India Water Week 2012 – Water, Energy and Food Security : Call for Solutions, 10-14 April 2012, New Delhi

An Evaluation of Domestic Water Rate adopted by Kerala Water Authority

Seeja J. Selin
Assistant Executive Engineers,
Kerala Water Authority, Trivandrum, Kerala.

Grace John
Assistant Executive Engineers,
Kerala Water Authority, Trivandrum, Kerala.

Dr. Georgee K.I.
Associate Professor in Commerce,
Mar Ivanios College, Trivandrum, Kerala.

SYNOPSIS

Setting appropriate prices for water is central to the reform of the water sector in Kerala. Current level of water pricing adopted by Kerala Water Authority (KWA) is deficient in several respects. Under-pricing of water may convey the consumers the illusion that the real value of water is at the low price level which they are paying at present.

Consumers of Kerala Water Authority can be considered mainly in three categories namely, domestic, non-domestic, industrial categories. Tariff structure for these categories was developed by Kerala Water Authority only after 1991 and this has gradually increased the annual revenue of the utility. The billing and collection is based on metering. At present, the frequency of billing is bimonthly in urban areas and once in six months in rural areas. But in both cases, the rates are calculated based on monthly consumption.

The scope of the paper includes the evaluation of water rates adopted by KWA from the point of view of an average domestic consumer. The water rate is compared with the electricity charges paid by the consumer. Consumer price index is also taken as another variable for comparison of water rates. Domestic water rate of a consumer having an average consumption of 35 kilolitres per month is compared with the electricity rate per month incurred by him/her and the consumer price index.

The objective of the paper is to analyse the water rates implemented by Kerala Water Authority in relation to the electricity rates and consumer price index for the past 15 years and to present a regression model representing the pattern in which the water might have been changed in the past 15 years to match with the electricity rate and consumer price index.

Regression model for water rate based on electricity rate alone is considered first. Secondly, regression model for water rate based on consumer price index alone is arrived at. Thirdly, multiple linear regression model for water rate considering the influence of both the electricity rate and consumer price index was done. The regression models are arrived at with the help of statistical analysis software SPSS.

The finding from the single linear regressions is that the association between the water rate (dependent variable) and the electricity rate and the consumer price index (independent variables) is strong to enable the independent variables to predict the water rate. The multiple linear regression model leads us to the conclusion that the water rate presently adopted is 5.7 times lower than what it should be if it has to match the electricity rate and consumer price index.

INTRODUCTION

Water is vital for life and plays an important role for economic development of countries. Pricing of water and sanitation services is based on a number of factors such as depreciation, operation and maintenance costs, re-investment and profit. The determination of price of the service for a particular segment of the customer profile may vary according to the objectives of the utility, political and social criteria. The price of water is low in relation to the cost that is incurred on its provision. Water prices or recoveries from the sale of water and other charges relating to water provision are approximately 22-25 per cent lower than the operation and maintenance costs *(Administrative Report (Internal)*, Kerala Water Authority, 2005-06).

Under-pricing has resulted in poor service and reduced incentives to expand the spatial coverage of services. According to a recent paper, although most cities and towns have been able to reach a reasonably high level of access to safe water, house hold access to tap water within premises is as low as 29.3 per cent in Kerala.

The Government of India and the World Bank recently reported that urban water systems in India deliver on average 50 to 60 per cent of their capacity to end-users, compared with 80 to 85 per cent in other countries. Poor, and sometimes non-existent management leads to waste and inefficiency, with the resultant large claim on resources that could be redeployed for service improvements.

Tariff adjustments to achieve cost recovery are central to the water sector. Most water supplying entities in India operate at a loss. They finance the shortfall between tariff revenue and costs through operating and capital subsidies from the government and through depreciation of capital. The result is a low level equilibrium characterized by low tariff, poor service and limits on access, especially of poor households (T. Nandakumar, 1986).

Water price reform is an important agenda in many developing countries. See the following quote. "The reformulation of tariffs and subsidy policies is central to the reform of water and sanitation services in developing countries. The traditional model of service provision has coupled public ownerships with tariffs that are set well below the cost of the service, justifying this in terms of the importance of water services for the health status of the poor. However, results have often been unsatisfactory. Service quality and coverage remain inadequate in many countries, and subsidies directed at public water companies have often benefited the middle classes rather than the poor, who remain unconnected to the public network. Reformers have proposed to break out of this low level equilibrium through a combination of private sector provision, full cost tariffs, and better targeting of subsidies." Source: Walker in Pricing, Subsidies and the Poor.

