Effect of Covid-19 on Noise Pollution in Nzoia River Basin, Kenya

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Abstract: **Nzoia River Basin lies entirely within Kenya along the border with Uganda in the Lake Victoria Basin, and has a population of about 3.7 million people with mixed demographic characteristics displaying mixed distribution patterns. The purpose of this study was to assess noise pollution levels in the basin before and after the onset of the COVID-19 pandemic. A cross-sectional research design was used in the study. Three counties were randomly selected from the basin for study with Busia representing the lower catchment, Kakamega middle catchment and Trans Nzoia upper catchment. Control of noise pollution, other public nuisances and outdoor advertising is a devolved function of county governments in Kenya. A person intending to engage in such activities is by law required to apply for a permit from the county governments. The number of permits issued by the county governments will give an indication on the number of people intending to engage in noise pollution and hence, the level of noise pollution in the county. This study used the number of noise pollution permits issued by county goverments, in-depth expert interviews (key informants) with selected stakeholders from national and county departments of environment, academia and scientists, field observations, recently published literature and industry experiences to assess the effect of COVID-19 on noise pollution levels in Nzoia River Basin. A questionnaire was sent to the county governments of Busia, Kakamega and Trans Nzoia to collect information on the number of monthly noise pollution permits issued for the two years 2018 and 2019 preceeding the COVID-19 outbreak and 2020 after the onset of the pandemic. The data were analyzed using descriptive statistic of percentages in order to compare the changes in overall noise pollution levels and then presented in Tables. The findings of the study revealed that the year 2020 had the smallest number of permits issued as compared to the two preceeding years, 2018 and 2019. In-depth expert interviews (key informants) and field observations revealed that noise pollution hotspots in the basin are major towns and urban areas, major highways, airports and airstrips, industrial manufacturing centres and agro-based processing plants, quarrying sites and Webuye Broadrick waterfalls. This study sheds light on the consequences of the sudden occurrence of a major pandemic and raises awareness on the critical impacts to the environment in terms of reduced noise pollution levels. The findings of this study can be used to formulate strategies for noise pollution control in the basin. Noise is known to cause ill health, and therefore any efforts made to reduce the level of noise pollution in the basin will result into the improvement of the health status of the residents. The widely observed reduction in noise pollution in the basin is welcome news on the positive environmental effects of COVID-19, but proper planning mechanisms for the post COVID months to come will be required in order to sustain the reduced noise levels.**

Keywords: **Nzoia River Basin, COVID-19, Noise pollution level**

I. INTRODUCTION

Noise is defined in Kenyan law as "any undesirable sound that is intrinsically objectionable or that may cause adverse effects on human health or damage to the environment". The law goes further to define noise pollution as "the emission of uncontrolled noise that is likely to cause danger to human health or damage the environment" (GOK, 2009). Generally, noise pollution is recognized in three categories: community noise, industrial noise and airport noise. Industrial noise and airport noise refer to noise emanating from industrial processes and airport operations, respectively, whereas community noise (or environmental noise) is noise emanating from human activities such as transportation, recreation, entertainment, worship, businesses, animal rearing, construction and internal domestic activities (Ahmad,1998). In Kenya, not much has been done to study noise pollution. However, in 2009, the noise problem was recognized and the Noise and Excessive Vibration (Pollution) Control Regulations, 2009 (Noise Act or Legal Notice Number 61) enacted. This legislation, annexed to the Environmental Management and Coordination Act, EMCA, 1999, provides for relevant noise criteria for different environments and empowers the National Environment Management Authority (NEMA) to enforce the noise regulations.

