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Comparison of Rate of Change in the Consumption of Various Sources of Energy in Nepal

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The present study examines the rate of change of various sources of energy like biomass, coal, petroleum products, electricity and renewable sources of energy in Nepal by employing secondary data collected from various published resources. It also aims to measure the consistency or variability in the consumed quantity of various sources of energy during the period of 20 years, from 1998/99 to 2017/2018. Simple statistical tools and methods like ratio, percentage, mean, range, coefficient of range, standard deviation and coefficient of variation are used to describe and explore the viability of consumption. Descriptive and exploratory research designs were used in this study. The condition of energy consumption during the study period is found an increasing trend. The consumption of electricity is found more consistent or stable than other sources of energy.

Keywords: Tone of Oil Equivalent (TOE); consistency; variability; energy; traditional sources; renewable resources.

1. INTRODUCTION

Power derived from the utilization of physical or chemical resources, especially to provide light and heat or to work machines is called energy. Energy is a quantitative property that must be transferred to an object to perform to work on or to heat the object. The law of conservation of

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energy states that energy can be converted in form, but not created or destroyed. Nepal is blessed with vast natural energy resources; however, its fruitful utilization for the well-being of its growing population is lagging due to the economic, geographical, and techno-political conditions. The potential could not be achieved due to political instability, inability to attract foreign direct investments (FDIs), and delay in project execution over the last decade [1]. Nepal does not have its reserves of gas, petroleum products, and coal. Biomass, petroleum materials, coal, and renewable sources are the major sources of energy. Coal and petroleum products are purchased from foreign countries. The country has huge potential for hydroelectricity but less than 2% of the potential 83000MW of hydroelectricity is currently generated. The current generation is approximately 1300 MW. 78 percent of people have access to grid-connected energy. However, 82% of the population used solid fuels such as coal, dung, and wood as cooking energy. The per capita energy consumption is 245 KWh and expected to be 1500 KWh in the next five years. Last year Nepal spent almost 20 billion importing electricity from India, on top of Rs. 90 billion in petroleum products. Nepal's' economic and social development is hampered by its inadequate energy supply [2].

Most of the Nepalese citizens have historically met their energy needs from biomass. Firewood is the predominant energy carrier, counting for nearly 63% of the total energy consumption [3]. However, its use is inefficient and poses a threat to the forest resources of the country. At the same time, indoor pollution is the result of firewood, which hampers the health of the people especially those who are involved in cooking. Compared with other countries, Nepal has high energy consumption concerning its GDP [1]. It does not yet have a strategy for sustainable efficient use for either the electricity sector or its main primary energy sources i.e. biomass. Nepal mainly uses four types of sources of energy i.e. traditional sources, coal, petroleum products, electricity and renewable resources of energy. Firewood, agricultural waste and animal dung come under traditional sources of energy. Petroleum products include petrol, kerosene, aviation fuel and LP gas, etc. Similarly, renewable sources of energy include solar energy and biogas.

Normally, the consumption of energy is measured in the Tons of Oil Equivalent (TOE). The ton of oil equivalent (TOE) is a unit of energy defined as the amount of energy released by burning one ton of crude oil. It is approximately 42 gigajoules or 11.63-megawatt hour, although as different crude oil has different calorific values, the exact value is defined by convention and several slightly different definitions exist. TOE is sometimes used for large amounts of energy. Multiples of the TOE are used, in particular the mega TOE (Mtoe, one million TOE) and the Giga TOE (Gtoe, one billion TOE). A smaller unit of kilogram of oil equivalent (Kgtoe) is also sometimes used denoting $1/1000$ TOE (Wikipedia). In the calculation, 1 TOE =11.63 megawatt-hours (MWh) or 1 TOE = 41.868 gigajoules (GJ) or 1 TOE = 10 Giga calories (Gcal) or 1 TOE = 1.42857143 tons of coal equivalent (TCE) are also used as per the necessity [4].

