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Minireview

Impact of COVID-19 lockdown in Tamil Nadu: Benefits and challenges on environment perspective

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Prior to COVID-19 lockdown in our country, the air around us was highly polluted due to emission of greenhouse gases for over centuries. Melting of glaciers and rising of the sea levels were evidenced as the alarming signs of Global warming. Environmental degradation was observed rapidly due to depletion and exploitation of natural resources like soil, water and air. But there are few changes observed in the environment after the country's lockdown due to coronavirus pandemic. The effects of lockdown are also entwined with human and political effects such as uncontrollable public mobility, poor access to health care due to lack of sufficient medical facilities, unemployment, migrants' crisis, starvation and prevailing poverty. However, apart from sufferings of entire country especially the people by social, economic and psychologic effects in day-to-day life, this lockdown has given to the nature the most optimistic scenarios in environment especially with enhanced air quality, cleaner water and undisturbed pristine forest. The present review brings out the actual picture of the eco-processes that reduced man-made pollution in air and water as well as disposal of domestic or biological waste along with societal implications after imposing lockdown in the state of Tamil Nadu.

Keywords: Biomedical Waste management, Societal implications, Waste Disposal

Coronavirus disease (COVID-19) outbreak caused by Severe acute respiratory syndrome (SAR-CoV-2) virus has affected every country on the planet infecting 12, 197, 837 people and claiming 5, 52, 784 lives as of 7th July, 2020[1]. Most countries are fighting against the unprecedented impacts caused by coronavirus by establishing new public policies, massive screening tests and regulations for social distancing[2]. The mortality rate by COVID-19 is high in individuals with deprived immune system as in extreme age groups (Children and elderly) and also in people with pre-existing chronic pathological conditions including cancer, diabetes, lung diseases, high blood pressure, asthma, liver disease, cardiac diseases *etc*[3]. It is highly contagious and mainly spreads from human to human transmission through droplets sprayed in the process of sneezing or coughs by an infected person[4]. To address this issue public lockdown was implemented by Government in India, initially for 21 days from midnight of 24th March to 14th April 2020 based on the epidemiological logic that the incubation period of COVID-19 is 14 days and any residual source of microbial infection would be vanished in 21 days. The lockdown periods were further extended from 2nd to 5th time (2nd Phase from 15 April to 03 May; 3rd from 04 –17 May; 4th from 18 – 31 May; 5th from 01 – 30 June 2020, respectively) in a phased manner in India by MHA to contain the rapid spread of the virus at community level. Till now, there is no specific drug available or has been developed to prevent or cure COVID-19 infections. Therefore, the priority of all countries revolves around the health of the people[5]. Consequently, the indirect effects of the virus on the environment has not been analysed in detail. This is the first study that estimates the positive and negative impacts of SARS-CoV-2 on Indian environment. Climate experts have predicted that the emission of greenhouse gases has dropped to significant proportions which is never seen after second World War[6]. This outcome is due to the social distancing policies adopted by the government, halting of production in industries and decreased emission of greenhouse gases like nitrogen dioxide, particulate matter due to restricted movement of vehicles during lockdown[7]. The effects of lockdown are entwined with humanitarian and political effects such as uncontrollable public mobility, decreased access to health care, lack of sufficient medical facility, unemployment, migrants'

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crisis, starvation and prevailing poverty. However, apart from sufferings of entire country especially the people by social, economic and psychologic effects in day-to-day life, these lockdown has given to the nature the most optimistic scenarios in environment especially with enhanced air quality, cleaner water, and undisturbed pristine forest with movements of wild animal in the urban area, reduced man-made pollution and other polluting agents. The reduced movement of 1.3 billion people in public places during nationwide lockdown in India has paved a positive impact in the environment and decreased its pollution at all levels[8].

Based on the above considerations, this review focus on unintended benefits to environment and negative effects of COVID-19 lockdown situation in Tamil Nadu. The objective of this review is to bring out some pros and cons of post COVID-19 scenario perceived gains which includes the quality of life, increased humanitarian approach of people, much socially inclined reduction in using routine things in daily life, less water consumption and paves enhanced air quality, meteorological implications (greenhouse effect and repairing process of ozone layer) and socioeconomic impacts (unemployment, aggrieved poverty and huge movements of migrants between states). It paves a way to provide some suggestive measures to the mass in the post COVID-19 scenario. This review aims to highlight the indirect positive and negative effects of the COVID-19 lockdown on the environment. After analysing the indirect effects, objective suggestions are presented.

Rivers regaining its power

Rivers are one of the most significant natural resources of India which is very much essential and inevitable requirement to every life at most and also for many material requirements in day to day of livelihood. The need of water is felt very long back itself but in recent decade the demand for fresh water increased in many folds because of exponential growth of population to meet their daily requirements. Most of the rivers in India are fulfilling this demand. But the indiscriminate release of pollutants from religious rituals, domestic sewages and industrial effluents are decaying the natural stream water (Jindal and Sharma, 2010) into polluted water or importable one[9]. Central Pollution Control Board (CPCB) in 2015 and Centre for Science and Environment in 2018 have reported that 61948 mL of urban sewage is discarded every day in Indian rivers[10]. The absence of tourism activity, industrial shut down, devoid of transportation, other production-based processing units quarantine by lock down and individual distancing measures due to COVID-19 pandemic has caused a prominent change in the water quality of numerous rivers in Tamil Nadu including the major example is the river Cauvery.