The outbreak of SARS-CoV-2 virus (COVID-19 disease) during the last months of 2019 and first months of 2020 has presented considerable challenges to governments around the world. The strategies designed by different governments to combat the pandemic in many countries have been very diverse, but many countries have chosen lockdown and restrictions on people's mobility (Aktay, et. al 2020). Measures implemented aimed at containing the spread of the virus included, among others, social distancing (>2 m distance between people when outdoor and "stayhome" recommendations), stopping non-essential productive and social activities, mostly outdoor, and commuting, as well as limiting air, sea, railway, and road traffic to the bare minimum. While the above measures are having immense social and financial implications, with adverse effects that will be felt for years, they also had some unintended positive consequences in terms of environmental pollution (Aletta et al, 2020). With most productive and industrial activities suddenly on hold and strict limitations on domestic and international travels, significant decreases are being observed

for both air and noise pollution. Amongst all pollutants, the World Health Organisation has reported that noise pollution is the third most hazardous type of pollutant after air and water pollution (WHO, 2005).

Health impacts due to an increase in environmental noise are a concern worldwide (Alves, et al, 2015; Ongel & Sezgin, 2016). Noise sensitivity can be an important contributor to psychiatric disorders such as anxiety and depression (Ongel & Sezgin, 2016). Recent studies suggest that an increase of 5 dB roadside noise can raise the chance of hypertension by 3.4 % (Kim, et.al, 2019). Exposure to a high level of noise can result in hormonal dysfunction and can also contribute to the rise in blood pressure which can severely impact the cardiovascular system in the body (Said & El-Gohary, 2016). Pregnant women might be at a greater risk of being affected by noise pollution beceause of greater sensitivity to environmental stress factors (Selander et al., 2019). Ashin, et al, (2018) noted that road traffic noise can increase gestational diabetes mellitus, which leads to glucose intolerance that occurrs during the beginning of pregnancy. Based on 29 case study analysis where pregnant women were exposed to 80 dB or higher noise, Dzhambov, et al, (2014) documented that the risk for having gestational hypertension, small for gestational age and babies with congenital malformations increases significantly.

Studies have shown that the noise pollution from urban road traffic has the highest level of exposure given that roads are located in close proximity to built infrastructures such as schools, offices and residential buildings (Paiva, et al, 2019; Godinho, et al, 2018). Studies have indicated further that not only the noise pollution, but the duration of exposure to traffic-related noises negatively impacts health outcomes (Tonne et al., 2016). Human-generated noise pollution can potentially alter biodiversity by impacting the distribution and behavior of species and their habitat quality (Estabrook, et al, 2016). Although noise levels are generally highest around the roadways and near transportation terminals, the exposure of the large majority of city inhabitants is determined by a city's overall background noise (Khan et al., 2018). Studies have further revealed that several factors such as morphology of the city (aspect ratios of buildings), current and projected population as well as household density, noise regulations laws and policies, traffic network design, availability of affordable public transport nearby of the area, frequency of traffic jams, the ratio of public vehicles to private vehicles on road, the average insulation of the homes and the noises escaping from the building, and the motorized driving behavior, possibility of construction of new buildings, etc. can determine noise levels at different scales (Bouzir & Zemmouri, 2017). The material building blocks used for the construction of building infrastructure as well as building and street design at the nearby vicinity and neighborhood quality are correlative factors responsible for determining the level of noise (Salomons & Pont, 2012). This study investigates the effect of COVID-19 on noise pollution levels in Nzoia River Basin. New regulations imposed by the national government in an effort to curb the spread of COVID-19 has resulted into reduced sound levels, hence reduced noise pollution across the basin might be expected.

