or be supplied to the market with more environmental friendly way [8]. So, people are becoming more aware about the concept of

environmental consciousness. This reduces the usage of modern manufactured products. Traditional or conventional products are those that are manufactured in a conventional way. Thus the study is to analyse the perception of customers towards green products with reference to Kottayam District.

STATEMENT OF THE PROBLEM

Consumers are very keen in purchasing green products, slow and study the change is happening [9]. However, it will take some more time that all consumers to return to the green consumption, besides, the manufacturers have to shift their production to green production by controlling emissions, sewage, etc. [10]. This study analysis the consumers part, how they get the source of information, their attitude, whether they are willing to pay more, how they chose between the brands and non-branded green products, available in the market, place of preference of purchase, and so on in Kottayam, Kerala. A perfect parity between the green products and purchase behaviour is vital to make the environment healthier. Therefore, green consumption has become integral part of everyone's life and to save the mother Earth. In this context it is imperative to make a study on the green consumption behaviour among the consumers of Kottayam, and the present research work has tremendous relevance to the society and consumers to over-come the purchase of non-green or to say conventional products.

NEED FOR THE STUDY

Environmental sustainability is a matter which cannot be ignored, so business organizations have to recognize the competitive advantages and business opportunities to be gained from green marketing although it may cost to the organization. Consumers also have to largely aware of the usefulness of adapting to the green products. Green marketing incorporates a broad range of activities, including product modification, changes to the production process, packaging changes, as well as modifying advertising. [11]. Today, marketing parishioners of FMCG sector in India use environment friendly packaging and modify the products to minimize the environment pollution. However there is a big argument among the marketing philosophers regarding attractiveness of green product to customers in developing country like India. Hence, this is study will provide a knowledge, how far the consumers' in Kottayam have adopt to the eco-green consumer products.

OBJECTIVES OF THE STUDY

To obtain influencing factors among consumers towards green products among selected respondents in Kottayam.

To explore purchase behaviour among the consumers towards green products among selected respondents in Kottayam.

SCOPE OF THE STUDY

The study covers the extent of consumer's preference and satisfaction regarding green product consumption in Kottayam. In the prevailing globalized economic scenario the consumers have multiple choice to select green products, because, many manufacturers have shifted to green product

manufacturing [12]. Native producers and global producers are competing in the market, some of the native producers are non-brands, but their quality is good compared to the global brands. It is important to understand the influencing factors that motivate the consumers to buy green products [13], as well some factors uninfluenced the consumers to buy non-green products, in some case due to price consumers are provoked to buy non-brands, or those goods produced by local manufacturers. Hence, the present study aims to analyse the consumers' attitude and satisfaction towards purchase of green products.

RESEARCH METHODOLOGY

Type of research: Descriptive research.

Type of sampling: Simple random sampling. Sample size: 250

Data Collection Method: Survey based analytical method is used for data collection, which was thought fit for this research.

Tools used for the study: Percentage analysis, Mean rank, Chi-square and SEM analysis

LIMITATIONS OF THE STUDY

Research or any study has their own limitations, this study too has its own limitations, and this is due to the nature of the study. This investigation depends on overview technique, study research has its own confinements, further assets like cash and time has encouraged pushing the work quick, because of these blunders might be, regardless of care taken up in concluding the report. Second, the respondent's views are one of the uncontrollable factors, respondent's opinion is final, so the results may vary if applied to other areas, therefore, and the findings are not the final. Thirdly, data collection was very problematic, because most of the consumers are reluctant to provide information. However, at-most care was taken-up in the study, there are some of the limitations exists in the research study.

ANALYSIS AND INTERPRETATION

SOCIO ECONOMIC PROFILE OF RESPONDENTS

Table 1:

S.NO. AGE	RESPONDENTS	PERCENTAGE
18 Years - 27 Years	21	8.5
28 Years to 37 years	53	21.1
1 38 Years - 47Years	83	33.4
48 Years to 57 Years	51	20.6
Above 57 Years	41	16.4
Total	250	100.0
GENDER		

2	Male	170	67.9
	Female	80	32.1
	Total	250	100.0
EDUCATIONAL QUALIFICATION		0	
3	Matric	35	13.8
	HSC	63	25.4
	Degree	63	25.4
	Diploma	88	35.4
	Total	250	100.0
MARITAL STATUS		0	
	Married	92	36.6
4	Unmarried	91	36.3
	Separated	45	18.1
	Widow	23	9.0
	Total	250	100.0
EMPLOYMENT		0	
	Public sector employee	17	6.8
	Private sector employee	50	20.1
5	Selfemployed	37	14.6
	Agriculture	32	13.0
	Allied works employee	114	45.5
	Total	250	100.0
MONTHLY INCOME		0	
	Up to Rs.25,000	50	20.1
6	Rs.25001 - Rs.50,000	100	39.9
	Rs.50,001 to Rs.1,00,000	50	20.0
	Above Rs.1,00,000	50	20.0
	Total	250	100.0
7.	**DEPENDENT**	0	
	One	36	14.4
	Two	108	43.1
	Three	54	21.4
	Four	35	11.1
	More than four	18	7.0
	Total	250	100.0

It is clear that the respondents belong to the age group of 18 years to 27 years (8.5 per cent), 28 years to 37 years (21.1 per cent), 38 years to 47 years (20.6 per cent), 48 years to 57 years (20.6 per cent) and above 57 years (16.4 percent). The maximum of the respondents belongs to the age group of 38 to 47 years (33.4 per cent). It is clear that 67.9 per cent of the respondents are male and 32.1 per cent of the respondents are female. The majority of the respondents are male (67.9 per cent). It is clear that the educational level of the respondents is matriculation (13.8 per cent), Both HSC level and Degree level (25.4 per cent), and Diploma level (35.4 per cent). The majority of the respondents belong to the diploma level (35.4 per cent). It is clear that 36.6 per cent of the respondents are married and 36.3 percent of the respondents are unmarried, 18 per cent of the respondents are separated and 9 per cent of the respondents are Widow. The majority of the respondents are married (36.6 per cent). It is clear that the respondent Occupational level of the respondents is public sector employee (6.8 per cent), private sector employee (20.1per cent), self-employed (14.6 per cent), Agriculture employee (13 per cent) and Allied works employee (45.5 per cent). The maximum of the respondents belongs to the allied works employee (45.5per cent). Most of the respondents are allied works employees (45.5 per cent). It is clear that the monthly income of the respondents is up to Rs. 25,000 (20.1 per cent), Rs. 25001 to Rs. 50,000 (39.9 per cent), both Rs. 50,001 to Rs. 1, 00,000 and above Rs. 1,00,000 (20 per cent). Maximum of the respondent's monthly income is less than Rs. 25001 to Rs. 50,000 (39.9 per cent). From the above table, it is known that 14.4 per cent of the respondents have one dependent, 43.1 per cent of the respondents have two dependents, 21.4 per cent of the respondents have three dependents, 14.1 per cent of the respondents have four dependents and 7.0 per cent of the respondents have more than four dependents. The majority of the respondents have two dependents (43.1 per cent).

Environmental concern that influence purchase of green products

Table 2:

Environmental factors	Mean	Rank
Variable 1	3.84	1
Variable 2	3.65	2
Variable 3	3.64	3
Variable 4	3.64	4
Variable 5	3.20	5
Variable 6	3.19	6
Variable 7	3.08	7
Variable 8	3.06	8
Variable 9	2.79	9
Variable 10	2.73	10

Variable 11	2.61	11
Variable 12	2.60	12
Variable 13	2.60	13
Variable 14	2.57	14
Variable 15	2.52	15
Variable 16	2.48	16

From the table, it is known that Firms that damage or disrespect the environment should be punished, Environmental declarations demonstrate that the manufacturer may have concern with the environment and Agricultural toxins and dangerous substances in food harm the environment with mean score of (3.83, 3.649 and 3.643 respectively)are the top influential environmental concerns leads to buy green products and I am worried when I see people dirtying streets and parks has placed last place with mean score of 2.48 .

Man-nature orientation that influence purchase of green products

Table 3:

S.no	Man-nature orientation factors	Mean	Rank
1	Influence 1	4.86	1
2	Influence 2	3.76	2
3	Influence 3	3.68	3
4	Influence 4	3.68	3
5	Influence 5	3.59	4
6	Influence 6	3.57	5
7	Influence 7	3.42	6
8	Influence 8	3.34	7
9	Influence 9	3.23	8
10	Influence 10	3.23	8
11	Influence 11	3.22	9
12	Influence 12	3.22	10
13	Influence 12	3.12	10

It is clear that, I motivate and support every person who takes to save ecological system has scored first rank with mean score of 4.86, My family is accustomed to use green products has scored second rank with mean score of 3.76, third rank has been shared by I respect cultural values and I am associated with green groups with mean score of 3.68, I prefer recycled products to save ecological system has scored fourth rank with mean score of 3.59, I prefer green advertising has scored fifth rank with mean score of 3.56, I advise my wards and friends to save ecological system has scored sixth rank with mean score of 3.42, I do not use plastics has scored seventh rank with mean score of 3.33, eighth rank has been shared by I prefer to save nature and Me and my family members are only using green products, as they are safe for health with mean score of 3.226, I adhere to the principle of nature living has

scored ninth rank with mean score of 3.223, I take initiative in saving animals, birds, and plants as they are part of ecological system has scored tenth rank with mean score of3.221 and I am very careful in disposing non-green products safely has scored last rank with mean score of 3.1.