The river Cauvery is the lifeline for two states Tamil Nadu and Karnataka. Tributaries of river Cauvery seem cleaner as people stay at home and lockdown imposition keeps pollution away from the water sources. Stringent enforcement of lockdown in entire country especially Tamil Nadu state due to coronavirus pandemic has stopped the discharge of effluents from industries, dumping of solid wastes from residential areas and prohibition of religious activities has reduced the river water pollution level to greater extent. Imposing lockdown has become a boon for Cauvery (Fig. 1) and other rivers in Tamil Nadu. The main tributaries of river Cauvery are Amravati, Hemevati, Shimsha, Bhavani, Arkavathi, Thenpennaiyar and Kabini. Two rivers that originate from Karnataka flow in Tamil Nadu and these rivers as well as their tributaries especially Arkavathi and Thenpennaiyar are highly polluted with discharge of untreated sewage and inflow of industrial effluents from various places of Karnataka. The pollution of river Cauvery and its tributes analysed by four main parameters such as biological oxygen demand (BOD), chemical oxygen demand (COD), pH level, dissolved oxygen, electrical conductivity and faecal coliforms revealed that after lockdown imposing Cauvery tributaries have regained their power by meeting the criteria limits of water quality[11]. Unprecedented nationwide lockdown imposing due to corona virus has significantly increased the water quality of river Cauvery and the fate of other rivers in Tamil Nadu was not different from Cauvery. The

Fig. 1 — River Cauvery respires after lockdown

purity of most of the river water in Tamil Nadu has regained its colour and composition that flows once again the same way as it used to be few centuries back until industrialization leads to environmental deprivation. The lockdown imposing has significantly reduced the dangerous quantity of faecal coliforms, suspended solids, fluoride and lead levels in all the rivers of Tamil Nadu[11]. In terms of pollution, edaphic factors have favored the environment and encouraged the cloud forming which has improved the raining by improved precipitation level.

Upgraded water quality

Lockdown has improved the water quality in all sources by not mixing or inflow of domestic drainages, industrial wastes in the form of effluents with various domestic sewers inflow. Due to imposing of COVID-19 lockdown the water bodies in Tamil Nadu are breathing freely due to Plastic-free lakes, cleaner ponds and irrigation canals. Kalingarayan canal that irrigates about 15,743 acres in Erode district becomes cleaner and clearer as it used to be two decades ago in post COVID-19 lockdown imposing. The pristine water in the canal is restored due to shutdown of textile and tannery industries which discharges effluents in the Kalingarayan canal. In Chennai the Coum river near Napier bridge becomes clear without empty trashes, the Perumbakkam lake (Fig. 2) becomes spotless and the Green Emerald wetlands at Thirumazhisai satellite township becomes home for ducks waddling in clean water. Evidently all the water bodies in Tamil Nadu are heaving a sigh of relief as their main pollutants (manmade/human based) are staying away from them during this lockdown tenure. For instance, Pidari Ponniamman pond inside the Ambattur industrial estate which used to be a dumping yard filled with garbage along with effluents from many industries now appears cleaner, which is also filled up due to recent rainfall. Environmentalist foundation of India have also reported that few water bodies in Chennai including Cooum, Korattur, Ambattur and Adyar rivers as well as their tributaries has not significantly improved their water quality because of domestic sewage from the city still continue its flow into these rivers and there were reports for recent contamination of these rivers with domestic sewage. The drastic reduction of plastic wastes in Mannivakkam and Karasangal lakes in Vandalurare now become nests for varied chirping bird population including egrets, herons, kingfishers and painted storks inching back to its purity few decades before[12].

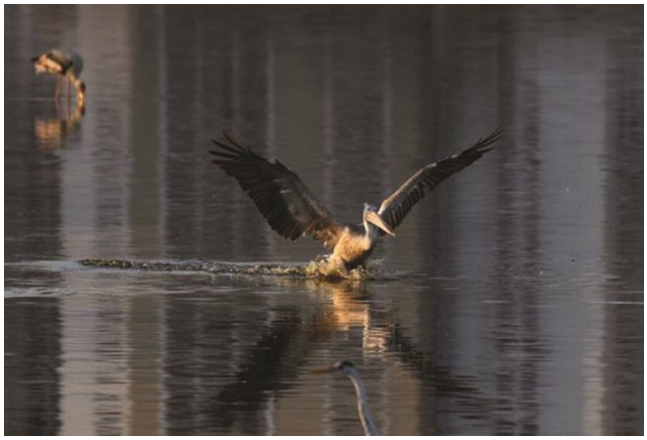

Fig. 2 — Cleaner water in Perumbakkam lake in Chennai

Adyar river that flows 42.5 Km from Thiruneermalai to Bay of Bengal is now carrying 70 cusecs of froth free and pollution free clean water due to devoid of chemical wastes and effluents from tanneries and other industrial units in Chromepet and Tirumudivakkam. The channels which normally carry the effluents from Madras export processing zone to rivers became dry after imposing COVID-19 lockdown. Public works department officials in Chennai declared that domestic sewage flowing into Adyar River, Cooum and Buckingham canal through illegal discharging points still continues even in lockdown situation makes water bodies sully though there is no effluent flow from closed industries. Buckingham canal that used to get 20 cusecs of water polluted with industrial and domestic waste now gets only 3 to 4 cusecs mainly containing illegally let domestic sewage through tankers. Officials also declared that the discharge of effluents from Industrial estates in Kakalur into Thaneerkulam which flows into Kosasthalayar basin has also stopped after lockdown and consequently only 10 cusecs of grey water flows from industrial units, automobile service centres, hotels *etc*., instead of usual 60 cusecs of grey water. This lockdown has also decreased the pollutants levels in the ponds and lakes which are now free of poultry waste and construction debris that has greatly enhanced water quality. Moreover, the smell of the pristine Adyar River is back and the nature took care of herself. Therefore, the lockdown has temporarily stopped the inflow of untreated waste water into water bodies[13].