II. MATERIALS AND METHODS

2.1 Study area

Nzoia River Basin is located between latitudes 10 30' N and 00 05' S and longitudes 340 E and 35045' E in Western Kenya and covers an area of 12,959 km2 with a river length of 334 km up to its outfall into Lake Victoria (Figure. 1). The area has a population of approximately 3.5 million people that is rising rapidly with the majority of the people living in rural areas. The basin covers the nine counties of Elgeyo/Marakwet, West Pokot, Trans Nzoia, Uasin Gishu and Nandi (in former Rift Valley province); Kakamega, Bungoma and Busia (in former Western province) and Siaya (in former Nyanza province). The basin is characterised by three physiographic regions namely; the highlands (characterised by Mt. Elgon and Cherangani hills); the upper plateau (which includes Eldoret and Kitale); and the lowlands (which includes Busia that experiences the majority of flooding in the basin).The dominant topography consists of rolling hills and lowlands in the Eldoret and Kitale plains. Nzoia river is one of the largest rivers in Western Kenya which drains into Lake Victoria contributing to the waters that form the source of River Nile (Odwori, et.al 2018).

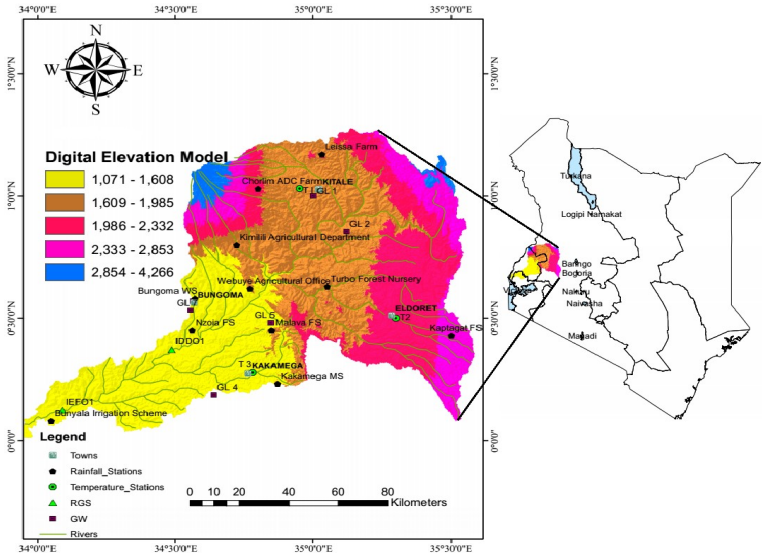

Figure. 1: Map of Nzoia River Basin, Kenya
(Source: Researcher, 2020).

The Climate of Nzoia River Basin is predominantly tropical humid, but it varies from county to county due to varying landscape and elevations in the basin. The region experiences four seasons due to the inter-tropical convergence zone (ITCZ), however, the local relief and influences of Lake Victoria modify the regular weather patterns. There are two rainy seasons and two dry seasons, namely, short rains (October to December) and the long rains (March to May).

The dry seasons occur in the months of January to February and June to September. The mean monthly rainfall in the basin for the period 1970 to 2001 varies from about 16.26 mm in January and December (Chorlim ADC. Farm) to about 300.79 mm in April (Kaimos Tea Estate). The basin experiences lowest monthly maximum tempratures occuring in July at 16.1 0 C (Eldoret), minimum tempratures in January, July and September at 10.0 0 C (Eldoret) and mean tempratures in July at 16.1 0 C (Eldoret) whereas the highest monthly tempratures in the basin for the maximum occurs in February and March at 29.5 0 C (Kakamega), minimum in April at 15.1 0 C (Kakamega) and mean in March at 22.0 0 C (Kakamega). Temperature trends in the basin are linked to altitude since the lowest temperatures are found at highest altitudes and highest temperatures at lowest altitudes.

Agriculture is the dominant land use in the region and the agricultural activities of the basin mainly depend on rainfall as most of the crops are under rain-fed agriculture with very limited irrigation being practiced. The main food crops grown are maize, sorghum, millet, bananas, groundnuts, beans, potatoes, and cassava while the cash crops include coffee, sugar cane, tea, wheat, rice, sunflower and horticultural crops. The inhabitants of the basin also practice dairy farming together with traditional livestock keeping. Nzoia river and its many tributaries provide water for domestic use, agriculture, industrial and commercial sectors. Nzoia River Basin has the soil type textures forming: clay (77%), loamy (9%) and sandy (14%). In the basin, the Ferralsol form well drained soils found mostly on level to undulating land. The Acrisols in the basin form clay-rich soils associated with humid tropical climates and supports forestry; whereas Nitisols compose deep well drained red tropical soils found mostly in the highlands occupying more than 75% of the catchment.

