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Assessment of Energy Consumption Statistics of Rurban Areas of Aurangabad during Covid -19

Shailesh Chitlangi*, Kishor Talnikar, Sheetal Bagde

Department of Architecture, Jawaharlal Nehru Engineering College,
MGM University, Aurangabad

*Corresponding Author's E-mail ID : astitvaarchitects@gmail.com,

Mob: +91-9822021930 Mobile no: +91-9423951020

ABSTRACT

As Indian government declared first lockdown in month of March 2020 to control covid -19 infections, the energy consumption of households in rurban areas fall down drastically. After relaxation, energy consumption started to recover but till date it is less than pre covid (March-May 2020). This study, investigated how COVID-19 crises affected Indian energy consumption during lockdown-1 as well as lockdown-2.

This paper has investigated the reasons for low consumption, with random sampling data collection and live interviewing methodology. Relevant Literatures were studied to analyze the results. Hypothesis, key finding, observations and conclusion were done. The statistics shows decrease in energy consumption in lockdown -1 and lockdown-2 than of 2019 same months of rurban households. The consumption increased to some extend with different uses, still as per billing unit's statistics; it is proven that electricity consumption during lockdowns was lesser than pre lockdown. The purpose of this study is to investigate the change in consumption pattern and reasons behind it, of rurban areas, This will act as design guidelines to avoid energy consumption load in future on their parent rurban areas.

Keywords : *Lockdown, Energy consumption, statistics, Infection, Rurban.*

1. Introduction:

The COVID-19 pandemic has forced governments around the world to impose tough restrictions on daily life to prevent the spread of the virus. With these restrictions, roads are nearly empty, shops and restaurants are closed, and industrial activities are largely hold.

As strict lockdown was imposed all over India from 25 March 2020 to May 2020, a significant decline in power demand was seen, a nearly 25% to 30% drop.

Conversely, this declining trend started to reverse from May 2020. The rate of the demand for energy depreciation recovered from 22% to 17%, and residential demand emerged compared to the industrial demand in May compared to April. In urban areas energy consumption has both sides of coin in some parts consumption is high where as in some parts consumption was lower. [1,2]

Rurban areas are emerging developments around cities; its consumption will impact in future consumption

of cities. This paper is to focus the change in lifestyles of rural households during lockdowns, as everyone knows, urban households are aware about online educations, work from home concepts before lockdowns also, due to this it doesn't affect more to energy consumption needs. But in rural households many changes are noticed in lifestyles, awareness about online educations and work from home during lockdowns.

So, this paper specially focuses to investigate the change in energy consumption statistics of rural area.

In several reports it is stated that the electricity consumption in households of rural areas was decreased to 15 -18% compare to 2019 March – May statistics, as in rural areas floating population migrated to their native villages, during lockdown many of the agricultural base families shifted to farms, use of electronic gadgets, home appliances, sources of entertainment is very less. Although it was peak summer use of air – coolers, air conditioners was very low, even people staying in homes also avoided use of air – coolers, air conditioners, as per government guidelines to avoid covid infection. [4]

Later in June lockdown had been relaxed with some regulations but migrated families avoided to come to rural areas they wait for things to get normal, later online education, added some burden on electricity consumption but still as users are less in families statistics shows decrease in consumption compare to 2019 pre-covid statistics.

In many countries, lockdown measures relaxed as the growth of new Covid-19 cases declined. The same situation of lockdown release in India, but in India, the relaxation process was conducted gradually by extending the lockdown five times. Although the number of cases itself continued to increase during each successive lockdown period, the growth rate of the cases slowed down, and regulations have been relaxed as time passed from the first lockdown rules on 25 March 2020 to the Lockdown 5 extended on 1 June 2020. In month of May some rise was seen as people started come back to their work places and temperature was higher in month of May. [5]

In lockdown -2, (in some major states) April 2021 rural areas electricity consumption change drastically, it took inclined rise as in lockdown one strict restrictions are there things worked in different way, in lockdown -2 restrictions are with many relaxations, rural people get aware about use of electronic gadgets, use of electronic home appliance increased, uses of air – coolers, air conditioners increased, all this resulted in high uses of energy consumption. Compare to lockdown -1, in lockdown -2 the energy consumption increased by 70%. Still in both the lockdowns energy consumption were less than 2019 of same months. Hence, it is expected that the lockdowns energy consumption was low compare to normal consumption of Indian rural households. Based on this anticipation, the following hypothesis has been stated. [4]

Energy consumption in rural areas was low during lockdown-1 and lockdown-2 than before the lockdown. Many studies have investigated the impact of covid-19 on air pollution, but as yet, no studies have examined the effect of the covid-19 pandemic on energy consumption, which is an important issue for villages like India. [5, 6]. In this paper, there is discussion on previous studies relevant to this paper's study, methods adopted for investigation of the study and inferences drawn from the results and concludes with key findings.