1.1 Statement of the Problem

Based on origin, Nepal consumed two types of sources of energy i.e. self-produced or own resources or purchased resources. The portion of purchased resources from foreign is more than their own or self-produced resources. Due to the increase in population as well as the purchasing power of people, the number of vehicles is increasing day by day. Therefore the demand for petroleum is also increasing. But the growth rate is not considered and compared with the growth rate of other economic variables. It does not yet have a strategy for sustainable, efficient energy use for the electricity sector or its main primary energy source, biomass. The power supply is particularly critical during the dry season, during which it is cut off for several hours a day, which hurts business and private households. Private households, the public sector as well as commerce and industry sector are largely unaware of the economic and ecological advantages of efficient energy use. There are no standards for energy-saving domestic appliances, lighting, or products and processes in industrial use.

Nepal has high energy consumption concerning its GDP, as compared to other countries. But there is a mismatch between the demand and supply of sources of energy till the date. Similarly, there are various studies on the condition, uses, and consumption patterns of various sources of energy. Especially, solar energy, biogas, and hydroelectricity are being the subject matter of various studies. But there is less attention to the comparison of variability of

the consumption of various sources of energy in Nepal. This is also a problem for the power sector. This has significance because it helps the planner and policymaker to forecast the power consumption in the country. In this study, the following research questions are determined.

- What is the structure of energy consumption of various sources in Nepal?
- What is the condition of annual change in energy consumption by sector in Nepal?
- Which sources of energy consumption are more consistent than other sectors?

2. LITERATURE REVIEW

Different studies have been conducted regarding the various aspects of various sources of energy. There are so many literatures are available on the condition, utilization and prospects of electricity, biomass, and renewable sources of energy. However, some important studies are reviewed that are relevant to this study.

Poudel et al. [5] examined the energy consumption pattern and renewable energy alternatives in a particular place (Kalyanpur) of the Chitawan district of Nepal. They found that the energy consumption pattern and greenhouse gas emissions are interrelated. The unsustainable use of biomass and widespread use of commercial energy are the major sources of greenhouse gas emissions. There was a substantial use of traditional sources of energy for cooking and preparation of animal feed along with LPG and biogas. All the people use SHS (Solar Home System) for lighting, as the area was deprived of grid electricity, far from the major market center and the availability of other sources of energy is limited [6]. Their study was limited to the consumption pattern of alternative energy, cost-benefit ratio, and environmental effect of various sources of energy.

Vallve and Hellpap [2] observed that 80.4% of energy supply comes from biomass. Similarly, 4.1% from coal, 11.6% from oil products, 2.8% comprises from electricity, and rest 1.15 from other various sources. 95% of the biomass is predominantly and traditionally used for household purposes. The estimated wood consumption is approximately 17 million tons per day. Nepal has 300 days of sunshine annually but 0.10 MW of solar electricity is joined in the main grid of NEA. The petroleum product is the second largest energy fuel in Nepal after firewood. It is the 8% of primary energy consumption in Nepal. Coal stands for 2% of the total energy consumption. Coal is mainly used in the industrial sector for heating and boiling processes [7].

Dhungel [8] used co-integration to determine electricity demand in Nepal. The estimated income elasticity and price elasticity of electricity are associated with changes in income and price. Malla [9] used a descriptive and analytical research design to present the current condition of the power sector in Nepal. In this study, he mainly covers the present scenario of hydroelectricity production, utilization and demand. The maximum peak as noted at 18 hours 1094.62 MW. At present, the net deficit is around 340 MW. As the annual increment on the demand side is estimated for 100MW, it has become necessary to plan and develop hydros on a long-term basis to solve the power crisis [9].

Poudel [6] used a descriptive and exploratory design to forecast the future demand for energy and Nepal's energy scenario. The demand for electric power is growing three times as fast as the world's population. By 2030, global electricity requirements could increase by two – thirds. Two of our neighboring countries, India and China, now account for about half of the global energy demand and its appetite continues to grow. GIZ [10] observed the energy consumption situation of Nepal in two headings i.e.; energy consumption by fuel type and by economic sectors wise based on the secondary data derived from CBS, GoN [11,12] and NPC. Biomass is by far the most utilized primary source and the electrification rate of the population is only about 70%, with approximately 63% in rural areas. Nepal's per capita electricity consumption is about 161 kWh-one of the lowest consumption in South Asia [10]. All these studies are related to the condition, uses, consumption patterns, and importance of various sources of energy. More research is related to various aspects of hydroelectricity, biomass and renewable sources of energy. But this study measures the annual change in the consumption and its variability of various sources of energy i.e. traditional sources, petroleum products, coal electricity, and renewable sources of energy. So it is different from the previous studies that were reviewed.

