Application of Geo-information Technology in Nepal "During and Post" COVID -19

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KEYWORDS

COVID-19, Geo-information Technology, Contact Tracing, Public Health, Citizen Science, Geomatics Engineering

ABSTRACT

At present, the world is facing the challenges to combat the pandemic situation due to outbreak of COVID-19. There is a global realization that the effects of COVID-19 will be in long term affecting various sectors of social and economic development. To support this health crisis, along with various non-pharmaceutical interventions (NPI) the application of geo-information technology have proven to be significant for delaying and containing the COVID-19 pandemic. The application of geo-information technology is one of the interventions adopted basically in the monitoring of the COVID-19 cases. This paper attempt to shade a light on the present scenario in the use of geo-information technology in Nepal and has attempted to throw lights on the need of wider application of such technologies to combat Post COVID-19 crisis. Further, the academic program like geomatics engineering currently running at Kathmandu University can be a contributor of technical human resources and can provide academic research output necessary for strengthening the domain of geo-information technology in the settings of Post Pandemic context.

1. THE GLIMPSE AT COVID-19 AND SHIFT TO NEPAL

The outbreak of virus (initially called 'Novel Coronavirus 2019-nCoV' and later renamed to SARS CoV-2) causing severe acute respiratory syndrome (coronavirus disease COVID-19) in December 2019, originally from Wuhan, Hubei Province, China (Boulos and Geraghty 2020) and had hit 188 countries (Johns Hopkins 2020) by 19th May 2020. There have been 4,735,622 confirmed cases of COVID-19 including 316,286 deaths globally as reported by WHO in 19th May 2020 (6:30 pm) (WHO 2020). Currently, the number of infections and deaths is still increasing rapidly. It is declared a public health emergency in international concern and the outbreak was declared as Pandemic by WHO on 11th March when virus spreading quickly in many parts of the world. The speeding up of global urbanization, increased population and interactions between people, and most importantly shortage of medical protection in developing countries have induced the difficulties of the prevention and control of COVID-19. Various Non-pharmaceutical interventions (NPIs) has been applied for preventing the spread of the viruses. The examples of such interventions are "testing and tracing, bans on large gatherings, non-essential business and school

and university closures, international and domestic mobility restrictions and physical isolation, and total lockdowns of regions and countries" (Oliver, Lepri et al. 2020)

Considering the serious threats that COVID-19 has brought in human health there is a serious threats in social and economic development as well. The threats in the sectors like food production, food security, social life functioning, tourism, business, education and many more are of serious concern around the globe.

In fact, this pandemic situation has already kept the questions on the achievement of The United Nations Sustainable Development Goals (SDGs) aiming to address social, economic, and environmental issues from 2015 to 2030. The United Nations SDGs contains 17 goals and 169 targets (Sachs 2012). Among all goals, SDG 3 that aims to ensure healthy lives and promote well-being for all at all ages seems to be difficult to achieve. In addition, the post pandemic situation is going to affect goal 1 that aims to ends poverty in all its forms everywhere and also goal 2 which is about ending hunger and achieving food security.

The outbreak shifted from China to Europe. As per the article published in BBC News, the worst hit European countries are UK, Italy, Spain, France, Belgium, and Germany (BBC 2020). Besides various countries, Nepal has also been counted into the effected countries list in the WHO Dash board. In Nepal, the first COVID-19 case was confirmed on 24th January 2020 when the student of age 31, returned to Kathmandu from Wuhan, tested positive whereas the first death occurred (29th year woman) on 14th May 2020.

2. THE GEO-INFORMATION TECHNOLOGY IN COMBATING COVID

The characteristic of COVID-19 is a long incubation period, strong infectivity and difficulty in detection, which have led to the sudden outbreak and the rapid development of an epidemic (Zhou, Su et al. 2020). This led to the need of Geo-information technology such as GIS, Remote Sensing, UAVs, Mobile/ Web GIS etc. in order to prevent the spread of the epidemic. The rapid responses and analysis of spatial information and fast supply of the spatial information related to the epidemic dynamics is needed to the decision makers supporting them to make a quick decision for preventing and controlling this pandemic.