3. Literature Review:

Many research papers, reports relevant to this paper's objectives has been studied, below review reflects the analysis of literature studied. In this paper there is narration during lockdown -1 (25 March to 31 May 2020) the electricity supply companies have not visited for meter readings, so most of the households received bills with average amounts based on previous month's consumption. After relaxation in the lockdown-1 many consumers received excessive bills. [3]

On the contrary, the analysis shows that the electricity consumption of many urban households in 2 tier and 3 tier towns is low on the basis of smart meters data analysis. Mainly decrease in energy consumption is seen in households with AC's.

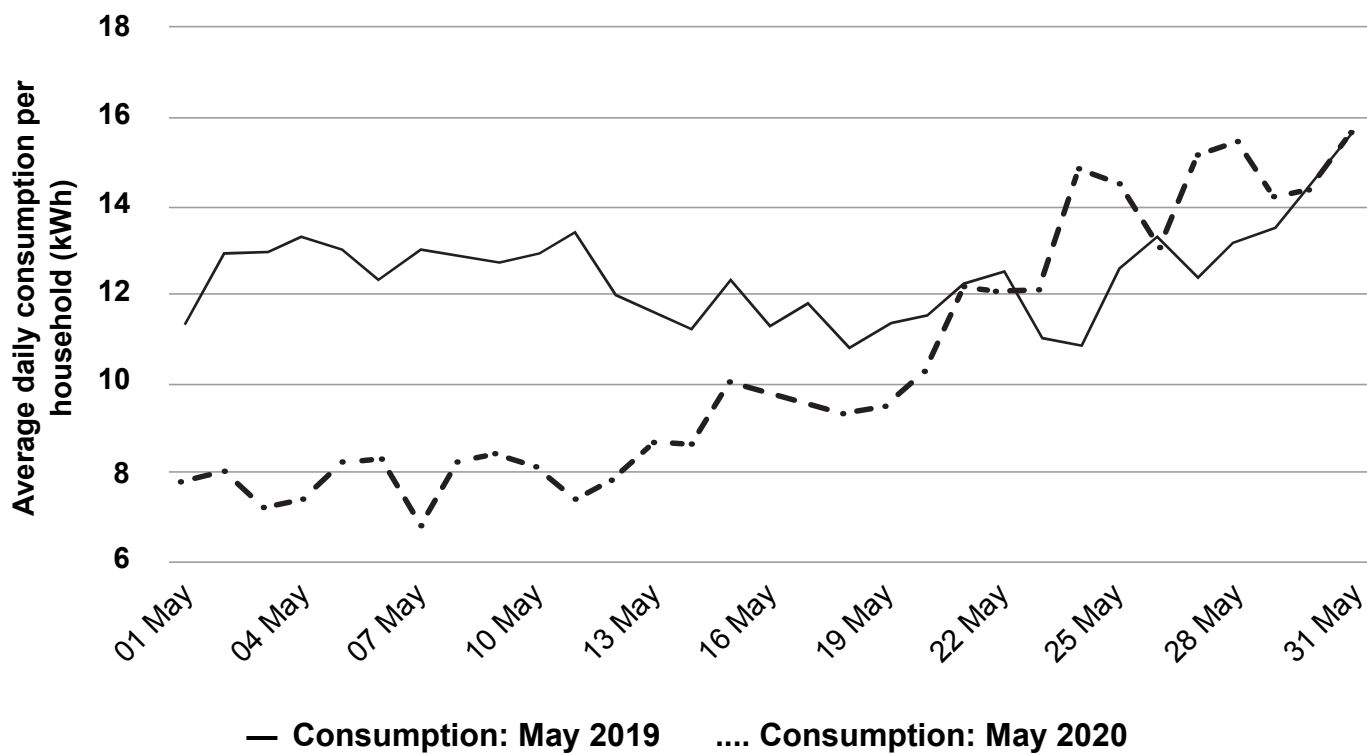


Fig.1 Electricity consumption graph of May 2020 compared to May 2019

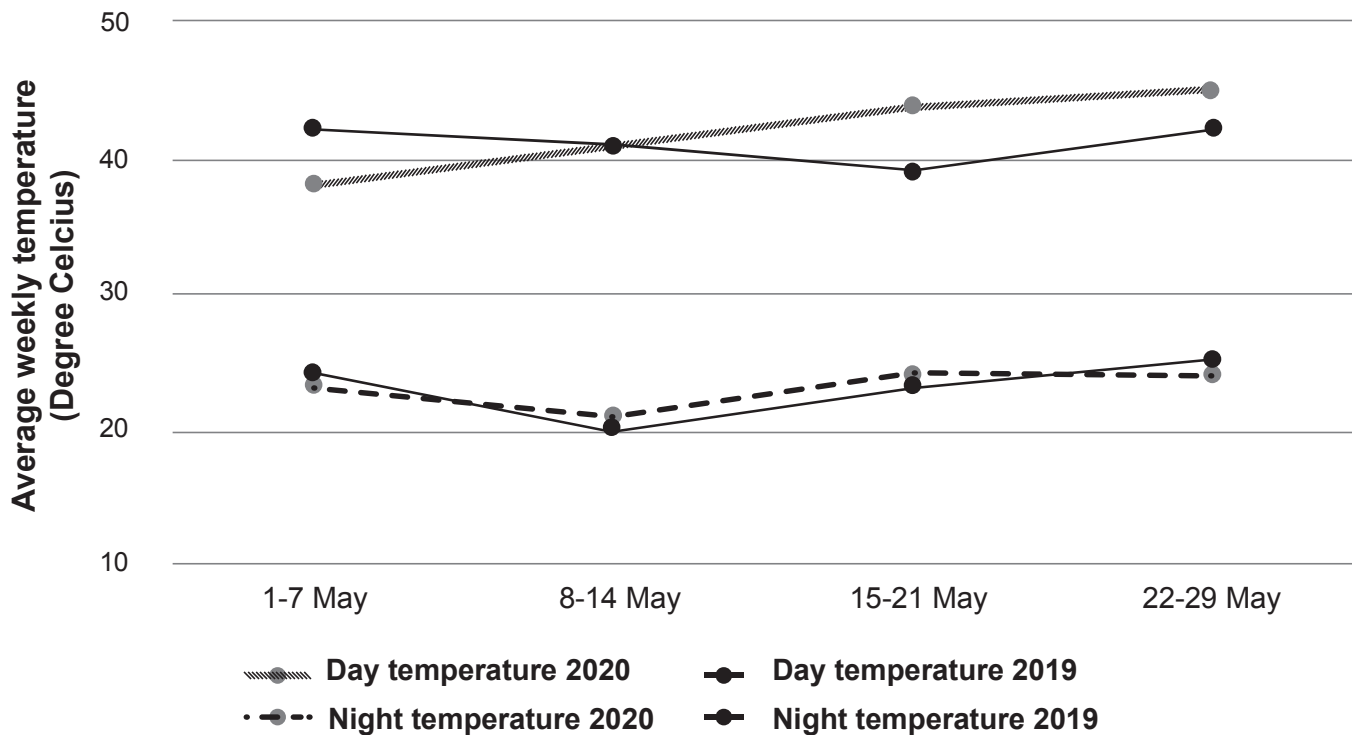


Fig. 2 Temperature graph of May 2020 compared to May 2019

The Fig.1 shows higher consumption in year 2019 as compared to energy consumption during lockdown. The researcher has compared the temperature of May 2020, as well as compared the temperature of 2019. The Fig.2 shows higher consumption in year 2019. The investigation is based on electricity consumption data of 48 households. This is considered as baseline for analysis.

In the Fig.3, comparison of predicted values and actual values is shown , author finds that actual consumption was low than predicted values till the third phase of lockdown -1 that is first week of May , later in fourth phase when temperature raised the predicted and actual values nearly meet. During 23

April – 23 May 2020 researcher find household consumption was 22 % less than predicted value.

There is low energy consumption observed from the interview of 20 households were conducted from author’s sample households, The reasons come up are high consumption of AC’s , servicing issues of AC’s , government guidelines for uses of cooling equipments , lower income ,drop in temperature etc. As per statistics, the electricity consumption during 1 May – 20 May 2020 of households with AC’s dropped drastically up to 33%, comparatively households with air coolers and households without AC’s and air coolers shown comparatively lesser drop as 21 % and 17 % respectively as shown in Fig. 3.