Decreased pollution and Meteorological implications

Bio-geo cycles, biological cycles, food cycles, ecological pyramid levels and a total life pattern of

flora and fauna have significantly changed and enhanced in all respect in the environment after imposing lockdown. Meteorological department have also stated that the strict lockdown measures imposed due to Coronavirus pandemic has had a notable impact on the weather condition now-a-days. There are many parameters which are influencing the Meteorology and its functions. Of which environmental parameters play an important role in altering the Meteorology either in positive or in negative ways. The scenario of COVID-19 has significantly improved the Meteorological status of the country which has shown a lot of positive implications in the country's Meteorological status? But simultaneously it has given the negative Meteorological implications too in the form of Amben Cyclone in India and Bangladesh; Nisarga cyclone in Arabian Sea near Mumbai, India and Hurricane at North Carolina in America is few to figure out some atmospheric changes[14]. But in the global scenario it has shown a positive trend in-terms of Meteorology which helps in many ways to improve the ecological conditions and environmental changes, over hauling of atmosphere which ultimately gives a favorable condition to wider biological diversity globally[14].

The significant drop in the emissions or air pollution due to total restriction on mobility in all mode in the lockdown period and shutting of industries have an impact on temperature especially during night that brought south-west pre-monsoon rainfall (Fig. 3) earlier in various places of Tamil Nadu and Kerala. Y E A. Raj, former deputy Director General of Meteorological department of India stated that the significant reduction of aerosol, particulate matter and carbon dioxide in terms of carbon foot print in the atmosphere due to imposing of lockdown will help Sun's irradiation to go back to space without

Fig. 3 — North east Monsoon advance in Tamil Nadu after lockdown

any hindrance, resulting in cooling of land rapidly by 0.5°C to 1°C[14]. He also added that other factors such as humidity, incoming radiation, direction of wind and carbon dioxide will play an important role in determining the drop in everyday temperature. Therefore, a dedicated data collection, proper investigation and statistical analysis on the levels of pollutants for longer period before and after lockdown become necessary to predict the level of variation in the weather pattern due to lockdown scenario. Director of Indian Meteorological department N. Puviarasan have also stated that cleaner air during lockdown could also increase the temperature of the day because of the radiation from Sun can penetrate the earth directly. Accordingly, the earlier weather forecast predicted by Indian Meteorological Department (IMD), Tamil Nadu was predicted to experience slight decrease of ± 5°C in temperature from normal during April and June 2020 with expected maximum summer temperature between 34 °C to 37°C[14]. However, the day temperature after lockdown is hovering around with temperature range between 26 and 35°C[14]. Factors such as direction of wind also play a key role in determining the daily temperature. As during April 2020 Tamil Nadu experience warmer easterly and south-easterly winds from sea during night, it is hard to predict if the temperature is influenced by wind or by lockdown. The Director of IMD also stated that, if winds are calm then the effect of lockdown on temperature can be studied precisely and the temperature variation due to reduced pollution is negligible as nitrogen and oxygen contributes to the maximum amount of atmospheric gases when compared to carbon-dioxide[14]. However, there are other contradictory statements given by the climate expert Professor Sridhar Balasubramanian from IIT, Mumbai that the suspended particles in the atmosphere trap the heat which leads to evaporation of clouds and the reduction in aerosols which would facilitate clouds to hang for longer time[14].However drastic increase in pollution level was observed in Tamil Nadu as soon as the state started relaxing the guidelines for lockdown although a sharp decline in the pollution levels occurred during the lockdown period. After 50 days lockdown in Tamil Nadu, the quality of clean air worsened due to easing of restriction on vehicles. Tamil Nadu Pollution Control Board (TNPCB) reported that the quality of air in Chennai crossed the permissible limit[15] of 60 μg/m^3. However, the level of particulate matter 2.5 was satisfactory in Royapuram,

Perungudi, Gumidipoondi and Manali was found to be 62, 60, 94 and 85μg/m^3, respectively[15]. Moreover, Central Pollution Control Board (CPCB) started that the quality of air in remaining parts of Chennai was within the permissible limits of 60 μg/m^3 while Alandur bus depot and Valechery recorded clean air quality[15] with 26 and 52 μg/m^3. Tamil Nadu Pollution Control Board officials also declared that the pollution levels of Alandur and Perungudi during lockdown was as low as 20 μg/m^3.