3. METHODOLOGY

3.1 Research Design

To measure the rate in change of energy consumption of various sectors, a descriptive

and exploratory research design is used. Quantitative data and simple mathematical calculations are made to describe and explore the rate of change in the consumption of energy from various sources in Nepal.

3.2 Sources of Data

The present study employs secondary data. The required secondary data are collected from economic survey of the government of Nepal, various plan documents, and the publication of the Central Bureau of Statistics (CBS).

3.3 Data Analysis

The data were analyzed by using simple mathematical tools like ratio, percentage, mean, range, coefficient of range, standard deviation, and coefficient of variation. Specifically, the coefficient of variation is given more emphasis to find the variability and consistency of annual change in the energy consumption from various sources in Nepal. In data analysis, the following statistical calculations are made by using the following formulae.

Mean ($\bar{X}$) = $\frac{sum\ of\ variable}{Number\ of\ obsrvation} = \frac{\sum X}{N}$

Range® -X_{max}-X_{min} and coefficient of Range= $\frac{X_{max}-X_{min}}{X^{max}+X_{min}}$

Standard deviation (σ) = $\sqrt{\frac{\sum X^2}{N} - (\frac{\sum X}{N})^2}$

or, $\sqrt{\frac{\sum(X-\bar{X})^2}{N}}$

Coefficient of variance (C.V) = $\frac{\sigma}{\bar{X}}$ ×100

Where,

X= value of variables N= No. of observation $\bar{X}$= mean of variable
X_{max}= maximum value of variable Xmin= Minimum value of variable
σ= standard deviation

3.4 Objectives of the Study

The general objective of the study is to review the annual change and its comparison of consumption of various sources of energy during the period of 20 years from fiscal year 1998/99 to 2017/18. The specific objectives are:

- To identify the structure of energy consumption of various sources in Nepal.
- To show the condition of annual change in energy consumption by sector in Nepal.
- To compare the variability or consistency of the annual change of consumption in various sources of energy.

3.5 Limitations of the Study

The present study is related to secondary data collected from various published sources. It only covers the annual data of 20 years from 1998/99 to 2017/18. Five sources of energy like traditional sources, coal, petroleum products, electricity, and renewable sources are included. This study examines the structure, annual change, and variability or consistency of the consumed quantity of various sources of energy. Various types of measures of dispersion are used to compare the variability or consistency of the consumed quantity of energy in Nepal.

4. RESULTS AND DISCUSSION

4.1 Structure and Change of Energy Consumption in Nepal

4.1.1 Structure of energy consumption in Nepal

The structure of consumption of various sources of energy has changed in the same direction. The consumed amounts of all sources of energy have increased, but the rate of change is different. On average, the rate of change of energy consumption is more than the population growth rate of Nepal. The consumption of traditional sources of energy has increased by 1.54 times during the period of 20 years. Similarly, the consumption of coal, petroleum products, electricity, and renewable sources of energy has increased by 11.2, 3.6, 6.35 and 14.8 times, respectively in fiscal year 2017/18 in comparison to 1998/1999. The structure and change in energy consumption are presented in Table 1.

In Table 1, the conditions of various sources of energy are presented. The traditional source of energy consumption ranges from 6540 to 9473 thousand tons of oil equivalent (TOE). So the range of traditional sources of energy consumption is 2933 TOE during the period of 20 years, and the coefficient of range is found 0.18. The data of consumption of coal, petroleum product, and electricity range from 68 to762, 661 to 2388 and 89 to 565 thousand TOE respectively. Similarly, the ranges of coal, petroleum products, and electricity consumption are found 694, 1727 and476 thousand TOE,

respectively. The range coefficient of coal is 0.84, the coefficient of range of petroleum product consumption is 0.57 and the range coefficient of electricity consumption is 0.73. It is found that the data on renewable energy consumption ranges from 20 to 296 thousand TOE during the period of 20 years. The range is found 276 thousand TOE and it's coefficient of range is found 0.87.