PERSONAL VARIABLES Vs FACTORS INFLUENCE GREEN PROD- UCT

Table 4:

Profile of the respondent	Chi square	DF	p	Sig.
Age	17.785	16	< 0.001	Highly Significant
Gender	21.907	4	< 0.001	Highly Significant
Marital Status	28.410	12	< 0.001	Highly Significant
Educational Status	24.682	12	< 0.001	Highly Significant
Annual Income	20.354	12	< 0.014	Significant
Number of Dependents	24.31	16	< 0.001	Highly Significant
Occupational Status	25.582	16	< 0.001	Highly Significant

It is noted that the p value is less than 0.05 for all the selected variables, the above hypothesis is rejected. I.e. there is a significant association found between the socio-demographic variables of the respondents and their factors influencing to choosing green products. It may be inferred that there is a relationship between the factors influencing for purchase of green products of the respondents and their socio-demographic variables like Age, Gender, Educational Status, Annual Income, Occupational Status etc. It may be inferred that factors influencing to purchase green products differ from one individual to another individual on the basis of their age, marital status, educational status, annual income etc.

Health consciousness attitude for green products

Table 5:

Health consciousness	Sum	Mean	Rank
V1	2669	3.75	1
V2	2614	3.68	2
V3	2544	3.58	3
V4	2528	3.56	4
V5	2362	3.32	5

My health is more important to has scored first rank with mean score of 3.75, I prefer to eat a product which improve my immunity power and stamina has scored second rank with mean score of 3.68, I am always purchase products which are prevents from side effects has scored third rank with mean score of 3.58, Consumption of non-green products may lead to health related problems has scored fourth rank with mean

score of 3.5606 and I wish to live long with good health has scored last rank with mean score of 3.3268 .

Purchase intention attitude for green products

Table 6:

| Purchase intention	Mean	Rank
V1	4.8549	1
V2	3.5831	2
V3	3.4141	3
V4	3.3268	4
V5	3.2239	5
V6	3.2155	6
V7	3.1155	7

From the above table, I feel trendy when I buy products with eco-friendly has scored first rank with mean score of 4.85, I prefer to buy products in reusable packages has scored second rank with mean score of 3.58, Opinion of my family members and friends relating to eco-friendly products impulse me to buy has scored third rank with mean score of 3.41, I purchase green products even if they are costly than the non-green products has scored fourth rank with mean score of 3.32, I feel comfortable when purchasing product with green image has scored fifth rank with mean score of 3.22, I am always prefer to purchase products that are eco-friendly has scored sixth rank with mean score of 3.21 and I prefer to purchase products which contribute money for environment protection purposes has scored last rank with mean score of 3.11 .

MODEL FIT INDICES OF SATISFACTION AND USING GREEN PROD- UCTS

Table7:

No.	TEST FACTOR	CALCU-LATED VALUE	ACCEPTABLE VALUE
1	GFI (Goodness-of-fit-index)	0.929	
2	AGFI (Adjusted goodness-of-fit-index)	0.854	>=0.90 and above satisfactory fit 0.80 to <0.9 acceptable fit al.2006)
3	CFI (Comparative fit index)	0.820	
4	NFI (Normed fit index)	0.806	
5	TLI (Tucker-Lewis index)	0.68 (Hair et	
6	RMSEA (Root mean square error of approximation)	0.108	0.05 or less would indicate a close fit of the model

No. TEST FACTOR

Figure 1:
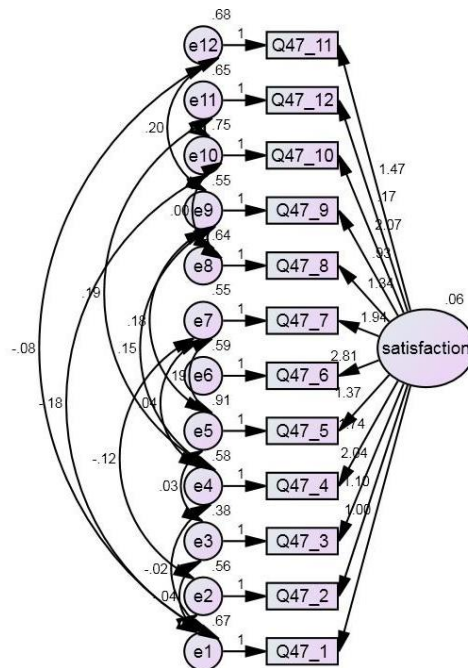
REGRESSION WEIGHTS FOR SATISFACTION AND USING GREEN PRODUCTS

Table 8:

Measured Variable	<—	Latent Variable	Estimate	S.E.	C.R.	P
Brand Image	<—	Satisfaction	1.000			
Product Quality	<—	Satisfaction	1.095	.205	5.342	Significant at 1% level
Visual Appeal and Attraction	<—	Satisfaction	2.036	.364	5.599	Significant at 1% level
Value for money	<—	Satisfaction	1.738	.326	5.339	Significant at 1% level
Positive proven personal experience	<—	Satisfaction	1.372	.293	4.676	Significant at 1% level
Social status enhancement	<—	Satisfaction	2.811	.502	5.603	Significant at 1% level
Agreement and approval by family members	<—	Satisfaction	1.938	.358	5.420	Significant at 1% level
Adherence to traditional	<—	Satisfaction	1.338	.270	4.963	Significant at 1% level

family customs					
Product certification	<—	Satisfaction	.926	.206	4.487 Significant at 1% level
Go green	<—	Satisfaction	2.068	.411	5.031 Significant at 1% level
Competitive cost	<—	Satisfaction	.165	.151	1.095 Significant at 1% level
Endorsement by others	<—	Satisfaction	1.468	.299	4.916 Significant at 1% level
					1% level

From this result as shown in table 4.46, it is noted that estimates of the coefficient of portability is high followed by ease of handling and it indicates that both factors are highly influenced the satisfaction level on green products. Further, the analysis indicated that all the variables are having positive relationship with the satisfaction level on green products and significant at 1% level.

FINDINGS

- 33.4 percent of the respondents belong to the age group of 38 to 47 years.

- 67.9 percent of the respondents are male.

- 35.4 percent of the respondents belong to the diploma level.

- 36.6 percent of the respondents are married.

- 45.5 percent of the respondents belong to the allied works employee.

39.9 percent of the respondent's monthly income is less than Rs. 25001 to Rs. 50,000.

43.1 percent of the respondents have two dependents.

The dominant part of the respondents has 61.4 percent have utilization of green items.

It is found that 54.4 per cent of the respondents take shopping bags along with them and 45.6 per cent of the respondents don't take shopping bags along with them. It is concluded from the chi-square test that a particular socio demographic variable is related to take a shopping bag while purchase green products. It is inferred that take a shopping bag while purchase green products differ from one individual to another individual based on their age, gender, education, marital status, employment, income, etc., .

SUGGESTIONS

Because positive attitude of consumers towards environmentally friendly products has not been found to be significant, consumer counseling programs are encouraged. Eco-labeling criterion should be standardized so that consumers may not be confused about claims of green products. Companies should assume at least some

responsibility for environmental deterioration. As consumer awareness and purchase intent of green products has been found to be positively correlated. So the producers can provide more value to their customers by highlighting the characteristic of being a "green product" producer. Consumers are aware of green products and they have the attitude towards the environment but an attitude to purchase a green product does not exist, so the companies producing "green products" may develop programs in communities to develop the attitude towards green products. The consumer may be aware through programs about the purchase of green products and how this purchase will contribute to the environment.

Government and business houses may consider the point that print media and websites seemed to be the least important source of spreading awareness about eco-friendly products and hence these media should be used sparingly in their mass communication efforts.

CONCLUSION

The conclusion is that, the complex and erratic behaviour of consumers pose challenges to the government and producers in addressing their issues and fulfilling their needs. Each and every organization of today have better knowledge about their environmental responsibility. They have realized that the mere importance of their responsibility towards the society and the environment is not sufficient. Many top companies around the globe have launched its footstep towards environmental responsibility. Environmental degradation taken into consideration by companies leads to the production of new green products. This helps the company to gain a sufficient reputation from the public. In turn this will increase its sales volume and profit. Hence, if all the companies make an effort to increase their responsibility towards the environment, it can surely help prevent environmental degradation and conserve ecology.

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A STUDY ON CONSUMER BEHAVIOUR AND SATISFACTION TOWARDS RETAIL STORES WITH REFERENCE TO KOTTAYAMDISTRICT KERALA

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ABSTRACT

The objective of purchasing behaviour facilities to raise the degree of consumer pleasure, [1]. If the level of customer satisfaction with purchasing behaviour is high, then the level of productivity is also high, which improves the percentage of profit as well. Thus, purchasing behaviour facilities serve as the foundation for profit [2]. When a company organisation sets itself the purpose of satisfying its numerous clients, the vast majority of the equipment in the business organisation will be effective in achieving that goal. Furthermore, they will be significant due to the fact that the primary goal for their presence has been achieved, and their long-term survival will not be endangered [3]. The primary goal of the study is to get an understanding of consumers' preferences for retail shops in the Kottayam Area/Region in general, as well as their attitude toward specific retail businesses in the KottayamArea/Region. Increasing customer loyalty is a key component of every promotional campaign. When a sample of 250 people was collected, statistical tools including percentage analysis, factor analysis, ANOVA (Anova on the mean), mean ranking, and descriptive statistics were used to analyse the data. The results of this analysis revealed that the customers were happy with the service they received but the stores have to look after further development to improve the variety of products with the store which leads to a positive buying behaviour with them.