Under pricing of water may convey the demander the illusion that the real value of water is at the low price level which the consumer are paying. Also, in the past decades, increasing population, urbanization and industrial development, have increased demand for water which has resulted in considerable decrease in annual renewable water resources per capita (The Conference Board of Canada, November 2009). Therefore design of water price structure is a crucial issue for water utilities and local communities to achieve an efficient allocation of the scarce water recourses.

The income and expenditure figures of water supply have never matched the inevitable result is the increasing deficiencies in the quality of service. Hence full cost recovery has become the operational requirement of present day water utility services, as the case with any service sector.

WATER TARIFF IN KERALA WATER AUTHORITY (KWA)

Kerala Water Authority, an autonomous body of the Government of Kerala has a **vision** to provide quality water supply and wastewater services in an environmental-friendly and sustainable manner. Its **Mission** is to transform itself into a customer-friendly organization providing services at the doorstep. This is to be achieved by being:

- Open and honest in its business dealings
- Financially self-sufficient
- Valuing and developing its employees
- Continuously improving its work practices

Kerala Water Authority has powers to lay down the schedule of fees for all services rendered by KWA to the Government, Local bodies institutions or individuals and to fix or amend the tariff and charges for water supply and sewerage services and collect all such fees for these services as may be prescribed provided that any revision of tariffs and charges for water supply and sewerage services shall be made only with the previous approval of the Government (section (iii) of section 15 of *Kerala Water Supply and Sewerage Act*, 1986).

Water tariff and revenue collection in KWA was not organized before 1991. For all practical purposes the service was almost free at least for the domestic sector. Tariff structure developed afterwards has gradually increased the annual revenue of the utility. The billing and collection is based on metering. Water charges are worked out on the basis of unit rate charges and the quantity of consumption.

Water rates were revised from 1.09.2008 onward, which has shown a direct impact on the financial position of the utility. There occurred a sudden change in this financial pattern of KWA during 2008-09 and 2009-10 because of the increased revenue collection. The non plan grant received during 2009-10 was the highest ie. Rs. 167.09 crores and hence the history of operating loss till March 2009 was shifted to operating profit of Rs. 77.06 crores.

But while considering the repayment of loans and interest also, the net deficit for the past ten years ranges between Rs. 60.97 crores to Rs.173.56 crores (Source – Reference 9 - *Annual Accounts*, KWA for 10 Years) . This shows that enhancing financial viability through full cost recovery envisaged in 9th five year plan is still a dream.

KWA water Tariff should be based on the obligations set out in Kerala Water Supply and Sewerage Act, 1986. The Act gives power to the Authority for fixation and revision of tariffs, taxes and charges for water supply and maintenance services in the areas covered by water supply systems of the Authority.

WATER RATE REFORM IN KERALA WATER AUTHORITY

Water rate reform involves substantial changes in rate formulas and levels, rate regulation, business environment, financial management approaches, subsidies and public relations, etc., which is complex in nature. It requires political will, long-term vision about sector development and a lot of patience but will result in long-term sustainable development of the utility based on demand for services and proper financing for all utility costs. The Government of Kerala vide GO MS NO.45/93/LAD dated 01.03.1993 has agreed for automatic increase of water tariff at a rate of 15 per cent annually. Accordingly, water tariff revision was effected on 1.06.1994. Further revisions in 1.06.1995, 1996, 1997 and 1998 could not be effected for want of prior sanction of Government. The next tariff revision was effected on 1.04.1999.

The Authority on 29.01.2000 resolved to recommend increase in water tariff by 30 per cent for domestic, non-domestic and industrial consumers considering the hike in power tariff between 1994 and 1999. It was also decided to recommend revising water charges in par with the periodical increase in power tariff. Based on this decision, proposals were submitted to the government for prior approval of the government. The government directed to undertake a financial restructuring as a pre-condition for allowing tariff increase. Again in 2003 Proposals were submitted to the Government to revise the water tariff for non-domestic and industrial consumers by 60 per cent of the then tariff. The next tariff revision was implemented in 2008.