4.2 Measurement and Comparison of Rate Change in Energy Consumption

The annual percentage change of traditional energy consumption ranges from -17.27% to 14.01% during the analysis period of 20 years. The annual percentage changes in coal, petroleum materials, electricity, and renewable sources of energy are -29.27 to 61.67, -5.62 to 63.76, -4.21 to 45.91 and 0 to 75.31 percent respectively. The average annual change in traditional sources of energy consumption is 2.1%. Similarly, the average annual changes in coal, petroleum materials, electricity, and renewable sources of energy are 17.5%, 8.0%. 10.6% and 16.7%; respectively. In the Table 2, the annual rate of change in various sources of energy consumption is measured. In this table,

We have, $\sum T = 40.66$ $\sum T^2 = 706.33$ $\sum C = 331.48$ $\sum C^2 = 21734.02$ $\sum P = 151.88$

$\sum P^2 = 6061.62$ $\sum E = 200.92$ $\sum E^2 = 3818.00$ $\sum R = 316.55$ $\sum R^2 = 12626.48$ $N = 19$

Calculation of mean value of annual change in consumption of various sources of energy

$\overline{T} = \frac{\sum T}{N}$ $\bar{C} = \frac{\sum C}{N}$ $\bar{P} = \frac{\sum P}{N}$ $\bar{E} = \frac{\sum E}{N}$ $\bar{R} = \frac{\sum R}{n}$

$= \frac{40.60}{19}$ $= \frac{331.48}{19}$ $= \frac{151.88}{19}$ $= \frac{200.92}{19}$ $= \frac{316.55}{19}$

=2.1 =17.5 =8.0 =10.6 =16.7

Calculation of standard deviation of annual change in consumption of various sources of energy

$\sigma_T = \sqrt{\frac{\sum T^2}{N} - \left(\frac{\sum T}{N}\right)^2}$

$= \sqrt{\frac{706.33}{19} - \left(\frac{40.66}{19}\right)^2}$

$= \sqrt{37.18 - (2.14)^2}$

$= \sqrt{37.18 - 4.58}$

$= \sqrt{32.60}$

$\sigma_C = \sqrt{\frac{\sum C^2}{N} - \left(\frac{\sum C}{N}\right)^2}$

$= \sqrt{\frac{21734.02}{19} - \left(\frac{331.48}{19}\right)^2}$

$= \sqrt{1143.90 - (17.45)^2}$

$= \sqrt{1143.90 - 304.50}$

$= \sqrt{839.4} = 5.71$

=28.97

$\sigma_P = \sqrt{\frac{\sum P^2}{N} - \left(\frac{\sum P}{N}\right)^2}$

$= \sqrt{\frac{6061.62}{19} - \left(\frac{151.88}{19}\right)^2}$

$= \sqrt{319.03 - (8)^2}$

$= \sqrt{319.03 - 64}$

$= \sqrt{255.03}$

=15.96

$\sigma_E = \sqrt{\frac{\sum E^2}{N} - \left(\frac{\sum E}{N}\right)^2}$

$= \sqrt{\frac{3818.00}{19} - \left(\frac{200.92}{19}\right)^2}$

$= \sqrt{200.95 - (10.57)^2}$

$= \sqrt{200.95 - 111.72}$

$= \sqrt{89.23}$

=9.45

$\sigma_R = \sqrt{\frac{\sum R^2}{N} - \left(\frac{\sum R}{N}\right)^2}$ $= \sqrt{\frac{12626.48}{19} - \left(\frac{316.55}{19}\right)^2}$ $= \sqrt{664.55 - (16.66)^2}$

$= \sqrt{664.55 - 277.56}$ $= \sqrt{386.99}$ =19.67

Table 1. The structure and change in energy consumption (Thousand tons of oil equivalent TOE)