Reduction in emission of greenhouse gases

The level of carbon foot prints are improved (17%) globally by reduction in mono-carbon and bi-carbon releases (Fig. 4A & B) due to less transportation, release of toxic emissions from various industries during this lockdown days (reported in DD news on 05.06.2020). The only proof of the reduction in emission of greenhouse gases is getting repaired the level of ozone hole of the atmosphere. Air quality in Chennai city is affected by many factors including industrial pollution, emissions from vehicles, garbage burning and dust pollution[16]. Although the sources of pollution in Chennai have been on pause during lockdown, the emissions from power plants in Ennore and landfills in Kodungaiyur as well as in Perungudi still remained constant[16]. The data to access air quality in Chennai such as particulate matter 2.5, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide was downloaded from web page of Central Control Room for Air Quality Management - All India. Central Pollution Control Board has set continuous quality monitoring stations in Manali, Alandur and Velachery and Tamil Nadu Pollution Control Board has a station in Manali. 24 h and 8 h data for particulate matter 2.5, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide after imposing lockdown were downloaded and compared with 2019 data as control[16]. Central Pollution Control Board has reported that the restricted movement of vehicles decreased the combustion activities during lockdown that has enhanced air quality in Chennai with significant 30% drop in particulate matter 2.5 levels. Officials of Central Pollution Control Board have also reported that the carbon monoxide and nitrogen dioxide levels reduced by 43% and 5%, respectively over pre-lockdown levels is due to decrease in emission of carbon monoxide by vehicles and nitrogen oxide by Industries[16]. Two air quality monitoring systems of Central Pollution Control Board in Manali which determines the nitrogen dioxide levels in the city due to location of petrochemical industries reported that though the levels of sulphur dioxide, particulate matter 2.5 (PM 2.5) and nitrogen oxide persisted within the permissible limits as specified in the national ambient air quality standards but the levels of particulate matter 10 data is yet to be analyzed for Chennai[16]. The lowest levels of PM 2.5, nitrogen dioxide and sulphur dioxide in Chennai during lockdown on a 24 h average was found to be 12 μg/m^3, 4 μg/m^3 and 80 μg/m^3, respectively. Hourly comparison of PM 2.5 showed maximum average concentration of 84 μg/m^3 at 9 am dropping to 34 μg/m^3 in 9 pm during lockdown period which was much lower level when compared to pre-lockdown period[16]. Moreover, the hourly concentration of PM 2.5 at 2 am before and after lockdown period was found to be 26 and 19 μg/m^3, respectively due to restriction of non-essential vehicles and industries during lockdown. The air quality index in Chennai was highest to 274 on March 21st and on March 25th, 2020[16].

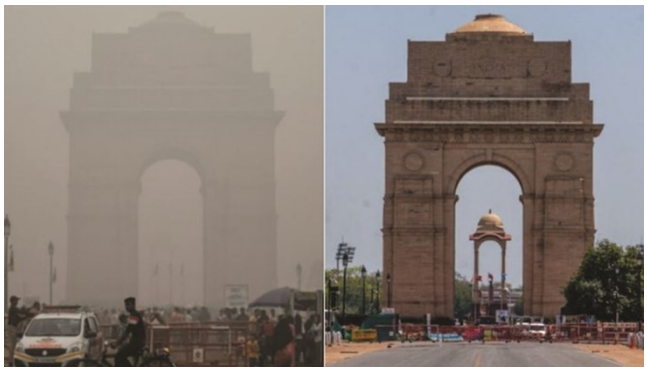

Fig. 4 — (A) Photograph of decreased greenhouse gases and air pollution during November 2019; and (B) March 30, 2020

About 1.8-fold decrease in PM 2.5 and nitrogen dioxide was observed in Chennai during the first phase of lockdown with the daily average of 25 μg/m^3 in all four continuous air quality monitoring stations which could be attributed to the halt in vehicular traffic and construction activities[17]. Reduction in nitrogen dioxide was higher in Velachery due to low traffic density than usual while no significant reduction was observed in Manali and Alandur due to working of power plants. Levels of sulphur dioxide and ozone in Chennai city did not show any significant reduction. However, the carbon monoxide reduced by 1.6-fold and sulphur dioxide levels remained constant during lockdown due to pause in the vehicular emission and burning of coal in power plants, respectively[17]. The secondary pollutant

ozone which is formed by the chemical reactions between carbon monoxide, nitrogen, sulphur and other gases in the atmosphere with Sun's did not show any change in three continuous air quality monitoring stations except in Manali when compared to 2019[17]. Therefore, sustained policy amendments are needed to address the pollution caused by landfills and power plants.