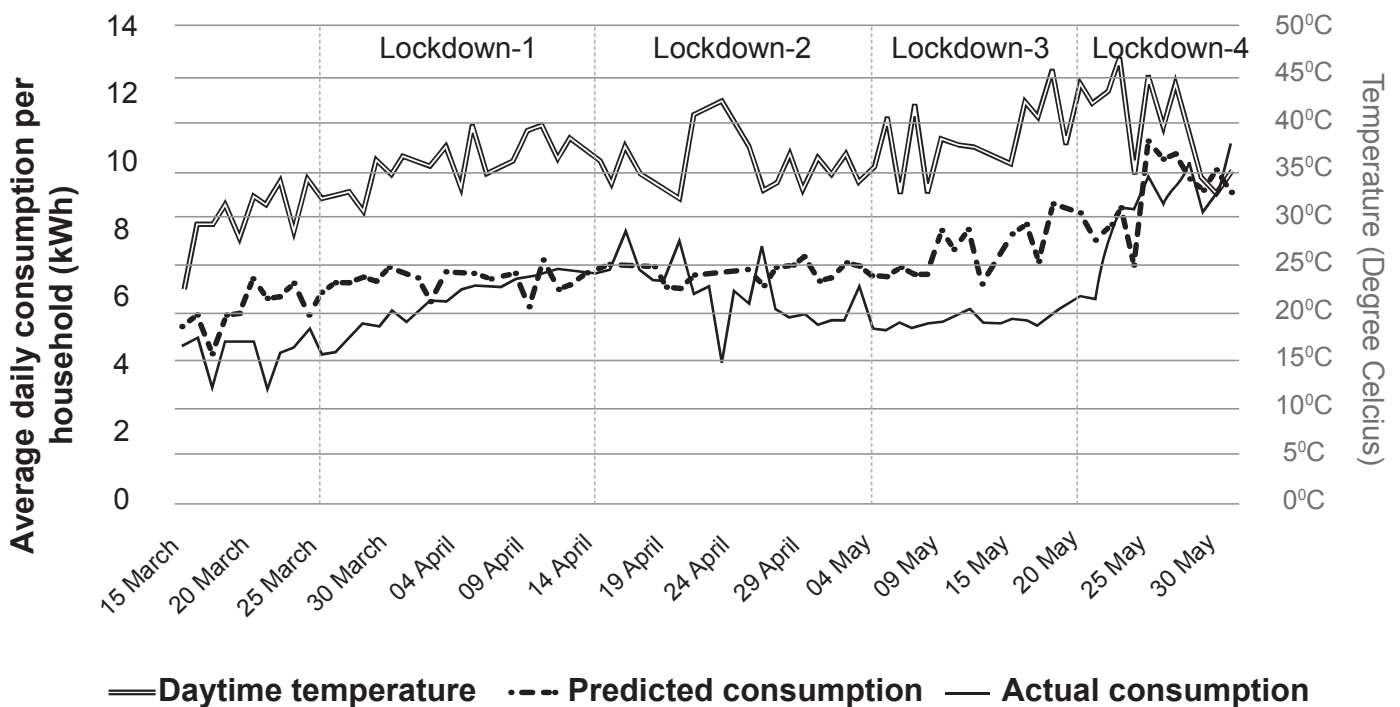


Fig. 3 Comparison of electricity consumption of predicted and actual values

This report shows how the lockdowns affected household electricity use, with different socio-economical factors, logistical challenges and many more .many families in small town consumed lesser electricity. In this article many on site studies and evidences are put up to prove that energy consumption in urban areas is low during lockdown. This literature study gave clear vision for further investigations and data collection.

4. Methodology:

This study of energy consumption statistics in rurban areas was taken out around Aurangabad city. The following research method has been adopted for field study.[7]

4.1 Sampling: Two types of samples have been taken into account. First, purposive sampling – this method was adopted in to select the study areas. Second,

random sampling – this was used for selecting the sample respondents. Random sample has been taken because the number of households in a single village consists of more than 600 families. Therefore, this paper has used random sampling with different income groups to collect data for the study.

4.2 Sample size: In this study 2 rural areas are selected, first is Patoda near Waluj midc, Aurangabad and second is Kumbhephal near Auric city, Aurangabad. 15 household are taken for study from each area. As study was performed during lockdown, it was not possible to get large number of samplings.

4.3 Data collection: For collecting the data, both primary and secondary sources are used. Primary data was collected by interviewing people of both rural households. For collecting quantitative data household survey was conducted. The secondary data's were collected from related articles, journals, literature, documents, published reports. Author was also partly a participant observer though it was short duration of study. This enhances findings and enables the author to connect the literature with the field.

4.4 Data analysis: Since this study involves both qualitative and quantitative data an SPSS analysis is used to interpret the quantitative data. Quantitative data were tabulated and put up in an excel sheet whereas, qualitative data were framed based on the information collected from case study through interview and observation.

4.5 Limitations: The investigation was carried out for the study with following limitations.

- Due to inadequate duration (lockdown) of the study period, it is not possible to collect the data from large number of rural areas. Therefore, some of the findings could be inconclusive.
- Less opportunity and time to gather exact facts and information.
- As there is communication gap especially in rural areas, collection of data takes a longer duration.
- Rural peoples are not clear and convince about the questions hence the answers they responded are sometimes confusing and difficult to analyze.
- Households sometime gave misinformation and hide the authentic data.

5. Study areas: This research paper has different study areas and their sub-study area of work.

5.1 Location of the study: Location of study has been selected in Aurangabad development zone. Two emerging rural areas are taken for this study. 1st location: 15 households survey conducted at Patoda rural village near Maharashtra Industrial Development Corporation (MIDC), Waluj MIDC, Aurangabad. 2nd location: 15 households survey conducted at Kumbhephal rural village near Shendra Maharashtra Industrial Development Corporation (MIDC), Aurangabad.