2.2. Study design

The study employed Cross-sectional survey research design.

2.3. Study population

According to Saunders et al. (2009), a population is the full set of cases from which a representative sample is taken for detailed study. The targeted population for this study were monthly noise pollution permits issued by the county governments of Busia, Kakamega and Trans Nzoia for the years 2018, 2019 and 2020; staff of the national and county governments department of environment, academia and scientists in the area of noise pollution.

2.4. Sampling procedure and sample size

The study randomly selected three counties from Nzoia River Basin; Busia representing the lower catchment, Kakamega middle catchment and Trans Nzoia upper catchment. The number of monthly noise pollution permits issued by each county government for the years 2018, 2019 and 2020 were collected by questionnaires sent to counties purposively. Staff of the national and county government departments of environment, academia and scientists in the area of noise pollution totaling 31 No. were purposively chosen for an in-depth expert interview using an interview guide prepared by the Researcher.

2.5. Type of data

In this study, primary data was first collected through questionnaires sent to county goverments of Busia, Kakamega and Trans Nzoia in form of the number of monthly noise pollution permits issued for the years 2018, 2019 and 2020. Secondly, primary data was also collected through in-depth expert-interviews (key informants) with selected stakeholders who included staff of the national and county departments of environment, academia and scientists in the area of noise pollution. Thirdly, field observations were also carried out in the study area. Field observation involved watching stakeholder activities and processes, and documenting processes and results. The Field observations had the added benefit of enabling the Researcher to identify processes or activities that may have been missed during surveys or in-depth expert-interviews. The study also collected secondary data which entailed the collection and analysis of published materials and information. The study used both published and unpublished reports that had some relevant information to noise pollution. Secondary data were gathered from textbooks, internet sources and journals and periodicals, conferences and workshops.

2.6. Data analysis

In this study, the number of monthly noise pollution permits issued by county governments for the years 2018, 2019 and 2020 were analyzed using descriptive statistic of percentages in order to compare the changes in overall noise pollution levels and then presented in Tables.

III. RESULTS AND DISCUSSION

Control of noise pollution, other public nuisances and outdoor advertising is a devolved function of county governments in Kenya. A person intending to engage in such activities is by law required to apply for a permit from the county governments. The number of permits issued by the county governments will give an indication on the number of people intending to engage in noise pollution and hence, the level of noise pollution in the county. This study used the number of noise pollution permits issued by county goverments, in-depth expert-interviews with selected stakeholders and field observations to assess the effect of COVID-19 on noise pollution levels in Nzoia River Basin. Monthly noise pollution permits issued by county governments in Nzoia River Basin with Busia representing the lower catchment, Kakamega middle catchment and Trans Nzoia upper catchment in the year 2020 were compared with the average number of permits issued in the preceding two years 2018 and 2019 as shown in Table-1. The year 2020 shows the least number of permits issued as compared to the two preceding years, 2018 and 2019. In 2020, Busia recorded 26 permits, Kakamega 43 and

Trans Nzoia 17; whereas in the year 2018 they recorded 185, 215, 159 and in the year 2019- 137, 170 and 146 respectively.

In order to compare the changes in overall noise pollution levels, the monthly permits issued in the year 2020 were calculated as percentages of the average monthly permits issued in the years 2018 and 2019 as shown in Table-2. Table-1 indicates that the mean monthly noise pollution levels in Nzoia River Basin reduced in the year 2020 as compared to the preceding two years 2018 and 2019.