At present, water tariff design in KWA has been done on the basis of the revenue deficit. Range of consumption to be defined in the tariff structure is fixed in the rage 0-5 KL, 5-10 KL, 10-20 KL, 20-30 KL, 30- 50 KL and 50 KL+ for domestic consumers and 0-50 KL and 50 KL+ for non-domestic consumers. Knowing the number of consumers coming in each range of consumption, total revenue that can be generated is calculated. Revenue expenditure for the last year is assumed for the future years also. For reducing the revenue deficit to a fixed percentage, the rate for unit consumption in each range of consumption for domestic, non-domestic and industrial categories is fixed by trial and error method.

WATER RATE FROM CONSUMER POINT OF VIEW

The attitude and respect of the consumers towards drinking water, the value of water, and the provider of potable water need a tremendous change to improve their willingness to pay. As a preliminary step to improve the consumer's perception and concept regarding the value of water, the appropriate value of water is to be analysed from the consumer point of view. The results of these analyses should be properly conveyed to the public or consumers in the simplest and best possible manner.

KWA has a variety of categories of categories of consumers. They are domestic consumers or house hold consumers, non-domestic or small shops other than domestic, and industrial consumers who uses water for industrial purpose. Other types of consumers are government schools, government offices and local bodies where public stand posts are provided. Consumers who utilise water for construction purpose are treated as special consumers. They are charged similar to non-domestic consumers till the construction is over and the connection is converted to domestic category. The water tariffs presently adopted by KWA for each of these categories are obtained from the official website (www.keralawater .org) and are presented in the form of graph in the figure 1.

The water charge of each consumer is the sum of a fixed water tax which is independent of the quantity of consumption and a water rate which is dependent on the quantity of water consumed. In the present paper, only the water rates are analysed and water taxes are not taken for the analysis.

SCOPE AND OBJECTIVES OF THE PAPER

The present paper views the price of water from the consumer side for an evaluation. Being the most dominant income producing consumer category of KWA (Seeja, 2012 - Reference 15), only domestic consumer category is selected for the study. For an average middle income domestic consumer average monthly consumption will be around 35 Kilolitres in Kerala. Analysis of water rates as perceived by such a consumer is focussed in this paper. He/ she may be paying electricity charge and for other consumer goods. Hence a comparison of domestic electricity rate per unit and the consumer price index are taken as the other variables for the analysis. The scope of this paper is confined to the study of the relationship between the water rate (dependent variable) with the

monthly electricity rate and yearly consumer price index (independent variables) using regression analysis and to find the regression coefficients.

