काठमाडौं महानगरपालिका

Kathmandu Metropolitan City

Mayor's Research Fellowship Program

MRF Research 2020/21

CITY PLANNING COMMISSION

January 2022

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Message from the Mayor

काठमाडौं महानगरपालिका
नगर कार्यपालिकाको कार्यालय
बागमती प्रदेश, काठमाडौं, नेपाल

The Mayor's Research Fellowship (MRF) Program is our effort to promote and embed research-based policymaking approach in our planning process. Such research-based policymaking effort is probably the first of its kind being adopted by the local government in Nepal. We are quite overwhelmed by the participation of the young scholars and their outputs in the first MRF Program 2020/21. I am pleased to include some of the recommendations made by the studies conducted under the MRF Program in our annual policy this year.

The objective of the MRF program is also to engage youth in the development process by encouraging them in identifying the social, environmental, physical and institutional issues and their causes through a rigorous methodological process and coming up with the potential solutions to overcome them. We tend to view the issues from one dimension and build our opinion based on the rumours or hearsay without making much efforts to substantiate them. The MRF Program aims to let the researchers do research in the topic of urban interest and explore evidence on the pre-conceived opinion. This process also allows researchers to review our policies, plans and programs and see their effectiveness at the local level. Direct interactions with the local people, community and the concerned stakeholders provide opportunity for the researchers in seeking their opinion about KMC and in return help us refine our policies and the programs.

Lastly, I would like to congratulate and thank all the research fellows, supervisors and CPC team for making this program a success.

Bidya Sunder Shakya
Mayor
Kathmandu Metropolitan City

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Preface

काठमाडौं महानगरपालिका
शहरी योजना आयोग
बागमती प्रदेश, नेपाल

Evidence-based policymaking (EBP) aims at linking research into various stages of planning and implementation which includes formulation of policy, identification of activities and exploration of modalities for the execution of various plans and programs. Rather than an isolated activity, EBP is generally desired to be integrated with the project cycle. It should, in fact, be the integral activity of the City Planning Department of the cities and should work the way quality assurance unit of any business organization does. Census, for example, is the most widely adopted and comprehensive mechanism for gathering socio-economic information of the people that opens up avenues for different sectoral agencies to analyze, interpret and understand the national situation. At the city level, many municipalities gather GIS-based information to access land use, infrastructure and level of services. Both Census and Municipal information are intended to gather evidence that could help policy makers to formulate policies, plans and programs. Preparation of well-structured questionnaire and employment of trained human resources for the collection and analysis of information will be conducive in acquiring valid evidence that eventually helps in identifying the needs of the community, policy gaps and the subsequent plans to fulfill them. As the plans get implemented, it is desirable to know their effectiveness in terms of service delivery, timely execution, accessibility to the target groups, cost appropriateness and the level of governance while delivering the service. For this, the organization may have to carry out extensive research that help explore the degree of effectiveness and allow decision makers to make necessary improvements in the plans.

Such practice of continued research ought to be done on a regular basis by any dynamic organization. In recent times with the advancement of technology, the EBP is being automated through real time analytical tools - mostly by social media, banking, financial organizations and countless other institutions including the city governments. This

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Preface

automated system provides even faster delivery of results and allows city managers to respond quickly. Information like land use changes, building construction, vital registration, traffic conditions, security situation etc. are tracked on real time basis and practiced by many cities in the world. KMC, though being the capital city, still continues to keep information manually which often calls for arduous engagement of staffs in getting the desired output. Moreover, the accuracy of these outputs has always been suspicious.

However, the issues that relate to social and human behavior or climate change require several contextual research works. Research fellowship programs could be one of such tools which help city governments to identify the problem - their causes and potential policies - to alleviate the problems. Such programs would not only encourage young researchers to partner with local government in city development endeavors but also helps develop the culture of evidence-based policy making.

We, the City Planning Commission, are immensely encouraged by the first Mayor Research Fellowship Program. This publication is an output of the nine research projects that took place during the period. I hope that this publication will be useful to researchers, students and policy makers at the government level. We are now launching the second series of MRFP with the aim of conducting studies on topics relevant to KMC. In this regard, I would like to thank the Mayor Bidya Sunder Shakya for owning the concept and extending full support. I would also like to extend my huge appreciation to Dr. Kirti Kusum Joshi, Member, CPC, for coming up with this idea of evidence-based policymaking and taking entire responsibility in managing the program. I am also indebted to the members and assistant experts of CPC for their relentless support to this endeavor.

Saroj Basnet
Vice Chairman
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About the Research Fellows

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Table of Content

Overview

Mayor's Research Fellowship Program: An Initiative of Kathmandu Metropolitan City for Evidence-based Policymaking

Jayshree Rajbhandary, Kirti Kusum Joshi

City Planning Commission, Kathmandu Metropolitan City

1. Background

With the promulgation of the new Constitution of Nepal in 2015, Nepal became the youngest federal country in the world. The federal structure of the country is based on a system of three-tiered governments that function at federal, provincial, and local levels. Among the three tiers of government, local governments, by nature, enjoy the closest relationship with people. For two decades before the promulgation of the 2015 Constitution, local governments (then termed as 'local bodies') functioned without elected representatives. But now, the Constitution has provided new hopes and opportunities for the local governments to serve people through the exercise of powers bestowed upon them through Schedule 8 (exclusive power of local governments) and Schedule 9 (concurrent power of all three tiers of government).

There are, however, multitude of challenges in front of local governments. The multi-level system of governance as envisaged by the 2015 Constitution (Article 232) relies on the principles of cooperation, coordination and co-existence among these three tiers of government (Government of Nepal, 2015), which is easier said than done. People expect local governments to act on all matters of public concern although not all such matters fall under the jurisdiction of local governments. As the federal capital city of the country where people from across the country come, live, and work, Kathmandu Metropolitan City (KMC) faces the biggest challenge among all 753 local governments in Nepal to deliver quality services to the people including floating population although KMC has the same constitutional powers as any other local governments.

KMC is committed to make the best use of available constitutional powers while formulating plans, policies and programs within the scope of its jurisdiction. The Mayor's Research Fellowship (MRF) Program, coordinated by the City Planning Commission (CPC) of KMC, is an attempt to promote and institutionalize evidence-based policymaking in KMC's planning approach such that its plans, policies and programs do not get guided by biased opinions but are supported by best available evidence and are results-oriented.

2. What is Evidence-Based Policymaking?

Evidence-based policymaking (EBP) is defined as a rational, rigorous, and systematic approach that puts "the best available evidence from research at the heart of policy development and implementation" (Davies, 1999) so that well-informed decisions could be made about policies, programs, and projects. EBP emphasizes on informing the policy process, rather than aiming to directly affect the eventual policy goals. EBP stands in contrast to opinion-based policy, which "relies heavily on either the selective use of evidence (e.g. on single studies irrespective of quality) or on the untested views of individuals or groups, often inspired by ideological standpoints, prejudices, or speculative conjecture" (Davies, 2004). EBP offers "a more rigorous approach that gathers, critically appraises and uses high quality research evidence to inform policy making and professional practice" (Gray, 1997).

Despite promises, EBP is not without challenges. Sutcliffe and Court (2005) highlight the following three issues surrounding the use of EBP:

(1) What evidence used in the policymaking process: Policy needs to be informed by a wide breadth of evidence. The quality, credibility, relevance, and the cost of the policy matter.

(2) How evidence is incorporated into policymaking: Policy processes involve different stages (e.g., from agenda-setting to formulation to implementation), and thus different evidences and mechanisms may be required at each of the policy stages.

(3) Evidence is not the only factor which influences policymaking: Policymaking is an inherently political process. At each stage of the policy cycle, a number of different factors other than evidence will affect policy, and this occurs both at an individual level (e.g., a policymaker's own experience, expertise, and judgement) and at an institutional level (e.g., in terms of institutional capacity). Moreover, a number of constraints may limit the extent to which evidence can affect policy (e.g., urgency to process information quickly).

Despite these challenges to creating an EBP approach, studies show that an evidence-based approach to policy and practice results into better outcomes (Sutcliffe and Court, 2005). Accordingly, KMC has also seriously considered recommendations highlighted in the research by the MRF research fellows and has used some of the recommendations to inform KMC policies for the fiscal year 2021/22 as described in the next section.

3. The MRF Program 2021/22: Process, Research Synopsis, and Policy Information

3.1 Process

The eligibility of candidates, evaluation criteria, and other administrative details are described in the Mayor's Research Fellowship Program Directives. Accordingly, the MRF program is open to Nepali researchers who have at least two years' experience in the relevant fields after their Master's degree. The research period is six months. Proposals are

invited through a public call. Proposals are accepted in any topic of relevance to KMC. Priority areas of research are mentioned in the public notice. Topics related to the Kathmandu Valley region can also be proposed provided that the role of KMC is clearly defined.

The first cohort of the MRF Program 2020/21 included nine research fellows selected on the basis of their research proposal, academic background, relevant experience, and interview. A formal contract with the research fellows was signed in October 2020 in the presence of KMC Mayor Bidya Sunder Shakya.

Interview round (left), contract signing ceremony (right)

The research topics included:

(1) Impact of Pedestrianization on Local Economy and Livability: A Case of Thamel

(2) Analysis of Air Quality and Air Pollution Dispersion Mechanism in the Kathmandu Valley

(3) Mapping of Blue Infrastructure of Kathmandu Metropolitan City

(4) Assessment of Biomass and Carbon Stock Potential of Avenue Plantation around the Ring Road of Kathmandu Valley for Mitigating the Impacts of Global Climate Change

(5) Non-Communicable Disease Risk Factors Survey and Policy Research for Suggesting Healthy Behavior in Schools in Kathmandu Metropolitan City

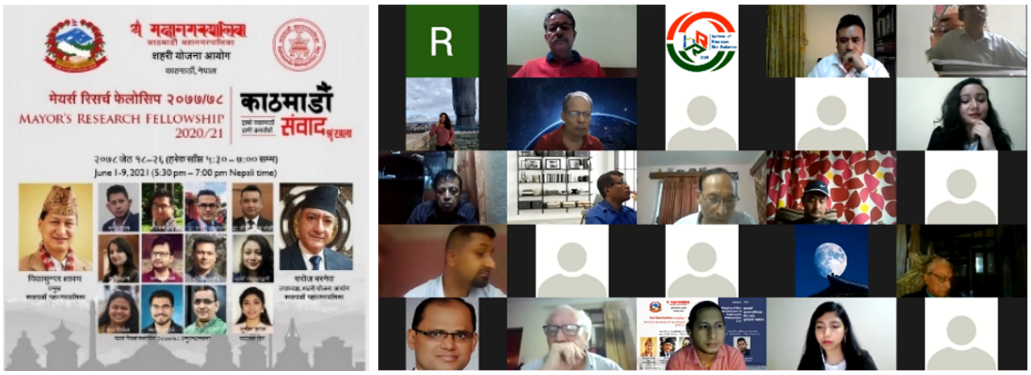
(6) The Urgency of STEAM Education for Driving KMC as an Innovation Hub

(7) Laws, Policies and Evidence on Quality of Life of Senior Citizens of Kathmandu Metropolitan City

(8) A Qualitative Examination of the Experiences of Female Principals in Community Schools of Kathmandu

(9) Role and Effectiveness of Communication System on the Urban Development Management in Kathmandu Metropolitan City from Plan Formulation to Implementation.

The research fellows refined their research proposal based on the feedback from the CPC officials and external research supervisors assigned to them. Several rounds of presentations, including online presentations due to COVID-19 risks, were organized to monitor the research progress and help the researchers if they were facing any obstacles in their endeavors.



Promo material for final dissemination of research findings (left), online presentation (right)

The research fellows made final presentation of their research findings along with policy recommendations through a public discussion series titled 'Kathmandu Sambad' organized virtually by CPC from June 1 to 9, 2021 with the number of participants ranging from 132 to 183 per episode. The research fellows also submitted final reports of their research, the summarized version of which is presented in this book.

3.2 Research Synopsis

Under the MRF Program 2020/21, nine research fellows conducted studies in different topics as mentioned above. The research synopsis is as follows:

(1) Impact of Pedestrianization on Local Economy and Livability: A Case of Thamel. Using a mixed quantitative and qualitative method including perception survey, key informant analysis and on-site observations, this study investigates the impact of pedestrianization of the streets of Thamel on its local economy and changes in livability of its residents. The survey results show that the pedestrianization project of Thamel had a positive impact on the livability of its residents and economy when it started. But over time, despite the pleasing environment of the pedestrianized street, the local economy did not improve as expected because of the traffic in the adjoining streets. To facilitate better mobility and habitation in the study area, the study recommends phase-wise development of Pedestrian Priority Zone with slow easing into a larger pedestrianized area with restriction on time for vehicles, improvement in drop off zones and parking management, pass system for local residents, and regular awareness campaigns for the promotion of pedestrian mobility as a sustainable mode of transport.

(2) Analysis of Air Quality and Air Pollution Dispersion Mechanism in the Kathmandu Valley. Analysis of air quality data such as PM 10 and PM 2.5 shows that the concentration of coarse particles reaches above 100 $\mu g/m^3$, whereas fine particle

concentration reaches up to 80 μg/m^3. Concentration of particulate matter is found to be very low in the summer due to the washout effect of frequent rainfall in the monsoon period. Numerical simulation shows the diurnal variation of mountain breeze (from midnight to the early morning) and valley breeze (9 AM to 9 PM) during the study period. Puff dispersion model reveals that the local wind flow significantly affects the pollution transport and dispersion in the Valley. The puffs generated mostly in the northern part of the KMC get dispersed throughout the Valley – mostly around the northern uphill. Similarly, emissions generated from the central part of the Valley (i.e. southern part of KMC) get dispersed throughout the Valley.

(3) Mapping of Blue Infrastructure of Kathmandu Metropolitan City. This study explores, assesses and maps hitis and ponds in the KMC based on the available literature. The study documents 99 hitis and 14 ponds. A total of 57 hitis and 17 ponds are found to be either missing or unable to be located. About 64.65% of the existing hitis are found to be either dry or non-operational. The study concludes that an increased understanding of the hitis and ponds will not only contribute towards realization of the historical and cultural importance but will also support urban ecosystem and integrated water resource management practices in the long run.

(4) Assessment of Biomass and Carbon Stock Potential of Avenue Plantation around the Ring Road of Kathmandu Valley for Mitigating the Impacts of Global Climate Change. This study assesses biomass and carbon stock potential of the avenue plantation around the Ring Road area of Kathmandu Valley considering a total of 9 different species of seedlings, 19 species of saplings, and 25 different species of trees in 40 sample plots. The total baseline tCO2e stock in the avenue plantation in Ring Road is found to be 28,573.60 tCO2e. The net emission due to the vehicle movements in the Ring Road is found to be 42,574.40 tCO2e, which means there is a deficit of carbon dioxide in terms of stock in the avenue plantations by 14,000.80 tCO2e. This implies that the existing plantation in the Ring Road area is unable to sequester/offset carbon dioxide that is emitted through the transport sector. Thus, open spaces like riverbanks and public lands should be considered for developing urban forests.

(5) Non-Communicable Disease Risk Factors Survey and Policy Research for Suggesting Healthy Behavior in Schools in Kathmandu Metropolitan City. This study is based on a survey of 415 students of four higher secondary schools in KMC along with four focus group discussions with students, and seven in-depth interviews with different stakeholders. The study finds that the proportion of current alcohol and tobacco users stands at 8% and 7.2% respectively. Nearly three out of five students do not consume fruits and vegetables as per the WHO recommendation. Only one in three students are physically active. Overall, the prevalence of symptoms of depression, anxiety, insomnia, and internet addiction is found to be 41%, 62.7%, 47.5% and 48.2% respectively. The study suggests strict regulation of tobacco and alcohol controls, regulation of the price of fruits and vegetables, restriction on the use of junk foods, establishment of parks for promoting physical activities, creation of a support mechanism at the family, school, and community level, increasing the availability of mental health services as well as reducing screen time of teenagers and young adults.

(6) The Urgency of STEAM Education for Driving KMC as an Innovation Hub. This research focuses on the readiness of KMC to implement STEAM (Science, Technology,

Education, Art and Mathematics)-based education. The study focuses on the five key stakeholders: schools, teachers, parents, students and STEAM service providers. The survey results show that most schools and teachers acknowledge the importance of STEAM-based education, but they lack the confidence to implement it. Most of the parents do not fully understand the concept of STEAM-based education. Most of the STEAM providers find it relatively harder to manage the necessary equipment for STEAM-based education. Most of the students have shown enthusiasm towards STEAM-based education. The results show that although KMC is taking steps to implement it, KMC needs more preparations to fully implement it. Strong policies to increase participation and maintain quality and standards are needed to implement a STEAM-based education system successfully.

(7) Laws, Policies and Evidence on Quality of Life of Senior Citizens of Kathmandu Metropolitan City. Based on the study of 206 samples collected from Ward no. 9 and 12 of KMC, this study finds that the quality of life of most of the senior citizens is generally good. Around 14-18% of the sample participants are found to have poor quality of life in physical health, psychological, social relationship and environmental domains. Moreover, gender, age, education status and health status are found to be the predictors of quality of life. Significant positive correlations are found between and with all four domains of quality of life, overall quality of life, and health satisfaction. Although the policy of KMC is commendable in prioritizing the formulation of the plans, policies and programs concerning senior citizens, some policy gaps exist. The study recommends KMC to focus on the qualitative aspect following a 'wellbeing approach' while also enhancing the capacity and competency of geriatric health care professionals.

(8) A Qualitative Examination of the Experiences of Female Principals in Community Schools of Kathmandu. Out of 92 community schools in KMC, only 25 (or 27%) have female principals. This study employs qualitative and quantitative methods to better understand the experiences of female school principals in the community schools of KMC. Based on the interviews with 24 female principals, the study identifies three major interrelated factors that hinder women leadership: personal, socio-cultural and political. The study recommends capacity building for female school leaders (including mentoring and coaching programs), developing performance indicators, outreach programs for family members, better incentives for school leaders, and nondiscriminatory implementation of policies.

(9) Role and Effectiveness of Communication System on the Urban Development Management in Kathmandu Metropolitan City from Plan Formulation to Implementation. This research evaluates the role of mass media in the development planning of KMC and the effectiveness of the public communication process among the officials, people's representatives, employees, and ward residents of KMC. A total of 300 residents of different wards of KMC participated in the survey for this study. The study has also reviewed the role of mass media in the reconstruction process of Ranipokhari and Kashthamandap. The study findings show that the role of mass media in urban development management of KMC is generally positive; however, KMC needs to be more supportive in terms of providing information to the media. The study suggests formulation of a mass media policy for KMC in consultation with communication experts and initiation of public dialouges for ensuring timely dissemination of information that would also support accountability, good governance, and transparency.

3.3 Contribution to Policymaking

KMC has duly considered research findings and recommendations while formulating its Annual Plan and Program for the Fiscal Year 2021/22. In particular, the MRF Program 2020/21 has helped inform or validate the following policy decisions made by KMC in its Annual Plan and Program for the Fiscal Year 2021/22 (काठमाडौं महानगरपालिका, २०७७):

- **Policy No. 44.** Provide an additional monthly pay worth Rs. 1000 to the principals of community schools for motivation.
- **Policy No. 48.** Continue establishment of STEAM clubs in all community schools along with different activities to promote STEAM education.
- **Policy No. 60.** Establish a specialized 100-bed hospital for the treatment of senior citizens.
- **Policy No. 63.** Provide regular medical examination services to senior citizens, including distant consultation services along with free medicines for high blood pressure and diabetes and free vaccination against pneumonia, influenza, and other communicable diseases under Manmohan Adhikari Senior Citizen Free Vaccination Program.
- **Policy No. 65.** Conduct programs to raise public awareness on non-communicable diseases.
- **Policy No. 68.** Conduct programs to raise public awareness on the adverse effects of alcohol and tobacco use on human health.
- **Policy No. 69.** Promote yoga and naturopathy and provide psychological counselling for the promotion of physical and mental health.
- **Policy No. 80.** Engage senior citizens in the implementation of community-based programs through Silver Volunteer program.
- **Policy No. 137.** Develop pedestrianization in Thamel and Basantapur area for the promotion of domestic tourism.
- **Policy No. 139.** Implement rainwater harvesting and groundwater recharge program in at least one public place in every ward.
- **Policy No. 172.** Establish a modern vehicle cleaning center at the Kathmandu Valley entry points for the control of dust pollution from vehicles.
- **Policy No. 173.** Gradually remove construction material depos located inside Ring Road.
- **Policy No. 177.** Promote urban greenery by planting ornamental plants, fruit trees, herb plants and trees with high biomass and carbon stock potentials along the sides of main roads and rivers, and on public lands, river plains, and public institutional open spaces.
- **Policy No. 185.** Make service delivery more transparent and managed through the increased use of ICT tools.

- **Policy No. 192.** Conduct Kathmandu Samvad program for intense discussions on issues related to KMC.
- **Policy No. 195.** Increase accessibility of media outlets to news on KMC's activities.

Not all recommendations could be accommodated in a single year's plan. The research findings will continue to inform future plans and programs.

4. Conclusion

Through the MRF Program, KMC is taking an initiative to promote and institutionalize evidence-based policymaking in its planning approach such that its plans, policies, and programs are supported by best available evidence. The MRF program also serves as a platform for Nepali researchers to tackle real-world urban problems and to understand the role and challenges of a local government in Nepal.

It is important to note that evidence-based policymaking alone is not enough to ensure achievement of desired results – what matters more if how policies are implemented. But even in that case, review of policies and investigation of policy implementation barriers could be and should be a subject of interest to policymakers.

Although "various constraints (time, capacity, cost) will affect the mechanisms available for mobilizing evidence for policy" (Sutcliffe and Court, 2006), particularly in a developing country like Nepal, KMC's initiative is expected to encourage other local governments to invest or collaborate in policy research. As for KMC, the experience of inaugural MRF Program will be instrumental in improving the quality and effectiveness of similar future programs.

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Impact of Pedestrianization on Local Economy and Livability: A Case of Thamel

Kriti Pradhan

Abstract

The historic towns of Kathmandu Valley have traditionally been planned as compact settlements with streets that serve pedestrian mobility. Pedestrian movement is a sustainable mode of transport owing to its environmental benefits in reducing vehicular emissions, economic benefits in improved business and social benefits in terms of interaction and promotion of equality and social justice. However, rapid urbanization of Kathmandu Valley has led to the replacement of traveling on foot by private vehicles resulting in degradation of air quality, cleanliness, road safety, and levels of social interaction. One feasible solution to upgrade mobility and create a better environment in Kathmandu Valley is pedestrianization. Pedestrianization means to convert a street into an area for the use of pedestrians only, by excluding all motor vehicles except emergency vehicles like ambulances, police, fire fighting trucks, etc. Three street segments of Thamel, Kathmandu were pedestrianised in 2017. However, whenever a street is about to get pedestrianised, there is often a huge opposition from businesses on those streets. Using a mixed quantitative and qualitative method including perception survey, key informant analysis and on site observations, this research investigates the impact of pedestrianization of the streets of Thamel on its local economy and changes in livability of its residents**.** The survey results show that the pedestrianization project of Thamel had a positive impact on the livability of its residents and economy when it started. But over time, despite the pleasing environment of the pedestrianised street, the local economy did not improve as expected because of the traffic in the adjoining streets. In order to facilitate better mobility and habitation in the study area, the study recommends phase-wise development of Pedestrian Priority Zone with slow easing into a larger pedestrianised area with restriction on time for vehicles, improvement in drop off zones and parking management, pass system for local residents and regular awareness campaigns for the promotion of pedestrian mobility as a sustainable mode of transport.