Fiscal years	Traditional sources		Coal		Petroleum product		Electricity		Renewable sources	
	Quantity	Annual change (%)	Quantity	Annual change (%)	Quantity	Annual change (%)	Quantity	Annual change (%)	Quantity	Annual change (%)
1998/99	6054	_	68	_	661	_	89	_	20	_
1999/00	6681	2.16	246	61.76	709	7.26	99	11.24	24	20.00
2000/01	6824	2.14	174	-29.27	734	3.53	108	9.09	29	20.83
2001/02	7066	3.55	152	-12.64	758	3.26	119	10.19	33	13.79
2002/03	7240	2.46	134	-11.84	753	-0.66	128	7.56	39	18.18
2003/04	7397	2.17	171	27.61	747	-0.99	141	10.16	45	15.38
2004/05	7556	2.15	152	11.11	705	-5.62	157	11.35	46	2.22
2005/06	7698	1.89	243	59.87	686	-2.70	164	4.46	53	15.22
2006/07	7854	2.o3	144	59.25	709	3.35	178	8.54	59	11.32
2007/08	8015	2.05	193	34.03	655	-7.62	190	6.74	59	0.00
2008/09	8185	2.12	182	-5.70	775	18.32	182	-4.21	64	8.47
2009/10	8342	1.92	286	57.14	965	24.52	213	17.03	70	9.38
2010/11	8500	1.89	293	2.45	1058	9.64	229	7.51	75	7.14
2011/12	7032	-17.27	348	18.77	1083	2.36	248	8.30	19	45.33
2012/13	8017	14.01	415	19.25	1182	9.14	257	3.63	166	52.29
2013/14	8983	12.34	320	-22.89	1264	6.94	375	45.91	291	75.30
2014/15	9104	1.35	465	45.32	1469	16.23	397	5.87	292	0.34
2015/16	9227	1.35	536	15.27	1275	-13.21	437	10.08	293	0.34
2016/17	9320	1.01	663	23.88	2088	63.76	507	16.02	294	0.34
2017/18	9473	1.64	762	14.75	2388	14.37	565	11.45	296	0.68

Source: - Economic surveys of Nepal (From F/Y 2010/11 to 2017/180) (Note:-The annual percentage is calculated from the available data)

Table 2. Measurement of rate of change in energy consumption in Nepal

Fiscal year	T	T^2	C	C^2	P	P^2	E	E^2	R	R^2
1998/99	_	_	_	_	_	_	_	_	_	_
1999/00	2.16	4.67	61.76	3814.30	7.26	52.71	11.24	126.34	20.00	400.00
2000/01	2.14	4.58	-29.27	856.73	3.53	12.46	9.09	82.63	20.83	433.89
2001/02	3.55	11.22	-12.64	159.77	3.26	10.63	10.19	103.84	13.79	190.16
2002/03	2.46	6.05	-11.84	140.19	-0.66	0.44	7.56	57.15	18.18	33.51
2003/04	2.17	4.71	27.61	762.31	-0.99	0.98	10.16	103.22	15.38	236.54
2004/05	2.15	4.62	11.11	123.43	-5.62	31.58	11.35	128.82	2.22	4.93
2005/06	1.89	3.57	59.87	3584.42	-2.70	7.29	4.46	19.89	15.22	231.65
2006/07	2.03	4.12	59.25	3510.56	3.35	11.22	8.54	72.93	11.32	128.14
2007/08	2.05	4.20	34.03	1158.04	-7.62	58.06	6.74	14.43	0.00	0.00
2008/09	2.12	4.49	-5.70	32.49	18.32	335.62	-4.21	17.72	8.47	71.74
2009/10	1.92	3.69	57.14	3264.98	24.52	601.23	17.03	29.02	9.38	87.98
2010/11	1.89	3.57	2.45	6.00	9.64	92.92	7.51	56.40	7.14	50.98
2011/12	-17.27	298.25	18.77	352.31	2.36	5.57	8.30	68.89	45.33	2054.81
2012/13	14.01	196.28	19.25	370.56	9.14	83.54	3.63	13.18	52.29	2734.24
2013/14	12.34	144.96	-22.89	523.95	6.94	48.16	45.91	2107.73	75.30	5670.09
2014/15	1.35	1.82	45.32	2053.00	16.23	263.41	5.87	34.46	0.34	0.12
2015/16	1.35	1.82	15.27	233.17	-13.21	174.50	10.08	101.61	0.34	0.12
2016/17	1.01	1.02	23.88	570.25	63.76	4065.34	16.02	256.64	0.34	0.12
2017/18	1.64	2.69	14.75	217.56	14.37	206.50	11.45	131.10	0.68	0.46
Total	40.66	706.33	331.48	21734.02	151.88	6061.62	200.92	3818	316.55	12626.48