Keywords: Buying behavior, Customer loyalty and Customer satisfaction.

INTRODUCTION TO CUSTOMER SATISFACTION

Customer satisfaction is a measure of how well a company's products and services meet or exceed the expectations of its customers [4]. Customer satisfaction is a significant predictor of customer purchase intentions and loyalty, according to a recent study. Among the most regularly gathered measures of market perceptions [5], client satisfaction metrics are among the most often used.

Customer satisfaction is a concept that is regularly heard in the marketing industry. Customer satisfaction is a measure of how well a company's products and services meet or exceed the expectations of its customers [6]. Customer satisfaction is defined as "the number of customers, or percentage of total customers, whose reported experience with a firm, its products, or its services (ratings) exceeds specified satisfaction goals [7]."

The brand, which is offered by the firm at any level of brand, does not just satisfy customers; the consumer expectation exceeds the grade of other facilities such as giveaways provided by the company [8].

Retail store

A retail shop may be defined as a major retail organisation with a number of departments all located in the same building and controlled from a central location. Each department specialises in a specific form of commerce and functions as a full entity within it [9].

This type of retail institution is also defined as one that meets a broad range of a consumer's personal and domestic durables product demands while also providing the consumer with a choice of several goods lines, at varying price points, over a variety of product categories [10]. Departmental shops often offer a wide selection of merchandise, including garments as well as furniture, household appliances, and gadgets, as well as a few more lines of merchandise such as paint, plumbing supplies, toiletries, cosmetics, photographic equipment, jewellery, and sports goods [11].

Retail storesin Kottayam

According to industry associations, there is a rising need in the state for the formulation of a retail policy in order to establish Kottayamas the country's retail center [12]. "Keralahas the potential to be the next Dubai or Singapore, the global leaders in facilitating retail tourism," said Kumar Rajagopalan, CEO, and Retail Association of India (RAI)[13].Indian retailers have emerged as one of the most dynamic and fast-paced areas of the economy, with sales increasing by an average of 20% annually. The whole retail market in India is predicted to increase at a rate of 12 % per year over the next five years. The efforts of governments like as Maharashtra, Andhra Pradesh, Kerala, and Karnataka to promote growth in this segment have led in the formulation of retail laws that are special to the industry [14].

Owing to Kottayam's strong tourist potential, growing per capita income, high literacy rate, and high technological usage, the state has an inherent competitive edge in terms of leading a retail revolution provided the appropriate laws are implemented. It was also discovered that, in areas such as Kottayam, a retail establishment must get around 30 permits in order to be operational, which is a highly unattractive situation for the expansion of the industry [15].In the opinion of industry experts, the involvement of retail establishments catering to grocery and food products under the Essential Services Act, the establishment of 24x7 working hours, the availability of overtime pay, and the capacity of female employees to work around the clock will go a huge way toward creating a friendly environment for the retail sector in Kottayam [16]. According to business organisations, the introduction of the Goods and Services Tax (GST) has facilitated the flow of goods across states. RAI has voiced its dissatisfaction with the failure of significant e-commerce businesses in India to disclose their financial results [17].The retail industry contributes more than 11 percent of the country's gross domestic product (GDP) and employs around 9 percent of the total workforce. As a result, the purpose of this study is to examine customer behaviour and satisfaction with regard to retail outlets in Kottayam[18].

STATEMENT OF PROBLEM

Segmentation is defined as the practice of dividing markets into groups of potential consumers who share common attributes or who are expected to demonstrate comparable purchasing behaviour[19]. The study area taken for the study is Kottayam and the stores taken for the study has four stores. The stores are those who are having only one store with Kottayam town. The study has not included with chain Retail stores who have their own brand name and that is also taken as a problem for the study to find out the brand reputation of small stores with the study area.

OBJECTIVES OF THE STUDY

1. To define the demographic profile of the respondents.

2. To find out their degree of satisfaction in select retail stores in Kottayam.

3. To evaluate the reasons for purchasing in retail store.

NEED OF THE STUDY

Assessing buying behaviour is not sufficient without also understanding the composition and origin of the consumers. Customers are drawn to imported items because of the excellent quality of the goods[20]. The country of India is home to a diverse range of national and international products. As a result, a lot of worldwide and national product companies have concentrated their efforts on identifying their customers and their purchasing habits. The findings of these researches have been beneficial in providing solutions to a variety of marketing problems that have arisen in retail outlets throughout Kottayam.

SCOPE OF THE STUDY

In marketing efforts, the perspective of the customer is a crucial factor to consider. The fate of the product and the organisations is determined by the perception of the customers[21]. There are a variety of things that influence the perspective of customers. These considerations include post-purchase behaviour, reputation, product availability, branding, and convenience, among others. "The scope of the study is restricted to Kottayam".

RESEARCH METHODOLOGY

Research Design: The study proposes to cover the customer behaviour towards retail stores. As the study is based on customerbehaviour towards various Retail stores Cluster sampling is been used in the research.

Area of the study: The survey was done in selected retail stores in Kottayam

Sample size

The sample is been collected from four Retail stores and the respondents are divided equally with all the four Retail stores selected for the study. The total sample size taken for the study is 250.

Data Sources

The study used both primary data and secondary data.

Primary data: The primary data was acquired by a field surveywith Questionnaire as survey method in the study area.

Secondary data: The secondary data was gathered from journals, websites and articles.

Tools used for Collection of Data: Frequency analysis, Chi square, Factor analysis and ANOVA.

LIMITATIONS OF THE STUDY

1) The study has been limited to the state of Kottayam.

2) The Response of the Migrant can be Skewed and Subjective.

3) Many Respondents were not vocal in stating their genuine opinions.

4) Due to time restrictions, the sample size was kept limited, and the viewpoint of the majority was not taken into consideration.

5) The sample survey was collected from the respondents using convenient sampling method.

6) There may be a bias in collection of data from the respondents.

ANALYSIS AND INTERPRETATION

Demographic variables of the respondents

Demographic variables	Particulars	Frequency	Percent
Gender	Male	103	41.2
	Female	147	58.8
	Total	250	100
Marital status	Married	156	62.4
	Unmarried	94	37.6
	Total	250	100
Age	Below 20 years	7	2.8
	20 years-40 years	89	35.6
	40 years-50 years	76	30.4
	Above50 years	78	31.2
	Total	250	100
Educational qualification	Schooling	19	7.6
	Diploma	81	32.4
	Undergraduate	123	49.2
	Postgraduate	21	8.4
	Professional degree	6	2.4
	Total	250	100
Occupation	Student	10	4
	Private Job	36	14.4
	Government job	34	13.6
	Home maker	119	47.6
	Business	51	20.4
	Total	250	100

70.4% are male and 29.6% are female. 2.8% are married and 97.2% are unmarried.2.8% are from the age group of below 20 years, 2.8% are from the age group of 20-40 years, 56.4% are from the age group of 40-50 years and 38% are from the age group of above 50 years, 6% have completed their schoolings, 32.4% have finished their diploma, 49.2% have completed their under graduation, 8.4% have completed their post graduation and 2.4% have completed their professional degree.24% are in to private job, 30.8% are in to government job, 37.2% are home makers and 4% are doing business.

Frequency of visiting the store

	Frequency	Percent
Once in a week	40	16.0
Fortnight	30	12.0
Monthly	50	20.0
Occasionally	130	52.0

	Frequency	Percent
Once in a week	40	16.0
Fortnight	30	12.0
Monthly	50	20.0
Occasionally	130	52.0
Total	250	100.0

The above table depicts about frequency of visiting the store by the respondents. Out of 250 respondents, 16% said they visit the store once in a week, 12% said they purchase fortnight, 20% said they purchase monthly, 52% said that they purchase occasionally. It shows that most of the respondents visit the store occasionally.

Average amount spent for purchasing per month in Retail stores

	Frequency	Percent
Up to Rs.3,000	42	16.8
Rs.3,000 to Rs.5,000	107	42.8
Rs.5000 to 7,000	62	24.8
Above Rs.7000	39	15.6
Total	250	100.0

The above table shows about average amount spent for purchasing per month in Retail stores were out of 250 respondents 16.8% are spending up toRs.3,000, 42.8% are spending from Rs.3,000 to Rs.5,000, 24.8% of the respondents are spending from Rs.5000 to 7,000, 15.6% are spending above Rs.7000. It shows that most of the respondents spending from Rs.3, 000 to Rs.5, 000 per month in Retail stores.

FACTOR ANALYSIS FOR LEVEL OF SATISFACTION OF CUSTOMERS

A total of 26 variables were identified for the purpose of collecting satisfaction from the customers. In order to reduce the number of variables and to identify the key factors contributing towards the expectations of customers, factor analysis is performed. KMO and Bartlett's test is conducted to identify the sampling adequacy.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.603
Bartlett's Test of Sphericity	Approx. Chi-Square	1.705E3
	DF	66
	Sig.	.000

KMO of sampling adequacy value for the service quality measures is 0.603 and it indicates that the sample is adequate to consider the data as normally distributed.