Keywords: Pedestrianization, vehicle free, sustainable mobility.

1. Introduction

1.1 Background

The historical towns of Kathmandu Valley have traditionally been built as compact settlements that encouraged traveling on foot. In recent years, however, rapid and unplanned growth has led to urban sprawl and an increasing number of vehicles on the streets of Kathmandu Valley. According to the Department of Transport Management, by the fiscal year 2017/18, 1,172,413 vehicles have been registered in Bagmati Zone out of which 91.8% were private vehicles running on the streets of Kathmandu Valley. Car friendly neighborhood design encourages people to drive more for a trip that could often be fulfilled by a walk (Kumar & Ross, 2006).

Higher road traffic levels have a large impact on air quality, cleanliness, road safety, reliance on imported petroleum products, levels of social interaction and community connectedness. As a result, urban settlements like the core Central Business District (CBD) and heritage towns of Kathmandu have degraded to the extent that people do not wish to visit these areas anymore. It is thus necessary to implement a sustainable transportation system in the core areas of Kathmandu.

One feasible solution to upgrade mobility and create a habitable ambience in such areas is to pedestrianise them. Pedestrianization refers to the process of converting a street into an area for the use of pedestrians only by excluding all motor vehicles except emergency vehicles (Soni & Soni, 2016).

Pedestrianization has been implemented in many cities around the world including New Delhi (India), Bangkok (Thailand), Istanbul (Turkey), New York (USA) among others. Nepal has also adopted pedestrianization in Basantapur, Bhaktapur, Bandipur, and Thamel. But whenever a street is about to get pedestrianised, there is often huge opposition from businesses on those streets as they feel it might affect their profits (Kumar & Ross, 2006).

Thamel is the main tourist center of Kathmandu. Almost all of the commercial activities in Thamel are related to tourism, directly or indirectly. Certain stretch of Thamel had been pedestrianized in 2017 with the joint effort from the Metropolitan Traffic Police Division and Thamel Tourism Development Council. Pedestrianization of Thamel was in effect from October 2017 to March 2020.

1.2 Objective

The main objective of this research is to determine the impact of pedestrianization of the streets of Thamel on its local economy and changes in habitation of its residents. Doing this would help enhance the limited body of evidence within the context of Kathmandu.

Specific objectives of the research include determining :

i. Impact on local economy, which is analyzed through -

- Changes in volume and type of economic activities
- Changes in property/ rental value

ii. Impact on extent of habitation, which is analyzed through -

- Changes in air quality
- Changes in environmental condition (cleanliness)
- Changes in the social life of the residents.

1.3 Limitations of the Study

As the study was conducted when pedestrianization was no longer in effect, the data collection has been taken from past experiences of the respondents. The study was also conducted during COVID- 19 pandemic, during a time when the movement of people, as a result of which the businesses, were enormously affected. COVID-19 has also resulted in massive reduction of tourists and visitors. Elderly and children were not seen on the streets of Thamel. However, the experiences of diverse visitors have been taken for this study to the maximum extent possible. Group discussions were not conducted as a precautionary measure for the pandemic.

2. Methodology

2.1 Approach

A mixed method of quantitative and qualitative study has been adopted for this study. Since planning and implementation requires extensive stakeholders' involvement, it is important to understand the perception of the local business owners as well as the local residents concerning the observed changes in their businesses and situation of habitation in order to address their level of satisfaction with pedestrianization.

For this study, 213 questionnaire surveys were carried out for various groups. Out of the 267 businesses, 90 located on the pedestrianised street and 31 located on the non-pedestrianised street were surveyed. Similarly, 31 pedestrians/visitors, 31 local residents and 30 transport service providers were surveyed (Figure 1). Kaiterra Laser eggs devices were placed at a private street segment (Mandala Street) within the then pedestrianised street and an adjacent non pedestrianised street for a comparative study for air quality (Figure 2).

Key Informant Interview

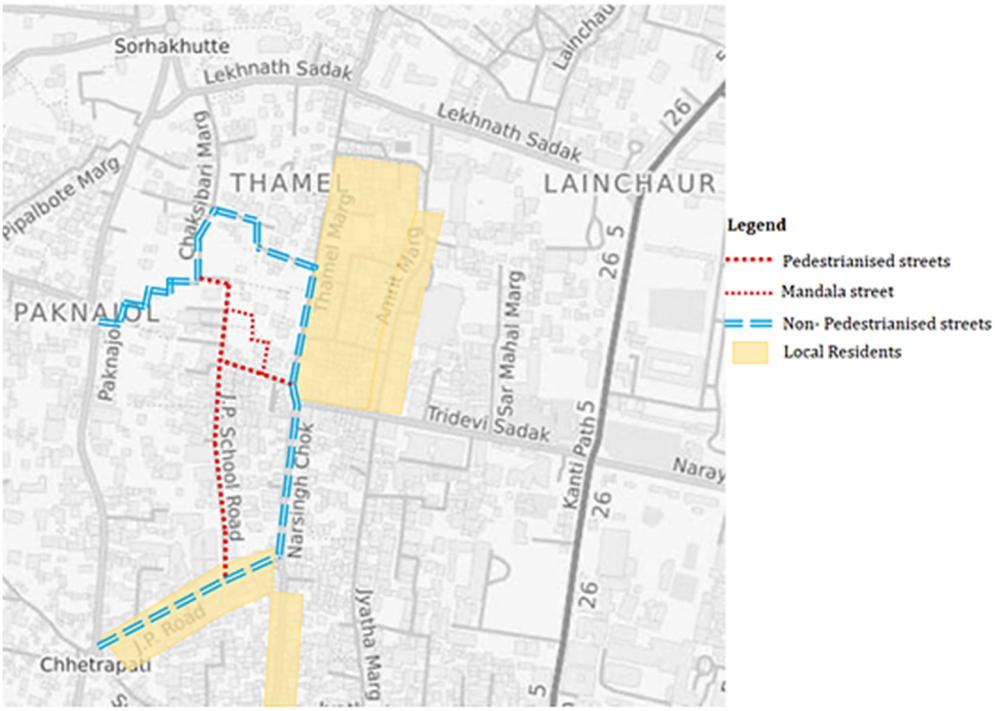


Figure 1: Map showing surveyed streets and locations

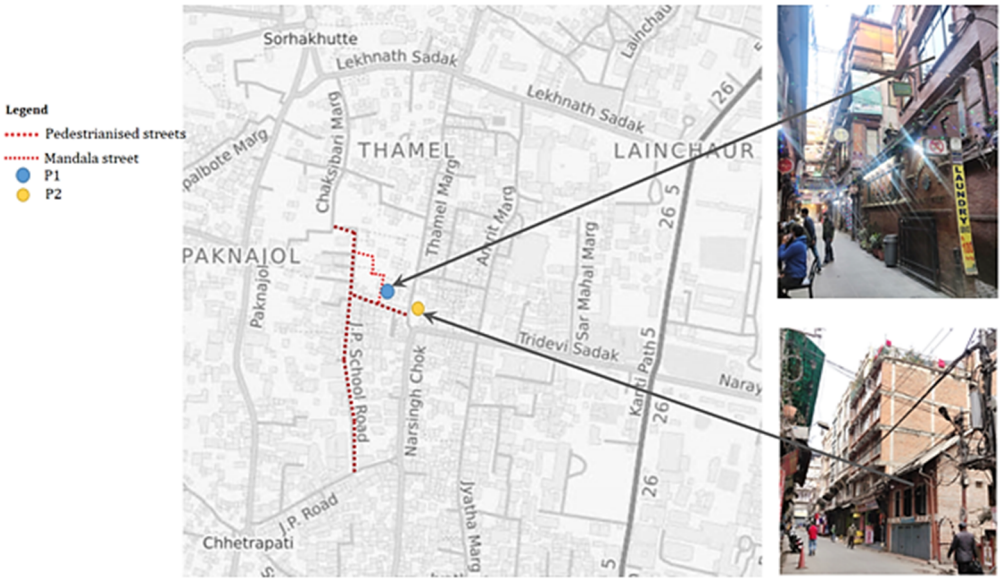


Figure 2: Map showing location of laser eggs

Key informant interviews were carried out with relevant stakeholders who have been closely working for the pedestrianization of the streets of Thamel including President and Vice President of Thamel Tourism Development Council, Program Officer of Resource Center for Primary Health Care (RECPHEC), Ward Chairperson, Kathmandu Metropolitan City Office, Metropolitan Traffic Police Division, social activists and local community members.

2.2 Literature Review

According to previous studies, pedestrian movement has a positive impact on health and safety. Fewer use of vehicles leads to lower consumption of fossil fuels and improved air quality. The 1.7 km pedestrianised stretch of Ajmal Road of Karol Bagh in India, had 2.5 times more pedestrian flow than non-pedestrianised streets (Roychowdhury, 2019). The average $PM_{2.5}$ concentration on non-pedestrian streets was 17.5µg/m^3 more than on the pedestrian streets during late afternoon/early evening (Roychowdhury, 2019). Similar results were found in Istanbul. After the pedestrianization in Istanbul, NO_2 levels in the area have decreased by 42% and average SO_2 levels have reduced by 80% (EMBARQ Turkiye, 2015). Walkability has a major impact on community livability including cleanliness, air quality, noise condition and community cohesion as perceived by residents and visitors. Pedestrian movement causes more communication, spreads more equality, social justice, and decreases social crimes.

A research that involved more than 100 pedestrianized cities found that the turnovers increased in 49% of the cities and remained constant in 25%. Cities in Austria, Germany and Scandinavia experienced an increase in turnover of more than 60% (OECD, 1978). The 1 km Khao San Road in Thailand, which is a famous tourist destination, is pedestrianised during specific hours of the day. A study conducted by Kumar & Ross (2006) on Khao San Road has found that the establishments that benefitted the most from pedestrianization were food and souvenir shops. Sales volume had either remained the same or had increased. Most of the shops (52%) had expressed no change in rental value, 22% of the respondents were building owners themselves, and 26% expressed increase in rent (Kumar & Ross, 2006). In New York's Times Square, after pedestrianization, per square foot rental rates had doubled in a single year (Khan & Solomonow, 2016) and economic activity had gone up by 22% between 2007 and 2011 (Pere, n.d.). Since Times Square was pedestrianised, pedestrian injuries have reduced by 40% and vehicular accidents by 15% (Warekar, 2017). A study that reviewed data from 1.1 million taxi trips determined that traffic overall moved 7% faster (Khan & Solomonow, 2016).

In Nepal, as a part of Bandipur Eco- Cultural Project (BECP), the Bandipur Bazaar area has been made traffic free and has been described as one of the main tourist destinations for international travelers. This has not only resulted in a higher number of inhabitants in Bandipur but also in a steady flow of international and domestic tourists (Ruska, 2012).

Old settlements of Kathmandu Valley, especially the core city of Kathmandu, Lalitpur and Bhaktapur were intended for pedestrianization from studies and plans as early as 1969. A study by CIUD in 2004 proposed to restrict vehicles in Thamel and operation of electric vehicles to meet the mobility demand of elderly and people with disabilities (Clean Energy Nepal, 2013).

According to a survey carried out by CEN/CANN in 2012, 87% of tourists preferred walking in Thamel, 85% of tourists preferred Thamel to be a vehicle-restricted area, and 72% of tourists said that they would walk more often if there were improvements in pedestrian infrastructures.

According to a perception study conducted in 2013, the majority of key stakeholders in Thamel were positive towards making Thamel a pedestrian friendly zone. However, the idea of making a complete pedestrian-only zone was not very popular among local residents. Nevertheless, they appeared to find the vehicle entry permit system appealing. Businesses, on the other hand, appeared to prioritize vehicular entry into Thamel only in the afternoon (12 pm – 2 pm) and at night (10 pm – 6 am). Around 70% of businesses believe that not having vehicles inside Thamel will have a positive effect on their businesses (RECPHEC/NEAT, 2013).

A survey conducted in September 2018 (after pedestrianization was implemented) by RECPHEC found that more than 50% of the respondents were comfortable to travel after pedestrianization of Thamel and 97% liked the vehicle free environment. Around 83% of the respondents said their businesses benefited from this (RECPHEC/NEAT, 2013). The pedestrianization of Thamel was in effect until March 2020 (until first lockdown due to COVID-19).

3. Results and Discussion

3.1 Mobility Status

When the streets of Thamel were pedestrianized, all vehicles except emergency vehicles and vehicles carrying essential items like ambulances, water tankers were restricted. Local residents who own vehicles were provided with passes. Businesses and hotels had to get their supplies during the night, that is between 10 pm and 7:30 am. When the three street segments of Thamel were pedestrianised, the other adjoining streets had one way traffic (Figure 3).

While traffic congestion had greatly improved within the pedestrianised streets as suggested by 67.7% of the pedestrians/visitors, the traffic condition of the adjoining streets was very congested, especially at the entry points. The entry points to the pedestrianised zone were self-converted to drop off zones for visitors. This created a traffic stop point at those places interrupting smooth flow of traffic.

At present, when pedestrianization has been lifted, the one way system still continues (Figure 4). The traffic flow of Thamel shows that there are more exits from Thamel than entry. This has been done to discourage vehicles that use these streets as bypass roads. The streets now only admit those vehicles specifically coming to Thamel.

Right after pedestrianization, many people had begun visiting the pedestrianised zone for a better environment and a pleasant place for social gatherings and recreation. However, visitors were unable to find parking spaces and hence were stuck in the traffic congestion. This discouraged the visitors from coming back to Thamel.

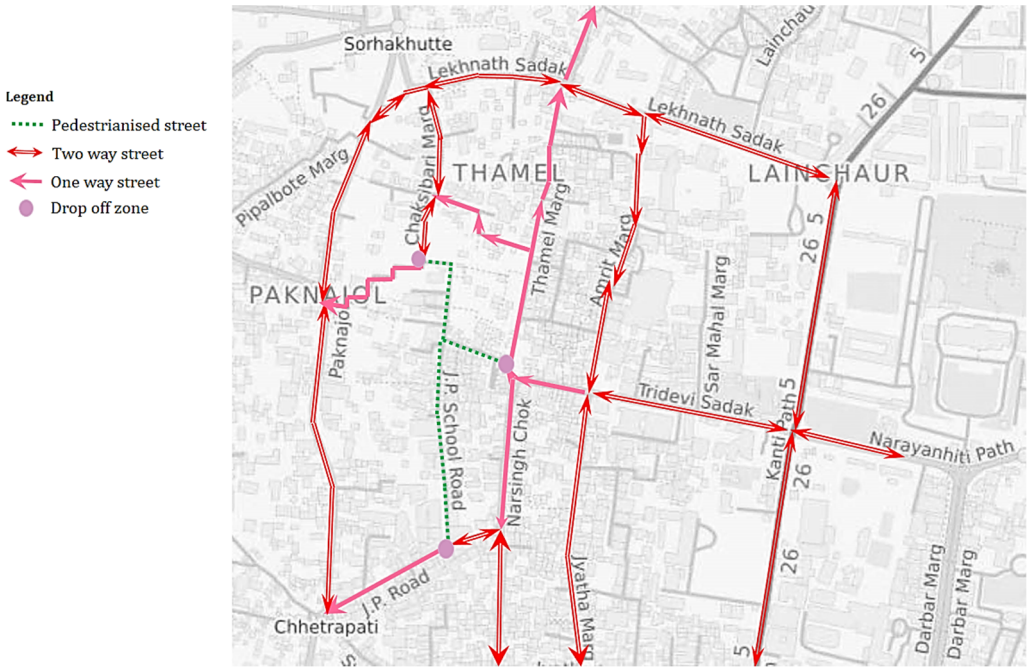


Figure 3: Traffic flow network during pedestrianization

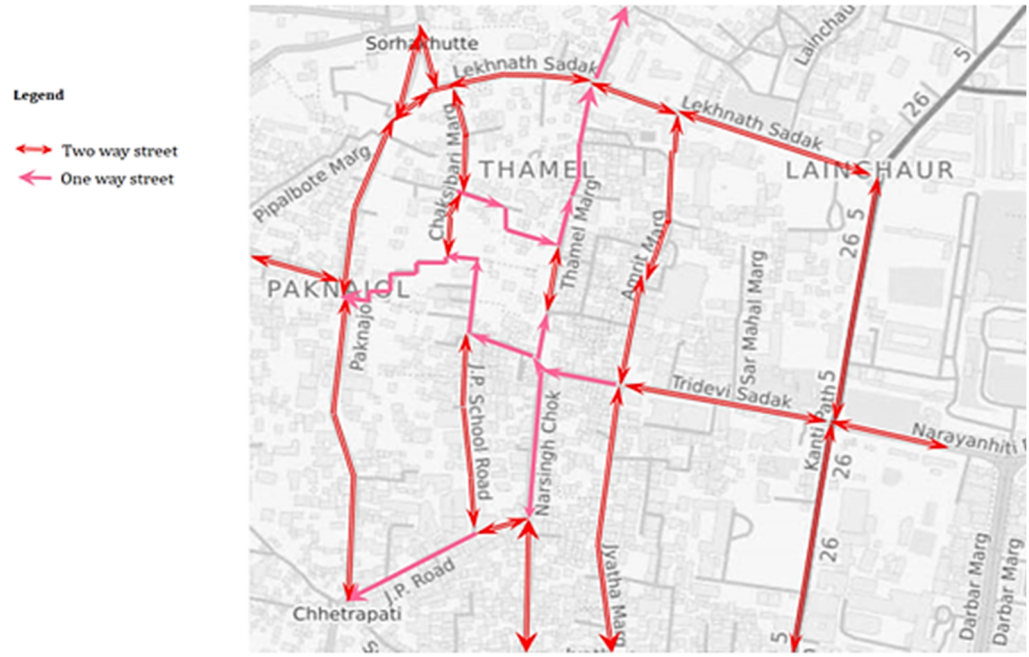
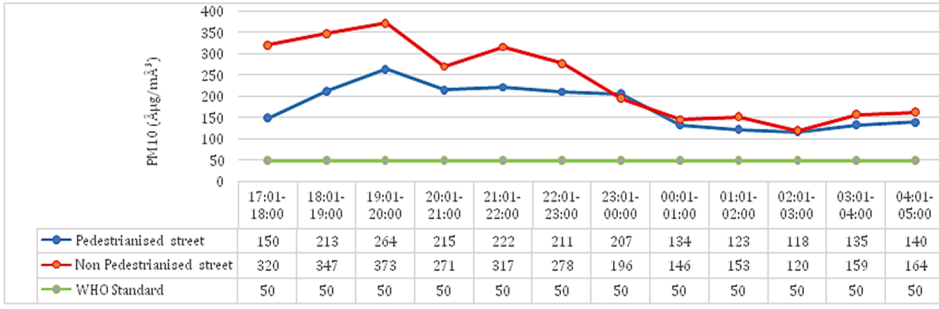


Figure 4: Traffic flow at present (after pedestrianization is lifted)

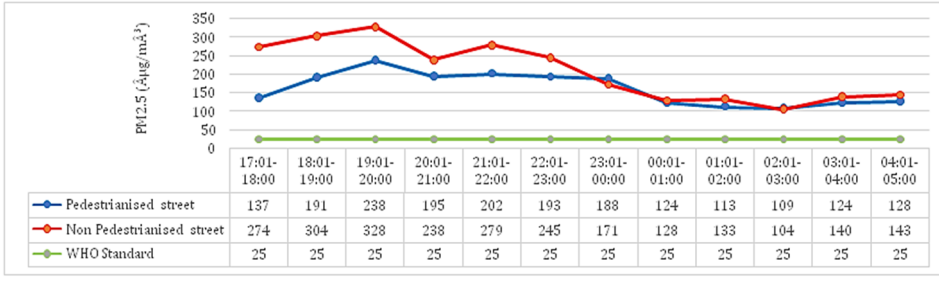
3.2 Impact on Habitation

A study conducted by Khadgi *et al.* (2018) on the effectiveness of vehicle-free zone in terms of air quality with a case of vehicle free zone of Thamel has found that the particulate matter at the vehicle free zone was lower than other non-pedestrianised reference stations. For this study, a 12 hour comparative air quality data was taken on a private pedestrianised street of Thamel (Mandala Street) and non-pedestrianised street (Narsingh Chowk). The data showed that the pedestrianised street had lower values for $PM_{2.5}$, PM_{10} and Overall Index compared to the non-pedestrianised street from 5:00 PM to 11:00 PM whereas these values were almost the same after 11:00 PM to 5:00 am (Figure 5, 6 and 7). This suggests that the time when vehicle movement takes place has lesser amount of particulate matter at the pedestrianised street.



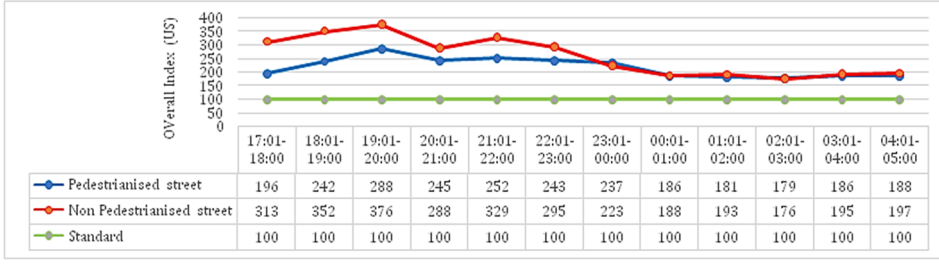
	17:01-18:00	18:01-19:00	19:01-20:00	20:01-21:00	21:01-22:00	22:01-23:00	23:01-00:00	00:01-01:00	01:01-02:00	02:01-03:00	03:01-04:00	04:01-05:00
Pedestrianised street	150	213	264	215	222	211	207	134	123	118	135	140
Non Pedestrianised street	320	347	373	271	317	278	196	146	153	120	159	164
WHO Standard	50	50	50	50	50	50	50	50	50	50	50	50

Figure 5: 12-hour PM10 variation in pedestrianised and non-pedestrianised street



	17:01-18:00	18:01-19:00	19:01-20:00	20:01-21:00	21:01-22:00	22:01-23:00	23:01-00:00	00:01-01:00	01:01-02:00	02:01-03:00	03:01-04:00	04:01-05:00
Pedestrianised street	137	191	238	195	202	193	188	124	113	109	124	128
Non Pedestrianised street	274	304	328	238	279	245	171	128	133	104	140	143
WHO Standard	25	25	25	25	25	25	25	25	25	25	25	25

**Figure 6: 12-hour PM2.5 Variation in pedestrianised and non-pedestrianised street **



	17:01-18:00	18:01-19:00	19:01-20:00	20:01-21:00	21:01-22:00	22:01-23:00	23:01-00:00	00:01-01:00	01:01-02:00	02:01-03:00	03:01-04:00	04:01-05:00
Pedestrianised street	196	242	288	245	252	243	237	186	181	179	186	188
Non Pedestrianised street	313	352	376	288	329	295	223	188	193	176	195	197
Standard	100	100	100	100	100	100	100	100	100	100	100	100

Figure 7: 12-hour overall index variation in pedestrianised and non-pedestrianised street

Perception survey also suggests better air quality on the pedestrianised street during the pedestrianization phase as experienced by 71% of the pedestrians/visitors and 83% of the transport service providers. Similar results were also found in Karol Bagh and Istanbul.