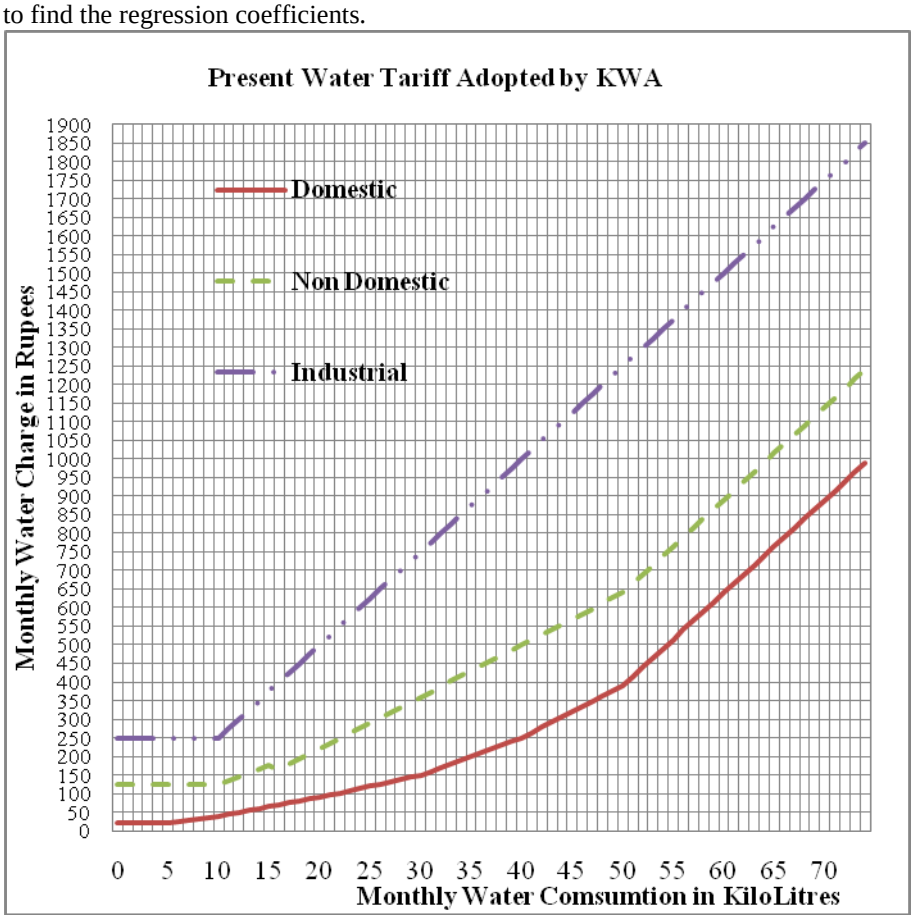

Fig.1 – Water tariff presently adopted

The objective of the paper is to analyse the water rates implemented by KWA in relation to the electricity rates and consumer price index for the past 15 years and to present a regression model representing the pattern in which the water rate might have been increased in the past 15 years to match with the electricity rate and consumer price index. List of variables are, R = Monthly water rates in Rupees per Kilolitre for domestic consumer with 35 KL consumption, CPI = Consumer Price Index and ELEC = Monthly domestic electricity rate in Rupees per unit. R is dependent variable and CPI and ELEC are independent variables. Values of all these variables for the past 15 years are collected and are tabulated in table 1 along with the water rate if it was increased by 15 per cent every year as decided by the government earlier. The analysis is based on the secondary data for the past 15 years.

WATER RATE INCREASE COMPARED TO INFLATION RATE ALONE

The word inflation refers to a general rise in prices measured against a standard level of purchasing power. Previously the term was used to refer to an increase in the money supply, which is now referred to as expansionary monetary policy or monetary inflation. Inflation is measured by comparing two sets of goods at two points in time, and computing the increase in cost not reflected by an increase in quality. There are, therefore, many measures of inflation depending on the specific circumstances. The most well known are the CPI which measures consumer prices.

The **Consumer Price Index** (CPI-U) data provided by the U.S. Department of Labor Bureau of Labor Statistic was made available from the web (source-www.US Inflation Calculator.mht, October, 2011). The data is based upon a 1982 base of 100. A CPI of 195.3, as an example from 2005, indicates 95.3 per cent inflation since 1982. (Paul E. Green and Donald S. Tull, 1986).

The assumptions made for the regression model are

1. The relationship between the R and CPI is linear
2. R is a random variable with normal distribution
3. CPI is fixed and non-random

Table 1: Domestic electricity rate, CPI and domestic water rate for 35 KL monthly consumption

year	Domestic electricity rate rupee per unit	Consumer Price Index	Domestic water rate Rs per KL	Domestic water rate as per the GO
(1)	**(2)**	**(3)**	**(4)**	**(5)**
1997	0.82	160.50	3.45	3.45
1998	0.78	163.00	3.45	4.02
1999	0.81	166.60	3.45	4.63
2000	0.90	172.20	5.00	5.32
2001	1.09	177.10	5.00	6.12
2002	1.47	179.90	5.00	7.04
2003	1.76	184.00	5.00	8.09
2004	1.77	188.90	5.00	9.30
2005	1.86	195.30	5.00	10.70
2006	1.81	201.60	5.00	12.31
2007	1.86	207.30	5.00	14.15
2008	2.17	215.30	5.00	16.27
2009	2.30	214.54	10.00	18.72
2010	2.44	218.06	10.00	21.52
2011	2.57	224.69	10.00	24.75

Regression Analysis

Data regarding CPI 1997 to 2011 and data on domestic water rate for these years are entered into statistical analysis of SPSS version 7.5. Domestic water rate for consumption at 35 Kololitres per month is taken for this analysis. Values of domestic water rates, for the past 15 years were submitted for regression analysis on SPSS as dependent variable and CPI for the corresponding years as independent variable. These values are shown in columns 4 and 3 of table1 respectively.

