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Adverse Effects Of 5th Generation Mobile Technology On Flora And Fauna:

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Abstract.
Technology plays a very vital roles in the growth of the economy of any nation. Hence, information communication channel needs to be very strongfor timely delivery of information and growth of any country. Mobile technology is the backbone of communication channel in any country who has incorporated it. Since 1980 mobile communication is very popular mode of communication and researches are going on in this area since that time. Starting from the first generation mobile network to fifth generation mobile network, every nation wants to enhance their information communication technology infrastructures in aspect of communication.
The 5G mobile technology is subject of debate now a day. Still, most of the countries are in the race for adopting this technology and are ignoring its adverse effects on human health and environments. 5G mobile technology uses millimeter waves and higher frequency band 6 GHz to 100 GHz for communication. Initially, there was appeal made in United Nation Council and later in European Union against the launch of 5G, which was signed bymore than three hundred scientists and doctors, stating that the 5G mobiletechnology is not good for environment.

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I. Introduction

Technology is very important for the human being in this revolutionary era; it is also helpful in the growth of the country's economy. Information communication Technology (ICT) movement toward mobile generation technologies focuses on mobility, latency, data rate and providing connectivity to the end user. Currently almost every nation has adopted theLTE network related to fourth generation mobile technology. This LTE technology emphasizes on high-speed mobile network that provides fast handover, low latency and high transmission data rate. The 5th generation mobile technology operates on 6 GHz to 100 GHz frequency, also called millimeter and sub-millimeter waves, and cannot travel to longer distances. When compared to earlier generations, for setting up a 5G network higher number of mobile base stations are required. A 5G base station has cell radius of maximum 20 meters, leading to the fact that about 800 base stations per square kilometer will be required to setup a 5G network. Thisimplies that in a highly populated area two antennas will be required at every ten houses.

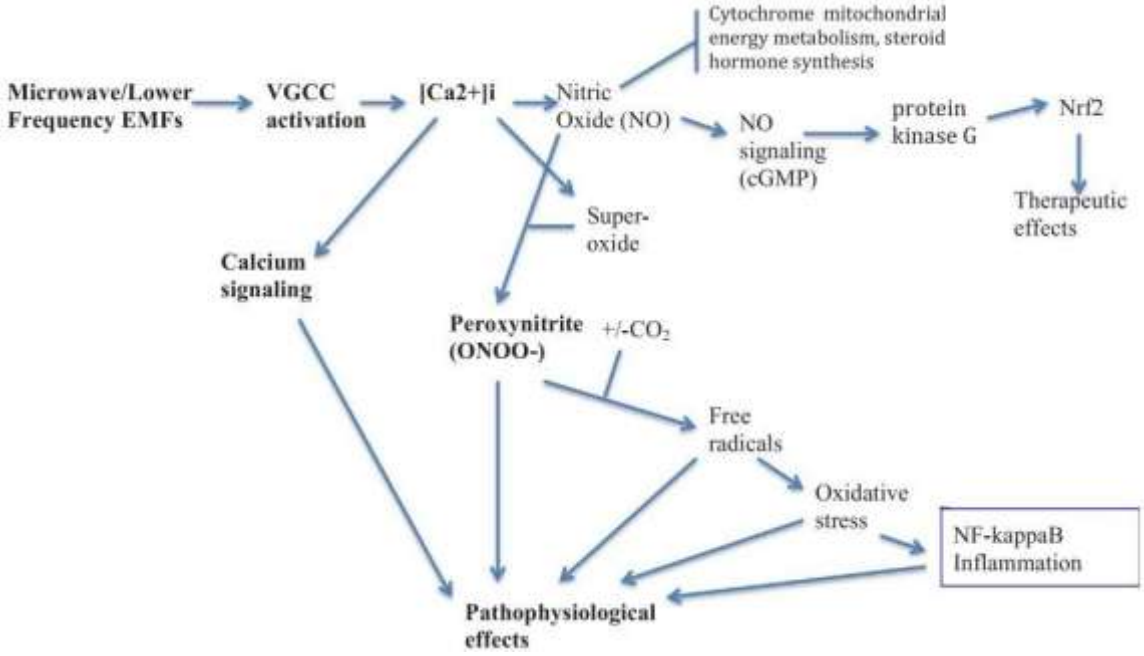
5G uses higher frequencies that travel in shorter distances and require dense infrastructure setup, these type of waves are called millimeter waves; they can create very strong radio frequency electromagnetic field (RF- EMF). EMF filed is invisible form of Energy. Radiation are two types ionizing and Non-ionizing, Ionizing radiations are very harmful for human body, it can damage human cells and can causes cancer. Non- ionizing radiations are safe to use but many scientists have suggested that they can create only thermal effect or tissue heating at higher exposure level on human body, which may lead the long term effects of human health and environment.