Wildlife thrives due to restoration of pristine forest environment

Due to COVID-19 lockdown the public intervention to environment in broader perspective and the forest in particular is very less and ease the routine pressure of being utilized indiscriminately in a continuous basis. The activities such as grasping by cattle, cutting trees for various requirements, collection of forest produces, poaching, honey gathering, hunting for small animals for food, unwanted cultivation of restricted crops (opium. Kanja, fennel *etc*.) have been reduced enormously[18]. The hydroelectric power generation, industrial activity, coffee and tea production have also been affected in the estates located in forest ecosystem due to labor disturbances (majority laborers being migrants in nature) and restrictions in laborers movements and activities. Due to reduction in the above activities, the animal movements, safety to fauna and flora, freedom of living for animals have improved due to lack of human intervention[18]. As a result of these, the pristine forest environment is restored as such in the environment in an in-situ manner. The freedom of movements of wild lives, abundance of food and fodders for grasping animals, improved environmental circumference, and drinking water availability along with eco-friendly environment made wild animals to visit the human inhabiting areas. The lockdown seems to have positive impacts on migratory birds which started staying longer as well as reduction in injuries by toxins to marine animals due to decrease in pollution level by chemical waste discharges and human interference[18]. Ramanathapuram forest range officer reported that many varieties of partial migratory bird species from other parts of India such as painted stork, spoonbill, open bill stork, spot-billed pelican, ibis and grey heron were found to extend their stay from March till month of May in bird sanctuaries located at Keelaselvanur and Therthangal[18]. Moreover, the officers also stated that reasonable storage of water available in water bodies due to good northeast monsoon has increased the nesting of birds in the sanctuaries and the forest department officials ensure the good and clean storage of tanks or feeder channels inside the sanctuaries. Birdwatchers from Madurai and Karaikudi suggested that restricted movement of human and minimal noise pollution due to absence of functions like grand marriages during lockdown has benefitted birds that prompted them to stay longer[18]. Also, the absence of movement of boats during lockdown has reduced injuries and accidents caused by propellers of the boat to marine organisms such as sea turtle, dolphins, dugongs *etc*. Moreover, during lockdown good numbers of peacocks and spotted deer were found in Thiruvadanai and Thondi area[18]. In response to the reports of coronavirus infection to tiger in New York zoo, the National Tiger Conservation Authority (NTCA) framed a set of protocol to examine such as tiger deaths in the Tamil Nadu forests[19]. Teams of reserve forest officials along with veterinary doctors patrolled the forests in Mundanthurai, Kadayam, Ambasamudram and Papanasam to provide medical attention to injured animals, to prevent incidence of wildfire and to examine the carcasses for collecting the data of coronavirus deaths in animal during lockdown[19]. District forest officers in Sankarankovil, Gangaikondan, Sivagiri and Kadayanallur ensured the regular filling of feeder troughs and water tanks for the wildlife in these forest regions[19]. Wildlife experts in Tamil Nadu reported that the ecology was recovered during the lockdown as wildlife started revisiting their ancestral places which has been transformed to tea and rubber estates, jackfruit or banana plantations and revenue lands/temples located in close proximity to the wildlife hotspots. Due to restricted vehicular movement and ban of forest fringes during lockdown, Boars, Bears, Indian gaurs and Elephants were invaded to and found straying in villages near Pollachi, Sathyamangalam, Valparai, Kodaikanal, Coonoor and Palani. Wildlife forage freely in the famous shrines such as Maasini temple, Bannari Amman temple, Sorimuthu Aiyanar temple and Karuna Varuna temple located inside tiger reserve[19]. Also, deer and mongoose were found in deserted mosques and churches during lockdown. Environment experts reported that this free wildlife movement indicates the revival of ecology which was adversely affected by manmade activities like urbanization and indiscriminate use for past two decades[20]. Significant number of wild boars, spotted deer, jackals, monitor lizards and palm civets were spotted in forests in Tiruvallur, Kancheepuram and Tiruvannamalai[20]. Wildlife including Black Panther

Fig. 5 — Black Panther roam freely in streets of Ooty after lockdown

(Fig. 5), spotted sloth bears and leopards begin to stray freely around human habitats as well as in the streets of Udhagamandalam and Coonoor due to empty roads during lockdown[21]. Though the wildlife thrives in this lockdown, officials and activists are dealing with more cases of wildlife poaching near Cheyyar[21]. Wildlife crimes have spiked in Nilgiris forest due to lockdown and about ₹1.5 lakhs were collected as penalty by officials of forest department for hunting or trying to hunt wild boar, sambar deer, black-napped hare, barking deer and jungle foul[22].

Disposal of domestic waste and reduced waste recycling

Lack of use of normal livelihood materials, commercial ventures, packaging material of goods, debris of vegetable markets, animal markets, other water-based wastages are the main reason for reduction in generation of wastes. Thus, the recycling processes also get down in a greater level. Greater Chennai corporation official statistics of waste disposal during lockdown reported that generation of waste in the city decreased by 30% and was around 3665.3 tonnes only per day during lockdown which usually will be about 5100 tonnes per day in normal days[23]. Corporation sources also declared that about 600 tonnes of wet waste and 280 tonnes of dry waste were being processed per day in addition to the remaining 4000 tonnes of waste being sent to power generation, briquetting and to land filling. Huge piles of domestic waste are disposed in major cities of Tamil Nadu especially in Coimbatore, Theni and Tirunelveli districts (Fig. 6)[23]. The municipal officials advised the residents and garbage recovery team to segregate the