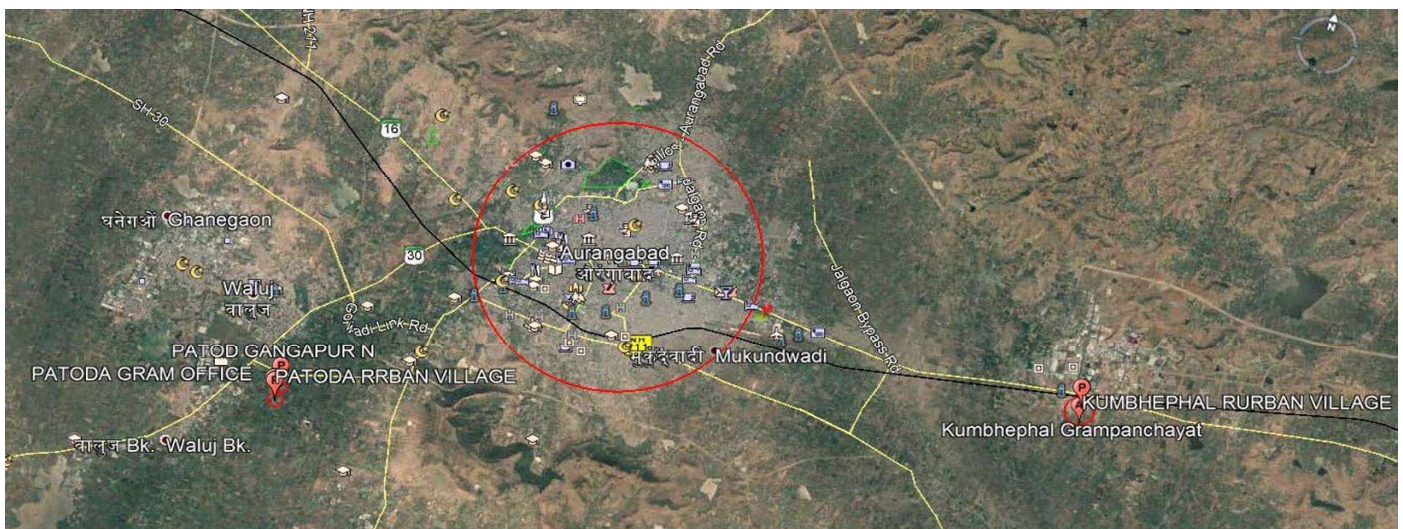


Fig. 4 Google earth location of Patoda rural and Kumbhephal rural

5.1.1 Patoda:

Patoda village has 3350 population (Census 2011) with floating population of 1500 [8]. This village has literacy rate 95 % [8]. This village has 24 hours electricity of good quality, In Patoda, gram panchayat provides many facilities to villagers like free floor mill, papad machines use, free hot water with 14 thousand liters of water distributed at convenient spots with

capacity of 1 thousand liter each, digital display boards. Few households own their biogas plants and running successfully from last 8 years. In Table 1, comparison of consumption in billing unit for pre and during lockdowns is shown for Patoda rurban. Fig. 5 shows graphically on y-axis average sampling household billing units (kWh/month) and x-axis month of the year for 2019, 2020 and till May 2021.

Table 1. Monthly average billing unit of household at Patoda village

Month	Units Consumption in Year 2019 (kWh/month)	Units Consumption in Year 2020 (kWh/month)	Units Consumption in Year 2021 (kWh/month)
January	-	78	61
February	-	71	60
March	-	51	105
April	-	51	84
May	-	298	100
June	127	105	-
July	105	94	-
August	166	124	-
September	93	80	-
October	104	76	-
November	71	56	-
December	65	111	-