The result of the perception survey conducted during this study suggests that 96.7% of the respondents felt that they had good health implication during the pedestrianization phase, which has been retained to some extent as 80.6% of the respondents have continued to have good health even after the pedestrianization has been lifted (Figure 8).

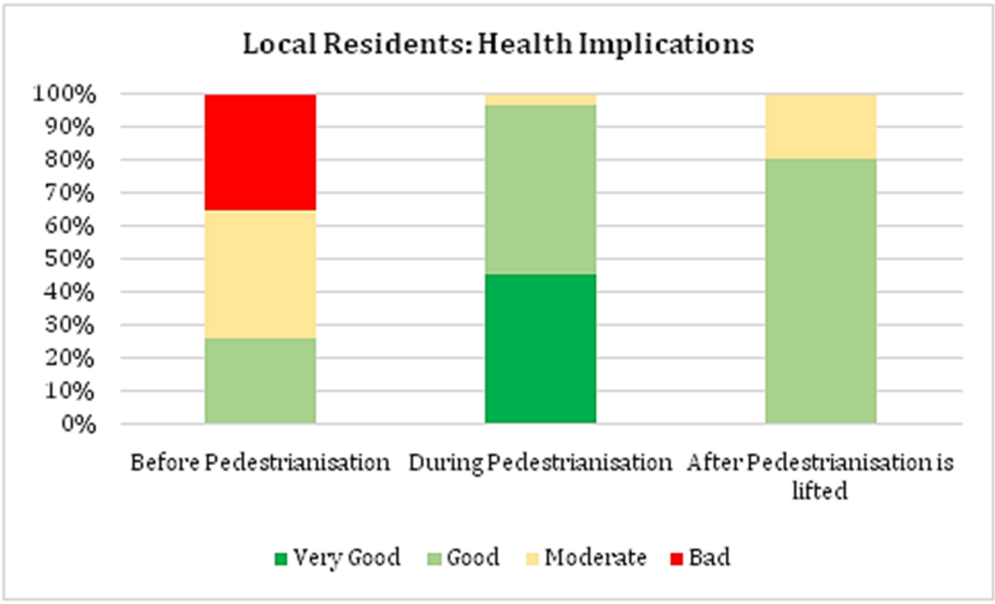


Figure 8: Perceived health implication on local residents

Almost 97% of the participants responded that the noise condition during the pedestrianization phase was good or very good. However, since the pedestrianization has been lifted, this percentage has reduced to 32.9%. Similarly, 100% of the local residents agreed to an improvement in noise conditions after pedestrianization. All of the respondents responded to having experienced improved cleanliness during pedestrianization. The percentage of participants that experienced good cleanliness dropped to 30% after pedestrianization was lifted.

Social interaction highly improved after pedestrianization, as mentioned by 100% of the respondents. Pedestrianization seems to have had a continued impact on social interaction as 72.4% of the respondents think they have good social interaction at present. Pedestrianization creates inclusive public space for more interaction, communication and social cohesion and helps promote equality and social justice in terms of space use.

From the primary survey, conducted among local residents, it was found that 100% of the local residents and 58.06 % of the pedestrians/ visitors thought road safety had improved after pedestrianization. Hence it was found that all aspects of habitation improved due to pedestrianization.

3.3 Impact on Local Economy

Average rent per sq. ft. in the pedestrianised street was found to be 1.51 times more than that in the non-pedestrianised street of Thamel. All of the businesses in the pedestrianised street stated that there was no change in rent after pedestrianization. Similarly, 58% of the residents replied that there was no change in rental or property value whereas 42% responded that there was an actual increase. Key informant interviews also suggest no change in rental or property value due to pedestrianization. Pedestrianization had not caused any decline in rental value. Similar results were found in Khao San Road. However, rental rates at Times Square were found to have doubled in a single year.

According to a perception survey conducted by RECPHEC (2018), 83% had said that their businesses had benefited due to pedestrianization. However, the primary survey conducted in Thamel during this study found that overall 55% of the respondents felt that there was a decrease in footfall and 43% stated decrease in average sales after pedestrianization. However, compared to the non-pedestrianised street and while pedestrianization was in place, the average footfall per day on the pedestrianised street was perceived to be 1.52 times higher. The average sales per day on the pedestrianised street was also perceived to be slightly higher (1.05 times) than that of the non-pedestrianised street.

Much of the literature suggests more pedestrian flow in pedestrianised areas such as in Karol Bagh. Cities in Austria, Germany and Scandinavia had more than 60% increase in turnover after pedestrianization. Sales volume in Khao San Road of Bangkok was found to have increased or remained the same after pedestrianization. Economic activity in Times Square went up by 22% after pedestrianization. Yet, despite pedestrianization in Thamel, the perceived footfall and average sales both dropped over time.

The vehicle free zone had created a chaotic traffic congestion for the streets adjoining the pedestrianised zone especially at the entry points where drop off zones had been organically created. The large number of visitors being dropped off at this area created huge traffic congestion on that road. Unavailability of parking also discouraged people with vehicles to visit Thamel. The pleasant and clean environment created in the pedestrianised zone was overpowered by the unpleasant traffic chaos that was indirectly created at the exteriors. The number of visitors hence may have decreased, thus creating a decrease in footfall and economic activities within and around the pedestrianised area. The timing could not have been worse as this was immediately followed by the global pandemic and nationwide lockdown. The COVID- 19 pandemic and the economic crisis further alarmed the people who did not want to risk losing more income. In a situation of such frustration, the locals did not want further disruption to their economy that they perceived to have resulted from the traffic congestion brought about by pedestrianization.

3.4 Inconveniences

Major inconveniences faced by businesses located on the pedestrianised street included difficulty in visitor and customer movements (86.2%), transportation of goods (79.5%), personal travelling (41.3%), and parking (24.1%). For the local residents, major inconveniences included movement of visitors (86.2%), supply of essentials (31.03%), personal travelling (20.68%), and parking (20.68%). Majority of the stakeholders including

local residents had concerns regarding proper parking and pass system for those residing inside the vehicle free zone. These inconveniences need to be addressed for pedestrianization to be successful.

Additionally, it was suggested that the entire area of Thamel be pedestrianised rather than a small stretch. This way all the businesses would benefit and one will not have an advantage over the other. As the area of Thamel is quite large, an electric mode of transport - tuk tuk was suggested for those that need assistance to travel from one part of Thamel to the other.

Perceptions of other stakeholders collected during this study suggest that pedestrianizing an area is a continuous process. There should be continuous effort in maintaining the area with different street activities as well as awareness raising programs. Thamel had quickly given up on the vehicle free status. There should have been more effort from all concerned authorities and organizations in maintaining the vehicle free status of Thamel.

3.5 Opinion on Pedestrianization

The general opinion on pedestrianization on the pedestrianized street was found to be good or very good as mentioned by 76% of the respondents. Likewise, 74% of respondents on the non-pedestrianised street considered pedestrianization to be good or very good (Figure 9).

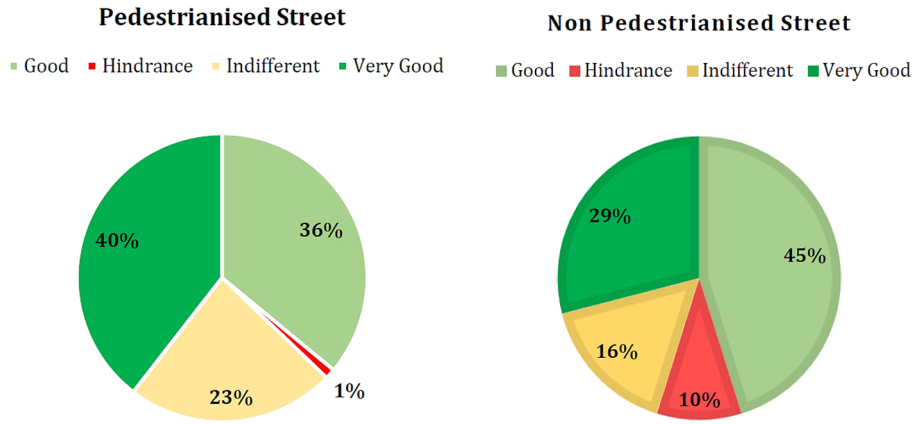


Figure 9: Opinion on pedestrianization on pedestrianised street (left) and non-pedestrianised street (right)

Local residents are also supportive of pedestrianization with 96% of them agreeing it to be good or very good. In the case of pedestrians or visitors of Thamel, 78% feel that pedestrianization is good or very good. Likewise, transport service providers also find pedestrianization to be good (96%) (Figure 10).

According to literature review, some of the interventions that facilitated pedestrianization include supply of public parking facilities, adequate supply of transport facilities, accessible bus stops at walking distance (like in Khao San Road), pleasant environment and lighting, sidewalk cafes, fountains, other street furniture, valet service to pick and drop from market

to parking lots (in Karol Bagh), E- rickshaw services (in Karol Bagh), traffic calming (in Khao San Road).

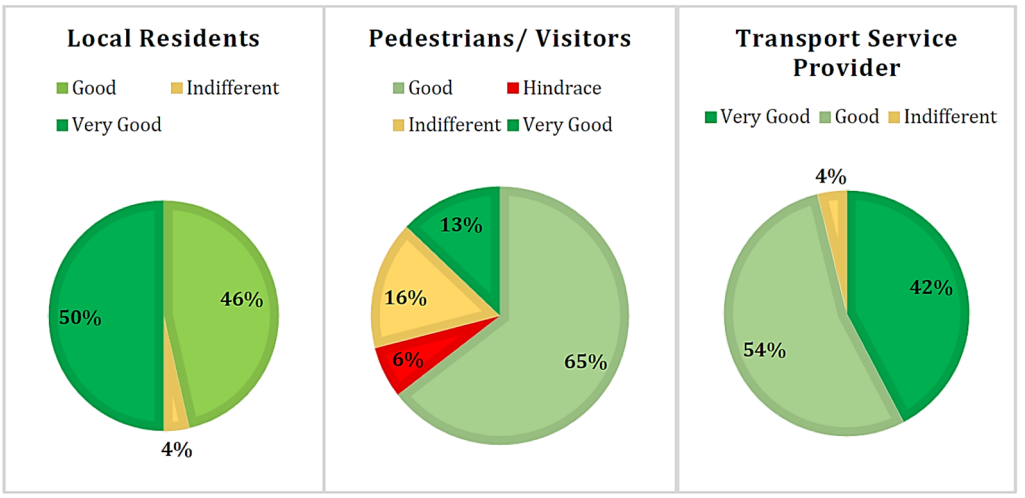


Figure 10: Opinion on pedestrianization of local residents (left), pedestrians/ visitors (center) and transport service provider (right)

4. Conclusion and Policy Recommendations

The pedestrianization project of Thamel had a positive impact on the habitation of its residents and the local economy when it started. But over time, even with the pleasing environment and ambience in the pedestrianised street, the economy did not improve as expected because of the traffic congestion in the adjoining street. An alternative approach to such an area would be a gradual phase-wise development. Instead of completely restricting vehicles and calling it a vehicle free zone, a phase wise development is recommended for a Pedestrian Priority Zone (Figure 11).

The main objective of the process would be to improve the mobility and living condition of the people in Thamel. It would be easier for people to get adapted to a slow development process where vehicles would initially share the street with pedestrians while giving preference to pedestrians. After this, the vehicles would slowly be restricted for a few hours a day. Gradually, the streets would be completely pedestrianised with vehicles allowed for a certain period of time.

As transfer of essential goods during off hours was brought out by several of the participants (79.5%) as a major hindrance, a transfer station should be established that would store and deliver all essential items during the time frame of vehicle entry or via some allowable means of transport (tuk tuk). As understood from the key informant interviews, continuous awareness campaigns are absolutely essential in order to make this strategy successful.

For planning and implementation of any kind of strategy, consultation should be held among the relevant stakeholders for successful participatory planning. A management committee could be formed including the stakeholders, which would oversee the planning

and implementation. Monitoring and evaluation mechanisms may also be essential in this regard. The stakeholders in the case of Thamel include Ward 26, 16, 27, 17, City Planning Commission, KMC, Thamel Tourism Development Council, Kathmandu Metropolitan Traffic Police, Building and Heritage Division, Kathmandu Metropolitan City, local community members and social activists.

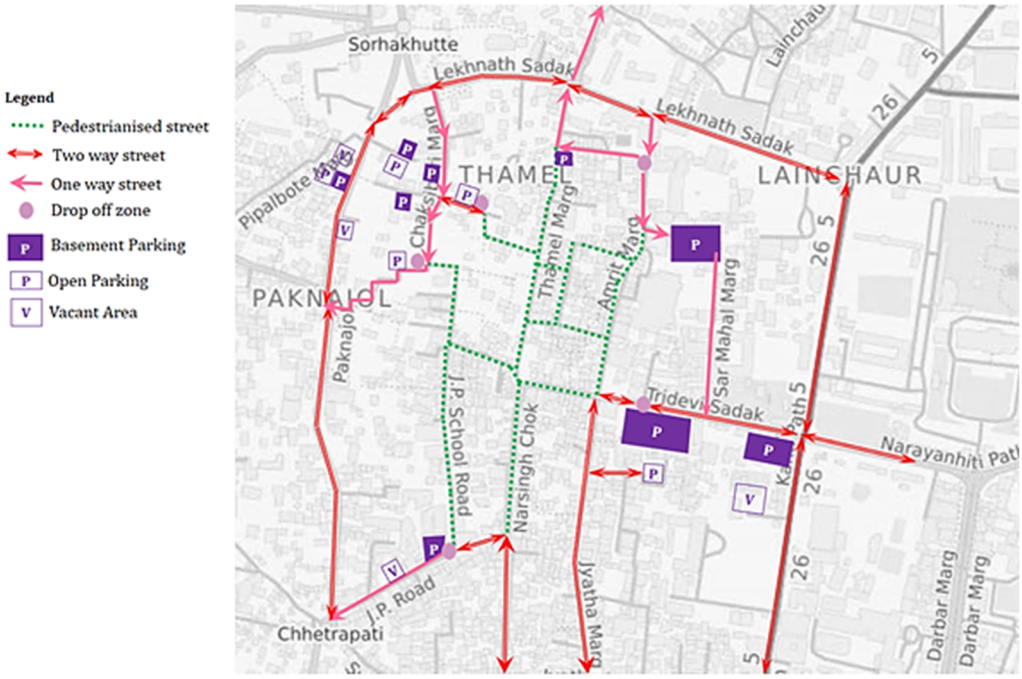


Figure 11: Proposed pedestrian priority map for Thamel

Following activities are recommended for phasewise development over two years:

1. First Phase (6 months):
    - Identify and manage parking area using Smart Parking Mobile Apps from which users can identify available parking areas.
    - Demarcate Pedestrian Priority Zone (PPZ) in coordination with main stakeholders and consultation with local residents and businesses.
    - Replace paving to coarse material as traffic calming measures with differently coloured pavement so that road users identify PPZ.
    - Limit vehicle speed to 20 kmph in PPZ.
    - Identify and establish transfer station near PPZ for transport of essential items (water, cooking gas, etc.) within PPZ in off hours.
    - Implement vehicle free street with on-street events such as exhibitions, musical programmes, etc. once a month.

2. Second Phase (6-12 months)
    - Allow only two wheelers and restrict four wheelers to area to PPZ (10:30 am-6:30 pm).
    - Limit vehicle speed to 15 kmph.
    - Design and construct drop off zones at entry points to PPZ for taxis.
    - Introduce valet parking to assist vehicles from drop off zone to and from parking.
    - Initiate full-fledged management of smart parking.
    - Operate electric tuk tuk/Pedi cabs within PPZ.
    - Inform public about PPZ with alternative routes.
    - Implement vehicle free street with on-street events such as exhibitions, musical programmes, etc. once in two weeks.
3. Third Phase (12-18 months)
    - Allow only two wheelers and restrict four wheelers to area to PPZ (from 10 am to 7 pm)
    - Limit vehicle speed to 10 kmph.
    - Introduce pass system for local residents.
    - Develop easy access to public transport.
    - Implement vehicle free street with on-street events such as exhibitions, musical programs, etc. once in a week.
4. Fourth Phase (18-24 months)
    - Enforce PPZ allowing emergency vehicles, essential services from 9:30 am to 7:30 pm.
    - Implement pass system for local residents.
    - Initiate full-fledged tuk tuk operation within Thamel.
    - Organize monthly awareness programs to support pedestrianization.

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Analysis of Air Quality and Air Pollution Dispersion Mechanism in the Kathmandu Valley

Rajib Pokhrel

Abstract

Environmental quality management has been challenging to concerned authorities as a result of the rapidly growing population in the Kathmandu Valley. In this paper, meteorological, particulate concentration and the meso-scale numerical simulation studies have been carried out in order to analyze the air quality of Kathmandu Valley where both primary data and secondary data were examined. Meteorological data and air quality data recorded at different stations located in the Kathmandu Valley were collected and analyzed scientifically. The data from these sources show that the daily mean temperature varies from 10°C to 24°C throughout the year when the highest temperature was recorded in June and lowest temperature was recorded in January. Moderately strong wind speed (approximately 6 m/s) was recorded during spring and summer season. Mostly, more than 50% calm wind (wind speed between 0.5 m/s to 2.1 m/s) was recorded during the autumn and winter seasons. Analysis of air quality data such as PM 10 and PM 2.5 shows that the concentration of coarse particles reached above 100 μg/$m^{3,}$ whereas fine particle concentration reached up to 80 μg/m^3. Concentration of particulate matter was very low in the summer due to the washout effect of frequent rainfall in the monsoon period. Numerical simulation shows the diurnal variation of Mountain/Valley breeze in the Kathmandu Valley during the study period. Here, the mountain breeze was generated from midnight to the early morning, while the Valley breeze occurred from 9 AM to 9 PM. The momentum of the Valley breeze was double than that of the Mountain breeze, although a calm breeze is observed in the winter season. Puff dispersion model revealed that the local wind flow significantly affected the pollution transport and dispersion in the Valley. The puffs generated mostly in the northern part of the KMC dispersed throughout the Valley although a majority of the pollutants dispersed around the northern uphill. Similarly, emissions generated from the central part of the Valley dispersed throughout the Valley as well.

Keywords: Meteorology, mountain/valley breeze, air pollution, dispersion model.

1. Introduction

1.1 Background

In the last three decades, the population of Kathmandu valley has increased drastically and the city has been expanded and densely urbanized. Kathmandu valley with its three districts including Kathmandu district accounts for a population density of 97 person/km^2 whereas Kathmandu Metropolitan City has a density of 13,225 person/km^2. Annual population growth rate in the valley was above 4.5% while the nationwide population growth rate was approximately 2.5% (Central Bureau of Statistics, Nepal, 2001). Therefore, it has been a great challenge to maintain a clean environment, including and not limited to air quality in the Kathmandu Valley. WHO reports show that Kathmandu is one of the most polluted cities in Asia, where road dust, vehicle emission, brick kiln and other airborne pollutants are severe throughout the year.

Map of Kathmandu Valley

Cross-sectional view along X-X axis

Cross-sectional view along Y-Y axis

Figure 1: Map of Kathmandu Valley and cross-sectional views

In 2003, the air quality of the Valley was seen to be improving, but it was not sustained as the air quality worsened in 2005 again. There was a slight improvement in air quality in 2006 but it has been steadily worsening since 2007. Dust particles, oxides of nitrogen (NOx), carbon monoxide (CO), sulfur oxides (SOx), hydrocarbons (HCs), benzenes, etc. are the major pollutants in the valley air (Panday *et al.*, 2009). The increased exposure of PM 10 is associated with various adverse health effects, such as respiratory diseases, cardiovascular mortality, morbidity and probably malignant lung diseases (Goldberg *et al.*, 2006; Chang *et al.*, 2005; Kan *et al.*, 2003; Donaldson *et al.*, 2001).

Fine particulate matter is mostly generated from vehicle emissions and secondary pollution aggravates the atmospheric visibility by scattering or absorbing the visible light (Pokhrel & Lee, 2011). Similarly, the gaseous pollutants in the air cause severe physical environmental and health effects (Panday *et al.*, 2009). In addition, the inversion height is

below the surrounding mountains and it plays a role like a lid for the Valley air mostly in the winter season when the air pollution is accumulated in the confined boundary and the air quality is aggravated further (Pudasainee *et al.*, 2010; Sapkota & Dhaubadel, 2002; Sharma, 1997).

A large number of vehicles, brick kiln factories, concrete grinding factories, etc. are the major sources of air pollution in Kathmandu valley. Brick kiln industry contributes largely to air pollution as brick is one of the most used construction materials in the valley and its neighboring areas. The total production of 350 million bricks in turn leads to the production of sulfur dioxide and suspended particulate matter in the valley, which contributes to more than 60% of emissions and is responsible for 31% of TSP (Total Suspended Particle) and 28 % of PM10 (Tuladhar *et al.*, 2002; World Bank, 1997; Shrestha *et al.*, 1996). Although this industry has a significant contribution to the valley air pollution, there is a lack of emission inventory data from each stage of brick production. Moreover, a large number of construction works happening around the Valley has fueled increasing emissions.

Recently, the government of Nepal has also started focusing on environmental quality and public health, and thus a number of air quality monitoring stations have been established at different locations, such as in Ratnapark, US Embassy, Pulchowk, Bhaisipati, Birendra School, etc. (Figure 2). Real time air quality data covering PM10, PM2.5, Temperature, Pressure, Relative Humidity and Wind speed have been recorded and published simultaneously. Data published in 2017 by the Environmental Division shows that the air quality in Kathmandu was much worse than the recommended standard. The data shows that average PM 2.5 in Ratnapark area was about 42 $\mu g/m^3$ which is more than the national standard value of 40 $\mu g/m^3$ (KVAQMP, 2076).

There are many factors that need to be considered and restructured for the improvement of air quality of Kathmandu Valley. One factor that plays a significant role for the transport and dispersion of air pollution in the Valley is the locally generated wind. If we consider the air flow pattern and thermodynamic boundary when establishing the large service industries, brick kilns, material manufacturing industries and other pollutant emitting sources, additional pollution in the valley can be minimized.