Statistical analysis for linear regression was done using SPSS. The result generated by SPSS contains model summary, ANOVA table and the coefficients. The calculated F ratio (U.K. Srivastava, 1983) for the linear regression is 21.542. The value of r^2 obtained is 0.619 and is satisfactory for indicating that the water rate for domestic consumer in average consumption of 35 KL, R is linearly related to Consumer Price Index. It implies that 61.9 per cent of the variation of R is explained by the variation in CPI and only 38.1 per cent of variation of R is explained by error. The association is strong to enable CPI to predict R. The model formed is shown as significant by SPSS and the model is as follows

R = 0.787 * CPI - 10.561

Where R is the domestic water rate for 35KLmonthly consumption and CPI is the consumer price index for the year.

WATER RATE COMPARED TO ELECTRICITY RATES ALONE

Electricity rates for different categories of consumers for Kerala State Electricity board for the past years are shown in figure 2, which is represented in the form of a graph.

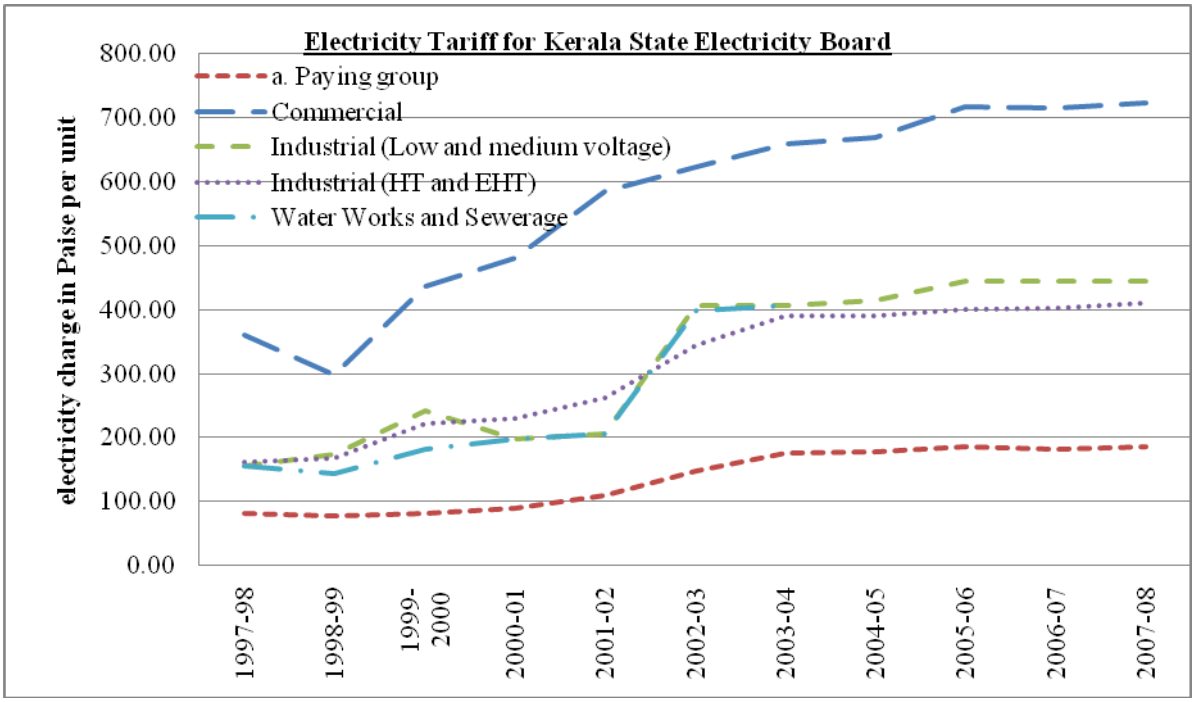

Fig.2 – Year-wise change in Electricity charges

On analysing the above figure, it can be understood that the electricity rates for commercial consumers are more than 4 times that of domestic rate. Industrial rates are nearly twice that of domestic rates. However, As far as a domestic water consumer is concerned, he/she may be interested mainly in analysing the water rate with the domestic electricity rate he/she needs to pay. Hence for the analysis of rate from the consumer point of view, the lower rate i.e, domestic rate is taken as the independent variable for the regression analysis (F.E. Brown, 1980, Paul E. Green and Donald S. Tull, 1986).