Table-1: Noise pollution permits issued by County governments in Nzoia River Basin, Kenya

Month /Year	Nzoia River Basin								
	No. of permits issued from January – December, 2018, 2019 and 2020								
	Lower catchment (Busia county)			Middle catchment (Kakamega county)			Upper catchment (Trans Nzoia county)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Jan	14	11	0	9	13	2	17	10	4
Feb	10	6	3	9	11	4	8	12	2
Mar	20	6	9	7	13	7	12	8	3
Apr	6	10	2	22	17	0	16	22	1
May	8	6	0	19	15	1	10	7	0
Jun	14	16	1	7	9	0	18	11	1
Jul	10	9	2	11	14	0	5	9	0
Aug	20	17	0	26	15	1	9	7	1
Sep	17	13	3	15	10	1	8	12	0
Oct	11	15	0	16	13	3	18	16	0
Nov	25	17	4	30	28	5	17	13	3
Dec	30	11	2	44	29	5	21	19	2
Total	185	137	26	215	170	43	159	146	17

Source: Researcher (2020)

As shown in Table-2, Busia recorded the lowest percentages in the months of January, May, August and September; whereas for Kakamega it was in the months of April, June and July; and for Trans Nzoia, May, July, September and October. These lowest percentages of 0% in the year 2020 represent the times of minimal to no noise incidances.

Busia County, the highest percentage recorded was in the month of March, 69.2% of the average noise level experienced in March, 2018 and 2019 period; implying that noise pollution in Busia County went down by 30.8 % in 2020 compared to the same period in 2018 and 2019. Kakamega showed highest noise level as 70% in March; implying that noise pollution in Kakamega County went down by 30 % in 2020 compared to the same period in 2018 and 2019. Trans Nzoia had 30% as highest noise level in March; implying that noise pollution in Trans Nzoia County went down by 70 % in 2020 compared to the same period in 2018 and 2019.

Table-2: Number of Monthly Noise pollution permits issued from January to December, 2020 as a percentage (%) of the average monthly permits issued between 2018 and 2019

Month /Year	Nzoia River Basin					
	No. Monthly Noise pollution permits issued from Jan – Dec 2020 as a percentage (%) of the average monthly permits issued between 2018 and 2019					
	Lower catchment (Busia county)		Middle catchment (Kakamega county)		Upper catchment (Trans Nzoia county)	
	Average	2020 as	Average	2020 as	Average	2020 as
	for 2018 - 2019	% of 2018 – 2019 Average	for 2018 - 2019	% of 2018 – 2019 Average	for 2018 - 2019	% of 2018 - 2019 Average
Jan	12.5	0	11	18.2	13.5	29.6
Feb	8	37.5	10	40	10	20
Mar	13	69.2	10	70	10	30
Apr	8	25	19.5	0	19	5.3
May	7	0	17	5.9	8.5	0
Jun	15	6.7	8	0	14.5	6.9
Jul	9.5	21.1	12.5	0	7	0
Aug	18.5	0	20.5	4.9	8	12.5
Sep	15	20	12.5	8	10	0
Oct	13	0	14.5	20.7	17	0
Nov	21	19.1	29	17.2	15	20
Dec	20.5	9.8	36.5	13.7	20	10
Total	161	16.2	192.5	22.3	152.5	11.2

Source: Researcher (2020).

Busia recorded an annual percentage of 16.2% of the average noise level experienced in 2018 to 2019 period; implying that noise pollution in Busia county went down by 83.8 % in the year 2020 compared to the years 2018 and 2019. Kakamega had an annual percentage of 22.3% of the average noise level experienced in 2018 to 2019 period; implying that noise

pollution in Kakamega county went down by 77.7 % in 2020 compared to the years 2018 and 2019. Trans Nzoia showed an annual percentage of 11.2% of the average noise level experienced in 2018 and 2019 period; implying that noise pollution in Trans Nzoia county went down by 88.8 % in 2020 compared to the years 2018 and 2019. In January, Busia county recorded the lowest percentage of 0% of the average noise level experienced in 2018 to 2019 period; representing minimal to no noise incidances whereas Kakamega county showed 18.2% of the average noise level experienced in 2018 to 2019 period; implying that noise pollution in Kakamega county went down by 81.8 % in 2020 compared to the years 2018 and 2019; and Trans Nzoia recorded 29.6% of the average noise level experienced in 2018 to 2019 period; implying that noise pollution in Trans Nzoia county went down by 70.4 % in 2020 compared to the years 2018 and 2019.