II. EMF effects are often cumulative and irreversible

One question that has been raised about the effects of these low-intensityEMFs producing biological effects is are they cumulative?

We are aware of three different types of evidence for cumulative effects. Three of the human occupational exposure studies from the 1970's reviewed in Raines (1981), showed that effects increased substantially withincreasing time of exposure to a particular type and intensity of EMF.

The impacts of such EMFs on animal brains were reviewed in Tolgskaya and Gordon (1973) and discussed in Pall (2016b). Initially exposures over period of 1–2 months produced relatively modest changes in structure of the brain and the neurons and when exposures ceased, most of the structural changes disappeared – that is the changes were largely reversible. However more months of exposure produced much more severe impacts on brain and neuronal structure and these were irreversible.



III. Methodology.

A database search of the current literature in the field found that it is subdivided based on two classifiers. The first is the target group investigated: non-human vertebrates, invertebrates and plants; the second is the RF-EMF frequency studied, which is subdivided between a lower (0.45-6 GHz) and a higher frequency range (6-300 GHz). The former frequency range includes those frequencies where the current telecommunication networks operate, while the latter is the range in which 5G will partially operate. This resulted in six categories, which are reviewedseparately.

IV. Results.

Dielectric heating due to RF-EMF exposure of biological tissue in all categories. This heating causes internal temperature increases in organisms or cells, which in turn has biological effects such as a thermoregulatory response. This implies that there is always a level of RF-EMF power densitythat will cause biological effects, referred to as thermal effects. Decoupling effects caused by elevated temperatures and the presence of RF-EMFs within biological tissue are major issues in this field of study. Many studies focus on demonstrating (the absence of) non-thermal effects. These are effects that are caused by RF-EMF exposure but are not associated with any changes in temperature. A wide variety of other effects of RF-EMF exposure are studied. However, no effect, apart from dielectric heating, is studied in all categories.

V. Adverse Effects of the 5th Generation Mobile Technology onHuman Health

Telecommunication companies worldwide, with the support of the government, deployed 5th generation technology. It started from China then USA, Europe and other developed countries implemented it. China based Hawaii Company is the leading manufacturer for developing the 5G infrastructure worldwide, however other companies are also working in the deployment of the 5G infrastructure. 5G infrastructures play very big role inboosting the economy of the country preliminary from development that will be smart home, smart city, smart business, smart highway, driverless vehicle, massive IOT devices that are capable to store data in cloud. Every individual on earth can access high speed wireless connection with very low latency, always connected to public internet. Due to its wide range of available application in IOT, cloud based storage and high speed internet access, every country wants to adopt the 5G mobile technology to empower their economy. The main point ignored by entire nations is its adverse effect in the environment. 5G infrastructure uses 6GHz to 100 GHz frequency (Sub-millimeter and Millimeter wave) to transfer data, Millimeter waves cannot travel longer distance and have poor penetration capability for solid. Due to that the carrier needs to install base station every 100 meter. The infrastructure of the 5G networks have massive antenna everywhere, near office, footpath, streetlight, at home, park and every street. 5G antennas are arranged in 'Phrased Array' that work together to emit focused, steerable, laser like beam which tracks each other.

Skin Effects:

5G mobile technologies formed a strong EMF that causes tissue heating and burning in the skin or rashes in the skin. During initial phase of 5G, which was deployed in USA, people noticed that they got rashes on their skin.

Though there was no study carried out that the rashes appeared on the skin due to 5G radiation exposures, but there are many studies reporting that there are adverse effects of 5G radiation on skin tissue and thermal effects notified on human body. Millimeter waves have skin penetration power up to 1.0 mm, when millimeter waves strike on the skin some of its waves reflect back and some are absorb by skin. The Specific absorption rate (SAR) can be measured by the rate at which energy of radio frequency absorbed by the human body, there is strict guideline issued by International Telecom Union to all service provider. The FCC limit for public exposure from cellular telephone is an SAR level of 1.6w/kg, the basic restriction on SAR value prevents excessive tissue heating and minimizes stress. Elementary restrictions for human whole-body exposure in expressions of SAR are 0.4 W/kg in occupational settings and 0.08 W/kgfor general public exposure as describe for 5G network. However skin penetration and absorption of millimeter waves depends on various factors that are different according to gender, skin, body type, hydration level and skin thickness. A naked skin has more exposure as compared to covered skin and sweat also play major role in absorbing radiations.