This study focuses on the study of air flow/air pollution dispersion mechanism using Lagrangian approach in the Kathmandu Valley where the produced results will be helpful for the policy maker of City Planning for planning the clean and sustainable city in further.

1.2 Objective

Atmospheric environment of Kathmandu Valley is different from the plain and the coastal land where the local meteorology, especially inversion height and air flow patterns affect the air pollution dispersion from its source into the surrounding. The general objective of this study is to estimate the air pollution dispersion pattern and its effective zones in the Kathmandu Valley, and suggest possible measures in order to improve the Valley's air quality.

2. Methodology

2.1 Study Site

Kathmandu, located between 27º37'30" N and 27º45'0" N Latitude and 85º15'0" E and 85º22'30" E Longitude, is about 1500 m above the sea level and covers about 340 km^2. The cross section of the Kathmandu Valley is about 20 km north-to-south and 30 km east-to-west. Kathmandu Valley has a bowl-like shape surrounded by four major mountains namely Shivapuri, Phulchowki, Nagarjun and Chandragiri at an elevation of approximately 1400 m from its base. Kathmandu Valley covers Kathmandu Metropolitan City and 17 other municipalities.

Four distinct seasons viz. spring, summer, autumn and winter are observed in the Kathmandu Valley. During the course of study, the temperature of the valley varied from 5°C to 32°C and dry air with low temperature was frequently observed during the winter season whereas high humidity (more than 90%) and hot weather were observed in summer seasons.

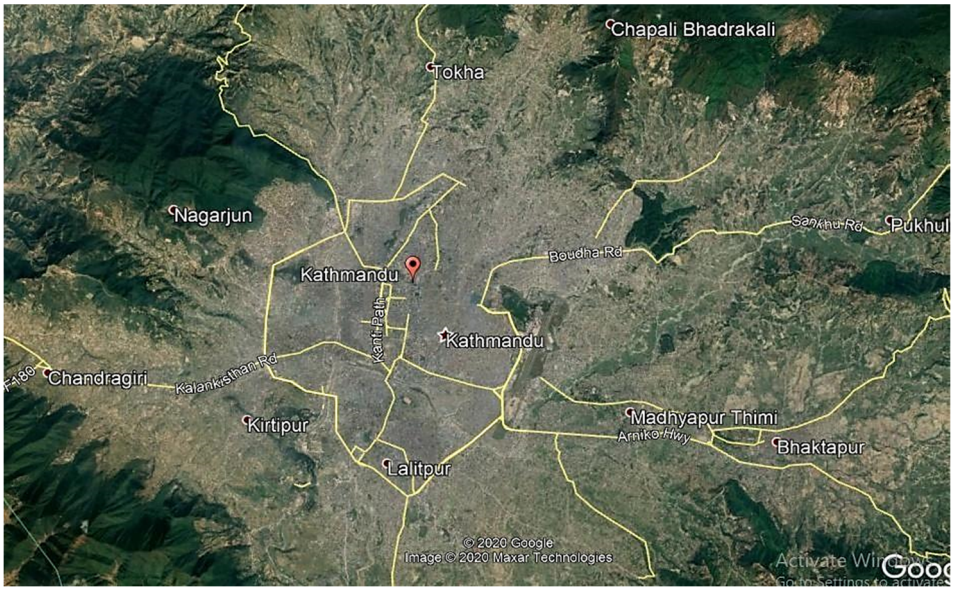


Figure 2: Study domain which covers the downtown area in the central, residential/agriculture area mostly outside of Chakrapath and the high hills

2.2 Data Collection

Meteorological data were collected from the existing monitoring stations at Tribhuvan International Airport (TIA) and Babarmahal, Kathmandu. The station at TIA only records wind speed without wind direction, therefore the data recorded at Babarmahal station are used to aid the analysis of the wind flow pattern by plotting a windrose diagram in this study. The air quality data (PM10, PM2.5) are collected from existing monitoring stations

such as Ratnapark, Phora Durbar (US-Embassy), Pulchowk, Bhaisipati, US-Embassy (Kathmandu), Shankapark and Birendra School (Bhaktapur).

The hourly average data for the whole year are collected to analyze the monthly as well as seasonal variation of air quality in the Valley. Moreover, additional data are referred from other published secondary sources for setting the boundary conditions and discussing the meteorology and air quality situation of the valley. Big data (USGS 30") of topography and land use have been used for numerical simulation. Numerical simulation for the air flow and air pollution dispersion has been carried out using the Lagrangian approach (A2C flow/t&d).

2.3 Validation of the Modeling Tools

2.3.1 Breeze Modeling for Ideal Condition

The ideal case study has been designed to check the model performance with the required boundary conditions even though the model has already been validated and results discussed with the scientific community and then published in different scientific journals. The modeling process has four major parts including selecting the study domain by extracting the topographic and land use data, setting initial conditions for A2C (Atmospheric to Computational fluid dynamics) flow and for the source information for A2Ct&d (transport & diffusion), as well as presenting the simulation results.

USGS 30" resolution geographic data (about 800m resolution at mid latitude) was used for extracting the geographic information to set the modeling domain. The modeling domain covers the geographic location of Kathmandu Valley and its neighboring mountainous areas. The topographic information was modified for the ideal modeling case. Figure 3 shows the modeling domain for ideal case study, wherein the modeling domain the land surface is perfectly plain just above 1m from the water surface.

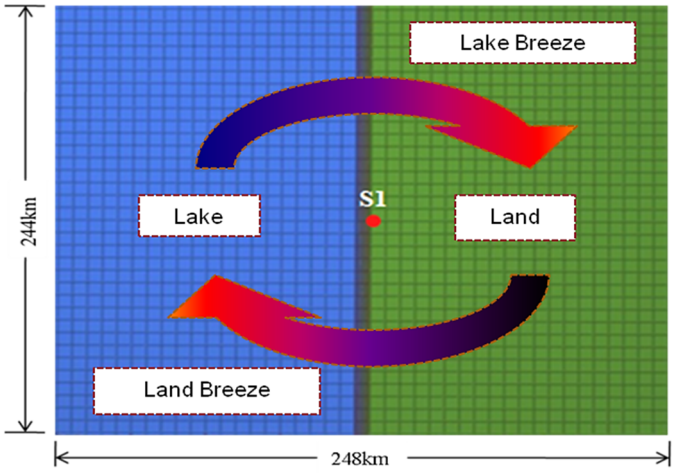


Figure 3: Ideal modeling domain

The modeling period was selected in late July (Julian day 101 - 103) which is the pre-monsoon period and so, windblown dust events are frequently observed. In general, there exists high chances of boundary effects at the beginning and at the end of the simulation period, which is why the simulation has been carried out for Julian day 102. The average potential temperature, 295 K and the reference pressure, 1000 hPa were set up by referring to the published data as well as the manual guideline. The inversion height is approximately the boundary layer height in the daytime. The inversion height was suggested between 1000 m to 2000 m in the software manual. It was used as 1000 m for this simulation. Initial wind speed of 0 m/s was set by assuming the pure breeze case, i.e. without the effect of external or synoptic wind. The wind flow at the beginning of the modeling period was set 0 m/s, therefore the initial wind direction is insignificant for this condition. In addition, the nudging option was set active for maintaining boundary conditions similar to the initial values and stable A2C flow computations. Earth rotation option was set active by considering the Coriolis effect. The simulation was carried out after setting rest of the parameters such as turbulence variables, radiation variables, etc. as the default values based on the manual.

2.3.2 Validation of Modeling Data with Monitored Data

Results generated by any simulation tools need to be compared with observed data to identify the sensitivity and reliability of the modeled data. Due to the lack of upper air data of the modeling domain in this study, the modeling domain for the validation case was selected in the west coast area of Incheon, South Korea where upper air data were monitored using the SODAR system/Radio Sonde. Required meteorological data for setting the boundary conditions and validations introduced in this study were referred from the author's previous publications (Pokhrel & Lee, 2011).

2.4 Air Flow and Air Dispersion Modeling

Kathmandu valley, located in the bowl type geography, has high levels of air pollution, especially high concentration of PM in the ambient air throughout the year. Understanding the pollutant types, sources and dispersion mechanisms are the basic criteria for establishing an air quality management plan. Previous studies show that mobile sources (vehicles) point sources (brick kilns, grinding industries, cement industry, commercial buildings, etc.) and area sources (forest fire and agriculture sectors) in the nearby vicinity are the major polluters in the Kathmandu valley. Local meteorology, especially air flow mechanism, plays a significant role for the transportation and dispersion of air pollution in the study area. In order to simulate the local air flow mechanism and puffs dispersion in the study domain, the modeling tool - A2C flow and A2C t&d were introduced in this study, where puffs are considered as non-reactive primary pollutants. The chemical reactions occuring in the atmosphere during the transport and diffusion of pollutants by the local air flow (mountain/valley breeze) was not considered for the mesoscale simulation study.

The modeling domain (84°35"E, 27°03"N to 86°10"E, 28°12"N) was set using the USGS 30" resolution topographic and land use data. It covers Kathmandu Valley and its nearby mountains as in Figure 4. The outer domain covers 150 km × 129 km with grids resolution of 3 km, interim domain covers 75 km × 75 km with grids resolution of 1.5 km and innermost domain 33 km × 33 km with grids resolution of 500 m.

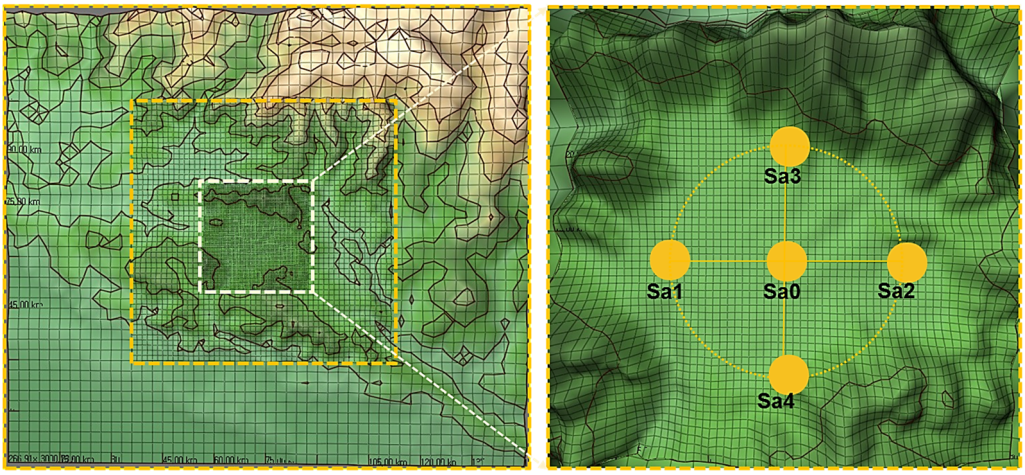


Figure 4: Modeling domain covering the Kathmandu Valley as well as the inner domain, and its vicinity

Modeling cases are designed by considering the local meteorology condition and avoiding the external driving effect such as the monsoon seasons. Around 60-70 % of annual rainfalls during the monsoon season when external wind (monsoon wind) dominates the local wind. Therefore, the three modeling cases are designed during the (a) Spring – (pre-monsoon period), (b) Winter (mid-winter), (c) and with the modification of land use change. Corresponding meteorological information has been used for setting the initial and boundary conditions.

Case Study of Spring Season

The modeling period selected for this study included mid spring, i.e. in April (Julian day 105 - 111) and before the monsoon season began when the effect of external wind was minimal in the study region. The potential temperature (298 K), reference pressure (1013 mb) were based on the meteorology data monitored at the airport and the inversion height (700 m) was referred from the literature (Regmi *et al.*, 2003). The initial wind speed (0 m/s) was set by considering the pure breeze and rest of the parameters were set as default suggested in the manual (HOTMAC® and RAPTAD® 7.8; Yamada Science & Art Corporation). In addition, the puff sources (Sa0, Sa1, Sa2, Sa3 and Sa4) were set at the center, east, west, north and south part of the internal modeling domain (in the Kathmandu Valley) where Sa0 is located in-between Ratnapark and Dillibazaar (27.709N, 85.326E), Sa1 is located in Tahachal near to Chakrapath (27.702N, 85.282E), Sa2 is located at Bhaktapur area (27.6643N, 85.4460E), Sa3 is located at north part of the Valley (27.7469N, 85.335E) near to Narayan Gopal Chowk, and Sa4 is located near to Sunakothi Lalitpur (27.632N, 85.3227E) as in Figure 5. Elevation of all the puff sources were set 10m above the surface and the puff emission option was set continuous with the emission rate of 1g/s. Moreover, the nudging option was activated to minimize the effect of initial and boundary conditions and the earth rotation was activated to take into consideration the solar angle and gravity effect on air flow.

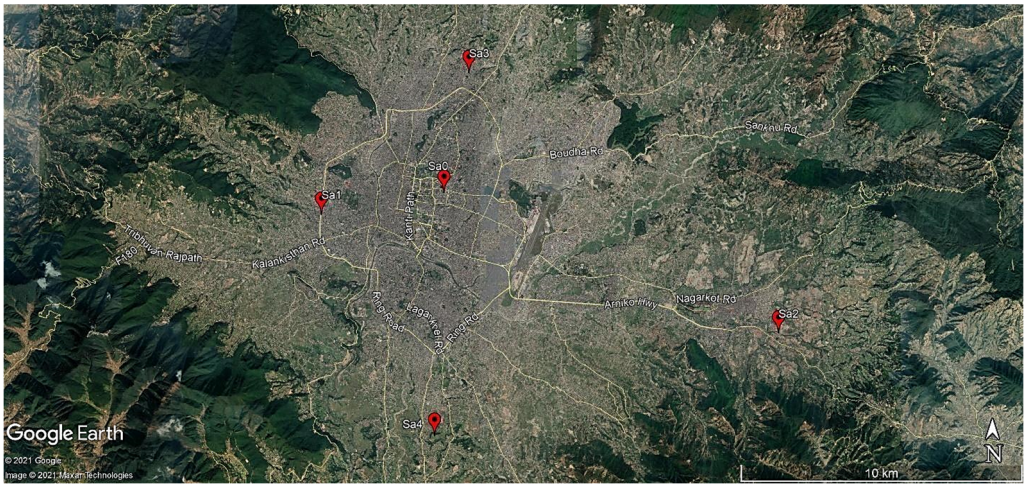


Figure 5: Position of puff sources in Google Map.

Case Study of Winter Season

The modeling period for the winter season has been selected in mid-winter, i.e. in January (Julian day 1-7) as there is no possible monsoon effect as in the summers. The temperature in the winter season is low in Kathmandu Valley. The potential temperature (285 K), reference pressure (867 mb) were based on the meteorology data monitored at the airport and the inversion height (400 m) was referred based on expert opinion. The temperature inversion can be observed frequently below the height of the surrounding mountains in the valley where the pollution is trapped inside the valley, mostly in the winter season. Other parameters were set similar to the previous case study of the pre-monsoon period. Moreover, the impact of land use change on local breeze flow has also been analyzed by modifying the land use properties in the model.

3. Results and Discussion

3.1. Meteorology of the Kathmandu Valley

There are four distinct seasons in Kathmandu Valley where daily mean temperature varies from 10°C to 24°C. Highest temperature was recorded towards the end of May till mid-June and the lowest temperature was recorded in the month of January. Generally, the temperature of the Valley varies from 2°C to 29°C, where winter is moderately cold and rest of the seasons are cool. Approximately 1500mm rainfall has been recorded in the Valley. Around 70% rain falls in the three months of the summer season, although there is slight variation each year.

Moderately strong wind speed (approximately 6m/s) occurs during the spring and summer seasons. Mostly, calm and moderately calm winds (wind speed of 0.5m/s to 2.1m/s) are evidenced during the autumn and winter seasons. The lower temperature in the valley caused the formation of temperature inversion in the surface level where the calm wind

speed catalyzed the temperature inversion and caused accumulation of pollutants in a confined region.

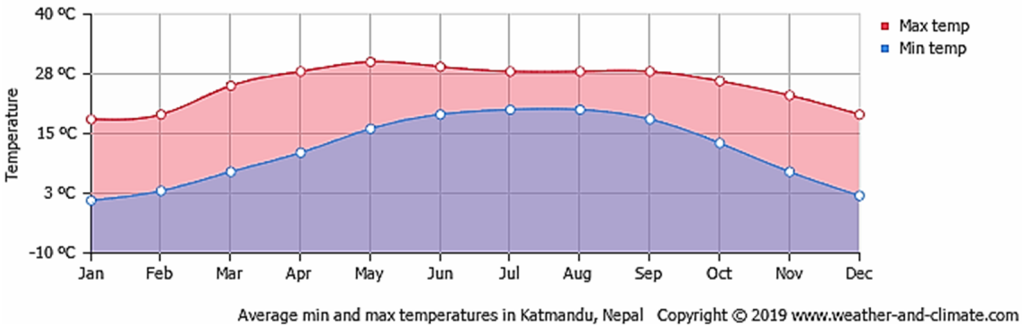


Figure 6: Climate data for Kathmandu Valley for the year 2019

Source: www.weather-and-climate.com for Kathmandu Valley.

3.2 Air Quality of the Kathmandu Valley

Particulate matters such as PM10 and PM2.5 which have been monitored at Ratnapark, US-Embassy (Phora Durbar), Pulchowk, Bhaisipati, US-Embassy (Kathmandu), Shankhapark and Birendra School (Bhaktapur) were collected and analyzed to identify the monthly and seasonal variation of particulate matter in the Kathmandu Valley as in Figure 7.

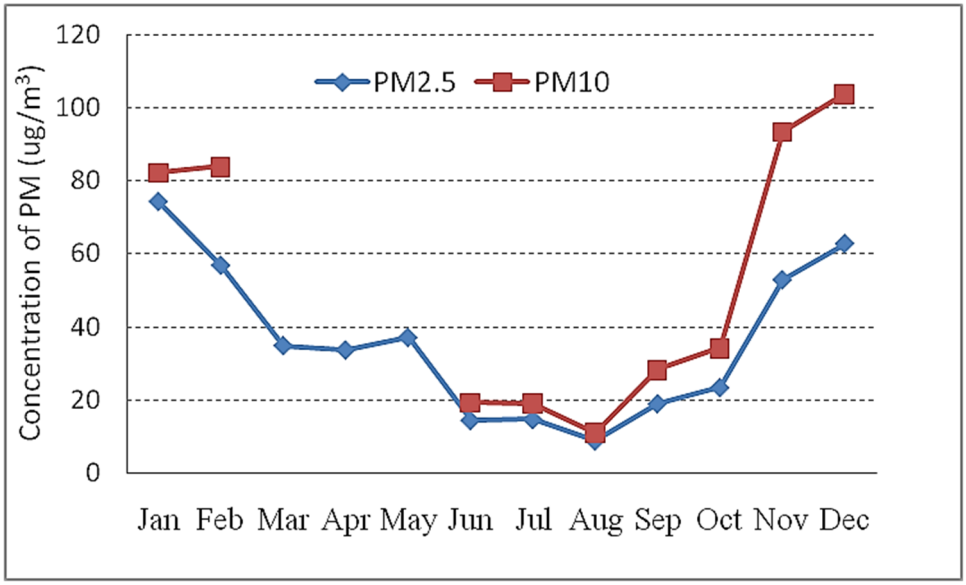


Figure 7: Monthly variation of the particulate matter in the Kathmandu Valley for the year 2018-2020

Due to technical errors, there was PM10 data missing for the spring season although the PM2.5 was recorded successfully. The data shows that the air pollution level was more than two times higher in the winter season (December, January and February) than the spring season (March, April and May) and the autumn season (September, October and November). Moreover, the concentration of particulate matter was very low (both PM10 and PM2.5 were less than 20 μg/m^3). There was more than 70% rainfall in the summer season only. The frequent rain may wash the dust out from the atmosphere as well as the re-suspended dust from the surface.

3.3 Validation of the Modeling Tools

3.3.1 Breeze Modeling for Ideal Condition

The simulations were carried out with the initial and boundary conditions for the ideal modeling domain as mentioned in previous sections. Solar radiation energy is one of the major factors that controls the thermal environment of the study area. The solar radiation energy changes with the diurnal time period, consequently the temperature of earth surface is varied. Due to the different heat capacities of land use objects, the differential temperature and pressure gradients are developed between the sea side and the land side which subsequently generates the thermally induced wind.

Figure 8 shows the wind flow field in the early morning when the land breeze is observed and Figure 9 shows the lake breeze flow field for the daytime. Data sampling points were set at 3 km from the coastline in the offshore area. Wind speed, wind direction and temperature profile data were retrieved during the mid-simulation period for a whole diurnal cycle (24 hours) with an interval of an hour.

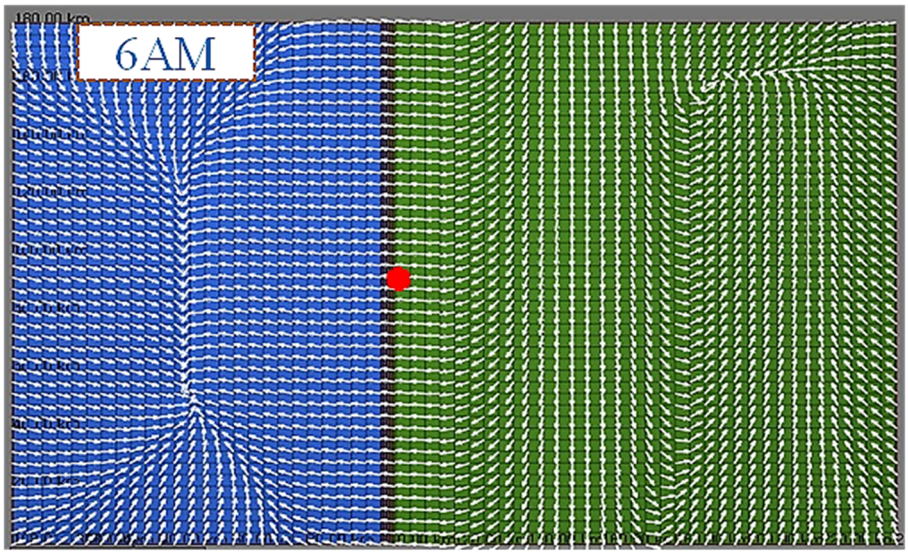


Figure 8: Air flow field in the early morning around 6 AM

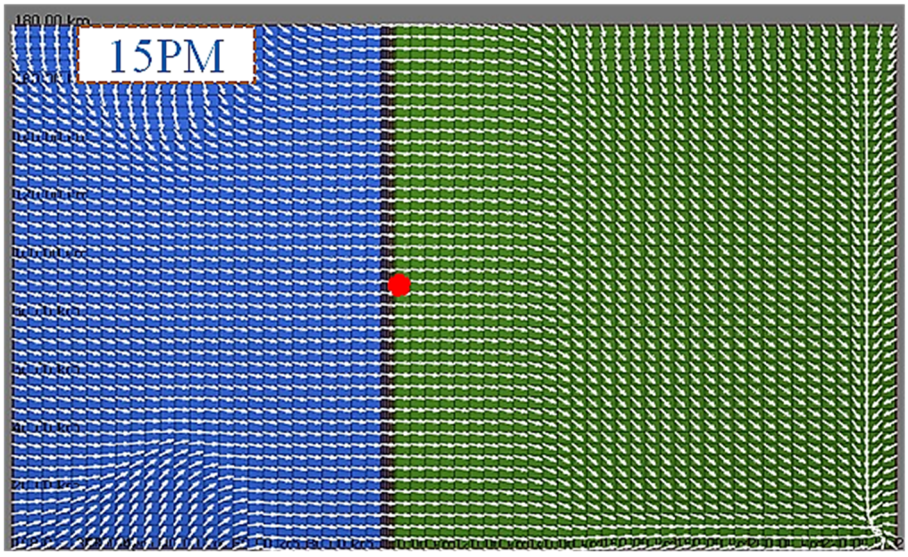


Figure 9: Air flow field in the daytime around 3 PM

Figure 10 demonstrates the diurnal variation of wind speed at 10m above the surface, where the negative wind speed represents the land breeze and positive wind speed represents the lake breeze. The maximum wind speed during the land breeze period was around 5AM to 6AM in the morning and that during the lake breeze was during midday. The speed of the lake breeze was nearly double of the land breeze, which can be seen from Figure 10. In addition, the transition periods of the wind field were identified to be around 9 AM to 10 AM and 9 PM to 10 PM.