The assumptions made for the regression model are

1. The relationship between the R and ELEC is linear
2. R is a random variable with normal distribution
3. ELEC is fixed and non-random

REGRESSION ANALYSIS

Data regarding domestic electricity rate in rupees per unit from year1997 to 2011 and data on domestic water rate for these years are submitted as variables to the statistical analysis of SPSS version 7.5. Domestic water rate for consumption at 35 Kilolitres per month is taken for the analysis. Domestic water rate is submitted to SPSS as dependent variable (R) and domestic electricity rate in rupees per unit (ELEC) as independent variable. These values are shown in columns 4 and 2 of table1 respectively.

Statistical analysis for linear regression was done using SPSS. The result generated by SPSS contains model summary, ANOVA table and the coefficients. The calculated F ratio (U.K. Srivastava, 1983) for the linear regression is 22.566. The value of r^2 obtained is 0.634 and is satisfactory for indicating that the water rate for domestic consumer in average consumption of 35 KL, R is linearly related to domestic electricity rate. It implies that 63.4 per cent of the variation of R is explained by the variation in domestic electricity rate and only 36.6 per cent of variation of R is explained by error. The association is strong to enable electricity rate to predict R. The model formed is shown as significant by SPSS and the model is as follows

R = 0.797 * ELEC + 0.837

Where R is the domestic water rate for 35KL monthly consumption and ELEC is the domestic electricity rate in rupees per unit for the year.

The single linear regression models show that there is a high degree of association between water rate and CPI as well as Water and electricity rate. Water rates for the past 15 years are calculated based on these regression models and shown in column 5 and 6 of table 2.

WATER RATE INCREASE AS PLANNED BY THE GOVERNMENT DURING 1993

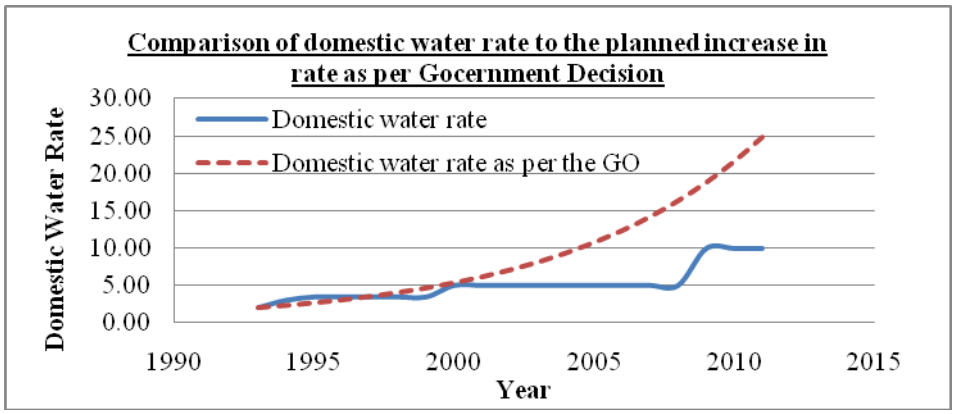

Fig.3 – Comparison of water rate with that of planned water rate

The Government, vide GO MS NO.45/93/LAD dated 01.03.1993 has agreed for automatic increase of water tariff at a rate of 15 per cent annually. If water charges were increased accordingly from that 1997 onwards, domestic water rate for 35 KL consumption calculated based on 1997 rate is shown in column 5 of table 1. The figure shows that there is an increasing gap between the planned yearly rate revision and the rate actually implemented.

DOMESTIC WATER RATE BASED ON ELECTRICITY RATE AND CPI

For analysing the combined influence of CPI and ELEC on the variable R, these two variables are to be added as independent variables in a single regression analysis (F.E. Brown, 1980).

Regression Analysis

Values of all the three variables R, CPI and ELEC for the years 1997 to 2011, shown in columns 4, 3, and 2 respectively of table 1 are submitted for the statistical analysis. Domestic water rate is submitted as dependent variable and CPI and ELEC are submitted as independent variables. Statistical analysis for multiple linear regressions was done using SPSS. The result generated by SPSS contains model summary, ANOVA table and the coefficients. The model formed is shown as significant by SPSS and the model is as follows

R = 0.261 * CPI + 0.544 * ELEC – 3.018

Values of water rates are calculated based on the above regression equation and shown in column 7 of table 2. These values are plotted against CPI, electricity rate and actual and planned water rates and shown in the figure 4. It can be noted that the values of water rates obtained from regression model always lies between the values of CPI and electricity rates.