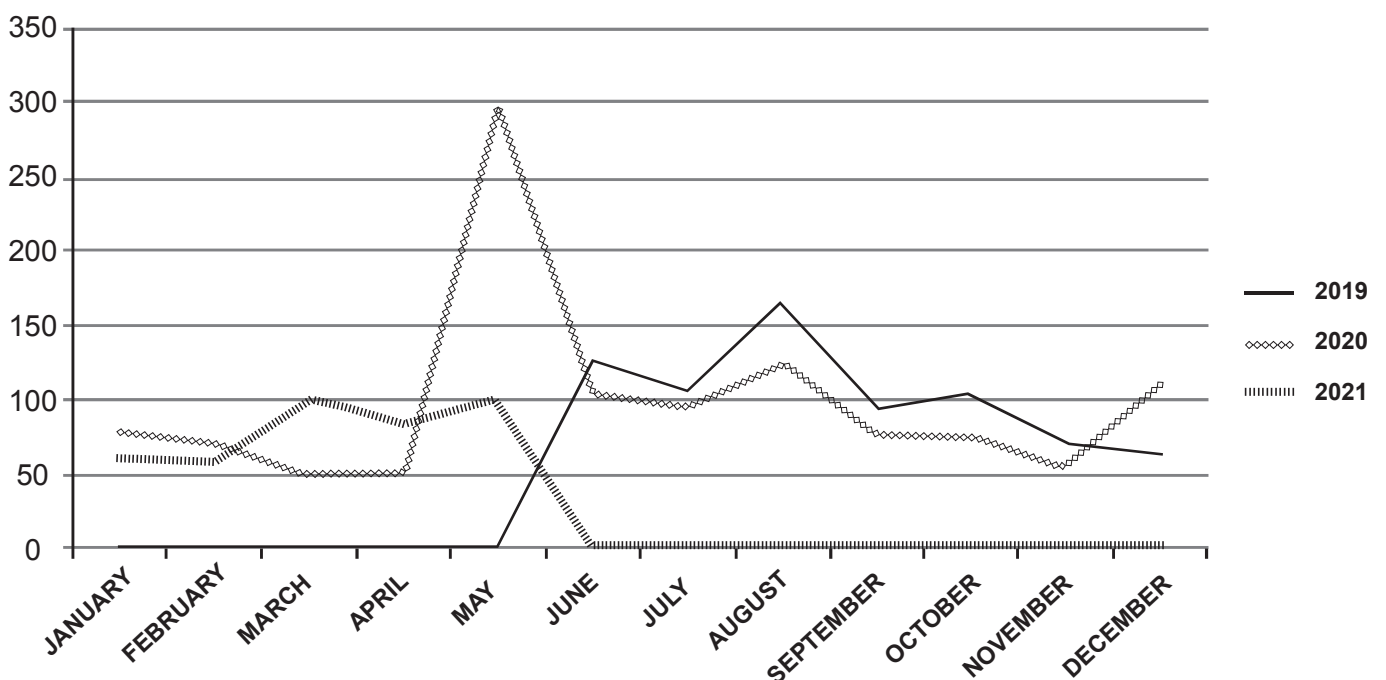


Fig.5 Monthly average billing unit of household at Patoda village

5.1.2 Kumbhephal:

Kumbhephal rurban area has 4263 population (Census 2011) with floating population of 7500 [8]. This village has literacy rate 73 % [8]. Kumbhephal is an emerging rurban area surrounded with 5 star industries as Shendra and Auric MIP. Kumbhephal has 24 hours of good quality electricity supply, gram Panchayat provides only free drinking water supply. It is also called as industrial town. Due to large floating population huge burden of energy consumption comes on gram Panchayat. In Table 2, comparison of consumption in billing unit for pre and during lockdowns is shown for Kumbhephal rurban.

Table 2. Monthly average average billing unit of household at Kumbhephal rurban area

Month	Units Consumption in Year 2019 (kWh/month)	Units Consumption in Year 2020 (kWh/month)	Units Consumption in Year 2021 (kWh/month)
January	-	81	78
February	-	99	83
March	-	84	117
April	-	84	137
May	-	388	165
June	162	113	-
July	140	111	-
August	133	117	-
September	99	97	-
October	72	112	-
November	82	70	-
December	75	72	-