T = traditional sources, C= coal, P= petroleum products, E = electricity, R= renewable resources

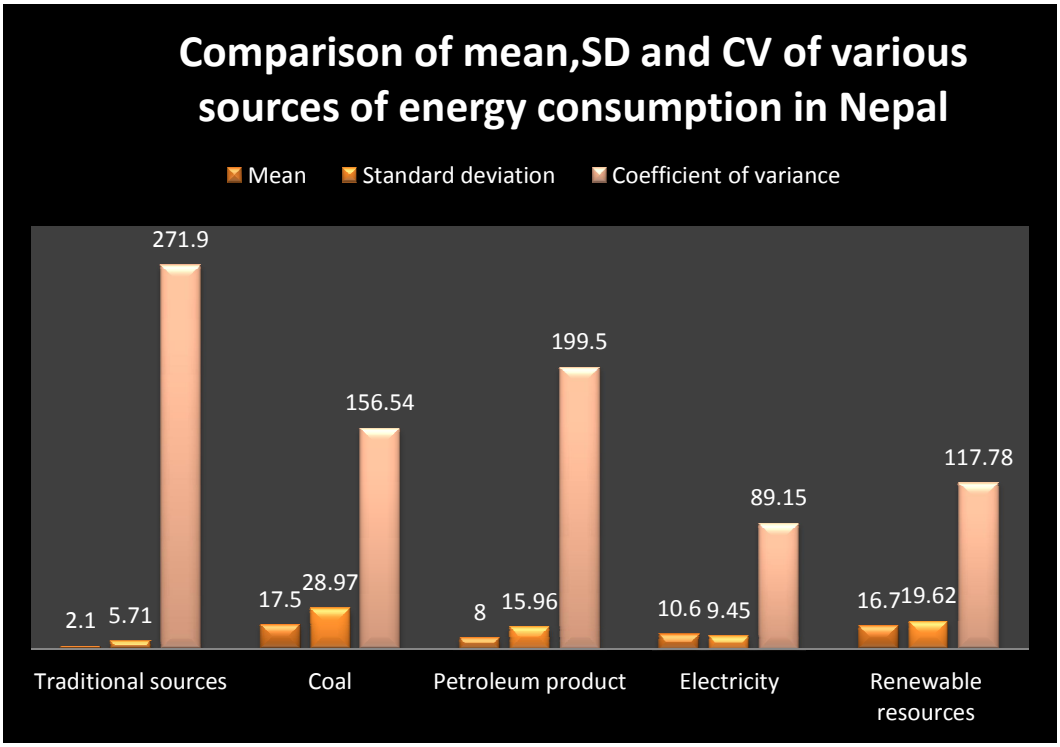

Fig. 1. Condition of tools of comparison

The mean of traditional sources of energy is more stable because its standard deviation is less than other sources of energy. Similarly, the mean of annual change in coal consumption is less representative because it has the highest standard deviation compared to other sources of energy. Recall that the standard deviation is the most important measure of the variability of data. For the observations, which are close to each other, the standard deviation is small and for the observations which are widely spread, the standard deviation is large.

Calculation of coefficient of variation

$C.V_T = \frac{\sigma_T}{\bar{T}} \times 100$
$=\frac{5.71}{2.1}\times 100$
$=271.90\%$

$C.V_C = \frac{\sigma_c}{\bar{c}}\times 100$
$=\frac{28.97}{17.5}\times 100$
$=165.54\%$

$C.V_P = \frac{\sigma_P}{\bar{P}}\times 100$
$=\frac{15.96}{8.00}\times 100$
$=199.50\%$

Again,

$C.V_E = \frac{\overline{\sigma_E}}{\bar{E}}\times 100$
$=\frac{9.45}{10.6}\times 100$
$=89.15\%$

$C.V_R = \frac{\sigma_R}{\bar{R}}\times 100$
$=\frac{19.67}{16.7}\times 100$
$=117.78\%$