Skin is made of two layers that are outer epidemics and underlying dermis. Dielectric properties of the human skin need to be considered where the source of radiation is close proximity to the body. Around 40% of the incident power is reflected at the skin surface and remaining 60 % of the power is absorb by epidermis and dermis layer of the skin. Due to this property human skin is able to absorb the electromagnetic radiation that causes various skin related diseases. However the penetration power of millimeter waves is not deep in the human skin because of that it can only create the thermal effect on the human body.

RF-EMF Exposure Effects:

5G mobile technology uses non-ionizing radiation (Millimeter waves) perceiving that it is harmless due to lack of potency, but here potency is notan issue the main problem is their pulses due to dense network. 5G mobile technology uses a phased grid narrow beam antenna that directly points toward user, the main problem is that around in one km of radius about 800 antennas need to be setup that will create a strong concentrated electromagnetic filed. So the radiation emitted by 5G base station will be ten to hundred times greater than 4th generation technology cell station.

The cellular antenna mounted everywhere in 5th generation network, near park, street, home roof will create a huge electromagnetic filed exposure as compared to previous generation network, because a person is near to transmitting antenna is at more exposure of electromagnetic field. There are a lot of researches carried out related to dangerous health effect of EMF exposure to human body. Pulse EMF creates various harmful effects on human being related to irritation, excessive stress, DNA damage, loss of sperm count, loss of memory, even more serious circumstances the excessive exposure of EMF causes cancer as the study carried out by US National Institute of Health (NIH). A person who heavily uses cell phones can prone to brain tumor, even a person who puts cell phone in their shirt pocket are prone to cardiovascular disease. EMF fields are more dangerous for children, now a day children are using electronic gadget excessively, and the strong EMF filed directly damages their memory power, brain competency that lead to neurological disorders. Excessive exposure (who are living close to signal transmitted antenna) of electromagnetic radiation can increase chance to get infected with cancer by 300 %.

Neurological/neuropsychiatric Effects:

The person living near to electromagnetic fields is more prone to develop various health risks, like depression, headache, memory loss, irritation, sleep disturbance, loss of appetite, dizziness, loss of vision and cardiovascular disorder.

Gene Expression:

Gene expression is process by which the information encoded in a gene is used to direct the assembly of a protein molecule. Some of the study suggested that EMF generated above the frequency for 30 GHz can changein gene expression.

Fertility:

As per a study carried out by various researchers, there is high impact on sperm quality due to excessive exposure of EMF radiation. It also affects female fertility rate by changing their ovarian remodeling and oocyte loss. Various studies suggest that total of 50 % fertility rate drop in human being was observed in those persons who were excessively exposure to EMF radiation for many years.

Hormonal Effects:

5G radiation exposure can bring hormonal changes in human body, steroidhormone level can drop and other hormonal levels can increase. Due to change in hormonal condition in the human being various problem encountered like rashes on skin, thyroid, and growth of organ and appetitedisturbance.

VI. Adverse Effects of the 5th Generation Mobile Technology onAnimals and Plants

Vertebrates:

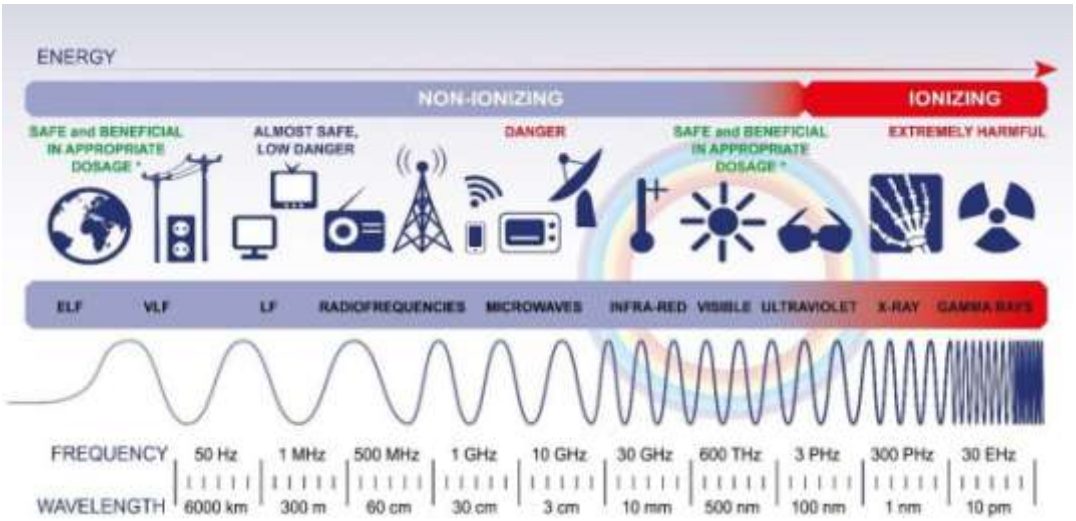
In the lower frequency range, in vitro studies on non-human vertebrate cells showed mixed results on cellular genotoxicity and cellular transformation under RF-EMF exposure. Previous researches on these subjects conclude either that the evidence for such effects is weak or that the result is inconclusive. Regarding non-genotoxic effects of RF-EMF exposure, there are reports claiming that neural activity can be altered in vitro through RF-EMF exposure. Other cellular effects are either not proven or contested, or there are not enough studies to come to any conclusions on such effects. In vivo studies on genotoxicity of RF-EMFs found contradictory results. There is a debate in the literature on whether RF- EMF exposure can induce (transient) changes in the permeability of the blood-brain barrier. It seems that the most recent studies could not show such effects. There are mixed results regarding the in vivo effects of RF- EMF exposure on the neural system. There seems to be a consensus that animals can hear (pulsed) RF-EMFs above a certain threshold, so-called microwave hearing. However, there is little evidence that telecommunication signals can induce this effect. Environmental studies on RF-EMF exposure and vertebrate behavior focus mainly on animal nesting, reproduction, orientation and abundance near RF-EMF sources. There are a limited number of studies that conclude that behavioral and reproductive effects might occur for birds and bats under RF-EMF exposure.

Invertebrates:

RF-EMF exposure of invertebrates in the lower frequency range has been studied by several authors. In addition to dielectric heating, there is a focuson developmental, genetic, or behavioral effects. In vitro studies have shown increased neural activity in invertebrate neurons. In vivo studies on invertebrates are faced with several experimental problems and present inconclusive results on a series of investigated parameters. More research of higher quality, sham-exposed control groups is necessary. As for the limited number of studies that investigated non-insect invertebrates, they all found effects (in vitro and in vivo). This calls for more research on this topic. A very limited number of environmental studies focus on invertebrates and studies on non-insect invertebrates are underrepresentedas well. These topics require more research in the future.

Plants and fungi:

Dielectric heating of plants has been shown in the lower frequency range. This heating might have beneficial effects, but will also induce plant mortality at a certain level. At lower levels of RF-EMF exposure, the research on plants and fungi shows contradictory results and is plagued by experimental shortcomings. The numbers of studies and plants studied, especially for fungi, is limited in comparison to those studies that focus on animals. More research in this area is necessary, and should focus on a higher quality of unexposed control and sham control groups, temperatureand exposure monitoring, and dosimetry.



VII. Higher frequency range (6 to 300 GHz)

Vertebrates:

In the higher frequency range, in vitro studies on both vertebrate and invertebrate neurons have shown effects of RF-EMF exposure on neural activity. In vivo studies on vertebrates have shown that RF-EMF exposure of the eye can induce corneal lesions and cataract. Effects on male fertility have been demonstrated in rodents as well. Mixed results of RF-EMF exposure on behavior and prevalence of vertebrates are found. One research group demonstrated that RF-EMF exposure can have a hypoalgesic effect in mice. These effects should be replicated by other research groups. There is some evidence that high-frequency RF-EMFs can be used to induce an anti-inflammatory response, up to a certain dosage. A limited number of in vivo studies have shown that high frequency RF-EMFscan reduce tumor growth.

Invertebrates:

In the same frequency range, there have been in vitro demonstrations of neurostimulation and in vivo demonstration of developmental and teratogenic effects on invertebrates at relatively high power-densities.

These effects should be investigated further at lower power densities. The literature on invertebrate exposure to RF-EMFs in this frequency range islimited and warrants further investigation.

Plants and fungi:

The literature on fungi and plants in the higher frequency range is very limited and no conclusions besides the existence of dielectric heating can be drawn at this moment. It is necessary to execute further research in this area.