Rotated Component Matrix

	Component			
	1	2	3	4
V1	.277	-.065	.863	-.095
V2	.013	.461	**.785**	.044
V3	.869	.226	.104	.152
V4	**.731**	-.004	.149	.113
V5	.350	**.747**	.092	.005
V6	.366	.026	.421	-.497
V7	.460	.258	.405	.051
V8	.301	-.168	.092	.877
V9	.116	.290	-.036	.821
V10	-.289	.683	.497	.191
V11	**.795**	.256	.053	.034
V12	.441	**.797**	.048	.014

From the above table the common factors above 0.5 are taken for decision making process of the study and the factors are level of satisfaction towards quality of the product, Level of satisfaction towards reasonable price, level of satisfaction towards accurate weight/adequate quantity, level of satisfaction towards exchange of defective/damaged goods, level of satisfaction towards door delivery.

Descriptive statistics for level of satisfaction of customers towards departmental stores

Particulars	N	Mean	SD
Level of satisfaction towards range of products	250	**3.00**	1.206
Level of satisfaction towards quality of the product	250	**2.89**	1.110
Level of satisfaction towards availability of fresh items	250	2.66	.915
Level of satisfaction towards reasonable price	250	2.66	1.030
Level of satisfaction towards accurate weight/adequate quantity	250	**2.92**	1.175
Level of satisfaction towards offers and discounts	250	**2.92**	1.085
Level of satisfaction towards customer services	250	2.61	.815
Level of satisfaction towards parking facilities	250	**2.98**	1.064
Level of satisfaction towards billing facilities	250	**2.91**	.986
Level of satisfaction towards availability of trolleys/shopping bags	250	2.67	1.147
Level of satisfaction towards exchange of defective/damaged goods	250	**3.01**	.967
Level of satisfaction towards door delivery	250	2.70	.929
Valid N (listwise)	250		

The above table shows about the descriptive statistics for factor related to level of satisfaction of customers with Retail stores. Based on the result the factors above the average mean (2.82) are taken for decision making process of the study. The factors are level of satisfaction towards range of products, quality of the product, towards accurate weight/adequate quantity, offers and discounts, customer services, parking facilities, billing facilities and exchange of defective/damaged goods**.**

RANKING ON REASON FOR PURCHASING IN RETAIL STORE

S.NO	Ranking on reason for purchasing in Retail store	Average mean	Mean rank
1	One roof shopping/convenient shopping	4.40	1
2	Saves time and efforts	5.76	6
3	Variety of products	6.56	8
4	Quality of products	4.42	2
5	Reasonable price	5.58	4
6	Offers and discounts	5.82	7
7	Brand image	5.62	5
8	Reputation of the Retail store	4.84	3
9	Door delivery	5.94	9
10	Nearby residence	6.06	10

The above table shows about the mean rank of the factors related to reason for purchasing in Retail store were the priority was given to One roof shopping/convenient shopping and these factor is taken for decision making process of the study.

Comparison between age and factors related to level of satisfaction

Ho1: There is no relationship between age and factors related to level of satisfaction

		Sum of Squares	df	Mean Square	F	Sig.
Level of satisfaction	Between Groups	26.773	3	8.924	7.838	.000

towards quality of the product	Within Groups	280.091	246	1.139		
	Total	306.864	249			
Level of satisfaction towards reasonable price	Between Groups	58.606	3	19.535	23.386	.000
	Within Groups	205.494	246	.835		
	Total	264.100	249			
Level of satisfaction towards accurate weight/adequate quantity	Between Groups	19.014	3	6.338	4.804	.003
	Within Groups	324.542	246	1.319		
	Total	343.556	249			
Level of satisfaction towards exchange of defective/damaged goods	Between Groups	15.771	3	5.257	5.954	.001
	Within Groups	217.193	246	.883		
	Total	232.964	249			
Level of satisfaction towards door delivery	Between Groups	47.334	3	15.778	23.164	.000
	Within Groups	167.562	246	.681		
	Total	214.896	249			

The above table shows about the relationship between age and level of satisfaction of various factors filtered from factor analysis. It shows that there is a significant relationship between age and Level of satisfaction towards quality of the product (0.000), Level of satisfaction towards reasonable price (0.000), Level of satisfaction towards accurate weight/adequate quantity (0.003), Level of satisfaction towards exchange of defective/damaged goods (0.001), and Level of satisfaction towards door delivery (0.000).

FINDINGS

- Most of the respondents are married.
- Maximum of the respondents are from the age group of 20-40 years.
- Most of the respondents have completed their under graduation.
- Maximum of the respondents are home maker in our survey.
- Most of the respondents are having 4-5 members in their family.
- Maximum of the families are earning from Rs.30, 000 - Rs.40, 000 as their family income.
- Most of the families have 3-4 earning members in their family.
- Maximum of the respondents visit the store occasionally.
- Most of the respondents spending from Rs.3, 000 to Rs.5, 000 per month in Retail stores.

- Maximum of the respondents said they purchase grocery items from Retail stores.
- Based on descriptive statistics the factors level of satisfaction towards range of products, quality of the product, towards accurate weight/adequate quantity, offers and discounts, customer services, parking facilities, billing facilities and exchange of defective/damaged goodscan be taken for decision making process of the study.

SUGGESTIONS

- The Retail stores can act as a one stop shop like Walmart to the core as the respondents prioritize the same based on the survey conducted. If it so then it leads to increase in sales and brand image of the store.
- The Retail stores can give the products to a reasonable prize when compared to their competitors so that it will create a goodwill for the store and there will be a positive buying behaviour towards the store.
- Based on the service quality satisfaction the stores have to be keen on quality of the product, reasonable price, weight/adequate quantity, exchange of defective/damaged goods and door delivery.

CONCLUSION

The customers are satisfied with the service provided but the stores have to look after further development to improve the variety of products with the store which leads to a positive buying behaviour with them.

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IMPROVED ARTIFICIAL NEURAL NETWORK THROUGH METAHEURISTIC METHODS AND ROUGH SET THEORY FOR MODERN MEDICAL DIAGNOSIS

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Abstract- A novel meta-heuristic soft computing model with feature selection implemented using Rough set (RS) theory for the diagnosis of coronary artery disease in diabetes patients is proposed in this study. The binary classification method in multiclass classification problems is applied by the One Versus Rest approach (OVR) is incorporated. To avoid the redundancy problem, a mathematical approach known as rough-set theory (RS) is applied to identify the most significant features from the dataset. The Artificial Neural Network with improved hidden layers is used as the classifier which is optimized through a metaheuristic population-based method, known as the Grasshopper Optimization Algorithm (GOA) with a single objective optimization approach integrated for improving the accuracy of the model. Mean Square Error (MSE) is taken as the objective function and the result shows that the accuracy of the model has been improved significantly from 89.1% to 95.25% after optimization.

Keywords: **One Versus Rest (OVR); Artificial Neural Network (ANN); Rough Set (RS); Grasshopper Optimization Algorithm (GHO); Mean Square Error (MSE).**

1.Introduction

Diabetes is a chronic condition that has the potential to lead to many side effects and heart disease is one among them. According to the report of the World Health Organization, diabetics patients have a higher probability of heart diseases. The statistics show that the death rate due to heart diseases are on a rise. Diabetes can cause damage to the blood vessels as well as the nerves which control the functions of the heart. This will lead to cardiac disorders and coronary artery problems. Heart disease being a major health hazard is an issue that immediately requires more academic research. The risk of heart disease can be avoided or reduced by controlling the diet, blood glucose level, and regular physical activity. Therefore, early prediction of the possibility of heart disease in diabetes patients will help to improve their health conditions. The main objective of the study is to find out the possibility of heart disease especially among diabetes patients. Artificial Neural network is used as the classifier for the proposed study. It is widely accepted that backpropagation in the Neural Network is a very strong tool for forecasting and estimation. The main power of the Neural Network is that we can do many complex problems with large datasets that can be estimated without any complex mathematical expressions. In Neural Networks, weight optimization plays an important role in the accuracy obtained. By using the activation function and error value obtained in each iteration, the weights of the Neural Network are adjusted until it reaches the optimum value. But during these steps, the local optimization problem can arise. To overcome this issue, metaheuristic population-based algorithms such as grasshopper optimization algorithms are used to optimize the weight of the Artificial Neural Network and the optimal weight value is used for the prediction.

Grasshopper Optimization is one among the stochastic methods of search optimization [Janmenjoy Nayak, (2020)] which will help to overcome the issue of local optima problem in Neural Network. It is developed based on the life cycle and food search pattern of insects known as Grasshoppers. During their life cycle, grasshoppers follow

two stages: The nymph and adult stage. During the Nymph stage, it follows slow movement, and during the adult stage, it follows the abrupt movement. These two movements will be adjusted in the algorithm with the help of mathematical methods. This feature of GOA helps to find out the optimum results by overcoming the stochastic gradient descent problems in the Neural Network.

Another main concept used in the study is dimensionality reduction. A mathematical foundation tool called Rough Set is used for feature selection by finding the most relevant subsets. A reduced subset retains all the features of the parent feature set. In the study, the Framingham dataset is used for classification purposes.

2. Literature Review

Ashir Javeed and Sanam Shahla Rizvi proposed a floating window with adaptive size [Ashir Javeed, (2020)] method for dimensionality reduction purposes. They have proposed this method to create a subset feature and is given as the input to the Neural Network architecture. ANN and Deep Neural Networks are used as the classifiers. The cleveland dataset was used for the analysis. The result shows that the proposed model achieves an accuracy rate of 91.11% for ANN and 93.33% by the Deep Neural Network.