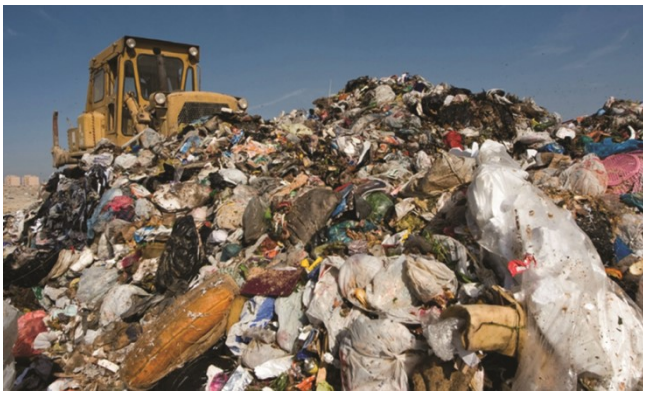

Fig. 6 — Huge piles of waste from Coimbatore, Theni and Tirunelveli districts of Tamil Nadu

domestic and house-hold wastes as degradable and non-degradable with color coded carboys. This decrease in waste generation is due to shut down of major waste generators including restaurants and malls during lockdown[23]. Moreover, Koyembedu market alone usually generates 159 tonnes of waste per day till its shutdown[23]. Despite reduction in generation of solid wastes have decreased substantially since lockdown in all places of the state, the plastic waste generated continue to be a problem in Coonoor as it remained constant as in pre-lockdown levels[24]. Waste generated in Coonoor during lockdown has reduced to half, about 10000 Kg waste was generated per week from usual 20000 Kg/week[24]. Though paper waste and non-recyclable waste was reduced by 62% and 6150 Kg (from 11500 Kg) per week, respectively in Coonoor, the plastic waste generated remained almost constant at about 2800 Kg/week[24].

Bio-medical waste management

Proper solid waste disposal is the important factor for maintaining environmental hygiene and to control the spread of other microbial infections. Although it is evidenced in the reduction of domestic waste generation and disposal but there is a steady increase in the quantum of bio-medical waste generation and disposal which is meeting or at par with the average generation of solid wastes from the hospitals. Another major problem faced by many states of India including Tamil Nadu is the improper disposal or illegal dumping of bio-medical wastes due to the lack of infrastructure, machinery, technology or incinerators to dispose the bio-medical wastes generated in treating coronavirus infected patients. According to the revised guidelines for disposal of medical waste in 2018, the hospital should send their medical waste in color-coded bags to

the nearest incinerating site for disposal[25]. However in the context of coronavirus infection huge amount of medical waste are being generated and to avoid the cost of incineration, most of the hospitals send only a small portion of their medical waste to incineration point and the remaining wastes are dumped illegally in water bodies, suburban areas, empty lands and also in neighboring states which pose severe public health issues[25]. Failure to disposing the medical waste is due to erring hospitals, expensive disposal charges, improper medical disposal monitoring system and poor accountability. Therefore, government has to revise and implement the medical waste disposal model to ensure public health[25]. Treatment of each coronavirus infected person or suspected cases generates 500 g of waste including personal protective equipment (PPE), syringes, vials, plates and cotton swabs used in special isolation wards[26]. Data from eight common biomedical waste treatment and disposal facilities in Tamil Nadu shows that, two facilities are in Chennai which used to handle 8-9 tonnes/day of biomedical wastes is now handling only 4-4.5 tonnes/day after impose of lockdown. Tamil Nadu Pollution Control Board officials stated that biomedical wastes from hospitals were collected as per guidelines specified by Central Pollution Control Board (CPCB)[26]. Moreover, Tamil Nadu Pollution Control Board has approved collection, treatment and disposal of biomedical waste in Chennai has been allocated to common bio-medical waste treatment and disposal facility (CBMWTF) in G J Multiclave (India) Pvt Ltd. and M/s. Tamil Nadu Waste Management Ltd. Chennai is home for about 900 hospitals but only two biomedical disposal facilities are available in the city that resulted in dumping of wastes along Kundrathur to Porur road, in suburban regions and in water bodies[27]. Disposed biomedical wastes in water bodies and river banks could affect the quality of ground water, spoil the environment and pose serious health issues to the neighbouring dwellers. There are about 9 more biomedical disposal facilities available in rest of Tamil Nadu to manage the wastes from 6000 hospitals[27]. Due to coronavirus pandemic many hospitals in Trichy have shut down the outpatient departments and therefore the generation of medical wastes has significantly reduced. Biomedical wastes of various hospitals in Trichy are sent to biomedical waste treatment facility Medicare Enviro Systems located in Thanjavur. During lockdown the average of biomedical waste in Trichy has come down to these treatment centres from 1700 Kg/day to 700 Kg/day with about 20 Kg from Mahatma Gandhi Memorial Government Hospital[28] itself. Biomedical Waste Disposal guidelines for hospitals is flouted in Chennai and most of the medical wastes are being dumped regularly near Vandalur, Kundrathur, Chembarambakkam, Injambakkam, Nazarethpet, Anakaputhur, Chrompet (Fig. 7) and Thiruneermalai[29].

Societal implications or changes

We are being at home, by that our needs are restricted and confined to basic requirement. The COVID-19 pandemic has spoiled the economic status of the individual and society in a broader perspective. The COVID-19 pandemic devastated the entire world in many ways in which human death and economic slowdown are the main key factors which influenced much in shaking the world[30]. The population reduction in terms of death due to COVID-19 pandemic, population shift through migrants, change in requirements and priorities, poverty, starvation, losing jobs, loss to small industries andMinistry of Micro, Small & Medium Enterprises (MSME), political situations, change in life style, focusing on precautions, personal hygiene, sanitations and public heath are the few areas in which the government will focus for societal benefit[30]. COVID-19 pandemic and subsequent lockdown has huge negative impact on livelihood of hundreds of intra and inter-state migrant workers in Tamil Nadu especially in textile hubs like Tirupur and Erode who were hired in textile industry based on piece rate with no security benefits including Provident Fund (PF), Insurance, Employees State Insurance (ESI) *etc*. The migrant workers are struggling for survival during this lockdown due to lack of wages, rations and relief fund (Fig. 8). Despite government orders, these workers have lost their wages during lockdown[30]. During slow release of lockdown, Tamil Nadu government has reopened