VIII. Comparative Analysis of Adverse Effects of 3G, 4G, and 5GTechnology

3G technology brought the revolutionary era in the development of wireless networking. Multimedia technology to high rate data transmission, various technologies were adopted during this era. There were large number of base stations deployed during this era, for providing better end user connectivity and multimedia services. There is strict ICNIRP guideline for service providers, depending upon the population density in the region. Guidelinesdiffer according to population density of the area and also impose number of safety standards and regulations for the users. These safety standards were necessary because scientists have already discovered the adverse effects of the wireless technology. The similar safety standards and safety guidelines with improvements were also provided by the regulatory body for 4G and 5G network technologies. 5G wireless technology have adverse effects on flora and fauna as discussed in the section 2 and 3. There are short term and long term effects of EMF-RF exposure. The short term effects are aches and pains, headache, decrease in sperm motility, tingling or burning sensation, anxiety, stress and irritability and the long term effects are cancers, brain tumors, fragmented DNA, mutated cells, neurological disorder. 5G radiation effects on children's brains are more as compared to adults because children's brains are in growing stage, whereas adult brain has already developed. Studies show that impact of electromagnetic radiations imposes behavioral disorders and decreases thegrowth rate of brain among children

IX. Conclusion:

5G has brought revolution in the mobile technology of the 21st century. For high speed data transmissions over wireless medium, 5G provides peak data rate of 20Gbps and latency of less than one millisecond. There is huge IoT infrastructure inbuilt in 5G wireless technology and advanced machine learning techniques to support the millions of machines to machine communications among devices. 5G is using millimeter wave technology and dense base stations infrastructure for communication. Various scientist communities have suggested that there may be the adverse effects of millimeter waves on the environment, but there is no strong evidence that suggests the adverse effects of millimeter waves on human health, if the exposure is only for a short duration. But based on the above review study, it is deducible that the higher frequency millimeter waves have adverse effects on humans, animals and plants species, if the exposure is for long term. Most of the experimental studies were conducted on rats, mice or other animals, whose biological structure were different from human beings. Further, the environments considered in the laboratory for the experiments have several factors that were different from real environments, making those results questionable. Effects of RF-EMF long term exposures are more dangerous as compared to those that appear because of short term exposures, because in long term cases the exact cause of the ailments is difficult to find out. There were very few researches whichwere based on the exact real environmental exposures of RF-EMF radiations. Hence a proper experimental setup must be considered to find out the exact impact of 5G radiations on human health, animals and plantslives.

X. Possible Solution

5G uses wireless transmission medium for communication and there is no existing technology that can remove the adverse effects of wireless networks. Hence, it becomes utterly important that every individual must follow some protective measures and all service providers must follow strict guidelines and safety standards while deploying the network. The research suggests some protective measures to avoid those adverse effects, few of them are mentioned below.

- Keep distance as much as possible from cell phones and wireless devices.
- Reduce calls and cell phone usage.
- Avoid cell phone when network is weak and cell phone battery is low.
- Wait to speak and listen before call gets connected.
- Use headphone and toggle method (keep cell phone far from ear).
- Use Low SAR cell phone.
- Minimize cell phone usage.
- Best way to protect your house from radiation is to create highly conductive enclosure around your home, window should be painted withcolors that reduces radiation effects.
- Turn off the Wi-Fi router if it is not in use.
- Keep cell phone out of bedroom at sleeping time. If the smart meter is installed at home, then use smart meter guard protection from radiation.

Another solution is QOC (Quantum Optical Communication). QOC is an alternative way in revolutionary communication era. It uses photons, the quanta of the electromagnetic field as flying qubits, which transports qubitsfrom a physical quantum emitter. The use of photons as flying qubits has weak interaction with environment. It is assumed that through quantum communication adverse effects of radiation will not be perceived by the environment. The United States of America has already adopted the quantum theory and researches are going on in this filed.

XI. Policy options:

Given the results of this research, four policy options were formulated. A first policy option could be to fund research on RF-EMF exposure of plants,fungi and invertebrates at frequencies below 6 GHz and to fund research on non-human vertebrates, plants, fungi and invertebrates at frequencies of between 6 and 300 GHz. These studies could form the basis for evidence- based policies regarding RF-EMF exposure of non-human organisms. A second policy option could be to call for systematic monitoring of environmental RF-EMFs, since these are the main source of exposure for non-human organisms and it is expected that this exposure will change over time. A third policy option could be a request to make information on the RF-EMF operational aspects of the telecommunication networks public.This would again be aimed at quantifying environmental RF-EMF exposureover time. A fourth policy option could be to require compliance studies for organisms other than humans when base station antennas are installed in the telecommunication network. This would prevent the excessive RF-EMF exposure of non-human organisms near such antennas.

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