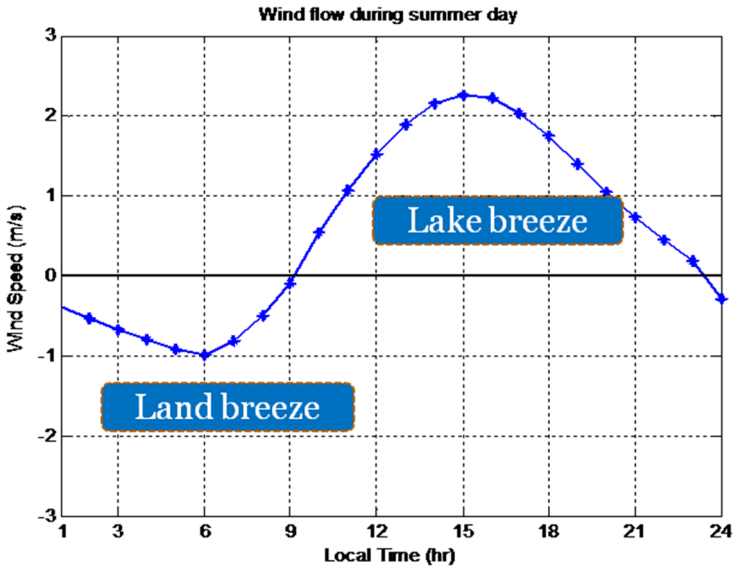
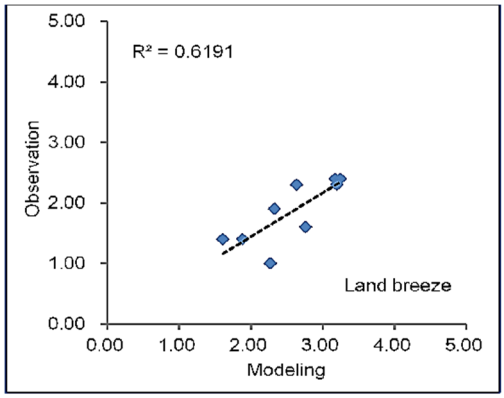


Figure 10: Diurnal variation of the breeze flow in the study area

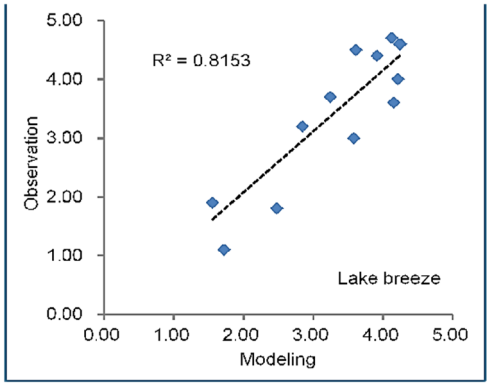
The results from the ideal case study have followed the general principle of lake/land breeze as suggested in various handbooks and existing publications, but the magnitude of breeze speed has been found significantly different. The difference might be visible as a result of the differences in topographic data, modeling period and boundary conditions.

3.3.2 Validation of Modeling Data with Monitoring Data

For this study, statistical analysis has been carried out to identify the accuracy of the predicted data with the observed data. Figure 11 shows the correlation between the predicted data and the observed data for the breezes where the correlation coefficients of R^2= 0.85 and R^2= 0.9 have been found between the predicted and the observed data for the land breeze and the sea breeze periods respectively. It proves that the modeling tool selected for this study is appropriate for carrying out the further study in the study area.



(a) Correlation between modeling and observation data in the land breeze period



(b) Correlation between modeling and observation data in the lake breeze period

Figure 11: Correlation between the modeled data and the observed data

3.4 Airflow and Air Dispersion Modeling

3.4.1 Case study of Spring Season

Mesoscale air flow/dispersion modeling was carried out in the study area by setting the initial and boundary conditions as described in the methodology. Local air flow is generally produced due to the differential heating and cooling effect on the earth surface. In the Mountain/Valley area, a thermal circulation often develops due to the diurnal heating and cooling of the mountain slopes. Solar radiation warms the Mountain slopes or Valley walls, which in turn warms the air in contact with it. The heated air (being less dense than the air at the same elevation above the Valley floor) rises as an upslope wind and is called Valley wind. Due to the outgoing radiation during the night, the mountain slopes cool quicker as compared to the Valley floor. The air in contact with the slopes and up to certain depth generally cools through conduction and turbulent mixing. This cooler air flows down the slope and is called a slope or a mountain wind (Arya, 1999). In the study area, the Valley wind is particularly strong in the south-facing slopes. However, the Valley is surrounded by high mountains with most of the Mountain slopes facing the midday sun, and therefore, a significant amount of Mountain and Valley winds are developed. The surface elevation in the study domain varied widely, ranging from 78m to 6688m (maximum surface elevation from the sea level). The internal modeling domain covered Kathmandu Valley with a base elevation of approximately 1350m from sea level and an elevation of approximately 2825m (Nagarjun) in its surrounding mountains.

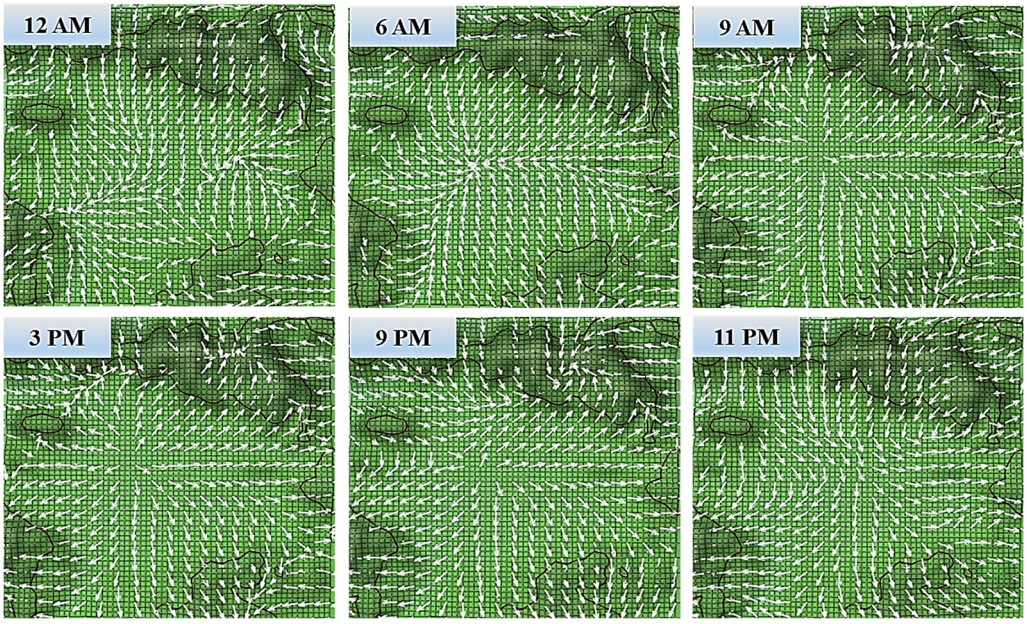


Figure 12: Wind flow vectors 10 m above the surface in the study domain at 12 AM, 6 AM, 9 AM, 3 PM, 9 PM and 11 PM

Figure 12 shows the diurnal variation of the air flow vectors at different time intervals. Most of the Valley area is covered in urban structures and the mountain area is covered with forests. After sunset, the mountain slopes released heat faster than the Valley surface, which is characterized by its urbanization pattern and land use type/material and consequently, influences the airflow. The times at 12 AM, 6 AM and 11 PM - show the breeze flow towards the Valley (Mountain breeze), while the times at 9 AM, 3 PM and 9 PM show the breeze flow towards the mountain slopes (Valley breeze) (Figure 12). The momentum of the breeze and its direction varied with time and geographical location. It is known that the intensity of solar radiation as well as the surface emissivity is time-dependent; however, surface elevation, land-use parameters, meteorological parameters, etc. also vary with location.

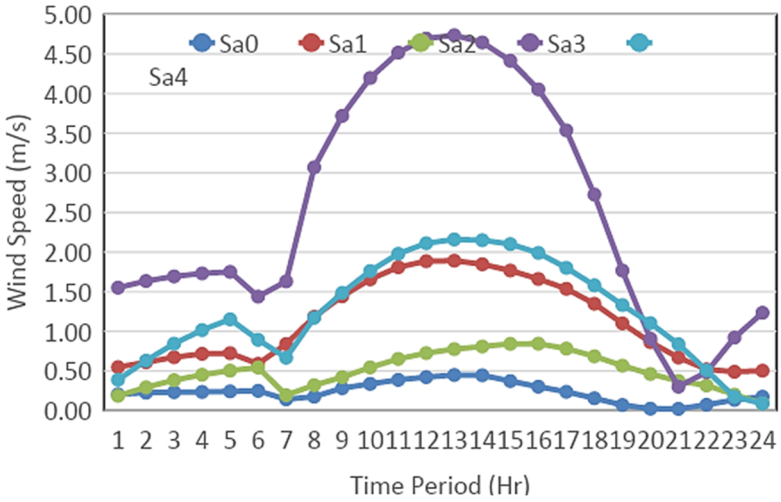


Figure 13: Diurnal variation of Mountain/Valley breeze at different sampling points; here the symbols represent as Sa0 (Ratnapark), Sa1 (Tahachal near to Ringroad), Sa2 (Bhaktapur), Sa3 (Near to Narayan Gopal Chowk) and Sa4 (Sunakothi, Lalitpur)

Figure 13 shows the diurnal variation of breeze flow for the monitoring points Sa0, Sa1, Sa2, Sa3 and Sa4. The momentum of the Valley breeze (up to 4.5m/s) was more than double that of the mountain breeze (up to 1.8m/s), despite the breeze's momentum varying at different locations. With the decline of solar radiation in the evening, the breeze's momentum reduced and it reached a calm condition around 9 PM. This could be referred to as the transition period.

As the air pressure at the Valley surface became lower than the Mountain slopes, at around 11 PM, the Mountain breeze was generated. This mountain breeze continued till 7 AM during the simulation period. The mountain breeze gained maximum momentum just before the sunrise and it reached a transition stage between 7 and 8 AM. Due to the higher solar intensity, mountain slopes generally heat faster and this in turn generates significantly strong Valley breeze. The Valley breeze gained maximum momentum at around 1-2 PM. The process repeats until the external air force or adverse climatological changes do not occur.

Puffs were emitted continuously with a constant emission rate from the point sources located at the central, eastern, southern and northern part of the Valley. Transport and dispersion mechanism of the puffs from the point sources at different locations varied with the local air flow mechanism. The puffs emitted from the center of the Valley (southern part of KMC) disperse throughout the Valley. However, from midnight to early morning, the major portion of the puffs skewed towards the south-west direction following the local air flow pattern. The puffs emitted from the eastern part of the Valley were transported and dispersed in the eastern and south-eastern part of the Valley and its nearby mountain area.

Similarly, the puffs emitted from the southern part of the Valley dispersed in the southern and south-eastern part of the Valley and its vicinity. Moreover, the puffs generated in the northern part of KMC transported towards the valley area in the late night to the early morning and it transported towards the uphill side in the daytime. The pollution transport and dispersion pattern in the Valley was affected by the local air flow characteristics. The smog generated in the eastern part of the mountainous area (touristic region) could be the effect of the pollution transported from the central and the eastern part of the Kathmandu Valley.

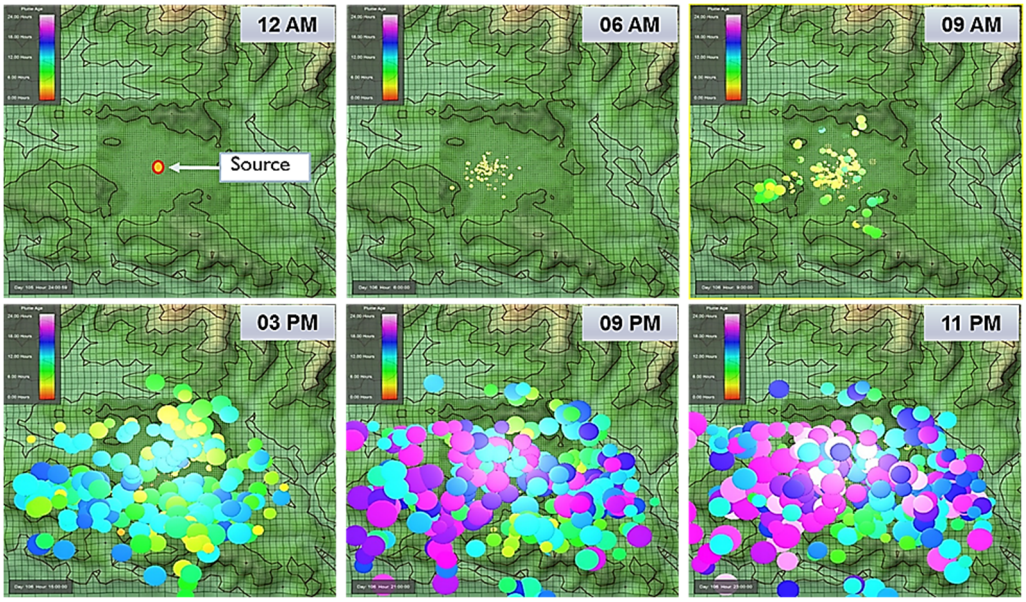


Figure 14: Puffs dispersion mechanism from the point source in the Valley wherein the puff source is at the central part of the Valley

Figure 14 and 15 show puffs dispersion mechanism from the point source wherein the puff source is at the central and eastern part of the Valley respectively. The red color represents the younger puffs and the white color represents the aged puffs. As the puffs become older, their size gradually expands and the color also transforms towards the aged puffs. Majority of the puffs in the surface area of the Valley mostly follow the breeze path. The aged puffs disperse at higher altitudes and wider areas where the breeze impact is the least.

Moreover, a large number of puffs capped the Valley top. This was due to the fact that the puff source - where most of the puffs were dispersed in the Valley area - was at the central part of the Valley. This shows that understanding the air flow characteristics and air flow corridor could be helpful for managing the air quality of Kathmandu Valley. This study also suggests that north to south air flow is common in the study area and the air flow corridors are mostly in the southern and south-eastern part of the Valley.

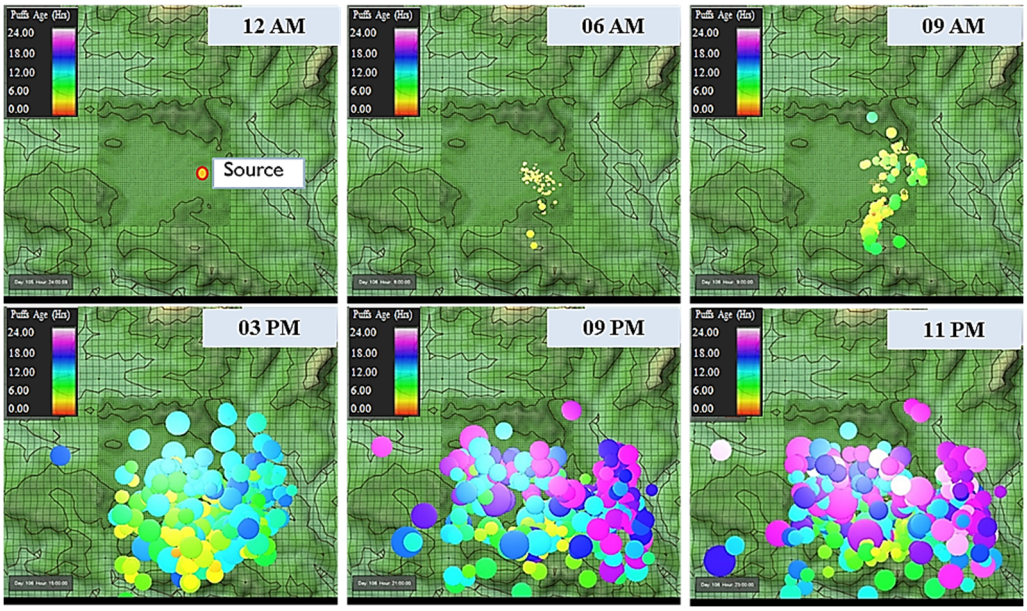


Figure 15: Puffs dispersion mechanism from the point source wherein the puff source is at the eastern part of the Valley

3.4.2 Case Study of Winter Season

Figure 16 shows the surface wind flow vectors at different periods during the winter seasons. Similar to the pre-monsoon period, distinct mountain/valley breeze events can be observed, where valley breeze can be observed after sunrise around 8 AM and it continues till 9 PM in the evening. Afterward, the valley breeze diminishes and mountain breeze starts to flow around 11 PM and it continues till 7 AM in the morning.

Similarly, puff emissions from the central part of the valley (vicinity of Ratnapark and Dillibazaar) are dispersed around the inland area and around the source by the mountain breeze. The puffs are transported towards the uphill side by the valley breeze during daytime. Majority of the pollutants generated at the central part of the Valley are transported towards the north-east direction although the pollutants are not confined only in one direction. Due to the shallow inversion height in the winter season, the pollutants are trapped in the narrow boundary, and consequently the pollution concentration becomes higher in the winters despite the emission being constant.

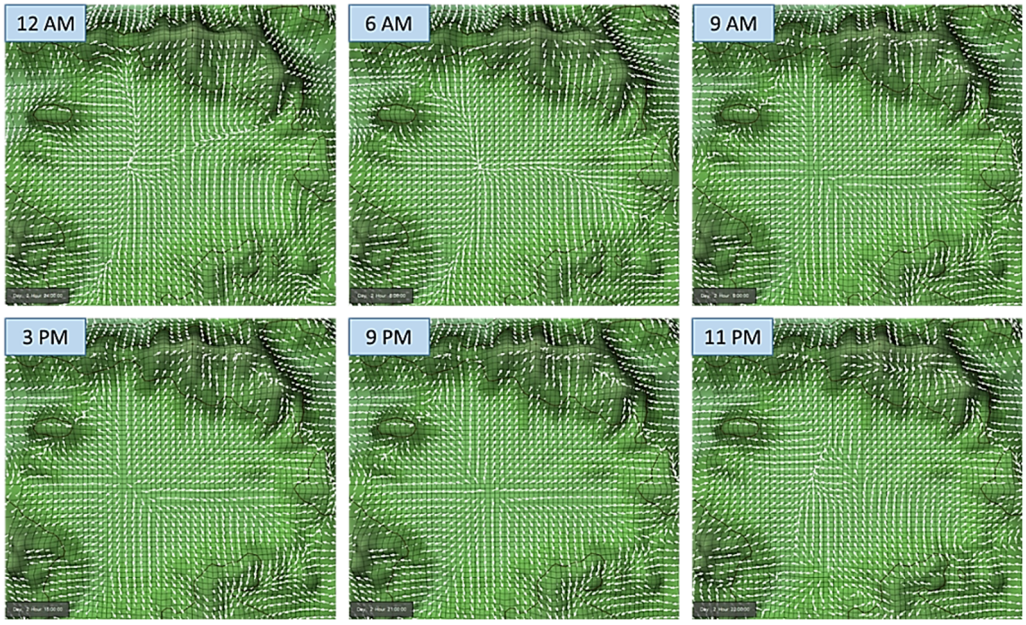


Figure 16: Wind flow vectors 10 m above the surface in the study domain at 12 AM, 6 AM, 9 AM, 3 PM, 9 PM and 11 PM

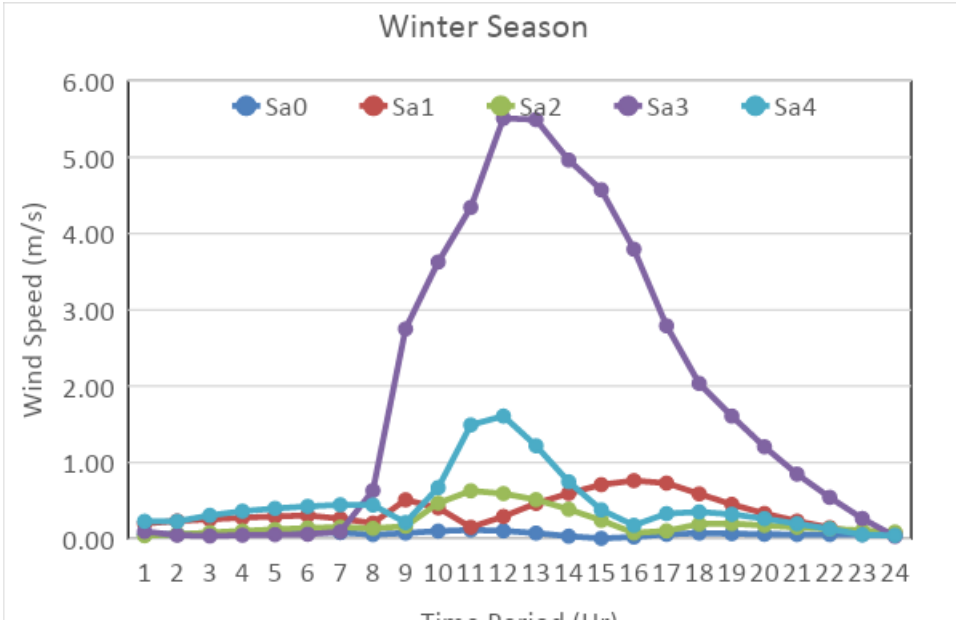


Figure 17: Diurnal variation of wind speed at different time period at Sa0 (Ratnapark), Sa1 (Tahachal near to Ringroad), Sa2 (Bhaktapur), Sa3 (Near to Narayan Gopal Chowk) and Sa4 (Sunakothi, Lalitpur)

Figure 17 shows the wind speed at different sampling locations where calm breeze events can be observed at most of the sampling points. Strong breeze, especially valley breeze, can be seen at the base of the high mountains as in sampling site Sa3. The valley breeze is comparatively stronger than the mountain breeze as the temperature difference between the valley base and the mountain is significantly higher during daytime than nighttime.