2.1 GIS based Platform to combat COVID-19 in International Context

After the COVID-19 outbreak, already various initiatives in geographical tracking and mapping of coronavirus disease has been taken in the international context. The use of geo-information technology has been applied for the purposes like real time data collection and dissemination of the COVID-19 confirmed, infected and death cases, contact tracing, surveillance during lock down, aid pledged, received and distributed Some of the examples of aforementioned applications are "Johns Hopkins University Center for Systems", "The World Health Organization dashboard", "HealthMap for analyzing and mapping online informal sources'', "close contact detector", "geosocial app and public service platform", "World Pop and EpiRisk predictive global risk analytics" and "maps for SARS-CoV-2 based on population movements out of Wuhan and travel destinations" (Boulos and Geraghty 2020). John Hopkins COVID-19 dashboard does automatic near-real time tracking and geo-visualization of global confirmed, death and recovered cases. It is by far the most visited site with over a billion hits a day.

The China-GI and Location Based Services (LBS) has been found to be used to combat COVID-19 Pandemic. The activities carried out by this application are "reporting the travel activities in the past two weeks, sharing information amongst command and emergency response agencies, disease control departments, highly precise location information of Beidou-Global Navigation Satellite System (GNSS) of China for Wuhan Vulcan Mountain Hospital construction, dynamic web maps via web portals and mobile applications and GI to deploy resources and provide emergency support" (Washaya and Li 2020).

The combination of geospatial technologies-GIS, Artificial Intelligence, Internet of Things and Big data is applied in tracking movement of the people and alerting officials when a quarantined person steps out of the quarantine zone (Zhou, Su et al. 2020).

The application of Unmanned Aerial Vehicles UAVs (Drones), is found to be applied in transporting medical supplies, spraying disinfectant, publicize information, surveillance and patrol, counting people in a specific location using real-time image recognition of images captured using drones(Washaya and Li 2020). In China, (UAV) are transporting crucial medical supplies and patient lab samples. In highly impacted areas, drones reduce human contact with lab samples and free up ground transport assets and personnel (Huber, 2020). Drones are also being used for broad disinfectant operations in China (Brickwood, 2020).

Mobile application-non-pharmaceutical interventions has been applied for self-assessment of possible infection of corona virus. The assessment result provided by the system mainly depends upon the decision rule deployed in the system. Similarly, the individual mobility, contact (close proximity) data including their geographic locations and social network which can be collected through mobile apps has supported in identifying infected persons (Oliver, Lepri et al. 2020). In short, the application of mobile geo-information technology has been applied in the various stages of the pandemic lifecycle to obtain data on human behavior, especially mobility and physical co-presence.

2.2 The Geo-information Technology in combating COVID in Nepal

Government of Nepal has initiated the use of various IT based technology for COVID-19 confirmed, infected and death cases, contact tracing, surveillance during lockdown. Besides there are some initiatives of real time mapping of COVID-19 confirmed, infected and death cases, location maps of essential services like hospitals for COVID test. However, the volunteer apps are not in the formal framework. In this paper, the initiatives from formal platform has been highlighted.

2.2.1 Web Portal

a. Ministry of Health and Population (MoHP)

The Ministry of Health and Population (MoHP) has developed a web portal to deploy demographic information on COVID-19 at National level. Basically, the portal tracks the number of suspected people who are tested through PCR and RDT, confirmed cases, number of people at isolation, quarantine, cured and dead throughout the country. The portal also has given the information of the testing labs, hospitals, isolation and quarantine centers. These spatial details are disseminated using web maps. Further, there is a provision of filling up self-assessment form of the symptoms of COVID-19 to determine the health status as per the information filled-up. In fact, the location information collected of the

individuals from the filled-up form will help in minimizing the risk of corona infection by easiness in contact tracing. In short, the spatial information related COVID cases on number of infected, cured, people in isolation, and death as well as data on vulnerable population helped to keep the public and health workers well-informed in real time (MOHP 2020).

b. Ministry of Home Affairs (MOHA)

National Disaster Risk Reduction and Management Authority (NDRRMA) under MOHA developed a dashboard named Nepal COVID-19 Dashboard disseminating demographics of COVID-19 isolated, active, recovered, death cases, total swab tested, quarantined number and resources available to combat the pandemic such as number of hospital beds, isolation beds, Personal protective equipment (PPE) etc. at district and provincial level. Additionally, this dashboard provides self-assessment form comprising questionnaire on travel history and test for symptoms. This portal disseminates aforementioned information on dual languages—Nepali and English. Even though this portal provides information on the number of returnees by country, the returnee number are less frequently updated with last update on 14th April, 2020 (information accessed date: 19th June, 2020). Additional feature unique to this portal is downloadable daily situation report. The information in the daily situation report is limited to provincial level and summary of COVID-19 cases and the available resources to combat the pandemic (MOHA 2020).