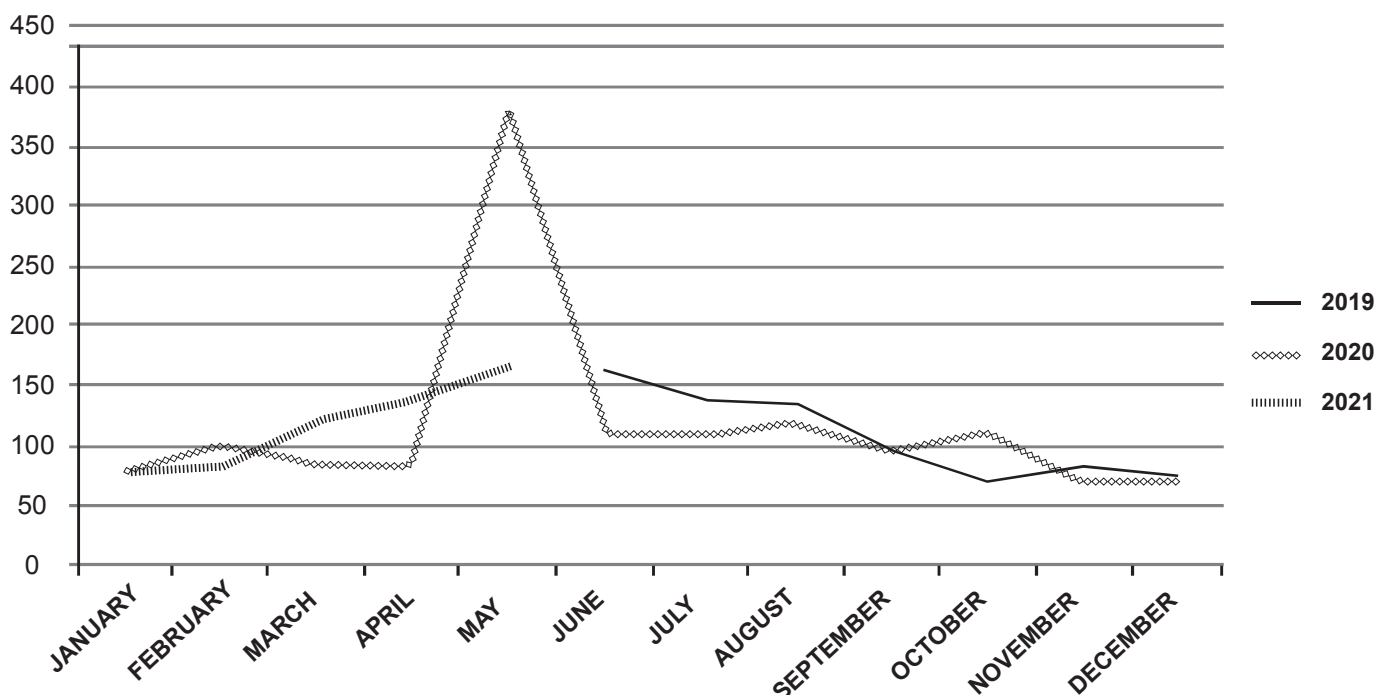


Fig.6 Monthly average billing unit of household at Kumbhephal rurban area

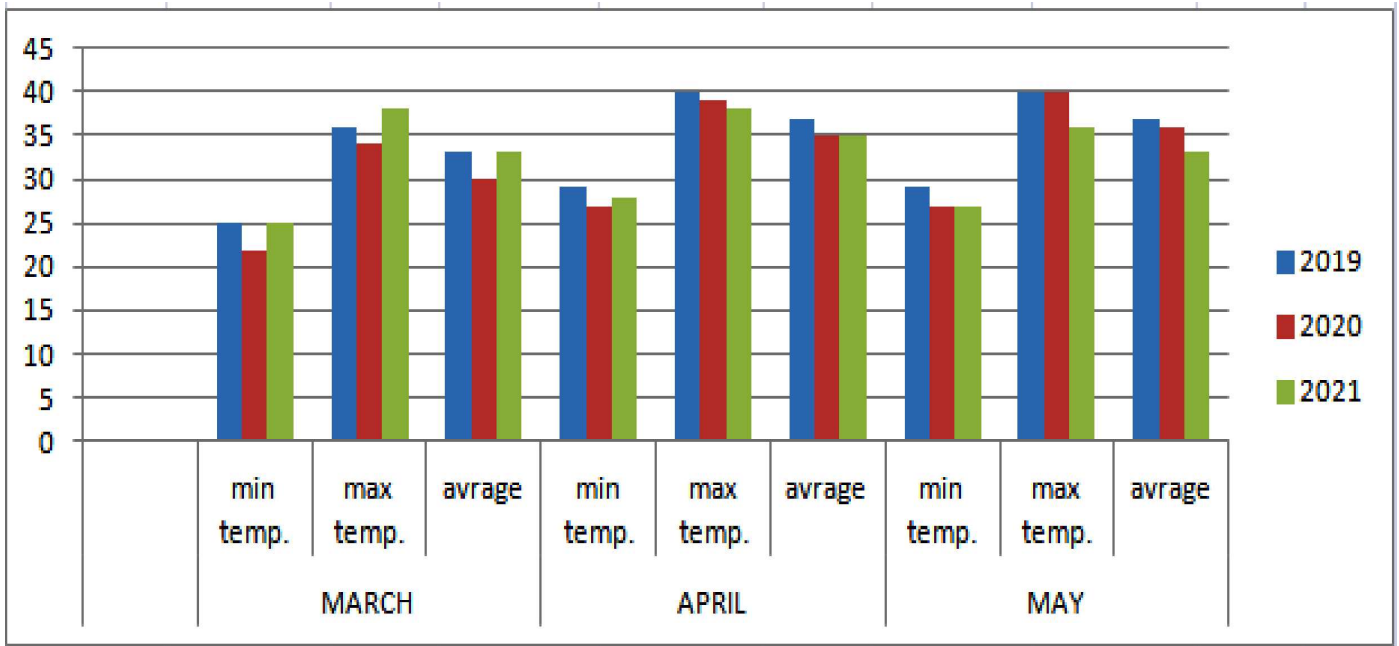


Fig.7 Comparison of ambient temperature (°C) of year 2019, 2020, 2021

The Fig.7 shows temperature drop in lockdown -1 (March – May 2020) than 2019, also shows some rise in lockdown-2 (March – May 2021) , to study the impact of low temperature, live interviews of households of both the villages are taken , impact of lockdown-1 as well as lockdown -2 has been studied. Different reasons are observed and put up in Fig.7 and Fig.8 respectively.

Reasons of low consumption	Number of households
Households re-migrated to their native villages	6
Shifting to farms	10
lack of awarnesses about online activites	6
Income level affected	4
low temperature	4
	2 4 6 8 10 12

Fig.8 Reasons of low energy consumption during lockdown -1

Survey of sample households for the reasons of low consumption during lockdown-1 in Fig. 9 shows that lack of awareness about online activities is the main reason.