4. Policy Recommendations

Air quality management in Kathmandu Valley has been a highly challenging and focal issue in recent years. There are many factors such as emission sources, types, topography, transboundary effects, etc. that need to be considered while developing air quality management plans. Soil-based dust and black soot from the combustion of fuel are the major pollutants in the Valley. Soil-based dust disperses in the atmosphere from all the constructions and demolitions, agriculture processes and the vehicle induced emission from the earthen road (through windblown dust and tires of the vehicles). For the sustainable management of the air quality in the Valley, KMC and its neighboring municipalities should work on a mutual agenda to make their efforts more productive. From this study covering a literature review, data analysis and dispersion modeling, some suggestions are recommended to the policy makers of the KMC for their future plans related to the city development.

The simulation results show that the calm wind blows in the central part of the Valley where the emissions generated reside around the source which add up the pollution level in the Valley in the long term. Moreover, the pollution generated from the south and south-eastern part of the valley has less effect on the Valley air pollution. This leads to the following recommendations:

- New development projects should be implemented in such locations which contribute to the least pollution. Similarly, if such projects are to be limited within the KMC, it is suggested to develop/locate such projects in the northern part of the valley.
- Potential air pollution sources should be decentralized from the core Valley area to safe surroundings and also limit the emission sources which help to mitigate the air pollution impact in the Valley. Replacing the petrol/diesel-based public transportation to electric energy-based transportation in the core valley area could be one of the examples.
- Urban greenery, pervious parking, farmland preservation, etc. are helpful for tackling the possible Urban Heat Island Effect in the core area of the Valley.
- Municipalities should include air pollution hazards in the multi-hazard assessment while preparing risk-sensitive land use planning.

Literature covering Kathmandu Valley Air Quality Management Action Plan 2076 shows that vehicle based, construction/demolition based, agriculture based emissions, etc. are the major pollutants in the Valley. Therefore, it is recommended to study in such affected areas in future. The additional recommendations for controlling the emission from these sources are:

- Strictly prohibiting the open construction and demolition in the Valley by developing the national construction and demolition guidelines.
- Washing every construction/agriculture related vehicle before entering the approach road from construction/agriculture sites.
- Designing the road in a way such that the soil from the bank of the road should not enter the main road via the tyres of vehicles, or wind and rainwater, etc.
- Developing an integrated plan for facility development such that the maintenance is sustainable. This is important because road maintenance is frequent in the Valley due to the ineffective communication among different departments.
- Developing a reliable vehicle emission testing facility and a policy guideline covering penalty provisions for polluted vehicles which should be made compulsory for all vehicles entering and running inside the Valley.
- Developing awareness programs to control the open burning of municipal solid waste as well as the forest fires in surrounding areas.
- Prioritizing emission less mass transportation and bicycling through inclusion of green technologies could be helpful in improving the air quality in the long run.

Acknowledgment

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Mapping of Blue Infrastructure of Kathmandu Metropolitan City

Suraj Gautam

Abstract

Kathmandu Metropolitan City is the hub of Nepal's urbanization. With the increasing urbanization and significant urban growth, there are several concerns regarding the status and conservation of the blue infrastructures. This study on Mapping of Blue Infrastructure of KMC has explored, assessed and mapped Hitis and ponds in the KMC based on the available literature, published reports and previous studies. The spatial and attributal information of 99 Hitis and 14 ponds were studied during the field visit. A total of 57 Hitis and 17 ponds that were either missing or unable to be located were recommended for further study. In the 32 wards, majority of the Hitis were found in Ward no. 15 and almost 64.65% of Hitis were found either dry or non-operational.The density of Hitis in the fringe areas (outer wards) were less but had good water flow as compared to the Hitis in core areas. The issues of conservation, drying up of the Hitis and ponds, encroachment issues are very much pronounced in the modern context and thus needs planning and implementation of conservation programs in the short-term. The strategic blue infrastructure network zoning of the city can be made to mark the buffer zones, land pooling and support urban expansion. With the participation from multiple stakeholders, the Recharge Kathmandu campaign of KMC can be strengthened and thus promoted towards restoration works. The increased understanding of the Hitis and ponds will not only contribute towards the historical and cultural importance, but will also support the urban ecosystem and integrated water resource management practices in the long run.

Keywords: Hiti, ponds, blue green infrastructure, mapping, conservation.

1. Introduction

1.1 Background

The concept of blue infrastructure has gained a lot of attention in the last decade, especially in the context of sustainable urban development in the planning process (Rusche et al., 2019). The blue (water) and green (nature, plazas, and parks) components of Blue Green Infrastructure (BGI) is associated with the urban hydrological functions and also serves as a feature to protect against droughts, cloudbursts, flooding and several other hazards. The multiple dimensions of these infrastructures serves as a valuable asset to the ecosystem services (Maes et al., 2015). However, human activities and their interactions have modified the existing urban areas, landscape heterogeneity, functions and the urban environment. These interactions have made it complex to describe and characterize changing landscapes, land use and land cover classification techniques (Foody, 1996; Ju et al., 2003). Understanding of the blue infrastructure contributes to the maximization of physical and functional connectivity as well as to the optimization of multi-functionality in terms of social, ecological and economic benefits through water sustainability. The effective mapping of such attributes therefore necessitates the ability to identify and characterize water storage units and ground recharge units.

Blue infrastructures refer to water elements like rivers, canals, ponds, wetlands, floodplains, water treatment facilities, and so on. However, this study has focused on the study of the traditional blue infrastructures like Hitis and Ponds in the Kathmandu Metropolitan City (KMC). The Hiti system consists of components like Raajkulo (canals), Pukhu (ponds), Hiti (spouts), Tub (the wells), and Dhown (the drains). The Hiti system makes the utilization of ground water, rainwater and surface water to serve the water flow throughout the year. This system is aided by the collection of rainwater in the aquifers (layers of permeable rock, sand or gravel through which groundwater flows). For the maintenance of water flow throughout the dry season, infrastructures like ponds are built, which acts as a reservoir to recharge those aquifers. The ponds built nearby the Hiti were also fed by the Rajkulos (the canal systems) for the daily use of water. With the help of stone spouts, the Hiti system gets discharged which are generally constructed at manmade depressions. Hitis, generally have one or a number of stone spouts carved in different shapes like the shape of crocodile heads (crocodile or makara in Sanskrit is the vehicle of Ganga, the Goddess of water) and so on. It is assumed that most of the Hitis and Rajkulos were built during the Lichhavi period and King Mandev is believed to have built the first Hiti in Handigaun in 550 AD. The Hitis in KMC exhibits the blending of the indigeneous and traditional knowledge, socio-cultural practices, norms and values.

Traditional blue infrastructures like Hitis and ponds exhibit blending of the indigeneous and traditional knowledge, socio-cultural practices, norms and values. Despite the cultural and historical significance, the status of Hitis and ponds in KMC is not up to the mark. The growing population, urbanization, and modern rapid development has neglected and even encroached the traditional infrastructure like ponds, canals, and the stone spouts. Similarly, there are cases of disruption of the flow of the traditional delivery mechanism and issues of conservation of the traditional stone spouts and ponds in the city. The integrated centralized inventory of water networks in KMC has been missing. This study of mapping traditional blue infrastructures in the city involves the study of the status of the

Hitis and the ponds. The distribution of Hitis in KMC is not uniform. This study also assesses the status of the Hitis in the core areas (covering 11 wards which includes wards 12, 17, 18, 19, 20, 21, 22, 23, 24, 25, 27) and in the fringe areas (covering 7 wards which includes ward 6, 7, 8, 9, 10, 31, 32) as shown in Figure 1.

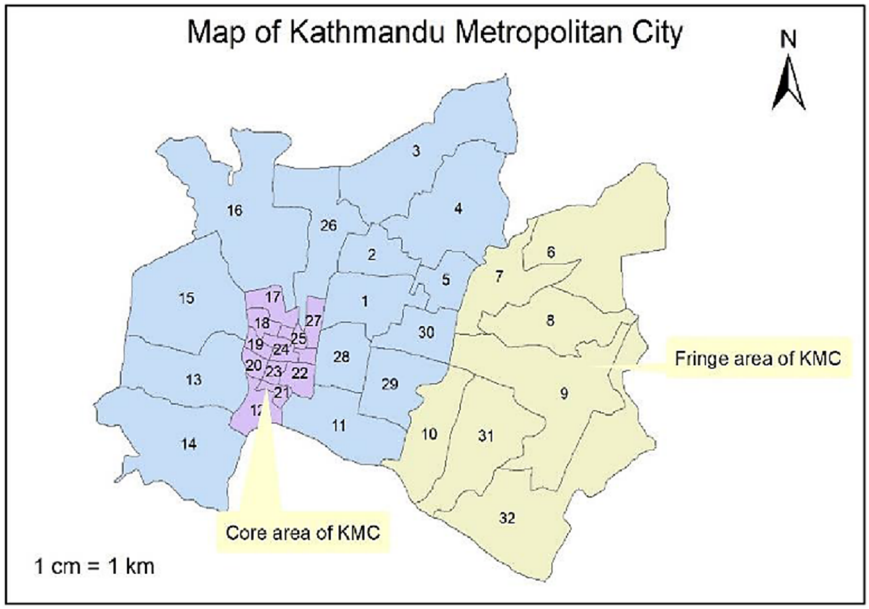

Figure 1: Study area (core and fringe area) of Hitis in KMC

1.2 Objective

The general objective of the study is to understand, assess and map the Hitis and ponds in KMC. The specific objectives of this research are:

i. Preparation of an inventory of traditional blue infrastructures (Hitis and ponds) of KMC with their attributes.

ii. Development of a platform to visualize the information of Hitis and ponds in KMC.

iii. Assessment of the operational, onservation and management status of the ponds and Hiti in the core and fringe areas of the city

iv. Suggesting ways to improve the status of the ponds and Hitis.

1.3 Study Limitation

The study of blue infrastructures was limited towards the study of traditional Hitis and ponds. Similarly, the study was mainly based on the information obtained through the available secondary datasets with ground validation at major locations. With the study being done in winter months, the discharge data was obtained for the dry season. Similarly,

due to the COVID-19 conditions, a thorough and extensive group discussion was not possible. However, this research, in the long run, can keep in track with all the potential resources. Further, the developed platform is also scalable onto several locations where KMC can take a leading role and share the learnings and dynamic platform to its sister and collaborating cities. The envisioned platform needs to be incorporated under the server and system of KMC which will require additional resources from KMC.

2. Methodology

2.1 Desk Study

The desk study was carried out to explore the idea on the Hitis. Research on traditional blue-infrastructure mapping and initiatives studied is listed in Table 1.

Table 1: Previous studies on the Hitis and Ponds

Year	Works/Publication	Individual/Institution
1982	Kathmandu Nagar Chhetra Inventory (Pati, Sattal, Stone water spouts and open spaces)	Kathmandu Valley Committee
1990	Dhunge dhara:A Case study of Three cities of Kathmandu Valley.	Pradhan (1990)
1994	Water Conduits of Kathmandu Valley	Becker-Ritterspach (1994)
1998	Restoration of traditional stone spouts in Sourcebook of Alternative Technologies for Freshwater Augmentation in some Asian Countries	UNEP (1998)
2002	The Pit Conduit Water Supply System of Kathmandu (VAASTU vol 4, May 2002),	Prof. Sudarshan Raj Tiwari
2002	Ancient Newari Water-Supply Systems in Nepal's Kathmandu Valley	Spodek (2002)
2008	Water Movements in Patan with Reference to Traditional Stone Spouts in Nepal: UN-HABITAT Water for Asian Cities Programme Nepal.	UN-HABITAT
2008	Traditional Stonespouts Enumeration and Mapping	NGOFUWS (2006)
2013	Dhunge-Dharas in the Kathmandu Valley-An Outline of their Architectural Development.	Becker-Ritterspach (1994)
2016	A Comparative Evaluation of Stone Spout Management Systems in Heritage and non-Heritage Areas of Kathmandu Valley, Nepal (Ph.D Thesis). New Zealand: Lincoln University.	Tripathi (2016)
2018	"Kathmandu water spouts, lost and found cases"	Khatri (2019)
2019	Survey of Hitis in ten municipalities of the Kathmandu Valley.	Kathmandu Valley Supply Management Board
2020	Study of Ponds in Kathmandu Valley and Analysis of their Present Situation.	Adhikari, Parajuli, and Adhikari (2020)

2.2 Inventory and Dataset Preparation

This phase involved the collection and exploration of the inventories regarding Hitis from the different secondary sources. Open Street Map (OSM) platforms were used for the digitization, reference for field visit and system development phases. The necessary attribute data to characterize and describe the Hiti (e.g., availability of water, status of infrastructure, locations, age, etc.) was also prepared. Reviews included:

- Digitization of Hitis and Ponds from Kathmandu Nagar Chetra Inventory (1982)
- Data from Kathmandu Valley Water Supply Management Board
- Status of Hitis, source, and the conservation activities.

2.3 Field Study

This phase focused on the collection of primary data through various field visits. A visual inspection of sites and natural settings of the research contexts was carried out. Global Positioning System (GPS) based surveys were performed by collecting information about the physical status, water flow status, photographs and several attributes which gives both the spatial and attribute data.

- **Direct observation & stakeholder mapping:** The observation and recording of spatial attributes and elements of Hitis were carried out. Similarly, the potential number of stakeholders were also identified along with their responsibilities and contribution. The provisions made by the institution regarding the Hiti and Pond mapping and conservation were also reviewed.
- **Key informant interview with resource person and authorities**: The interviews were mainly focused on the arrangement of meetings with different stakeholders, initiatives around preservation and protection of Hitis. The respondents were identified and information about the Hitis and Ponds were extracted. Necessary information relating to the status of the Hitis was collected in the form of survey forms. Closed one-to-one conversation and consultations are made to extract the information of the Hiti and its aspects. The exploration of the existing indigeneous and cultural practices for conservation (eg: Indra Jatra, Balachaturdashi, Naagpanchami) was also done.

2.4 Web-based Platform Development

The platform is capable of visualizing the spatial and attribute data in the map page under the boundary of KMC. The first landing page of the platform gives the basic introduction of the system as shown in Figure 2 and Figure 3.

The readable data can be fed into the system and various options of filters (like Select by Ward, Select by Operation Status, Select by Spout/pond, and so on) can be applied to visualize the system. Besides, this platform is also able to display the relevant images of the stone spouts on the left side of the map page and analytics on the right side. It is also able to cite and give acknowledgements to the important contributions and statements in the testimonial section.

Figure 2: Landing Page of the Platform for Hitis Mapping

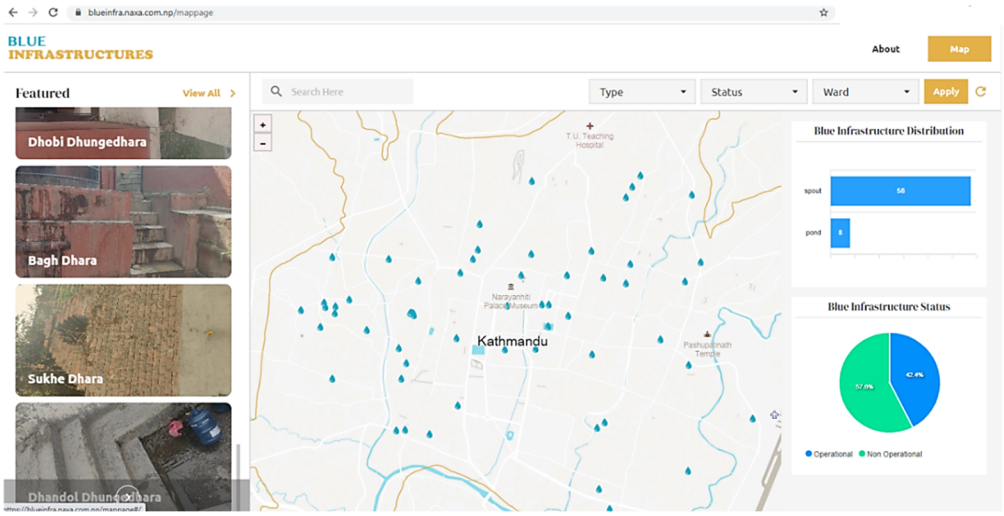

Figure 3: Map visualization page of the platform

Coding and Development: This process involved the development of the backend system and a map visualization system for the frontend user with Graphical User interface. Similarly, it also incorporated the filter option to choose the relevant component in the visualization. The admin/superuser can upload the ".csv" format file and upload images of the respective components. This platform is able to distinguish and disaggregate ward-wise data in the city and look at the status of respective Hitis as per the requirement. It is also able to generate the status report of Hitis and ponds.

Incorporation of Feedback: The feedback received from different stakeholders was incorporated in the system and subsequent changes were made.

System Testing & Debugging: This involved the testing of the system and applying necessary debugging of problems in coding and other technicalities.

Web App: The developed web-app system is hosted at: https://bgi.utilitymaps.org/ and https://blueinfra.naxa.com.np/mappage.

2.5 Data-Processing and Analysis

This phase involved the processing of data that included data cleaning, categorization and preparation of the data in a readable format. The processed data was then fed into the system for the analysis. Besides, this part also involved the assessment of the capacity of ponds and its linkage to disaster risk reduction. The number of Hitis in operational and non-operational status was identified. Similarly, the status of the Hitis and ponds, its physical status, drainage conditions and measures for the conservation were also studied.

3. Results and Discussion

3.1 Source of Water

Only 72% of the households in Kathmandu Valley have access to water (pipelines), while 10% of the households obtain water from different sources (MoUD, 2016). The households in Kathmandu fetch water through different sources such as private wells, KUKL and/or private tankers, stone spouts, public wells, bottled water dispensers, and public taps. Since the Municipal water supply in Kathmandu Valley has been found inadequate, sources like traditional stone spouts (natural springs) have also been important for poor urban dwellers.

Moreover, the traditional stone spouts have their own aesthetic and traditional value and act as sites of cultural heritage. However, due to urbanization, stone spouts seem to have dried up and some of them have also been encroached.

3.2 Hitis

NGOFUWS had conducted the enumeration of traditional stone spouts in 2004 and published a book entitled Traditional Stone Spouts: Enumeration and Mapping in the Five Municipalities of the Kathmandu Valley in 2009. 115 water spouts were identified from the inventory prepared by the Kathmandu Nagar Chetra Inventory (Pati, Sattal, stone water spouts and open spaces) in 1982. The spatial distribution of Hitis studied in this study is represented in Figure 4.

Out of 156 locations of Hitis visited during this study, only 99 (63.46%) of the spouts were found, while 57 (36.54%) of them could not be located as shown in Figure 5. The Hitis which could not be located during our field visit has been listed in Table 2.

Of the visited 99 Hitis, during the months of January to March, only 35 (35.35%) water spouts were operational, while (64.65%) 64 spouts were dry and non-operational. As per the KII, Hitis like Gairidhara Hiti, Dhungedhara Hiti, Naxa Dhara, Pakku Dhara, Chahari Dhara, Dhobi Dhara, Suddhicharan Dhara, Macche Hiti, and so on have a good supply of water during the summer season but poor supply during the winter.