According to this calculation $C.V_E < C.V_R < C.V_C < C.V_P < C.V_T$ i.e. 89.15 < 117.78 < 165.54 < 199.50 < 271.90. The coefficient of variation of electricity has the least value (89.15%) than other sources of energy. This means that the consumption of electricity is more consistent, uniform, or stable than other sources of energy. The consumption of electricity is more consistent than other sources of energy during the period of 20 years. The variability of consumption of traditional sources, coal, petroleum products, and renewable resources are found more than 100% during the analysis period of fiscal years 1998/99 to 2017/17. The coefficient of variation of traditional sources of energy has the greatest value (271.90%) than other sources of energy.

Therefore, the consumption of traditional sources of energy is more variable or inconsistent than other sources of energy. $C.V_T > C.V_P$. So, the consumption of traditional sources of energy is more variable than petroleum products. The consumption of petroleum products is more variable than the consumption of coal consumption because $C.V_P > C.V_C$. Similarly, coal consumption is more variable than the consumption of renewable sources of energy (i.e. $C.V_C > C.V_R$) and the consumption of renewable sources of energy is more variable than the consumption of electricity because $C.V_R > C.V_E$. The mean and standard deviation of the annual consumption change of traditional sources are smaller than other sources whereas the mean and standard deviation of the annual change of coal are highest than other sources. More standard deviation means more variability in the data set. The difference between the mean and standard deviation of the annual change in electricity consumption is least than other resources. Therefore the coefficient of variance is also least than other sources of energy. So the consumption of electricity is more preferable than traditional, coal, petroleum products and renewable resources. Recall that the comparison made from Coefficient of variance is assumed as more convenient than mean and standard deviation. This means that the demand for electricity is more consistently increasing compared to other sources of energy. The electricity use sector of electricity is not changed in Nepal. Normally, people use electricity for light, and then heat. The development process of industrial sector is very slow. This may be the cause of the consistency in demand and consumption of electricity. Recall that less coefficient means the data are less variable or more homogeneous or more consistent or more uniform or more stable or more stationary or more equitable than others.

5. CONCLUSION AND POLICY IMPLICATIONS

Traditional sources (firewood, agricultural waste, and animal dung), coal, petroleum product (petrol, kerosene, diesel, and aviation fuel), electricity, and renewable power resources (solar energy, bio-gas) are the major sources of energy in Nepal. Three sources of energy like biomass, hydroelectricity; and renewable resources are the own resources but coal and petroleum products are imported resources of Nepal. The most significant source of energy is water resources, but less than 2% of the potential 83000 MW of hydroelectricity is currently generated. There is a high fluctuation in the consumed quantity of sources of energy. Normally, the consumed quantity is annually increasing, but not at a certain ratio or rate. The consumption of coal, petroleum product, electricity, and renewable sources of energy has increased by 11.2, 3.6, 6.35, and 14.8 times, respectively in fiscal year 2017/18 in comparison to 1998/99. The consumption of traditional sources is more variable, and the annual change in the consumption of electricity is more stable than that of other sources of energy. The average annual increments of traditional sources, coal, petroleum products, electricity, and renewable resources are 2.1, 17.5, 8.0, 10.6, and 16.7 TOE, respectively. The average increment in energy consumption is more than the recent population growth rate of Nepal. Recall that the current annual population growth rate of Nepal is 1.35%. The population growth rate of 1.35% is less than the average annual increments in the consumption of various sources of energy in Nepal.

This study throws some guidelines to prepare the policy in the field of sources of energy and their consumption. The government of Nepal should decrease the proportion of the consumption of traditional sources to decrease the high pressure on forest resources and indoor pollution. There is high consistency in the consumption of hydroelectricity, so it is necessary to give high priority in the generation of hydroelectricity. Similarly, the consistency of consumption of renewable sources of energy stands in the second position. It also indicates to give priority to the installation of renewable power stations in every household or the community. People may encourage the installed biogas and solar systems when the government provides subsidies. The development of hydroelectricity and renewable resources decreases the pressure on the consumption of traditional sources, coal and petroleum products. This may be beneficial for the environmental and economic development of the nation.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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