A hybrid Model of Emotional Neural Networks (EmNNs) and Particle Swarm Optimization (PSO) [Afzal Hussain Shahid, (2020)] was introduced for the detection of Coronary Artery Disease (CAD) by Afzal Hussain Shahid. Feature selection was carried out by four different methods. To improve the learning capability of the Neural Network, emotional parameters are also taken into consideration along with the conventional weights and bias.

Nithyavishnupriya in her article used DNN for heart disease prediction. They used the statistical analysis Chi-Square analysis [Nithyavishnupriya and Ramprakash (2020)] along with DNN architecture. They utilized the Dataset collected from the UCI Repository which consists of 303 instances with 14 columns.

In the model, proposed by Archana Singh, they utilized Python programming in Anaconda (Jupiter) notebook [Archana Singh (2020)] as a simulation environment. They have tested various supervised machine learning algorithms and stated that the KNN algorithm is the most suited method compared with the other classifiers they have tested.

A Machine learning-based medical intelligence system was made by Amin Ul Haq [Amin Ul Haq, (2018)]. In his study, Relief, minimal-redundancy-maximal-relevance (mRMR), Shrinkage and Selection Operator (LASSO) were used to find out the most relevant and highly correlated features. Seven supervised classification algorithms are used for the prediction. Reduced feature sets obtained from each feature selection process were given as input to the classifiers. Time for prediction is also calculated.

Awais Mehmood proposed a new method of study known as cardio to help their study. CNN algorithm [Awais Mehmood, (2021)] was used for the construction of the model. The proposed model is used to study the probability of the presence of cardiovascular disease in a patient and the model achieved an accuracy of 97%.

Zubar in his studies proposes a hybridized method using KNN and the Spiral optimization method [A. H. Zubar and R. Balamurugan, (2020)] for the classification of cardiovascular diseases. The method enhances the clustering quality and also PCA is used for dimensionality reduction.

The author of the article [Irfan Javid, (2020)] used deep learning methods along with conventional machine learning techniques to predict heart disease. A voting-based method is adopted to strengthen the weak classifiers. LSTM is added along with RNN and is used as a deep neural network. 85.71% accuracy is achieved by the proposed model.

Kalaselvi and G N Nasira analysed the complex relationship between cancer and diabetes in their study. They propose a novel method known as ANIFS [Kalaiselvi and G.N. Nasira, (2014)] in their study. They have achieved 80% accuracy in the PIMA dataset using ANIFIS with adaptive KNN approach.
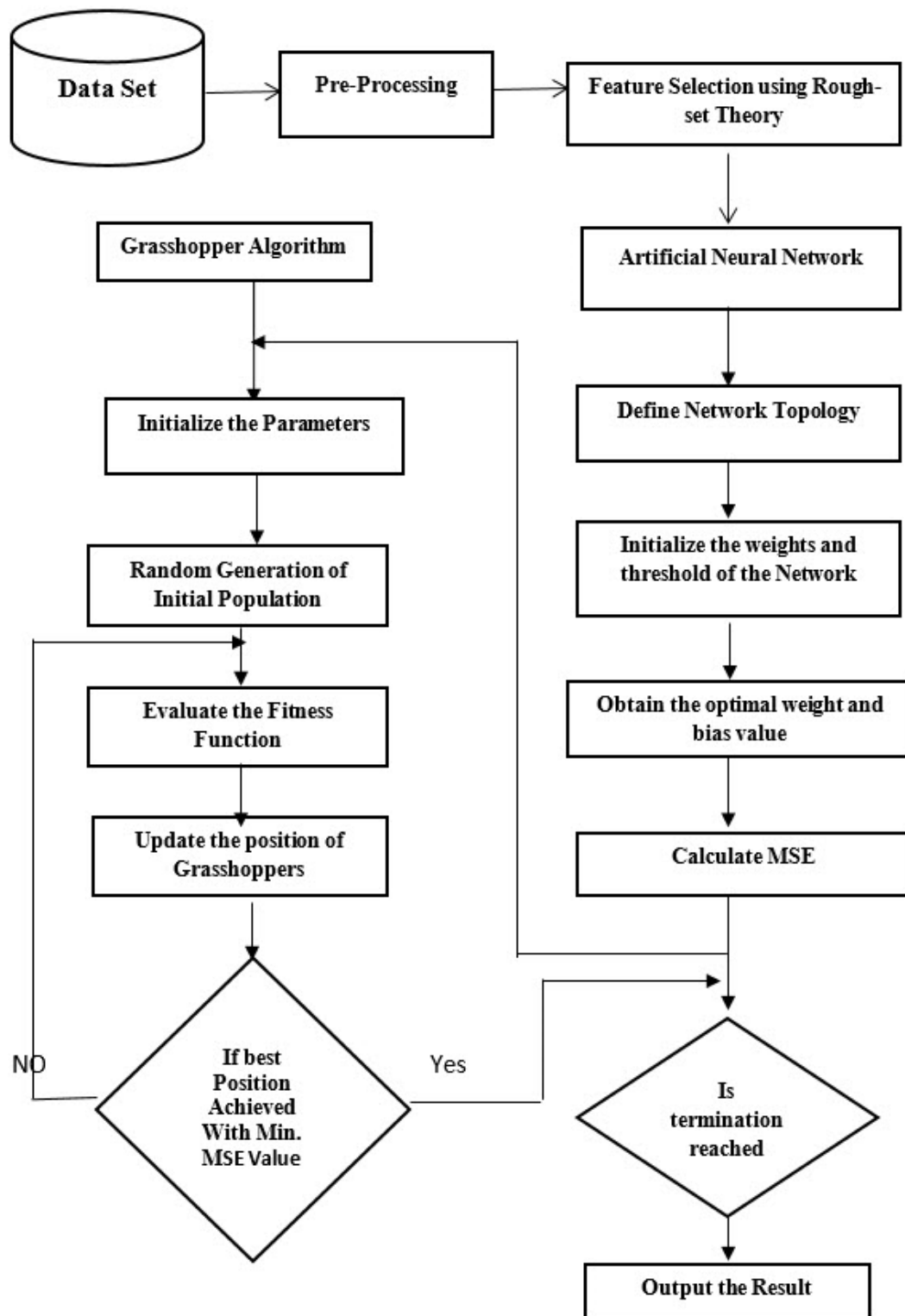
3.Proposed Methodology

Figure 1: Work Flow of GOA based Artificial Neural Network for Coronary artery disease.

The proposed work consists of three phases. In the first phase, the Rough Set-based feature selection approach finds the most significant subset attributes from the dataset. In the second phase, Artificial Neural Network with improved hidden layers is used for the classification. LSTM is added along with the hidden layers of the Neural Network. In the third phase where a metaheuristic algorithm known as the Grasshopper Optimization algorithm is used for optimizing the model.

By using Rough-set theory the most relevant features were extracted [Youness, (2018)] from the dataset for the classification. The reduced dataset is given as input to the Neural Network. Weights and bias of the hidden layers are initialized by the random initialization methods. Mean Square Error (MSE) is calculated. A single-objective optimization method is followed in the study. Grasshopper Optimization algorithm, optimizes the model, by setting the objective function as MSE.

In the beginning, the initial population is constructed using the random initialization method, and the fitness value for the population is calculated. Positions of grasshoppers are adjusted and the new fitness value is calculated. The process repeated until it received the best fit value. The best fit value is returned to the Neural Network. GOA computes the optimized weights by adjusting the initial parameters and the fitness value for each solution is evaluated. The best fit solution is returned to the Neural Network.

3.1. Rough set-based feature selection

Rough Set Theory (RS) is a mathematical tool [Javad Rahimipour Anaraki, (2013)] that successfully determines the data dependencies among attributes of a dataset and reduces the dataset through structural approach. The features selected by the rough set produce very useful and informative results while other attributes can be removed with less loss of information, as they have a high degree of dependency with the other attributes in the dataset. This will help to reduce redundancy. In this work, the dataset with discretized values of attributes are used to discover the subset of all attributes using the concept of RS, which selects the attributes that provide more information helping to predict the most relevant class attributes accurately.

3.1.1. Fundamental notations for attribute reduction in rough set theory.

In this study, all information is stored in the table format. The dataset contains all the information corresponding to the Information System [Richard Jensen, (2007)]. Assume that the Information System IS = (DS, A) where DS is the set of instances in the dataset A and Att is the non-empty set of finite attributes and att: $DS \rightarrow SV_{att}$ for each att $\in$ Att, where SV_{att} is the set of values that an attribute att may have. With any IP$\rightarrow$Att, it has its associated equivalence relation, ie (Independency) which is denoted as IND(IP) [Kanchan Shailendra Tiwari (2013)] as shown in the equation below [Javad Rahimipour Anaraki, (2013)]

$$IND(IP) = \{(u, v) \in DS^2 | \ \forall att \in IP, att(u) = att(v)\} \qquad (1)$$

IND(IP) partitions the instances corresponding to the dataset and it is represented as DS / IND (IP) (or *DS / IP*). If (u, v)) $\in$ IND(IP) then u and v are indiscernible by attribute of IP. In rough set-based feature selection dependency between the attributes is calculated, and if there is interdependency between the attributes exists, these features are removed. So that it can avoid redundancy in the dataset.

The attribute in an information system is classified into different categories using roughest. Decision attributes [Omnia S. Elazab and Hany M. Hasanien, (2020)] decides in which class the attributes belong at the same time. Conditional attributes, do not decide the class of an object, but it will help to decide the class which belongs.