RESULTS AND DISCUSSION

The calculated F ratio (U.K. Srivastava, 1983) for multiple linear regression is10.621, which exceeds Table F(2,12) value at 2 per cent level. Hence we can conclude that water rate is a function of electricity rate and CPI with a confidence level of 98 per cent. Hence the equation is a valid one.

Strength of association

For the validity of the regression equation, coefficient of determination, r^2 and multiple correlation coefficient, r are to be looked at.

The value of r^2 obtained is 0.639 and r is 0.799 which are satisfactory one for indicating that the water rate for domestic consumer in average consumption of 35 KL, R is linearly related to electricity rate ELEC and Consumer Price Index. It implies that 63.9 per cent of the variation of R is explained jointly by the variation in CPI and ELEC and only 36.1 per cent of variation of R is explained by error. The association is strong to enable CPI and ELEC to predict R.

Table 2- Results of Regression analysis in tabular form

Domestic electricity rate rupee per unit	Consumer Price Index	Domestic water rate Rs per KL	Domestic water rate as per the GO	Water rate Single Linear Regression CPI	Water Rate Single Linear Regression ELEC	water rate - Multiple Linear regression with CPI & ELEC
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
0.82	160.50	3.45	3.50	115.75	1.49	39.32
0.78	163.00	3.45	4.02	117.72	1.46	39.95
0.81	166.60	3.45	4.63	120.55	1.48	40.91
0.90	172.20	5.00	5.32	124.96	1.56	42.42
1.09	177.10	5.00	6.12	128.82	1.71	43.80
1.47	179.90	5.00	7.04	131.02	2.01	44.73
1.76	184.00	5.00	8.09	134.25	2.24	45.96
1.77	188.90	5.00	9.30	138.10	2.25	47.25
1.86	195.30	5.00	10.70	143.14	2.32	48.97
1.81	201.60	5.00	12.31	148.10	2.28	50.58
1.86	207.30	5.00	14.15	152.58	2.32	52.10
2.17	215.30	5.00	16.27	158.88	2.57	54.36
2.30	214.54	10.00	18.72	158.28	2.67	54.23
2.44	218.06	10.00	21.52	161.05	2.78	55.22
2.57	224.69	10.00	24.75	166.27	2.89	57.03