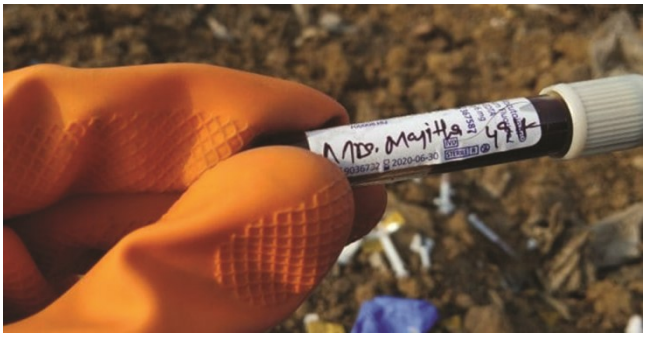

Fig. 7 — Improper disposal of Biomedical waste disposed in Chrompet

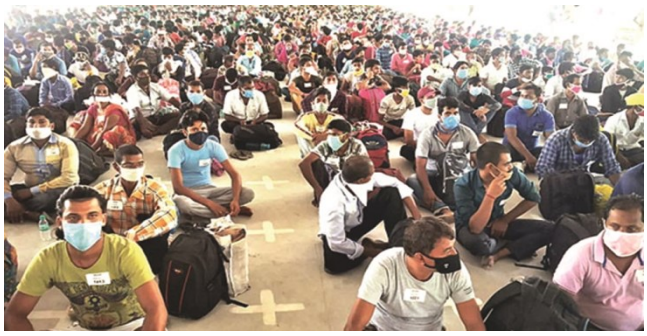

Fig. 8 — Mass exodus of migrants who work in Knitwear Units in Tirupur

TASMAC shops on May 7th, 2020 in-spite of heavy protest by public and various organizations. Women in some places risked their life for infection and have protested in the close proximity of TASMAC shops. However, the revenue generated in the first day of opening TASMAC was at ₹170 crore. Due to liquor consumption within 24 h have also witnessed the spike in murders, drink and drive accidents, many brawls and domestic violence[31]. Panic buying of essentials ahead of intensified lockdown in cities including Chennai, Coimbatore, Madurai, Salem and Tiruppur has brought down the mandatory social distancing norms[32]. Coronavirus lockdown had severe impacts on several societal aspects including the temple priests in Kumbakonam, Thanjavore, Kanchipuram and Madurai who mostly rely on the donation from devotees. Due to cancelling of scheduled festivals during lockdown, nearly 50% of 27000 temple priests in Tamil Nadu Poosarigal Peramaipu (Pujari's association), they were aged above 50 and are struggling to meet the day-to-day expenses[33]. The government fund relief of ₹1000/month and retirement fund that has been raised to ₹3000 from 1000 is restricted to the temple priests who have registered in the village temple welfare board[33]. The COVID-19 lockdown severely affects the social functions like wedding and event management industries throughout the state. According to the industry sources the lockdown has paralyzed the industry and hit various people (about 1 lakh people in Trichy alone) who are employed indirectly or directly in marriage halls and convention centres. Due to restricted guests in marriages during lockdown, many business marts such as textile showrooms, event managers, caterers, stage decorators, pandal operators, videographers, orchestra artists, purohidars and others that are linked to wedding industry are severely affected[34]. Tamil Nadu Siru Thozil Federation secretary have also reported that the extended lockdown in the state has immensely affected the revenue of small traders including petty shop owners, plumbers, electricians, cool drink manufacturers *etc*. Lockdown has also hit the livelihood of forest dwellers and tribal community including Kadar, Muduvar, Paliyar, Irulars and various tribes who live in 18 districts of Tamil Nadu. Most of their occupation is collection of minor forest produce like Tamarind, honey, Sal leaves *etc*. and the pandemic has forced the tribes to leave their village due to spread of the disease and move and built a village in the new place[35]. Coronavirus outbreak also had negative impact on education, student's mind-set, affect the psychology of individual's, mental stability along with depression. Despite increase in the online classes, majority of students don't have access to the e-learning technologies and adapted to that besides having the technology. The need for blended learning makes the teachers to learn the digital mode of teaching in Tamil Nadu. After relaxation of lockdown, Tamil Nadu government schools are witnessing a surge in new admission of students as many parent's loss their income and are unable to pay the high fees for their wards in the private schools[36].

Shaking of Population

The status of living and density of population in a given area has played a pivotal role in spreading of the pandemic and worsening the situation of livelihoods. The pandemic situation has started teaching so many lessons to all of us in leading our day-to-day life. The population density is one of the main parameters which becomes the bottle neck to contain the spread of COVID-19.The best example for population induced community spread of coronavirus in Tamil Nadu is Koyembedu market in Chennai as well as places like Worli and Dharavi of Mumbai in Indian context. Tamil Nadu became second worst hit state in the country for coronavirus and most of the affected cases are linked to Koyembedu market. One of the Asia's largest vegetable hub, 65-acre Koyembedu market in Chennai employs about 10000 laborers with 1-2 lakh visitors every day[37]. Congestion and overcrowding of people continued in this market during the first phase of lockdown with steady flow of retailers and customers due to panic buying with no regard of social distancing as shown in the (Fig. 9). During the subsequent lockdown in April, 2020 the Koyembedu

Fig. 9 — A Scene of crowded Koyembedu vegetable market in Chennai during April 2020 lockdown

market turned into the largest hot spot for coronavirus infection that has spread to vendors, laborers and spillover of cases has been witnessed in several districts of Tamil Nadu[37]. The district administration has closed the Koyembedu market until further order instead an alternative market has started functioning in Thirumazhisai from May 7, 2020 onwards[38]. The movement of migrant population of the wager community has made the current population of the country into so dynamic and shaking because of increasing death toll in entire nature and the spiking has not stopped yet.