Let Y $\subseteq$ *DS*. Then y can be approximated by calculating the information contained in IP by constructing IP Upper and IP lower approximations [Richard Jensen, (2007)]. IP-lower. and IP-upper approximations [Richard Jensen, (2007)] of Y as formulated as

$$\underline{IP}Y = \{y|[Y]_{IP} \subseteq Y\} \qquad (2)$$

$$\overline{IP}Y = \{y|[Y]_{IP} \cap Y \neq \emptyset\} \qquad (3)$$

$\underline{IP}Y$ represents the lower approximation and $\overline{IP}Y$ represents the upper approximations. The attribute values belonging to these regions can also be considered in the subset.

Assume that the IP and IQ are equivalence relations over DS, then their positive area can be represented as

$$PSV_{IP}(IQ) = \bigcup_{Y \in DS/IQ} \underline{IP}Y \qquad (4)$$

The positive region is comprised of all instances of DS which can be classified to classes of DS/IQ with the information in attributes IP. With this RST defines the degree of dependency of a set of attributes IQ on a set of IP attributes is formulated as For IP, IQ $\subset$ Att, it is signified as IQ depends on IP in a degree l $(0 \le l \le 1)$ represented as IP$\rightarrow$IQ if

$$l = \gamma_{IP}(IQ) = \frac{|PSV_{IP}(IQ)|}{|DS|} \qquad (5)$$

The dimensionality of attributes is accomplished by associating equivalence relations produced by sets of attributes. Once the redundant attributes are removed as the reduced set of attributes provides the same predictive ability of decision feature as the original dataset.

3.1.2 Algorithm.

For attribute reduction, an RS-based Quick Reduct [Javad Rahimipour Anaraki, (2013)] Algorithm is implemented. Att is a set of all features, CF is the conditional variable and DF is the decision features [Richard Jensen (2007)] RST denotes the reduced dataset corresponding to the conditional attributes CF.

$RST \leftarrow \{\}$

Do

$T \leftarrow RST$

$\forall y \in (CF - RST)$

If $(\gamma_{RST \cup \{y\}}(DF) > \gamma_T(DF))$ then

$T \leftarrow RST \cup \{y\}$

$RST \leftarrow T$

until $\gamma_{RST}(DF) = \gamma_{CF}(DF)$

Return RST

The reduced set of features were computed by the algorithm without exhaustively producing all probable subsets. It begins with an empty set and starts adding attribute one in the incremental order [Javad Rahimipour Anaraki, (2013)], attributes are chosen, which consequence in the greatest increase in rough set dependency, until it generates maximum possible value for the dataset.

3.2 Artificial Neural Network

A kind of computing approach and artificial intelligence which simulates the functioning and analyzing the behavior of the human brain is known as an artificial neural network (ANN). It has the ability of self-learning which enables it to generate better results when the dataset is voluminous. ANN is composed of three different layers. Each layer in turn comprised of processing unit sets. ANN has an input layer, output layer, and hidden layer. Figure2 shows the overall structure of a standard Artificial Neural Network. Each layer nodes are connected to the forwarded layer nodes through the links. The link among neural nodes or perceptrons indicates the stream of information passing from the previous layer node to the forwarding layer node. The neural network function receives the predictor values at the left side and the computations are done on the hidden layer and the output layer shows the predicted outcome.
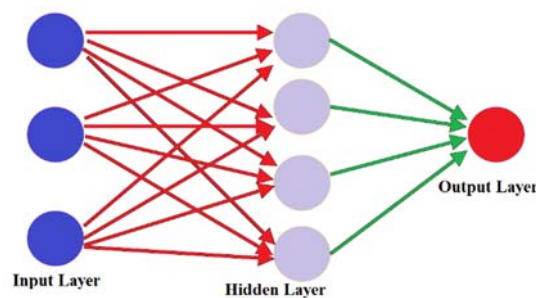

Figure2: General Structure of an Artificial Neural Network

The Figure 3 depicts the weight and bias assignment for each Neuron in an Artificial Neural Network. The hidden nodes receive the value from the previous layer and which is multiplied by weights, whose values are predetermined. The weighted input values received from all the nodes of the previous layer are summed together to generate a single value as shown in Figure 3. Next, an activation function known as ReLU is applied to the summed values which control the output of the nodes. Same as the hidden layer, the output layer's active node also does the relevant computations and produces the output. If the output value is binary then the sign of positive represented the presence and negative represented the absence which is highly dependent on the input data. The input nodes are passive, its function is to receive the input from the outside world and pass it to the next layer,

the hidden layer performs the multiplication of the received value with its concern weight assigned on each.
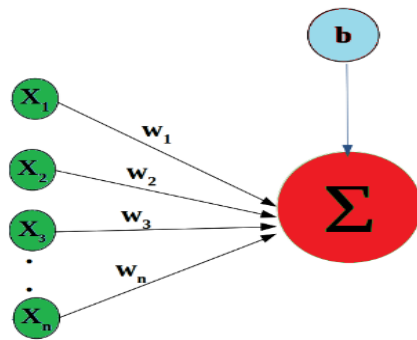

Figure 3: Assignment of weights and bias [20] of a Neuron in an Artificial Neural Network.

The weight for an input corresponding to an individual node is calculated as in the Equation (6)

$$netwrk_j = \sum_{i=1}^{n} w\, gt_{ij}.\, O_i \qquad\qquad (6)$$

where wgt$_{ij}$ signifies weights between two nodes i and j, and output from the unit 'i' is denoted as O$_i$. To generate the final output 'O$_t$' the sum is passed to the nonlinear filter φ called activation function which generates the output given in Equation (7).

$$O_t = \varphi(netwrk_j) \qquad\qquad (7)$$

where ϕ refers to activation function and the weighted sum of input values prior to the signal processes to the subsequent layer. Finally, the generated output is compared with the expected output and their difference is assigned as an error. The standard neural network uses the backpropagation method to update the weights on trial and error basis repeatedly until the accepted error rate is obtained. This result determining the appropriate weights to produce more accurate results. The error rate is defined in equation (8)

$$Error = \frac{1}{2}\sum_k (desireout_k - resultout_k) \qquad\qquad (8)$$

3.3 Grass Hopper Optimization Algorithm.

The Grasshopper Algorithm is a bio inspired metaheuristic method which mimics the life cycle of grasshopper insects. The life cycle of grasshopper consists of two different stages: Nymph and Adult. Even though the grasshoppers are seen individually, they will foam large swarms during their Nymph and Adult stage. The movement of this swam during the Nymph stage is very slow compared to that of the adult stage. At the adult stage, they will show long-range abrupt movements [Ali Asghar Heldari, (2018)].

Based on these movements of grasshoppers, the search process in the GOA algorithm usually follows two methods: exploration and exploitation. During exploration, an abrupt movement is shown by the search agents in exploration [Peng Chen and Xiaoqiang Zhao, (2020)] but a local movement is followed during exploitation. The swarming [Ali Asghar Heldari, (2018)] behavior of Grasshoppers can be mathematically expressed in the formulae given below:

$$Y_j = S_j + G_j + W_j \qquad\qquad (9)$$

Where Y_j defines the position [Ali Asghar Heldari, (2018)] of the individual grasshopper" j". S_j defines the social interaction of the jth individual, G_j defines the gravitational force of the jth individual and W_j defines the advection. The social interaction between the grasshopper is one of the main parameters for the search mechanism. It can be computed by the mathematical formulae,

$$S_i = \sum_{j=1\ j\#i}^{N} S(A_{ij})\hat{A}_{ij} \qquad\qquad (10)$$

A_{ij} is the distance between [Ahmed A. Ewees and Zhang Jianhua (2020)] the grasshopper i and j which can be mathematically expressed as $A_{ij} = |\ Y_i - Y_j\ |$. $\hat{A}_{ij}$ is a singular vector between grasshopper i and j and is mathematically denoted as

$$\hat{A}_{ij} = (Y_j - Y_i)/\ A_{ij} \qquad\qquad (11)$$

The social force [Omnia S. Elazab and Hany M. Hasanien, (2020)] between grasshoppers are mathematically calculated as

$$S(r) = f \, e^{\,(-r \,/\, l)} - e^{-r} \tag{12}$$

The intensity of gravitation is represented by f and l denotes the length of the social interaction. The impact of the interaction between the grasshoppers is denoted as S. A parameter C represents the mathematical formulation that can be used for balancing the movements [Omnia S. Elazab and Hany M. Hasanien, (2020)] of search agents.

$$C = (\text{Maximum Iteration}) - (\text{Current Iteration}) \frac{\text{Maximum Iteration} - \text{Mininmum Iteration}}{\text{Total No of Iteration}} \tag{13}$$