During field observations and in-depth interviews with key stakeholders in the study area, higher noise pollution levels were identified at a number of locations as follows: (1) Major towns and urban areas in the basin which included for Busia (Busia town, Bumala, Nambale, Port Victoria and Malaba boarder); Kakamega (Kakamega town, Mumias, Malava, Matunda, Mois Bridge, Butere and Lumakanda); and TransNzoia (Kitale town and Kiminin); (2) Major highways in the basin where road traffic was the main source of noise. (3) Airports and airstrips in the basin with Eldoret international airport as the highest noise polluter with big aeroplanes landing and taking off frequently. Bungoma, Kitale and Busia airstrips were also noted for periodic noise pollution from smaller flights. (4) Industrial manufacturing centres and agro-based processing plants in the basin which includes Mumias sugar factory, West Kenya sugar factories, Butali sugar factory, Nzoia sugar factory and Busia sugar factory; Maize and wheat millers, etc. (5) Quarrying activities in the towns of Mois Bridge, Webuye, Eldoret and Lumakanda Mwamba; and (6) Sounds from waterbodies such as Webuye Broadrick waterfalls.

The European Union have estimated that more than 40 percent of the total European population is exposed to a Day-Evening-Night (Lden) noise level of 55 dB or greater, while 30 percent of the population is exposed to the same noise level during night-time (WHO, 2017). City soundscape studies (Lebiedowska, 2005) have suggested that urban noise can be broadly classified in the following four categories: i) background noise: classified as unpleasant due to the presence of high pitched, piercing, strong, continuous, irregular, or intermittent noises that cause humming of the peripheral environment; ii) mechanical noise: noise caused by mechanical equipments such as vehicles, railway, and aircraft as well as large industrial plants generating noises; iii) human activity related noise: can generate from demonstrations, gatherings, sirens, trades, household noise due to usage of vacuum cleaners or drills etc.; iv) other environmental noise: can be attributed to the presence of storms, thunders, winds, and creaking. The Noise Observation and Information Service for Europe (NOISE) suggest that the majority of the noise affecting the exposure of the population is being generated by road vehicle traffic (Das et al, 2019). Studies have shown that the noise pollution from urban road traffic has the highest level of exposure given that roads are located in close proximity to built infrastructures such as schools, offices and residential buildings (Paiva, et al, 2019).

Table-3 shows the COVID-19 measures imposed by the Government of Kenya in the year 2020 aimed at curbing the spread of the virus. These measures are believed to have influenced the levels of noise pollution observed in Nzoia River Basin in the year 2020. In response to the rise of coronavirus cases in Kenya to three patients, on 15 March, 2020 the government closed all schools and directed that all public and private sector workers work from home, wherever possible. Travel restrictions were later imposed to prevent non-residents from entry. Kenyan nationals and residents were required to self-quarantine for a minimum of fourteen days. On 22 March, 2020, following the confirmation of an additional eight cases, bringing the total to sixteen nationally, the government introduced additional measures and directives to reduce the spread of coronavirus in the country. These measures included suspension of all international flights effective at midnight on 25 March, 2020, with the exception of cargo flights (all persons entering the country were compelled to undergo quarantine at government facilities). The government further stipulated that any persons, including senior government officials, found to be in violation of quarantine measures would be forcefully quarantined at their own expenses. All bars were to remain closed from 22 March, 2020, with restaurants allowed to remain open for takeaway services only. All public service vehicles were to adhere to passenger-distancing guidelines previously stipulated on 20 March, 2020. Further, all public gatherings at churches, mosques, funerals and elsewhere were restricted to no more than 15 people, and weddings were banned.