2.2.2 Mobile Application

a. MOHA Mobile APP

MOHA has developed a mobile based application named "Hamro Swasthya". It is an interactive application and it provides the same information as MOHA web portal. It is developed by MOHA with collaboration with many other concerned authorities. There is a provision of self-assessment of symptoms for the COVID by filling up the questionnaire in Nepali language (MOHP 2020).

b. COVID NP APP

COVID NP which is also a mobile based application, developed by Government of Nepal, for contact tracing, official information dissemination, self-test, counseling and certification on covid-19 at provincial level. Further, this app has facilities for applying electronic pass for the mobility within the same districts and also between the districts, reporting the suspect cases of COVID and also security issues (Nepal Government 2020).

c. Kathmandu Municipality: Nepal Covid-19 Surveillance System

Nepal COVID-19 Surveillance System is a collaborative effort of Nepal Research and Education Network (NREN), Center for Information and Communication Technology (ICT4D), Innovative Solution Pvt. Ltd. (Insol), I. Click Pvt. Ltd. (iClick), Public Health Concern Trust-Nepal (PHECT-Nepal), Nepal Disaster and Emergency Medicine Center (NADEM) and Innovative Data Solution Pvt. Ltd. (IDS). The system has been designed to detect the spread of diseases in the community level such that it will help government, local government and communities to fight against corona outbreak in the community level.

This system facilitates self-assessment to obtain general information about how likely the person is suspected for the infection. If the person is suspected for the infection, the system automatically suggests the person to remain in the quarantine for the next fourteen days and also ask for regular updating of their health until the person is in self-quarantine. The system also connected with the health service

providers such that the doctors/health worker can monitor the health status of the people under self-quarantine. The spatial information in province level regarding PCR Test, infected, recovered and death from COVID-19 seems to be helpful for the decision makers of disaster management team for strategic planning for addressing the critical issue related to COVID on the real time setting.

d . Other Mobile App:

COVID-19 Response App-Nepal developed by Nepal Army (Nepali Army 2020) in which one can report symptomatic persons in their neighborhood.

COVID-19 Quarantine App has found to develop under the framework of smart palika. The App has been developed specifically for contact tracing. Smartpalika—an IT company— developed this free app for implementation in all of the 573 local levels for live tracing, quarantine management, self-assessment, isolation and quarantine details apart from contact tracing (Smart Palika 2020).

3. LESSON LEARNED

Whilst screening the current use and development of geo-spatial technologies in the context of Nepal, following observations can be derived.

3.1 Repeated development of similar kind of application

In the current situation of COVID 19 pandemic, development and use of geo-information in Nepal is found to follow the similar footsteps as in the rest of the world. In particular, most of the works are concentrated in developing interactive dashboard to inform about the case loads. Many organizations, agencies are setting up interactive dashboard to inform about the current case load, confirmed new cases in near real-time.

3.2 Location Based Contact Tracing application:

Similarly, the government has announced that it will put contact tracing application in place to trace all the people who have come in contact with the confirmed cases. While these endeavors indeed deserve applauding, however, this does not mean that the application will produce similar effectiveness in every social, cultural and political context, until and unless careful considerations are given to its effectiveness and implementation. A review of contract tracing approach used during Ebola epidemic in Liberia, suggested various factors influencing the effectiveness of contract tracing implementation (Senga, Koi et al. 2017). Similar challenges might also be relevant in COVID-19 pandemic in the case on Nepal. Lack of integrated surveillance and proper data management system for reporting between the national laboratory, healthcare facilities, quarantine facilities, contact tracing and case investigation field teams might result into its less effectiveness in slowing the epidemic due to missed source cases and contacts. Therefore, strengthening integrated surveillance and electronic data systems, and the early adoption of the applications by wider citizens may improve timely reporting for listing and monitoring contacts. The organizational structure for contract tracing might lead to inefficiencies in its implementation and management. While self-assessment based mobile application seems relevant, challenges with adapting and implementing contact tracing protocols might arise. Similarly, community perceptions, stigma, and mistrust might lead to challenge in obtaining complete and reliable information, to delays or an inability to trace contacts due to evasion, and even to violence (Senga, Koi et al. 2017).