3.3.1 Fitness Evaluation.

The model follows a single objective optimization method. For finding the best fit solution, the fitness value of each solution is calculated. MSE is taken as the parameter for fitness evaluation. The experiment is repeated for 1000 iterations and the best fit value shows minimum MSE. MSE can be calculated using the Equation (14)

$$\text{MSE} = \frac{1}{n} \, (\, r_j - \hat{r})^2 \tag{14}$$

Where '**r**' represents the actual result and '**r̂**' represents the predicted result, the total number of instances is denoted as 'n'. The experiment is repeated for 1000 iterations and the best fit value is taken as the one with minimum MSE value. The fitness value corresponding to different iterations is plotted in Figure 4.
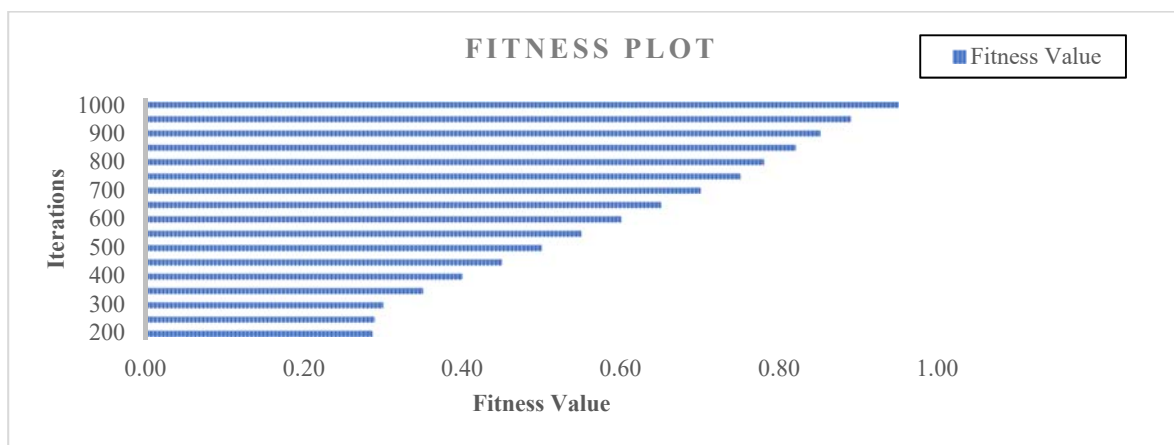

Figure 4: Fitness Plot generated by the Grasshopper Algorithm

4. Experimental Results and Discussions

4.1 Dataset description

Framingham Dataset from Kaggle Machine Learning Repository is used for the study. The dataset is comprised of 4240 instances with 16 attributes. They are gender information, age of the person, education of the person, current Smoker or not, cigarettes Per Day, Blood Pressure, prevalent Stroke, Prevalent Hyper Tension, diabetes, total Cholesterol, Systolic blood pressure, Diastolic blood pressure, Body Mass Index, heartbeat Rate, Blood glucose level with the class attribute Chronic Heart Disease   present or not.

To predict diabetic heart disease, a new class variable is generated to label the patients in four different risk levels such as without diabetic without heart disease as 0, presence of diabetic and absence of heart disease as 1, absence of diabetic, and presence of heart disease as 2 and presence of both diabetes and heart disease as 3. Inter Quartile Range is used to preprocess the dataset in this study. Ambiguous and erroneous data is replaced by the mathematical and statistical approach used in IQR.

4.2 Results & discussions

This work is implemented with the help of two different class variables in the dataset, they are responsible for generating the new class variable which determining the presence or absence of diabetes and the consequent heart failure possibilities among the patients. A new class variable is generated based on the values of these two class variables.

The proposed model RS-GANN is designed using Python and its performance is examined and compared with other prediction models like Naive Bayes and Logistic Regression. The parameters used for evaluating the performance of the model are Precision, Recall, F1-Score, Specificity and, Accuracy. The results are discussed in Table 1. The comparison of results is represented in a graphical format using Figure5. The proposed model is compared with the model before optimization (RS-ANN). Comparison results are shown in Table2 and Figure 6. The mathematical formulae for calculating the performance measurement parameters are given below.

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}. \tag{15}$$

$$\text{Recall} = \frac{True\ Positive}{True\ Positive + False\ Negative} \tag{16}$$

$$\text{Specificity} = \frac{True\ Negative}{True\ Negative + False\ Positive} \tag{17}$$

$$\text{F1 Score} = 2*((Precision* Recall) / (Precision + Recall)). \tag{18}$$

$$\text{Accuracy} = \frac{True\ Positive + True\ Negative}{True\ Positive + True\ Negative + FAlse\ Positive + False\ Negative} \tag{19}$$

Algorithm	Precision	Recall	Specificity	F1-Score	Accuracy
Navie Bayes	97.8	79.9	84.5	88.0	80.41
Logistic Regression	98.3	86.1	87.4	91.8	86.28
RS-GANN	99.1	95.6	92.2	97.3	95.25

Table1: showing the Performance of Comparison of Classifiers

The rate of positive predicted value can be explained by the parameter Precision. The recall is the result of the analysis which explains the percentage of relevant values predicted by the model. Specificity measures the ability of a classifier to identify non-disease individuals. The weighted average of Precision and Recall can be represented as the F1-Score of the Classifier. The accuracy of the model is computed by the mathematical formulae given in equation (19).

Algorithm	Precision	Recall	Specificity	F1 -Score	Accuracy
RS-ANN (Before Optimization)	98.8	88.9	90.9	93.6	89.1
Proposed Model	99.1	95.6	92.2	97.3	95.25

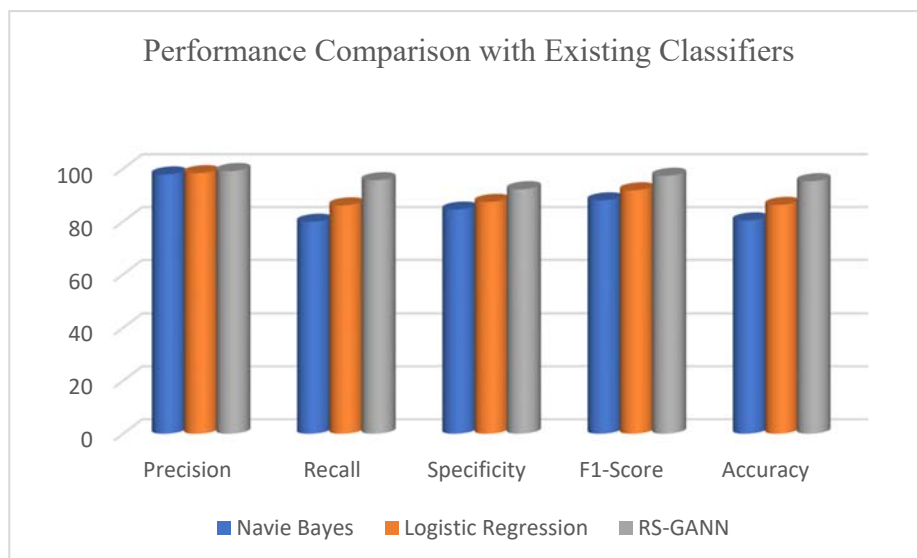Table 2: Comparison of Classifier Performance

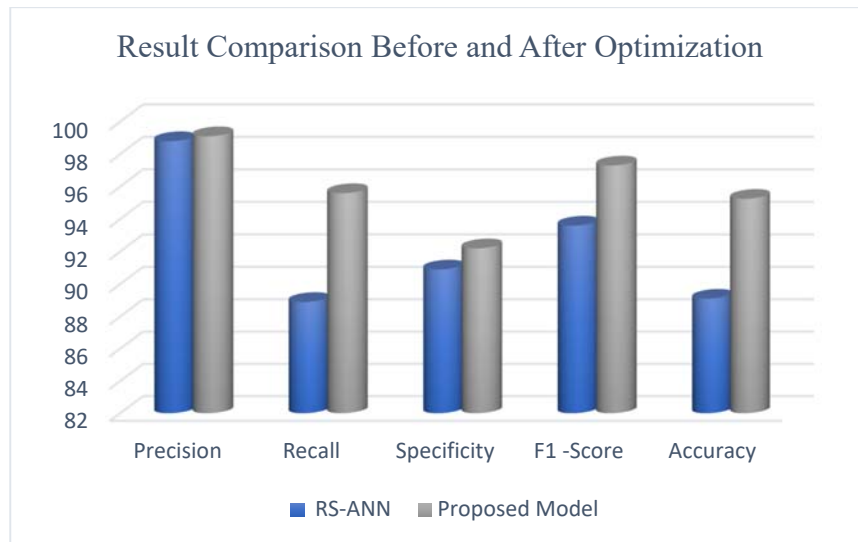Figure 5:   Performance Comparison with Existing Classifiers

Figure 6: Comparison of Result Before and After Grasshopper Optimization

5. Conclusion.

In this study, a novel soft computing model is proposed for heart disease prediction among diabetes patients based on Rough set-based feature selection with an Artificial Neural Network optimized using a metaheuristic stochastic algorithm known as grasshopper optimization. Evaluation of results is plotted in tabular as well as in the graphical format. The results revels that the proposed system shows better performance than the existing algorithms. After executing the proposed methodology, it is found that the classifier shows an improvement of 6.15% accuracy, 0.3% in precision, 6.7% recall, 3.7% in F1-Score, and 1.3% in Specificity while compared with the performance before optimization and that is a significant improvement.

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Authors Profile

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Dr. N.V. Balaji is a highly acclaimed academician with dedication and commitment towards education. As a veteran educationalist for more than a decade he renders his service as an academic contriver with zeal for 21 years. He enriched training and placements with immense enthusiasm scaling the academy to great heights. Dr. Balaji a pertinacious personality brought laurels upon the institutions by representing it at Cambridge University for Business English Certifications. He is a honorable recipient of the award of Ambassador for Computer based Learning and Assessment category in the year 2015.

Adding to his reputation he has accumulated 15 years of research experience in the field of computer science. He exhibits deep interest towards various genres such as Neural Networks, Fuzzy Logic, Image Processing, Classification and Data Mining. Embellishing the annals of education at Karpagam institutions, he has been an influential face between prime IT firms namely Infosys, Wipro, Cognizant and Zoho. Through his constant coordination with competent companies, he incorporated industry collaborated electives in the curriculum of computer science.