Suggestive measure for post COVID-19 scenario

The exact status of state population including floating population from other state (migrants) has to be surveyed and based on the population, the inevitable primary amenities such drinking water, food, shelter, sanitation, jobs for Individuals should be provided to the people of the state. The lockdown has suspended all the economic activities except supply chain for food and medicine[39]. Medical facilities like number of government medical colleges, private/government doctors, medical students, staff nurse, health workers, ICU facility and ambulance facility should be enhanced in the state disproportionate to the state's population. The public distribution system in the state should be enhanced to ensure distribution of food, essential commodities and relief packages equally to all the needy people in the state. The state agriculture and food security should frame new guidelines for production, procurement, storage facility and prices fixing that benefits farmers. The state government and authorities should extensively enhance the adopted public private partnership approach in development of roads for logistics of goods and transport of public and private vehicles. Free education in the state

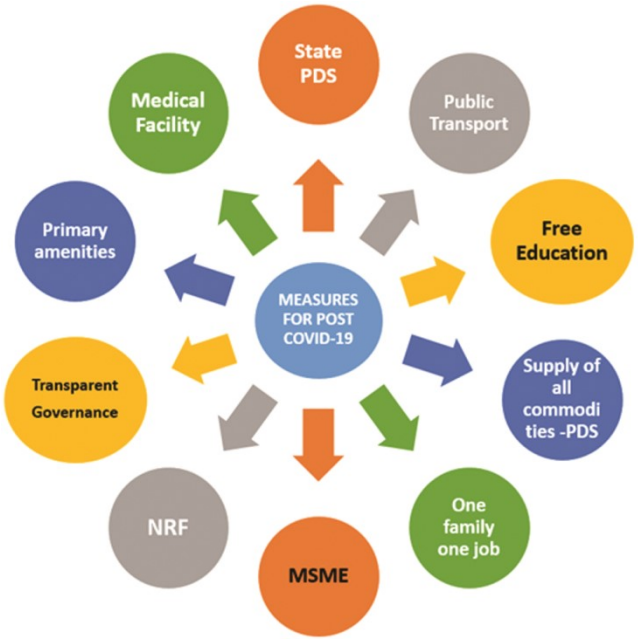

Fig. 10 — Suggestive measures for post COVID-19 scenario

can be implemented till eighth grade and both government and private schools should have equal fees till higher secondary education. Food and Hostel fee may be varied according to the facility. Teachers are to be regular, well qualified and in equalized in proportion to number of students. Since pediatric population evidenced Kawasaki disease or syndrome, vasculitis and lesions due to Covid-19 infections[40], the infrastructure including toilets, playground facilities and portable drinking water should be improved in schools. Systemize the e-payments/cash card and working out better strategies to sell or supply of all commodities through PDS including medicine. One family one job requirement can be implemented to avoid poverty and development of employment. Transparent and fare governance can be implemented by adopting e-governance approaches to the possible extent. Prioritizing public sectors, government departments and machineries over private concern facilitate the enhancement of Technical advancement. National Disaster Response Force (NDRF) can be deployed to shift the homeless and to undertake sessions at relief centres. A unified one week or ten days lockdown can be implemented uniformly throughout the country once in a year for natural relief to the ecosystem and its live forms. The measures that can be implemented in the state and country after coronavirus pandemic is given in the (Fig. 10).

Conclusion

No Monday morning scrambles, no traffic snarls, no have- to - go here, have to bag that. Life suddenly is stripped to its essentials we need to cook, clean, eat and sleep. Despite models and predictions by epidemiologist, global health supports and policy wonks, nobody is certain what tidings we might wake up to or when. Though most of us are at home, the very familiarity of our environment increases our disquiet. Apparently for humans, living with uncertainty is harder than living with pain. Purity pervades the air as loud honks and the quotidian cacophony of urban life has been put a pause. Now a days we hear more birds chirping and the air we breathe is palpably cleaner in the environment. Our lives are less harried and it's almost as if, Nature has pressed the pause button on earth. Perhaps, we, humans need to review, reflect, re-examine and reset our routines. In the prevailing situations we are all making do with less now; do we really repeat the consuming of more as we mindlessly did earlier? Having with greater wings, we traversed the globe either with reason or without reason, by not paying heeds to our carbon footprints. We need to emphasis on ways of working from home. In environment perspective, the dramatic measures taken during the coronavirus pandemic cannot be imitated directly in non-pandemic periods to attain positive effects. However, we hope that the lessons learnt from this pandemic is an inspiration from the fact that rapid positive impact on environment can be obtained when necessary action is taken.

Conflict of Interest

All authors declare no conflict of interest.

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