3.3 Wide scope of GIS application is needed

Few ad hoc applications of drones can also be seen in Nepal for activities such as monitoring the lock down situation, or supplying medicines etc. But wider application of geo-spatial technologies by various disciplines and sectors is yet to be seen. For example, GIS provides useful tools to help health organizations to anticipate vulnerabilities and thereby channel control measures such as ramping up hygiene and social distancing. Epidemiologists can use GIS modelling to forecast and visualize the changing rates of disease and its spread across space and time. Apps and maps can be used to provide various information on such as hospitals with available beds, clinics offering medical aid along with current wait times, grocery stores and pharmacies that are open, places to purchase personal protective equipment, and more. Volunteers and residents can use such applications to locate crucial aid and resources. With proper communication between hospitals and authorities, GIS tools can be developed to monitor the capacities of hospitals and compare it against increasing infection rates, allowing real-time rearrangement of resources to boost capacity where response is needed most. Likewise, GIS can also be used to identify underutilized facilities that can serve as makeshift hospitals and match them with concentrations of vulnerable populations and transit accessibility to increase capacity if needed. Another possible application of GIS can be seen in developing digital supply chain maps to support planning and ensuring geographical diversity in suppliers as well as aligning needs with distribution in order to tackle shortage of supplies at various places.

4. CONCLUSION: APPLICATION OF GEO-INFORMATION TECHNOLOGY IN WIDER SPECTRUM (POST-COVID)

The present context reveals that the application of the Geo-information technology in the fight of COVID-19 is concentrated in disseminating information about the case load, finding clusters of hotspots. However, such technology is yet to be adopted in the wider context. Moreover, there is a need to think about the potential of such technologies in post COVID-19 phase and for future pandemic.

There is now sufficient evidence to affirm that COVID-19 is not only affecting human health through direct pathways, i.e. disease spread and mortality. But it is also affecting health of the people by affecting other sectors on which overall health and well-being of people is dependent upon. For example, COVID-19 has affected on agriculture and the food supply chain, mainly affecting food demand and consequently food security, with a great impact on the most vulnerable population. Similarly, this pandemic has made it visible that health of the population is not the responsibility of health sector alone. Collaboration with other sectors are equally important to combat such pandemic and moreover, to improve health of the general population. For instance, public health interventions of hygiene and social distancing are being emphasized in this pandemic, nonetheless, these measures are futile in informal settlements that are characterized by problems of crowding and limited access to basic infrastructure.

Advancing, "Health in All Policies" (HiAP) with integration of Geo-spatial technology can be seen as a way forward to better prepare for future pandemics in an equitable manner. HiAP suggests to integrate health within the mind-set and the general policy imperative of other sectors (WHO 2014). It is a collaborative approach to improving the health of all people by incorporating health considerations into decision making across sectors and policy areas.

This transformative, collaborative approach to improve population health incorporates considerations like health, equity, and resilience into decision making across government agencies and policy areas. At its core, HiAP is about practicing a whole-of-government approach to address challenges that no one level of government, agency, and department can fix on its own as in the case of COVID-19. In this approach, integration of geo-technology can act as useful tool to provide evidence base on health-related impacts of other sectors. For example, such technology can be used to map the physical conditions in informal settlement (Shrestha, Tuladhar et al. 2016) such as crowding, lack of infrastructure and asses the possible consequences of disease spread (Gibson and Rush 2020).

Likewise, by leveraging geo-information technology in citizen science approaches and big data analytics, large amounts of data can be turned into actionable information to authorities for planning public health activities and implementation of the approach “Health in All Policies.

Finally, the academic program like Geomatics Engineering [*see in detail:* (Shrestha and Bhatta 2019)] can be integrated in the health, agriculture related sectors to produce interdisciplinary studies.

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