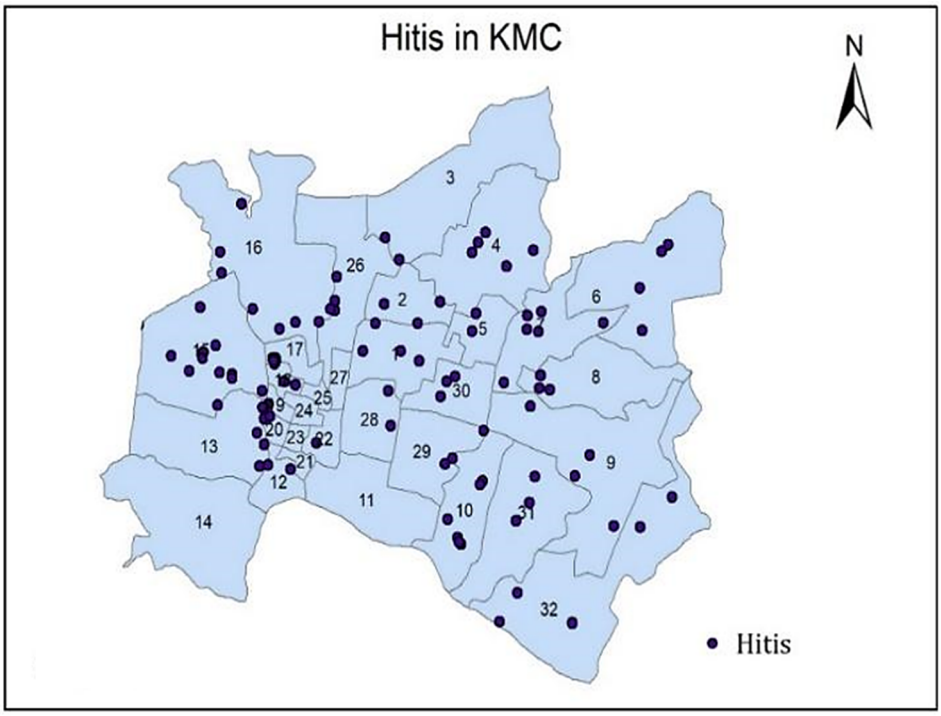

Figure 4: Spatial distribution of Hitis in KMC

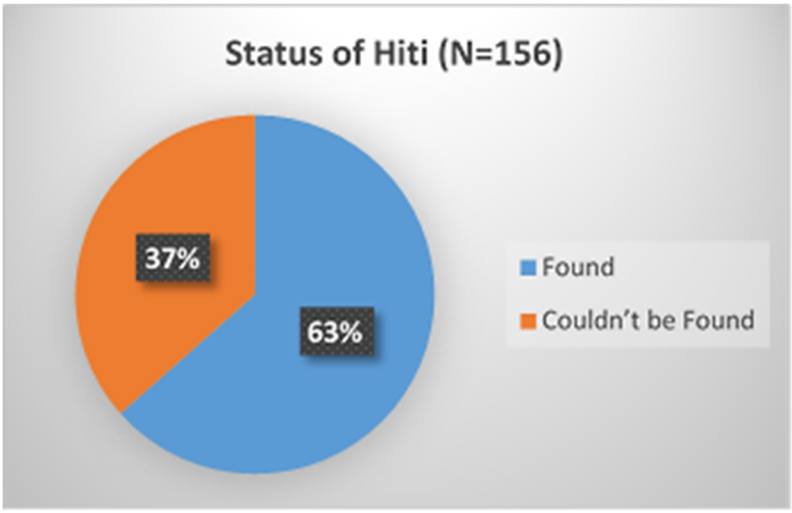

Figure 5: Existence of Hiti during the field survey

Table 2: Missing Hitis in this study

S.N.	Stone Spout	Location
1	Dhara	Airport
2	Jadibuti	Airport Marga, Koteshwor
3	Arubari Dhara	Arubari, Simaltar
4	Tanka Prasad Dhara	Baburam Acarya Marga
5	Dhobi Dhara B	Bagbazar
6	Bagbazar Hiti	Bagbazar Bidhyut Pradhikaran
7	Balaju Dhara	Balaju, Chakrapath
8	Tudal devi	Baluwatar
9	Bijuli Dhara A	Baneshwar
10	Banja Hiti C	Banju Tole
11	Boudha Hiti	Baudha Dhara Tole
12	Bhimsen Marga Hiti	Bhimsen Marga
13	Bhindyo Hiti	Bhimsenthan
14	Bag Durbar Hiti	Bhotebahaal
15	Bhubaneshwori Hiti (Gyan Dhara)	Bhubaneswori Mandir Premises
16	Binayak Dhara	Chahabil Ganesh Marga
17	Dhungedhara	Chandol
18	Ha Hiti	Chasan Tole
19	Kailash Dhara	Daurbar marga
20	Dhungedhara	Dhalku
21	Yara Hiti	Dhaungedhara
22	Gairi Dhara	Gairidhara
23	Gairi Gaun	Gairigau
24	Sinamangal Hiti	Gandaki Marga, Sinamangal
25	Gyolisang Hiti	Gyolisang marg
26	Pancha Dhara	Handigaun Marga
27	Turture Dhara	Hatisaar Sadak
28	Tin Dhara	Hattisar
29	Jamal Hiti	Jamal Nachghar
30	Jaybageswori Hiti	Jayabageswori Mandir, Gausala
31	Dhungedhara	Kamal Pokhari Naxal
32	Than Hiti	Khuslechaur Marga
33	koteshwor Hiti	Koteshwor, Chakrapath
34	Magargaon Dhara	Lakhechaur Marga
35	Latibunga Hiti	Lati Bung Galli, Paropakar
36	Mahadev Chau Hiti	Mahadev Char Sadak, Sinamangal
37	Maitidevi Hiti	Maitidevi
38	Kothanani Hiti	Maru Dhoka
39	Putali Dhara	Near Pancha Kumari marg
40	Paknajol Dhara	Paknajol
41	Panna Hiti	Panmahiti marga
42	Dhungedhara	Pepsicola
43	Dillibazaaar Dhungedhara	Pipalbot
44	Baburam Dhara	Purano Baneshwor
45	Ramdarshan Marga Hiti	Ramdarshan Marga Area
46	Gaucharan Dhara	Sano Gaucharan
47	Simaltar Hiti	shiromani Marg, Simaltar
48	Shreemarg Khursanitar Hiti	Shree Marg, Khursanitar
49	Tilingtar Dhungdhara	Shree Shiv Marg Tilingtar
50	Dhara	Shubarna Shamsher Road

S.N.	Stone Spout	Location
51	Sano Dhara	Simaltar
52	Simal Dhara	Simaltar
53	Subidha Nagar Hiti	Subidha Nagar
54	Saraswoti Dhara	Swaraswati Nagar
55	Tamsi pakha Ga -Hiti	Tamsi pakha
56	Tridev Dhara	Tridevi Marg
57	Yenga Hiti	Yengal Tole

The Hitis have gone dry and non-operational mainly because of the construction of buildings and roads in the vicinity, digging of boring, and so on. As per the KII with focal persons, several Hitis like Dillibazar Hiti, Poon Hiti, Lainchaur Hiti, Siddhi Hiti, Dhalku Hiti, Chwasapakha Hiti, Nyapacho Hiti, Kota Hiti, and so on went dry due to the construction of buildings near to the Hiti. Similarly, from the field survey, it was found that 81.82% of the Hitis were in their original condition, while 14.14% of them have been modified and supplemented with water from the tank, and 4.04% of them have received water from the existing pipeline.

There were several seasonal Hitis which have the flow during rainy seasons but look dry in our survey period. During the rainy seasons, there is a significant flow of water due to the infiltration of rainwater into the ground, while in other seasons, the infiltration is minimal. Around (31.31%) 31 Hitis had the presence of inscription while 68 (68.69%) water spouts did not have any inscription. Interestingly, from the KII carried out in the study area, it was found that there were no records of the Hiti being stolen in the past. The majority of the stone spouts had a single number of spouts. As per the field study, ward no. 15 of KMC had the highest number of Hitis. The ward-wise distribution of the Hitis is shown in Figure 6.

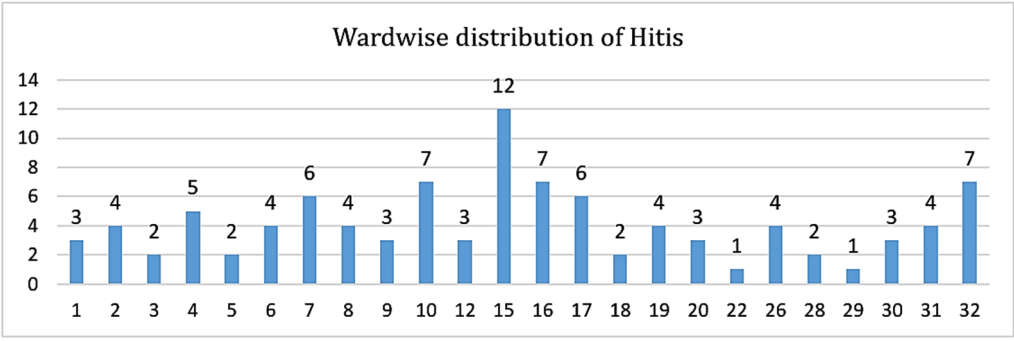

Figure 6: Distribution of Hitis in different wards of KMC

The study findings suggest that the water from the stone spouts is used for drinking, bathing, and washing. Besides these purposes, different kinds of festivals and cultural practices are also celebrated in the Hitis. From the KII with the locals, it was found that the people celebrate various festivals like Jatra, Nag Panchami, Shiva Ratri, Teej, etc by visiting the Hitis. Hence, Hitis also serve religious importances as shown in Table 3.

Table 3: Major cultural practices and festivals celebrated in the Hitis of KMC

S.N.	Name	Longitude	Latitude	Religious Value
1	Pinas Dhara	85.33739	27.69509	Bathing during Teej festival
2	Bang Ganga Dhara	85.33781	27.69558	Bathing during Teej festival
3	Savana Hiti	85.23423	27.68723	Celebrate Nag Panchami
4	Battisputali Hiti	86.29782	27.6936	Celebrate festival on 16 Shrawan, establishment date of the Hiti
5	Nyapacho Hiti	85.30383	27.69762	Celebrated Shivaratri Nag Panchami
6	Chahari Dhara	85.29958	27.71028	Daily Puja and Nag Puja during Nag Panchami
7	DHobi Dhara 3	85.30622	27.71243	Daily Puja and Nag Puja during Nag Panchami
8	Kumale Dhara	85.33212	27.69795	Daily Puja/Worshipping in morning and evening
9	Lainchaur Hiti	85.31529	27.72039	Festival celebrated during (22 dhara purnima)
10	Kapurdhara B	85.31555	27.72366	Funeral ceremony
11	Dhobidhara A	85.33324	27.69866	Funeral ceremony
12	Ganesh Hiti	85.34466	27.71834	Ganesh Jatra
13	Bhagwati Baha hiti	85.32812	27.71208	Ghode Jatra is celebrated
14	Siddhicharan Dhara	85.29472	27.71947	Local people celebrate Nagppanchami and Shivaratri
15	Layakha Hiti	85.30518	27.70612	Maha shivaratri and Nagpanchami celebrated
16	Gairidhara	85.30274	27.71923	Mahashivaratri and Nagpanchami is celebrated
17	Pandhero Dhara	85.33451	27.68692	Nagpanchami celebrated
18	Rajarajyashwori Hiti	85.34805	27.70816	Nagpanchami, Funeral works
19	Bhatbhateni Dhara	85.33136	27.72026	Nagpuja
20	Pakku Dhara	85.30507	27.69775	Nagpuja during Nagpanchami
21	Thulo dhara	85.34037	27.67626	Nagpuja during Nagpanchami
22	Gaushala dhara	85.34513	27.70587	Nagpuja during Nagpanchami
23	Dhobi Dhara 2	85.30629	27.71219	Nagpuja during Nagpanchami
24	Ranibari Dhungedhara	85.32295	27.72904	Nagpuja is celebrated during Nag Panchami
25	Ban Ganesh Dhara	85.34646	27.70835	People celebrate Nag Panchami and daily prayers
26	Mahadev Dhara	85.3431	27.68021	Worshipping, Shivaratri
27	Sincha Dhara	85.33683	27.71862	Sapta and funeral ceremony
28	Balaju baaisdhara	85.30104	27.73372	Religious value and also as recreational park
29	Dhalku Sincha hiti	85.30576	27.71244	Worshipping daily in morning and evening
30	Kayeta Hiti	85.30927	27.70878	Worship purpose
31	Dhungedhara	85.3251	27.75604	Worshipping
32	Tulsi Dhara	85.29778	27.72711	Worshipping of Lord Krishna
33	Dhobi Hiti	85.31462	27.71926	Worshipping purpose
34	Chabahil Hiti	85.34682	27.71888	Worshipping purpose
35	Ram Hiti	85.36512	27.72719	Worshipping of Lord Ram
36	Dhapa Hiti	85.3467	27.71011	Worshipping purpose
37	Himtaj Dhungedhara	85.36669	27.69336	Worshipping purpose

From the field study, a number of issues were heard from the KII regarding the status of the Hitis: (i) drying up of the Hitis, (ii) encroachment (iii) extinction (iv) lack of maintenance, and (iv) conservation practices. Besides these, the rapidly growing buildings, roads and other infrastructures, constructing wells and borings without the due consideration to the existing channels, water resources have resulted in the drying up of the Hitis.

The high-rise buildings that require excavating larger foundations have also resulted in the obstruction of the old water channels. With the amount of increasing built up areas, the areas for recharge of the rainwater have also been sealing and decreasing. Different Hitis are used for the purpose of bathing, washing clothes, etc. and has resulted in drainage problems due to the use of soaps and shampoos.

3.3 Comparison of Hitis in Core and Fringe

The status of Hitis in the core and fringe areas of KMC was studied. The distribution of Hitis in different wards of KMC is not uniform, thus the priority for Hiti conservation differs from one ward to other. Hitis in the core area refers to the inventory of the Hitis from our study in the wards 12,17,18,19,20,21,22,23,24,25,27 while the fringe area refers to the inventories in wards 6,7,8,9,10,31,32.

From the study, it was found that in every 1sq.k.m. of area in the core areas of KMC, there were almost 8 Hitis while in the fringe areas, there were under 2 Hitis. Hence, the distribution of Hitis seems dense in the core areas. Referring to the dry season flow, Hitis in fringe areas have good water flow as compared to the Hitis in core areas. This is mainly because of the compact and dense infrastructures built in the core areas with less areas for recharge. Regarding the cultural point of view, there was not much difference between the Hitis in core and fringe areas, as people visit Hitis and celebrate festivals in both core and fringe areas as per the KII. Since a significant number Hitis are operational in the fringe areas as compared to the core areas, the households fetching water from it are also found greater in the fringe areas. Interestingly, as per the KII, there are no records of the Hitis being stolen. From the study, it was also found that there are no major strict rules enforced in the Hiti premises in both the core and fringe areas shown in Table 4.

Table 4: Comparison of Hitis in Core and Fringe

Particulars	Hitis in Core Areas	Hitis in Fringe Areas
Area (km^2)	2.51	18.75
Number	20	35
Number per sq.km	7.97 (8)	1.87 (2)
In operation (flow) (Dry season flow)	15% (3)	42.86% (15)
No flow (Dry season)	85% (17)	57.14% (20)
Celebrating festival / religious value	40%	40%
Inscription	20& (4)	25.71% (9)
Physical status (Original as it was)	90% (18)	85.71% (30)
No. of households fetching	315	2000+
RL	1218m to 1314m	1291m to 1332m
Stolen in the past	None	None
Provision of drainage	75% (15)	80% (28)
Any strict rules in the Hiti premises	10%	14.28%

3.4 Ponds

In this study, the inventories prepared by Kathmandu Nagar Chhetra in 1982 and the relevant literature were reviewed. Some of the ponds in our study area were dry and as per the KII, such areas are filled only during the rainy seasons while it remains completely dry in other seasons. According to the Kathmandu Nagar Chetra Inventory (1982), there were 16 ponds documented in Kathmandu as shown in Table 5.

Table 5: Documented Ponds in KMC

S.N.	Name	Length (ft)	Breadth (ft)	Depth (ft)	Location	Construction Date
1	Gahana Pokhari	75	40		Hadigaun	16th Century
2	Ikha Pokhari	210	92	20	Nyhooka, Kanyamandir	16th Century
3	Kamal Pokhari	350	175	35	Kamal Pokhari	19th Century
4	Naag Pokhari	72			Baagdurbar	19th Century
5	Naag Pokhari	125	65		Naag Pokhari, Naxal	1730 Sake Sambat
6	Kamaladi Pokhari	79.10	39.7	4	Kamaladi, Ganeshthan	18th Century
7	Pachali Bhairav Pokhari	200	25		Pachali Bhairav, Teku	20th Century
8	Dayashwor Mahadev Pokhari	7	4	12	Lazimpat	
9	Pokhari	125	50		Hadigaun	18th Century
10	Ghoilesang Pokhari	200	50		Bauddha	19th Century
11	Pokhari	250	40		Kutubahil, Chahbil	19th Century
12	Raj Rajeshwori Pokhari	50	20	6	Raj Rajeswori, Pashupati	18th Century
13	Sorekhutte Pokhari	100	50		Sorrekhutte	1864 B.S
14	Nag Pokhari (Bhagwansthan)	80	50		Chahbil	18th Century
15	Pokhari	180	150		Haribhawan, Sundhara	17th Century
16	(Nhu Pukhu) Rani Pokhari	590	460	3.7	Ratna Park	17th Century

Only 9 ponds out of 16 identified by Kathmandu Nagar Chetra Inventory (1982) were found to be present, as shown in Figure 7.

Rani Pokhari (Nhu Pukhu) was built by the then King Pratap Malla in 1670 to mourn the death of his youngest son and console his wife. The pond had a temple at its centre built in the Granthakut (Shikar architecture) model. The earthquake of 1934 resulted in the collapse of the temple. However, it was reconstructed by the then Prime Minister Juddha Shamsher Rana in the Gumbaz style, a common architectural design during the Rana regime. But then, Gorkha Earthquake 2015 also destroyed the Balgopaleshwor temple.

It took almost five and a half years to complete the reconstruction of the Rani Pokhari restoration project. The reconstruction project, initially, was designed as a recreational

space by merging Shanti Batika and Ratna Park. However, there were serious concerns and protests on the proposed concept and the reconstruction was then halted. The problem was later solved after adopting the suggestion of the reconstruction of Balgopaleswar temple in Granthkut style from the Malla Era. The pond was initially provided with few underground borings but it was soon closed after the activists demanded measures to conserve underground water. The pond is now equipped with the rainwater harvesting system from the roof of Tri-Chandra College in the east and Durbar High school in the west and Biswojyoti complex in the north. The dimension of the ponds is 163 metres by 126 metres which has been filled upto a height of 5.2 feet with a capacity of almost 30 million litres of water since September 20, 2020.

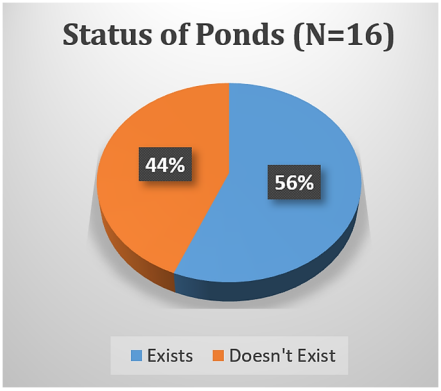

Figure 7: Existing status of ponds

Ikha Pokhari, which lies in the premises of Kanya Mandir School, is believed to have evolved in the 13th century Lichhavi Period. It lies within the settlement area and mainly serves as a rainwater reservoir in order to recharge the ground. It has its own historical, social and cultural importance as the KII suggested that there is a belief that the water of Ikha Pokhari once was used to cure eye problems. Besides, the pond currently has dried up and looks like a playing ground or a field. Considering the school request and public consent for its conservation, the Department of Urban Development and Building Construction prepared a Final Report and Summary of cost estimate of about 3.26 crore for the Conservation Plan of Ikha Pokhari in 2007. However, the implementation part has been deemed to be very poor. The major reason for the drying of the pond has been due to the heavy extractions of ground water and installment of a deep boring around the periphery of the pond for the water supply in nearby communities. Besides the inventory of Kathmandu Nagar Chetra Inventory (1982), following ponds were also identified during the field survey, which are shown in Table 6.

Table 6: Identified ponds during the field survey

S.N.	Name of Ponds	Location	Coordinates
1	Balaju Baishdhara	Balaju Bypass	27.7339760, 85.302276
2	Machha pokhari	Futung	27.7355340, 85.303736
3	Bhuikhel Pokhari (Thulo Pukhu)	Swoyambhu	27.713754, 85.293547
4	Bahati Pokhari	Sorakhutte	27.721119, 85.309731
5	Museum Marga Pokhari	Swoyambhu	27.70414, 85.29473

Several ponds have been identified in the past in the KMC. However, many of them have already disappeared, and only a few of them still exist. One of the biggest ponds in Kathmandu, Lainchaur Pokhari, is no longer available as the area has been now occupied by the building of Nepal Scouts. Similarly, Sindhuwaal Pokhari in Naxal, is also no longer available as the area has been inhabited by the Police Head Quarter Office. Bal Mandir Pokhari in Naxal has now been transformed into Nepal Children's Organization Office. Interestingly, as per the KII with the locals, the place where BacchaPokhari pond was located in the past has now got the Bacchapokhari lane in Naxal. Due to the excessive extraction of ground water from the Puwa Pokhari of Hadigaun, the pond became dry thereby resulting in its deterioration.

Lamh Pokhari in Chahabil, which was also known as Jumbu kunda, acted as a buffer for protection from flooding. It started retaining and piling sediments, which later resulted in filling up the pond (Adhikari et al., 2020). The problem of sedimentation has not only deteriorated and reduced the size of the pond, but has also resulted in the degradation of the aquatic environment.

Different ponds like Kaitahitimani Pokhari in Kalimati, Nag Pokhari in Sundhara, Matule Pokhari and Pachali Bhairav Pokhari in Teku, Hattisar Pokhari in Hattisar, Nag Pokhari and Lamh Pokhari in Chahabil, Kumari Ganesh Pokhari in Baneshwar, etc. have already vanished. Some of the ponds like the pond in Bhairabsthan Margh were destroyed during the Rana regime. Similarly, the ponds near Baluwatar, Ganesthan and Bishal Nagar were granted to the locals as caretakers for their shelter by the then King, thus transferring the ownership to the locals who later destroyed the pond.

When the ponds and Hitis were built in the past, the recharge of groundwater by rainfall alone was not sufficient. The source of water on the ponds were Rajkulos (the canal systems) for a long time. However, the traditional Rajkulos have either been damaged or not well maintained, thereby blocking the water movement on the channel system. Because of the Rajkulos not providing sufficient water and sufficient recharge, the number of ponds has already deteriorated.

The study from our field survey, KII with focal persons and the study from Adhikari et al. (2020) suggest the following missing ponds in the KMC (Table 7).

Table 7: Missing ponds in KMC

S.N.	Name	Location	Modern Day Existence
1	Sindhuwaal Pokhari	Naxal	Police Headquarter
2	Bachha Pokhari	Naxal	Residential Buildings
3	Bal Mandir Pokhari	Naxal	Nepal Baal Sangathan Office
4	Hattisar Pokhari	Hattisar	
5	Matule Pokhari	Teku	Ambe Building
6	Pachali Bhairav Pokhari	Teku	
7	Kaitahiti Mani Pokhari	Kalimati	Market
8	Nag Pokhari (Bhagwansthan)	Chahbil	Monastry
9	Lamh Pokhari	Chahbil	Lions Club
10	Sorekhutte Pokhari	Sorekhutte	Guthi
11	Puwa Pokhari	Hadigaun	Residential Buildings
12	Bhimsensthan Pokhari	Hadigaun	Residential Buildings

S.N.	Name	Location	Modern Day Existence
13	Lainchaur Pokhari	Lainchaur	Buildings
14	Khicha Pokhari	Sundhara	
15	Sundara (Nag Pokhari)	Sundhara	Buildings
16	Nagpokhari Pokhari	Bagdurbar	
17	Pokhari	Haribhawan	

The information from KII suggested that the number of irrational anthropogenic activities like the construction of large buildings, hotels, drainages and pipelines across the path of old channels resulted in the current status of the ponds in KMC. The haphazard construction of wells, hand pumps, and deep borings has also resulted in the huge extraction of ground water and deterioration of ponds. The KII also suggested that the issues of land ownership, encroachment, sensitivity, political support, dedicated institutional setup/mechanism, poor legislation and issues of implementation has also led towards the improper management of ponds.

3.5 Budget Allocation

For the fiscal year 2020/21, the budget allocated for the heritage is 6.65% (excluding conditional plan) as shown in Table 8. The heritage budget is allocated for the reconstruction, repair and maintenance of Ponds, Hitis, temples, Bihars, Gumba, Guthi, Pati, Sattal, Chautara, Kriyaputri building, entrance door, incinerator, funeral, etc.

Table 8: Yearly Budget and Program of KMC for 2020/21

S.N.	Department/Branches	Budget (in Rs. '000)	Percentage
1	International Relation	44500	0.27
2	Internal Audit	1800	0.01
3	Law	24500	0.15
4	Agriculture	36500	0.22
5	Land Consolidation project	960826	5.85
6	Public Health	293100	1.78
7	City Police	26500	0.16
8	Animal Service	30900	0.19
9	Infrastructure Development	3781106	23.02
10	Infrastructure (Ongoing Plan)	1902914	11.58
11	Province and Grant (ongoing)	289850	1.76
12	Administration	172000	1.05
13	Administration expenses	1806240	11.00
14	Building Permit	11000	0.07
15	Revenue	56500	0.34
16	Environment	246000	1.50
17	Environment (ongoing Plan)	39267	0.24
18	Finance	6500	0.04
19	Disaster Management	179500	1.09
20	Education	166906	1.02
21	Federal and other Grants (ongoing)	1120755	6.82

S.N.	Department/Branches	Budget (in Rs. '000)	Percentage
22	Auditorium	17000	0.10
23	Heritage	1092934	6.65
24	Heritage (ongoing Plan)	159431	0.97
25	Conditional (Ongoing Plan)	99418	0.61
26	Conditional Province	125000	0.76
27	Conditional Federal	1159500	7.06
28	Cooperative	18500	0.11
29	PPP	6500	0.04
30	Social	1622400	9.88
31	CPC	179500	1.09
32	Order	63000	0.38
33	Information	284500	1.73
34	Information Metro	32500	0.20
35	Hanuman Dhoka Durbar Area Conservation Program	369979	2.25
	Total	16427326	100

Source: Yearly Budget and Program of KMC for 2020/21.