Table-3: COVID-19 measures imposed by the Government of Kenya in the year 2020.

Year /Month	COVID-19 measures imposed by GOK
January, 2020	• On January 3, 2020 President Kenyatta banned political gatherings for 60 days. Organisers of burials and weddings were required to seek prior approval and have a maximum of 15 people attending. A nationwide curfew was enforced between 10.00 pm and 4.00 am daily. The President also prohibited all-night vigils popularly known as *keshas* and directed that all other religious gatherings be held in adherance to the existing Inter Faith Council guidelines.
February,	• The 60 day Presidential ban on political gatherings remained in force upto end of February. Directives issued to organisers

2020	of burials and weddings and the 10.00 pm to 4.00 am daily nationwide curfew continued.
March, 2020	• On March 13, 2020 the first case of COVID-19 in Kenya, a 27-year-old Kenyan woman who travelled from the US via London was confirmed. • On March, 15, 2020 President Kenyatta directed that the following measures to curb spread of COVID-19 be implemented: ➢ Travel from any countries with any case of COVID-19 be restricted. ➢ Only Kenyan citizens and any foreigners with valid residence permits were to be allowed to come into the country provided they proceeded on self quarantine or to a government designated quarantine facility. ➢ All schools and higher learning institutions were closed by Friday March 20, 2020. ➢ Government and businesses people started working from home except for essential services. ➢ Cashless transactions over cash were encouraged. Cost of transactions were reduced. ➢ No congressional meetings – weddings, malls, night clubs, churches and limitation of visits to hospitals. ➢ Hospitals and shopping malls were instructed to give soap and water/hand sanitizers to clients, and also ensure regular cleaning of facilities. ➢ Cargo vessels/ships and aircrafts were allowed to come into the country provided they are disinfected at point of departure and the crew quarantined on arrival. ➢ UN headquarters in Kenya continued operating diplomatic travels as they were exempted from the travel restrictions but observed the self-quarantine rule. ➢ A toll-free number (719) was set up to report suspected COVID-19 cases. • On March, 25, 2020 the first COVID-19 recovery patient was confirmed in Kenya.
April, 2020	• On April 6, 2020 President Kenyatta announced a cessation of movement in and out of Nairobi metropolitan area for a containment period of 21 days, other counties affected by the cessation were; Mombasa and Kilifi and Kwale county that would take effect as from 8 April, 2020.
May, 2020	• On May 6, 2020 President Kenyatta announced a 30 days nationwide dusk to dawn curfew running from 7.00 pm to 5.00 am.
June, 2020	• On June 6, 2020 President Kenyatta announced that the nationwide dusk to dawn curfew was to be extended for a further 30 days but now run from 9.00 pm to 4.00 am (previously the curfew run from 7.00 pm to 5.00 am). • The cessation of movement into and out of Nairobi metropolitan area, Mombasa county and Mandera county was on June 6, extended for a further 30 days. While the cessation of movement in and out of Eastleigh area in Nairobi metropolitan area, Old Town area in Mombasa county, Kilifi County and Kwale county were lifted as from 4.00 am Sunday June 7, 2020.
July, 2020	• On July 6, 2020 President Kenyatta announced the following measures:- ➢ The cessation of movement into and out of Nairobi metropolitan area, Mombasa county and Mandera county were lifted as from Tuesday July 7 at 4.00 am. ➢ Nationwide 9.00 pm to 4.00 am curfew was extended for a further 30 days. ➢ Ban on social gatherings and suspension on operation of bars was extended for a further 30 days. ➢ Places of worship were to commence phased re-opening in strict conformity with all applicable guidelines; with no congregants under 13 or over 58 years allowed. Those with underlying health conditions were also cautioned against congregating to worship. ➢ Local air travel was to resume from July 15 under Ministry of Health and Transport guidelines. ➢ International flights were to resume as from August 1, 2020.
August, 2020	➢ Nationwide dusk to dawn, 9.00 pm to 4.00 am curfew remained in force with other measures aimed at curbing the spread of COVID-19.
September, 2020	➢ Nationwide dusk to dawn, 9.00 pm to 4.00 am curfew remained in force with other measures aimed at curbing the spread of COVID-19.
October, 2020	➢ Nationwide dusk to dawn, 10.00 pm to 4.00 am curfew remained in force with other measures aimed at curbing the spread of COVID-19.
November, 2020	➢ Nationwide dusk to dawn, 10.00 pm to 4.00 am curfew remained in force with other measures aimed at curbing the spread of COVID-19.
December, 2020	➢ Nationwide dusk to dawn, 10.00 pm to 4.00 am curfew remained in force with other measures aimed at curbing the spread of COVID-19.