Reasons of increase in consumption	2	4	6	8	10	12
Households migrations to rurban areas						
Shifting to farms						
Spread of awarnesses about online activites						
Income level improved						
Use of air-coolers						
	2	4	6	8	10	12
	Number of households					

Fig.9 Reasons of increase energy consumption during lockdown -2

Survey of sample households for the reasons of increase in consumption during lockdown-2 in Fig. 9 shows that spread of awareness about online activities is the main reason.

In these present study two rurban areas of Aurangabad has been selected for data collection. Both the rurban are varied in geography, population, lifestyle, income, but they both are in surrounding of Aurangabad, which helped to reach results. Necessary data were collected by interviewing rurban people. This data is very helpful for study purpose of this paper.

6. Results:

Tables (1, 2) indicates the energy consumption units statistics for pre and during lockdowns, On the basis of above summarized statistics, it has been resulted, The consumption of rurban households in lesser in both the lockdowns compare to pre lockdown 2019. The statistics shows 17 % low consumption in lockdown-1 and 7 % lesser in lockdown-2 compare to pre lockdown 2019.

6.1 Key Findings of the Study: The key findings of the study are given stated as follows:

- In first lockdown many migrant shifted to their native villages.
- Households with agricultural base shifted to farms, it reduced load of energy consumption to greater extend. It was found that some

households zero reading during lockdown.

- In lockdown-1, Uses of electronic gadgets, electronic home appliance, air – coolers, air conditioners was very low.
- In lockdown-2, rural households doesn't shifted anywhere, uses of electronic gadgets, electronic home appliance increased, air – coolers, air conditioners 7%.
- In compare with 2019 energy consumption, in both the lockdowns energy consumption graph was decreased by 17 % and 7 % respectively..
- During lockdown temperature was lower.
- Awareness about social media uses increased.

6.2 Observations: The observations noted during this investigation are stated as follows:

This paper focuses on energy consumption statistics in rurban areas during lockdown-1(nationwide in 2020) and lockdown-2 in comparison with 2019 statistics.

In lockdown -1 (Nationwide in 2020): One major factor of low energy consumption identified during the study is most of the households of rurban area shifted to farms who have agricultural income base; some migrated families remigrated to their native villages.

In lockdown-2 (Statewide in 2021): In this lockdown some relaxations are there, so things are normal with restrictions only, after lockdown -1,

awareness about online education , entertainment increased to large extend, which added some rise in energy consumption than of lockdown-1.

6.3 Recommendations and Conclusion:

During this study researcher identified some loopholes and suggested some baseline interventions to overcome the loopholes and concluded in last section of this paper.

6.3.1 Recommendations:

This study found low consumption in lockdown-1 compared to lockdown-2, basic factor behind this is lack of awareness, but later on, the awareness is increased and it resulted in increase in energy consumption. With the use of different gadgets, it is observed that usage for comfort also increased as consumption of air coolers, fans, AC's increased. As far environmental concern during the study it has been observed that rurban houses are not planned clusters. Due to haphazard growth, no proper orientation, demand for comfort arised which added extra burden to energy consumption. On the basis of field study, interviews and statistical results, the researcher would like to suggest some environmental planning majors to overcome these problems and reduce the burden of grid energy consumption,

1. Orientation – if houses are in proper orientation as per sun path and wind direction with regional climatic conditions, it will give comfort.
2. Openings – if door and window openings are as per ratio, it will help to reduce burden of electricity consumption.
3. Green scapes – if green spaces are properly treated as per green building norms, it will naturally cool the surrounding and reduce demand of comfort gadgets.

If the clusters were planned in self- sustainable way, demand for comfort will be reduced.

6.3.2 Conclusion:

This research stated in the hypothesis, energy consumption in rurban areas was low during

lockdown-1 and lockdown-2 than before the lockdown. As per this short investigation carried out, there is low energy consumption in rurban households during lockdown-1, lockdown-2 due to migration of villages in the farms, workers (floating population) shifted to their native place and less use of coolers or ACs during the pandemic situation in the village/rurban areas. But to achieve this goal of low energy consumption permanently, some baselines needs to be set. The most prominent issue needs to be addressed is consumption for thermal comfort in these areas. The key conclusions that can be drawn from the investigation are as follows:

1. The households should have proper building orientation so that maximum solar energy is available for room day lighting
2. There should be availability of cross ventilation in the green spaces for ventilation and avoiding accumulation of heat energy as well as avoiding the suffocation inside the households.
3. The household design should also accommodate greens scrapes so that ambient will be naturally cool and provides natural comfort at the green spaces

These baseline recommendations are given in this paper to be implemented by local authorities and developers so that one can achieve lower energy consumption of rurban households.

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