He is meticulously marching towards success through significant strategies of prior planning and precise amalgamation of academics with practical experience. Emphasizing industry-based syllabus, he evolved a new theory of learning in order to elevate education as a wholesome experience. As a part of his educational expedition, he has visited United Kingdom and Israel for academic assignments. He is committed to the continuous growth of the institution by presently serving as a Dean of Arts, Science and Humanities at KAHE.

"ARE ECONOMIC KNOWINGNESS, ATTITUDE AND BEHAVIOR OF THE INDIVIDUAL LEADS THE ECONOMIC SUSTAINABILITY"?- THE ECONOMIC SUSTAINABILITY MODEL

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ABSTRACT
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Keywords: economic knowingness, economic attitude, economic behavior and economic sustainability

INTRODUCTION
The idea of sustainable development has its root in the oriental tradition, which teaches the values of conservation of nature and preaches harmonious co-existence of all living elements of the earth. Great ideas are usually simple ideas. The clear goal of economic development policy was to raise living standards throughout the world, providing steadily more goods and services to an expanding population.

"A global agenda for change" - this was what the World Commission on Environment and Development was asked to formulate. It was an urgent call by the General Assembly of the United Nations:

➢ to propose long-term environmental strategies for achieving sustainable development by the year 2000 and beyond;

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➢ to consider ways and means by which the international community can deal more effectively with environment concerns; and

➢ to help define shared perceptions of long-term environmental issues and the appropriate efforts needed to deal successfully with the problems of protecting and enhancing the environment, a long term agenda for action during the coming decades, and aspirational goals for the world community.

The United Nations report linked environmental sustainability and economic development. The Brundtland Commission stated sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" .This is a widely recognized definition of sustainable development. Recently, sustainability has become a popular concept in environmental, health, policy, and research domains . There is an increased knowledge and awareness regarding issues surrounding sustainability. The current prevailing definition refers to sustainability as a "dynamic equilibrium in the process of interaction between a population and the carrying capacity of its environment such that the population develops to express its full potential without producing irreversible, adverse effects on the carrying capacity of the environment upon which it depends". Sustainability has been extensively discussed as involving all aspects of economic, environmental, and social domains.

STATEMENT OF THE PROBLEM

A formal economic analysis arises the question of whether sustainability has any validity as an economic concept. The efficient resource allocation should have the effect of maximizing utility from consumption. This study aims to develop a model to economic sustainability based on economic knowingness(ek), economic attitude(ea) and economic behavior(eb) of individuals in Changanacherry Taluk. Hence, the problem is stated as "Are Economic knowingness, attitude and behavior of the individual leads the economic sustainability"?

SCOPE AND SIGNIFICANCE OF THE STUDY

The motivations behind sustainability are often complex, personal and diverse. It is unrealistic to create a list of reasons why so many individuals, groups and communities are working towards this goal. Sustainability comes down to the kind of future we are leaving for the next generation. Sustainability as a value is shared by many individuals and organizations who demonstrate this value in their policies, everyday activities and behaviors. Individuals have played a major role in developing our current environmental and social circumstances. The people of today along with future generations must create solutions and adapt. Today, it is essential that communities and governments place more emphasis on ensuring that economic development is achieved in a sustainable way.

OBJECTIVES

1. To examine the relationship between economic knowingness, economic attitude and economic behavior of individuals towards economic sustainability.

2. To develop an economic sustainability model.

HYPOTHESIS

HO: There is no significant relationship between economic knowingness, economic attitude and economic behavior of individual towards economic sustainability.

METHODOLOGY

For the purpose of the study, sample unit is selected as Changanacherry Talukand adopted a simple random sampling method to collect the data. The samples received was 113 and for analysis purpose only 100 samples were considered. A structured questionnaire was send through the google form to ensure the data collection within the time limit.

Tools for analysis

The data were analysed using SPSS statistical program. Responses Correlation technique used to measure the relationship between economic knowingness, attitude and behavior of individual towards economic sustainability Multiple regression analysis were used to build the economic sustainability model .

Theoretical framework

"A business model for sustainability helps describing, analysing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries."

Economic Sustainability (es)

Human communities across the globe are able to maintain their independence and have access to the resources that they require, financial and other, to meet their needs. Economic systems are intact and activities are available to everyone, such as secure sources of livelihood. Economic sustainability is measured through three important factors such as; economic knowingness (ek), economic attitude(ea) and economic behavior (eb).

es = (ek+ea+eb)

ANALYSIS AND INTERPRETATION

Table I showing Descriptive statistics

	Mean	Std. Deviation	N
Economic Sustainability	4.0840	.48715	100

Economic Knowingness	4.2960	.53521	100
Economic Attitude	4.2560	.57706	100
Economic Behaviour	3.7360	.65928	100

Table II showing the model summary of economic sustainability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.999[a]	.997	.997	.02503	.997	12472.076	3	96	.000

a. Predictors: (Constant), Economic Behavior, Economic Knowingness, Economic Attitude

Interpretation

The above table shows that, R value is .999 which reveals that there is a close perfect relationship between independent variables such as Economic Behavior, Economic Knowingness, Economic Attitude towards the dependent variable economic sustainability. R^2 shows the .997 degree of variation in the dependent variables.

Table III showing the ANOVA of economic sustainability

	Model	Sum of Squares	Df	Mean Square	F	Sig.
	ANOVA[a]					
1	Regression	23.434	3	7.811	12472.076	.000[b]
	Residual	.060	96	.001		
	Total	23.494	99			

a. Dependent Variable: Economic Sustainability
b. Predictors: (Constant), Economic Behavior, Economic Knowingness, Economic Attitude

Interpretation

This table indicates that the regression model predicts the dependent variable significantly well. The regression model statistically significantly predicts the outcome variable. That is ,it is a good fit for the data.

Table IV showing the Coefficients of the economic sustainability

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	Coefficients[a]					
		B	Std. Error	Beta		
1	(Constant)	-.021	.022		-.980	.329
	Economic Knowingness	.328	.007	.360	44.006	.000
	Economic Attitude	.337	.007	.399	47.449	.000
	Economic Behavior	.338	.004	.457	79.930	.000

a. Dependent Variable: Economic Sustainability

Interpretation

Economic sustainability(es) constant (-.021)= Economic Knowingness(ek) (.328), Economic Attitude(ea) (.337) and Economic Behaviour(eb) (.338) .

es = (ek+ea+eb)

es = -.021 + .328(ek)+.337(ea)+.338(eb)

CONCLUSION

The study was conducted in changanacherry Taluk. The knowingness, attitude and behavior of the individuals this taluk was considered. The study exhibits that there is a high degree of significant relationship between the economic variables and the economic sustainability and thereby it is fit for building the economic sustainability model.

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Theoretical framework

"A business model for sustainability helps describing, analysing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries."

Economic Sustainability (es)

Human communities across the globe are able to maintain their independence and have access to the resources that they require, financial and other, to meet their needs. Economic systems are intact and activities are available to everyone, such as secure sources of livelihood. Economic sustainability is measured through three important factors such as; economic knowingness (ek), economic attitude(ea) and economic behavior (eb).

$$es = (ek+ea+eb)$$

ANALYSIS AND INTERPRETATION

Table I showing Descriptive statistics

	Mean	Std. Deviation	N
Economic Sustainability	4.0840	.48715	100

Economic Knowingness	4.2960	.53521	100
Economic Attitude	4.2560	.57706	100
Economic Behaviour	3.7360	.65928	100

Table II showing the model summary of economic sustainability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.999[a]	.997	.997	.02503	.997	12472.076	3	96	.000

a. Predictors: (Constant), Economic Behavior, Economic Knowingness, Economic Attitude

Interpretation

The above table shows that, R value is .999 which reveals that there is a close perfect relationship between independent variables such as Economic Behavior, Economic Knowingness, Economic Attitude towards the dependent variable economic sustainability. R^2 shows the .997 degree of variation in the dependent variables.

Table III showing the ANOVA of economic sustainability

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	23.434	3	7.811	12472.076	.000[b]
	Residual	.060	96	.001		
	Total	23.494	99			
a. Dependent Variable: Economic Sustainability						
b. Predictors: (Constant), Economic Behavior, Economic Knowingness, Economic Attitude						

Interpretation

This table indicates that the regression model predicts the dependent variable significantly well. The regression model statistically significantly predicts the outcome variable. That is ,it is a good fit for the data.

Table IV showing the Coefficients of the economic sustainability

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.021	.022		-.980	.329
	Economic Knowingness	.328	.007	.360	44.006	.000
	Economic Attitude	.337	.007	.399	47.449	.000
	Economic Behavior	.338	.004	.457	79.930	.000
a. Dependent Variable: Economic Sustainability						

Interpretation

Economic sustainability(es) constant (-.021)= Economic Knowingness(ek) (.328), Economic Attitude(ea) (.337) and Economic Behaviour(eb) (.338) .

es = (ek+ea+eb)

es = -.021 + .328(ek)+.337(ea)+.338(eb)

CONCLUSION

The study was conducted in changanacherry Taluk. The knowingness, attitude and behavior of the individuals this taluk was considered. The study exhibits that there is a high degree of significant relationship between the economic variables and the economic sustainability and thereby it is fit for building the economic sustainability model.

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