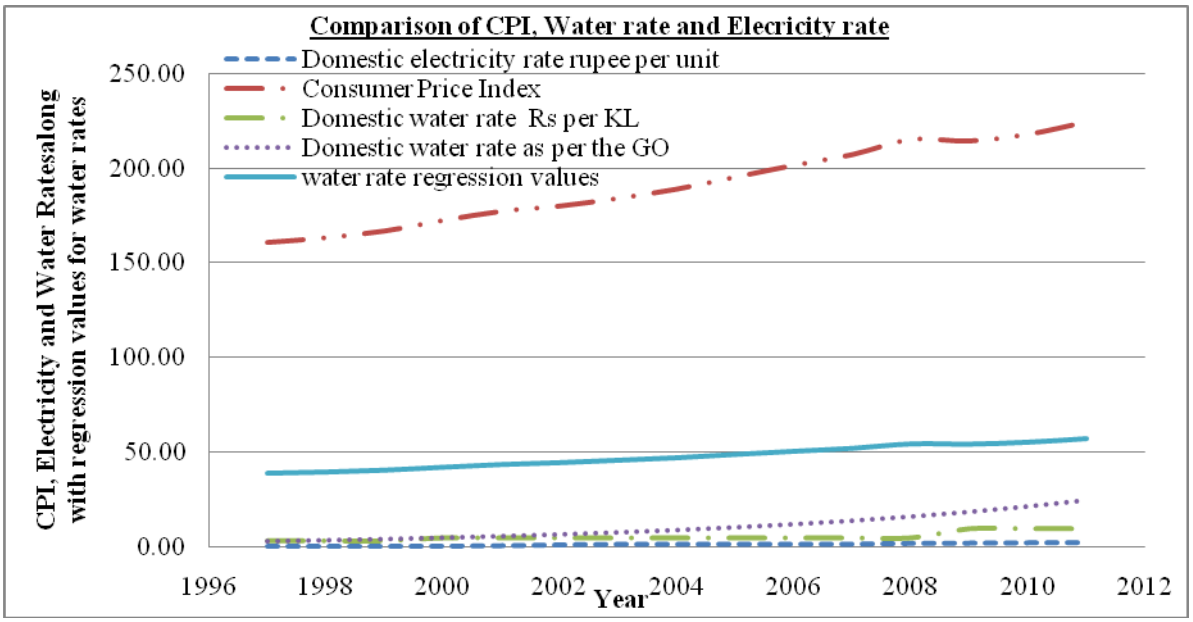

Fig.4 – Comparison of forecasted water rate with that of electricity rate CPI and actual and planned water rates

CONCLUSION

The objective of this paper is to the study of the relationship between the water rate (dependent variable) with the monthly electricity rate and yearly consumer price index (independent variables) using regression analysis and to find the regression coefficients. It was able to establish a functional relationship between the variables. The finding from the linear regressions is that the association between the water rate and the independent variables is strong to enable the independent variables to predict the water rate. 63.9 per cent of the variation in water is explained by the multiple linear regression model and only 36.1 per cent of the variation is explained by

error. The multiple linear regression model leads us to the conclusion that the water rate presently adopted is 5.7 times less than what it should be if it has to match the electricity rate and consumer price index.

ACKNOWLEDGEMENT

We would like to extend our sincere thanks to Sri. Ashok Kumar Singh, the Managing Director of Kerala Water Authority for all the help and support offered for obtaining the secondary data from Kerala Water Authority.

REFERENCES

1. F.E. Brown, 1980, *Marketing Research*, Addision – Wesley Publishing Company.
2. Paul E. Green and Donald S. Tull, 1986, *Research for Marketing Decisions*, Prentice-Hall of India Pvt. Ltd.
3. U.K.Srivastava, G.V., 1983, *Quantitative Techniques for Managerial Decision Making*, Wiley Eastern Limited.
4. *Consumer Price Index Data from 1913 to 2011*, US Inflation Calculator.mht, October, 2011.
5. *Kerala Water Supply Project –Institutional Strengthening-Organisation Review*, prepared by Tokyo Engineering Consultancy Consortium, June, 2005.
6. www.keralawater .org
7. *Kerala Water Supply and Sewerage Act*, 1986.
8. *Administrative Report (Internal)*, Kerala Water Authority, 2005-06.
9. *Annual Accounts, Kerala Water Authority*,1998-1999,1999-2000,2000-01, 2001-02, 2002-03, 2003-04,2004-05, 2005-06, 2006-07, 2007-08.
10. *Approaches to Urban Water Pricing*, Frontier Economics, Waterlines Occasional Paper No.7, July, 2008. National Water Commission, Australian Government.
11. David le Blanc, "A Framework of Analysing Tariffs and Subsidies in Water Provision to Urban Households in Developing Countries", DESA Working Paper No 63 Economic and Social Affairs January, 2008.
12. Software development for water pricing model, November, 2006, Report submitted in partial fulfilment of the degree of Master of Engineering (Civil-Environmental Management) by Aida Wee Sze Chia, University of Technology, Malaysia.
13. "Improving Infrastructure Management Municipal Investments in Water and Waste Water Infrastructure" The Conference Board of Canada, Report, November 2009.
14. Human Development Report Office Occasional Paper Cost and Tariff Model for Rural Water Supply Schemes April, 2003
15. Project Report submitted to Indira Gandhi National Open University during March, 2012, by Seeja J Selin, in partial fulfilment of the Master of Business Administration.
16. "Primer on Water Supply and Tariff Methodology and Financial Model", October, 2007, IDP Consult, Inc.
    Key Issues of Tariff Reform in the Water Sector in the EECCA
17. T. Nandakumar, "Water & Sewerage Tariffs – An Overview", National Seminar on Water and Sewerage Tariff, Srinagar, Jammu and Kashmir, 9th to 10th September, 1986.