Source: Researcher (2020).

This study established that the COVID-19 containment measures implemented by the Government of Kenya has resulted into decreasing trends in noise pollution levels in Nzoia River Basin. Similar observations have also been made in other parts of the world. In France, since the enforcement of the lockdown on 17th March 2020, an average reduction of 7.6 dB(A) (Lden) was observed on the road network of Paris, with noise emission reductions in the 60-90% range. Noise emissions from air traffic dropped dramatically in the Paris Charles De Gaulle airport area too, with reductions as high as 21.5 dB(A) (Lden), and a consequent decrease of noise complaints related to aircraft noise. The Department for Ecology, Urbanism and Mobility of Barcelona has been monitoring the reduction of noise levels in the city area on a weekly basis since the implementation of lockdown measures in Spain on the 14th of March 2020. The reports show average decreases of 9 dB (Lday) in noise pollution levels after one week, and an additional 2 dB reduction after two weeks (Aletta, et al, 2020).

Many local authorities are indeed now producing noise maps to compare the pre-COVID-19 scenarios with the current one. Some local authorities are also combining data from long-term environmental noise monitoring stations with online surveys to gather information on the residents' perception of their sound environment during the lockdown period (e.g., Acoucite, et al, 2020); and some researchers are advocating to harmonize the considerable amount of data that will emerge

from this monitoring campaigns around the world (Asensio, et al, 2020). It is important to get such information at city scale because it will reflect trends in reaction to environmental noise from the population, e.g., through noise complaints; indeed, recent research in UK cities has shown that noise complaints patterns will vary depending on urban structure and population factors: noise complaints are likely to be higher in service-oriented cities with high population densities; large and clustered cities also have a higher prevalence of noise complaints compared to others, while fragmented cities are likely to have less noise complaints (Tong & Kang, 2020).

IV. CONCLUSION

This study used the number of noise pollution permits issued by county goverments, in-depth expert-interviews with selected stakeholders and field observations to assess the effect of COVID-19 on noise pollution levels in Nzoia River Basin. This is a unique opportunity presented by the COVID-19 global pandemic since we cannot even predict when such pandemics will ever occur in the history of mankind. Noise pollution levels were found to have decreased under the COVID-19 containment measures in the basin. Assessing environmental change during a global pandemic such as COVID-19 is an important assignment because it gives us a picture on how behavioural shifts can influence some aspects of environmental pollution. The findings of this study can be used to formulate strategies for noise pollution control in the basin as noise is known to cause ill health, and therefore any efforts made to reduce the level of noise pollution will result into the improvement of the health status of the residents. The celebration on the widely observed reduction in noise pollution as a positive environmental measure of COVID-19 could be shortlived in the post COVID months to come if proper planning mechanisms are not put in place.

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