The budget for Ikha Pokhari Reconstruction, Rani Pokhari Area development, Rani Pokhari Beautification, Kamalpokhari conservation, repairs and beautification works have been allotted from the Infrastructure and Infrastructure (ongoing) headings. Besides, under the Heritage Department, following budgets are allotted for the Hitis and ponds. However, considering the budgets allotted for Heritage (Table 9) and Heritage (ongoing Plan), the proportion of budget for Hiti and ponds is only 1.92%.

Table 9: Budget allocated for hitis and ponds

S.N.	Name	Ward	Budget (in Rs. '000)
1	Dhobichaur Dhungedhara	2	2000
2	Dhungedhara area construction and repair	3	2500
3	Pashupati Bankali Pond conservation, Dhungedhara and Park	8	10000
4	Baneshwar Battisputali Dhungedhara reconstruction	9	3000
5	Dhungedhara Conservation, Thapagaun	10	1500
6	Hiti Pokhari Pati Reconstruction	1	5000
	Total		24000

Considering the four fiscal years, it is found that the budget allocation for the Heritage has an increasing trend. However, the percentage of allocation of budget for Hitis and ponds out of the Heritage Budget does not seem progressive.

Figure 8 shows the trends of budget allocation for Hitis and ponds. The amount of budget allocated for Hitis and ponds by the local users, committees, local clubs, conservation Guthis, cultural clubs, Tole development committees has not been included in the Hitis and ponds budget.

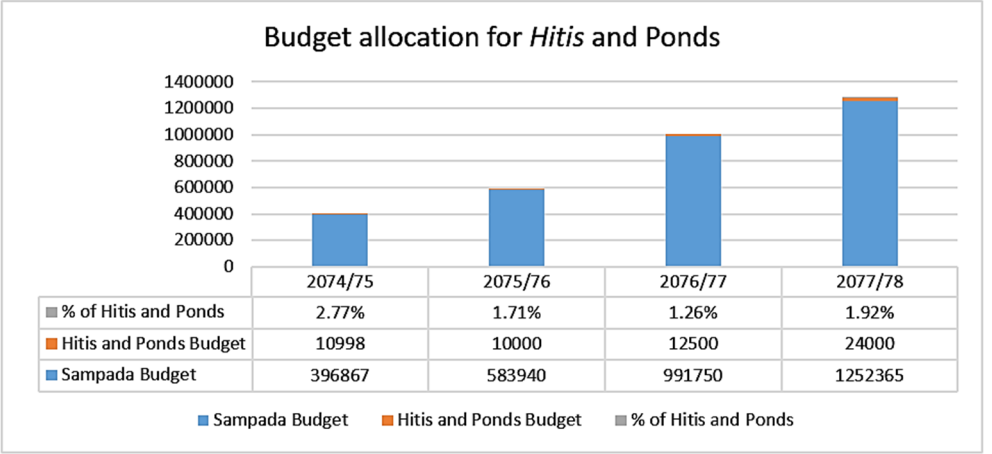

Figure 8: Budget Allocation for Hitis and Ponds in 4 fiscal years

3.6 Legal Provisions for Conservation of Hitis and Ponds

A study by Dixit and Upadhya (2005) suggested several initiatives for augmenting groundwater resources by artificial recharge (AGRAR). The study assessed the groundwater aquifers of the Kathmandu Valley and segregated them into Northern Groundwater district (NGD), Central Groundwater District (CGD), Southern Groundwater District (SGD). Similarly, the study also gave prospects on the artificial recharge through the following ways:

i. Rooftop water harvesting and injection methods,

ii. Constructing ponds,

iii. Recharging through Rajkulos,

iv. Using agricultural fields as natural recharge zones and

v. Injecting surface water into deep wells.

This study gave ways forward to contribute for the ground water recharge and water harvesting as a way to supplement water supplies in Kathmandu. The overall idea was to maintain and execute the entire Hiti system in a sustainable manner. Similarly, for the conservation of stone spouts, "Declaration of the National Convention on Stone Spouts of 2007" was made which had the following provisions (UN-HABITAT, 2008):

- The ownership of traditional water sources, including stone spouts is given to local authorities.
- The policy lacking in the field of stone spouts and source conservation will be addressed by the Government of Nepal.
- Local authorities will take the responsibility of preparing maps of the stone spout system from source to sink along with cadastral mapping.
- Historical stone spouts will be declared as national heritage.

- For the conservation of watersheds and aquifers, the government will declare the area as a watershed area.
- The annual budget will be allocated for stone spouts and source conservation.
- The municipalities will organize local communities, including women in formal user groups and strengthen them for the conservation of stone spouts and sources.
- Sithi Nakha festival will be celebrated as the national festival of sanitation and organize programmes of traditional water source conservation on that day.
- Acts will be promulgated to control unauthorized use of groundwater.
- Concrete programs will be set on stone spouts and source conservation by national and international non-governmental organizations.
- Concrete policies, programs and resources will be adopted for the conservation of stone spouts and their sources by local and central government.

The Declaration highlighted the need for the formulation and adoption of policies governing stone spouts, promulgation of Acts regarding stone spouts, budget allocation, formation of formal users' group, ownership issues and so on. Similarly, it also made the call for the celebration of Sithi Nakha, a national festival to promote traditional blue infrastructures (UN-HABITAT, 2008). Sithi Nakha festival is one of the innovative ways of celebration which gives continuity to the historical practice of thoroughly cleaning traditional water supply systems such as spouts and wells. Besides, auspicious days were selected to carry out cleaning and maintenance activities of stone spouts by Guthis. The workshop identified some key actions for effective implementation which included:

- Publicizing traditional stone spouts as national heritage as per the Ancient Monument Conservation Act, 2013.
- Sensitizing Department of Land Revenue and Department of Survey about the declarations and working with them in conservation efforts while considering the Ancient Monument Conservation Act, 2013 together with:
  - Traditional Stone spouts Enumeration and Mapping, NGOFUWS 2009
  - Second Annual Report, KUKL 2009
  - Situation of Traditional Water Spouts in Kathmandu Valley, ICON/UNESCO.

For the purpose of Hiti conservation, several stakeholders like UNESCO, UN Habitat, Water Aid, NGO Forums, must be involved. Several Tole Sudhar Samitis and local user committees have been formed working with the municipalities. The projects like renovation of stone spouts, rainwater harvesting for artificial groundwater recharge, constructing water treatment and distribution systems, have also been initiated under the participation of different stakeholders (UN-HABITAT, 2008). Nepal is committed to pursuing and achieving the Sustainable Development Goals (SDGs) by 2030.

The right to drinking water in Nepal has been protected by the Constitution of Nepal, 2015 in Article 25, sub-article 4 of Part 3 – Fundamental rights and duties (Nepal Law Commission, 2015). The water and sanitation related targets in SDG-6 are inherent in the

country's periodic development plan and guided by Nepal's WaSH Sector Development Plan (SDP 2016-2030).

The Constitution of Nepal, 2015 has accorded a high priority to protect, promote and use of water resources. Article 30 of the Constitution of Nepal, 2015 states the right regarding clean environment protection of environment. It states that 'Each person shall have the right to live in a healthy and clean environment'. Similarly, the Constitution has also suggested policy provisions to make multi-purpose development of water resources.

The conservation, management and the rational use of natural resources has been envisioned by the Constitution and thus has suggested that the State shall pursue a policy of prioritizing national investment in water resources based on people's participation and contribute to making it a multi-utility development of water resources. Similarly, the Constitution also envisions building a sustainable and dependable irrigation system by controlling water-related natural disasters with the management of the river systems. Thus, these provisions make a clear view for the rational use of the water resources.

The Constitution has mandated the federal government to conserve water resources and develop policies and standards for multi water uses. Similarly, it has mandated the provincial government to manage water resources within their provincial jurisdiction while the drinking water and watershed management is under the jurisdiction of the local government. However, water resource management is also under the concurrent rights of the state, province and local government. The jurisdiction of federal, provincial and local government as summarized by Regmi & Shrestha (2018) is shown in Table 10.

Table 10: Central, provincial and local jurisdiction for water resource management

Jurisdiction	Scope
Central jurisdiction	International boundary rivers, policies relating to conservation and multiple use of water resources, National and international environment management, national parks, wildlife reserves, and wetland, national forest policies, carbon services, land use policies, human settlement, development policies, tourism policies, environment adaptation
Provincial jurisdiction	State level electricity, irrigation, and water supply services and navigation, use of forests and waters and management of environment within the state
Central and Provincial jurisdiction	State boundary river, waterways, environment protection, biodiversity, utilization of forests, mountains, and forest conservation
Local jurisdiction	Local market management and environment protection, irrigation, water supply, small hydro-power projects, alternative energy, protection of watersheds, wildlife, mines and minerals
Central, Provincial and Local jurisdiction	Services such as electricity, water-supply and irrigation, Service fees, charges, penalties and royalties from natural resources, forests, wildlife, birds, water uses, environment, ecology and biodiversity, royalties from natural resources.

In order to successfully implement the strategic actions for the conservation of traditional blue infrastructures, there should be multisectoral collaboration and coordination among municipalities, Ministry of Water Supply, Kathmandu Valley Water Supply Management Board, Kathmandu Upatyaka Khanepani Limited, High Powered Committee for Integrated Development of Bagmati Civilization, and Kathmandu Valley Development Authority, among others. Additionally, Ministry of Urban Development in collaboration with Ministry

of Water Supply, Ministry of Federal Affairs And General Administration, Ministry of Health and population, KVDA, DUDBC, KVWSMB and metropolitan cities/municipalities should prepare strategic action for the conservation of Hitis and Ponds in Kathmandu Valley.

4. Policy Recommendation

Despite the multisectoral engagements and efforts to identify, map, assess and preserve the traditional blue infrastructures (Hitis and ponds), there are several issues in effective implementation. The rapidly increasing urbanization and haphazard constructions have not been adhering to the long term and sustainable approaches for the development of infrastructures. Several case studies of ponds like Bal Mandir Pokhari, Bachha Pokhari ponds, etc. from this study signifies that the urban infrastructures seem to receive higher priority thereby leading to the encroachment and extinction of traditional blue infrastructures.

The study from the KII also suggests that the construction of large buildings and other infrastructures has also resulted in the reduction of percolation and the recharging of aquifers, blockage of traditional channels, and deterioration of ponds. The increasing population, urbanization and water demands, if not taken with due consideration in time, will result in a crisis situation in the very near future.

The value of the contribution of blue infrastructure towards the natural ecosystem seems to have been hardly recognized. The specific plans and policies are to be enacted and implemented in every possible way for the sustainable management of traditional blue infrastructure. Thus, in order to contribute to the preparation of inventory as well as the management of Hitis and ponds, following recommendations are made:

Short Term Recommendations

A. Planning and implementing immediate conservation programs for ponds and hitis: This study has recommended the conservation of missing and non-operational traditional blue infrastructures in KMC. In order to assess and conserve the traditional blue infrastructures like ponds and hitis, the local government should take the lead and plan for the potential activities. For this, the following activities can be implemented in short term.

- Developing and installing Information boards regarding the importance and significance of Hitis and Ponds.
- Prioritizing Hitis and ponds based on its operational status.
- Allocating budget for regular cleaning and maintenance works.
- Preparing a study team to understand the dynamics of Hitis and ponds during the rainy season.
- Enacting strict rules and regulations through inscriptions and local institutions like Guthi and clubs.
- Ensuring Multi-stakeholders' participation and participatory approaches.

Different conservation activities should be planned and implemented as shown in Table 11.

Table 11: Convervation activities that should be preserved

S.N.	Activities	Level	Interval
1	Celebration of regional festivals like Sithi Nakha	Municipal, Local	Every Year
2	Regular cleaning and maintenance activities	Local and Participatory	Every month
3	Celebration of cultural practices like Indra Jatra, festivals like Nag Panchami, Shiva Ratri, and so on.	Ward and Municipal	Major festivals
4	Capacity building and preparing locals to update the inventories and status of ponds and Hitis, measuring flows (Preparing citizen scientist)	Municipal, Local	Regular interval

Medium-term Recommendations (2-3 years)

B. Treating root causes, not symptoms (Preparation of blue infrastructure network zones and buffers for KMC): KMC should work on the identification of the root causes for the existing status of the Hitis and ponds. This can be done through the preparation of a network map of traditional blue infrastructures like Hitis, ponds, rivers, modern systems like pipelines of the city, and so on. The urban expansion and development of the infrastructures should be in accordance with the existing blue infrastructure network map in the city and shouldn't block the channels or affect the aquifer and groundwater recharge. Similarly, following considerations should be made:

- **Buffer Zones:** Preparing buffers and demarcation of critical zones from the networks of blue infrastructures while constructing new infrastructures.
- **Land Pooling and Acquisition:** Blue Infrastructure Network map of the city should be properly assessed before going for the Land acquisition Process and New Urban Expansion areas. The proposed infrastructures should not obstruct or disturb the channel and its elements.
- **Maintaining Ground Coverage Ratio**: As per the building byelaws, KMC has made provisions for the 30-40% of the land allotted for open spaces. The new houses seem to have been constructed with 60-70% of the occupancy of the total land. This should be implemented in the commercial areas as well, as they seem to have maximum ground coverage.
- **Foundation Depth:** As per the field survey, the reduced level of stone spouts are generally found 5-10 ft below the existing ground level. The mandatory rule of thumb and even the building practices in KMC suggest the foundation depth to be 5-6 ft. Thus, in order to protect the water channels, blue infrastructure zoning has to be taken into consideration.
- **Deep Borings:** The haphazard digging of bore holes and extracting of excess ground water should be strictly prohibited. Special considerations and restrictions should be made for the blue infrastructures of heritage zones of KMC.

C. Effective implementation of "Recharge Kathmandu" campaign: The campaign **Recharge Kathmandu** was launched in 2019 which envisions the provision of recharge pits, recharge trenches, rain gardens, and so on. The existing deep borings in different areas

of KMC has resulted in the huge extraction of water and depletion of aquifers. In order to contribute to the percolation and recharge of the groundwater, KMC has been aiming for wise implementation. However, the implementation part is not sound yet. Following provisions can be opted for the effective implementation of this campaign:

- **Identification of the areas like open spaces** of school buildings, apartments, and hospitals and making mandatory provisions to make a hole in an effort to increase the underground water level of the city. The rainwater and extra water from household activities will be collected and passed through the recharge wells and pits to increase the underground water level.
- **Subsidy policy in building taxation:** A residential building having provisions for Recharge Kathmandu campaign or contributing significantly to the artificial recharge of ground water resources shall be provided with subsidies or a reduction in municipal tax while obtaining building permit system.
- **Guidelines for the allocation of spaces for recharge**: Every public and private building should allocate a minimum area for the provision of pits/trenches and open spaces for the purpose of recharge.

D. Exploring multiple solutions and implementing the best alternatives: The issues identified in this study can be a baseline to explore multiple solutions that can contribute towards the conservation and restoration of blue water infrastructures. Some of the possible approaches should be:

- **Development of flagship program:** Planning of the flagship program for the restoration and revitalization of missing Hitis and ponds should be prepared.
- Launching of various participatory campaigns like **Mero Hiti, Pokhari, Mero Abhiyan** in coordination with the locals and the municipal authorities,
- **Augmenting modern piped system to the non-operational/dried hitis and ponds:** As per the KIIs with the locals, some water spouts are still the major source of drinking water to many households in the city. Similarly, the ponds and stone spouts which are non-operational or which have been staying dry for a long time should be analyzed and studied for its restoration. It can also be augmented with the existing modern pipelines so as to supplement the water supply in this city, especially during winter seasons. This will also help in the promotion of aquatic ecosystems and biodiversity. KVWSMB has also been investing in the establishment of the Water ATM Service/Pani Padhero in the different areas of the city to provide safe drinking water to the public at a low cost. However, the non-operational stone spouts seem to have received less priority.

E. Establishment of monitoring, evaluation and reporting unit: There is a municipal authority to allocate the budget and also keep in track with the status of the implementation of planned activities. It is very much essential to establish a dedicated monitoring system for the mapping and assessment of the blue infrastructures like Hiti, ponds, and so on. The flagship programs, budgeted activities, conservation initiatives and implementation prospects should be reviewed through the monitoring system in order to prepare a regular progress report of the infrastructures. The regular monitoring, evaluation and reporting should include the following:

- Allocation of a core and dedicated Monitoring and Evaluation Unit for maintaining and updating of the information related to the inventory of the water heritages,
- Provision of trained Human Resource for the regular monitoring and maintenance,
- Recording a daily discharge of Hiti throughout the year to get an idea about the dry season and wet season flow,
- Assessment of the planned budget and implementation status of the activities,
- Assessment of the encroachment status,
- Regular Monitoring of the drainage and water logging problems,
- Documentation of the on-going initiatives, and progress update.

Long-Term Recommendations

F. Improving the understanding of blue infrastructure: The information regarding the contribution of blue infrastructures like ponds and Hitis to maintain the ecosystem and ground water conditions should be well disseminated at the household level. Blue infrastructure can serve to develop a sponge city contributing to the reduction of urban heat island effect and issues related to groundwater management, problems of water logging and urban flood issues. It also promotes cultural practices and adds aesthetic value. The water environment can also contribute to the management of the ecosystem and urban biodiversity.

The proper understanding of the blue infrastructures can enhance the urban livability and can even contribute to the various disaster risk reduction measures like fire fighting. It requires a good understanding of the context, which can be improved by:

- **Building up an internal stock of knowledge:** The understanding of the importance of blue infrastructures in the urban landscape is possible through the improvement of general knowledge and capacity of the local government as well as the local stakeholders. This can be done through a review of best practices, examples and study of similar case studies and recommendations.
- **Adpting participatory approaches** integrated with water resource management practices: The community level participation will support the immediate implementing body like municipalities and other line agencies in the preparation of the inventories and assessment of their status.
- **Learning from the pilot initiatives and indigeneous knowledge:** Implementing the pilot initiative in a sound manner can set a benchmark for the development of similar activities in the long run. Similarly, the traditional and indigeneous knowledges on Hiti, channels, and the flow network can be a good lesson for the establishment and conservation of a similar system. Also, the indigeneous knowledge can be blended with the integrated water resource management practices to explore the benefits of water heritages.
- **Turning wastelands into wetlands: T**raditional water heritages which have already dried or been covered with waste can be converted into wetlands.

- Considering the cultural, historical values, range of benefits, and its contribution to the ecosystem, the significance of the conservation of ponds and hitis should be identified along with stakeholder mapping and their delineation of the roles.
- Preparing plans for the sustainability of Hiti/Board/Guthi/user committee for conservation.

Table 12 summarizes the long-term management of blue infrastructures.

Table 12: Framework for the long-term management of blue infrastructure

S.N.	Function	Related Activities	Involvement
1	Planning and Development	Collection, recording, and analysis of data, status	Municipal Authority, Community
2	Design and Engineering	Sustainable management of the Hitis and ponds. Preparation of blueprints, master plans	Municipal Authority, Conservationist
3	Application and Funding	Preparing proposals and Applying for the possible budget on conservation plan, Master plan, sustainability of the heritage.	Municipal Authority
4	Participatory Engagement	Implementation of the initiatives, Ownership and Management of the heritages, developing sustainable solutions with integrated approaches	All Stakeholders
5	Communication and Networking	Improving Awareness of stakeholders, information dissemination through publications, web apps, video documentaries, features, policy dialogues	All Stakeholders
6	Construction and Restoration	Restoration and reconstruction of the heritages	Municipal Authority
7	Use, Operate and Govern	Activities and knowledge for the operation and optimum performance of the infrastructure Execution and Management of the resources	Local Stakeholders, Municipal Authority
8	Monitoring, Evaluation and Reporting	Regular monitoring and tracking of the information, dynamic inventory, mechanism for reporting	Municipal Authority, Local Stakeholders

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Assessment of Biomass and Carbon Stock Potential of Avenue Plantation around the Ring Road of Kathmandu Valley for Mitigating the Impacts of Global Climate Change

Nabin Raj Joshi

Abstract

This study presents a comprehensive baseline of carbon stock potential of avenue plantation around the Ring Road. A total of 40 permanent sample plots were placed randomly for the detailed biomass and carbon assessment. Mainly two carbon pools – above ground (trees, saplings, and herbs and grasses) and below ground (root) – were considered in the detailed assessment. The assessment recorded a total of 9 different species of seedlings, 19 species of saplings and 25 different species of trees in the avenue plantation sites. The distribution of trees based on their diameter class showed an interesting pattern. Around 67% of trees had a bigger diameter class (10 -70 cm), while around 33% of young trees had a lower diameter class (less than 10 cm). On average, the mean seedlings, saplings and tree density were found to be 2149, 585 and 185 per hectare respectively. The mean tree basal area and mean sapling basal area were calculated as 0.33 and 8.04 m^2 ha^{-1} respectively. The mean carbon stock per hectare in the avenue plantation of Ring Road area was found to be 24.03 $tCha^{-1}$ and the total carbon stock was found to be 7,785.72 tC. Likewise, the total baseline tCO_2e stock in the avenue plantation was found to be 28,573.60 tCO2e. The net carbon dioxide emission due to the vehicle movements in the Ring Road was calculated to be 42,574.40 tCO2e. There was a deficit of carbon dioxide in terms of stock in the avenue plantations by 14,000.80 tCO_2e (i.e., 3815 tC). This implies that the existing plantation in the Ring Road area is unable to sequester/offset the carbon dioxide that is emitted through the transportation sector. Thus, open spaces like riverbanks and other public lands, in which urban forests could be developed have to be planned for green infrastructure and plantation of multipurpose trees.

Keywords: Biomass and carbon, carbon emissions, climate change, avenue plantation

1. Introduction

1.1 Background

Trees including green vegetation store about 80% of all aboveground and 40% of all belowground terrestrial organic carbon, making forest ecosystems crucial to maintaining the global carbon balance and mitigating climate change (IPCC, 2001). Forest carbon sequestration is a measure that can be taken to mitigate climate change. But the amount of carbon stored in forests differs according to spatial and temporal factors such as forest type, size, age, stand structure, associated vegetation, ecological zones, management regimes, among other things. Forest management and associated silviculture treatments are key determinants of forest carbon dynamics. Vegetations, along with associated soil types, are viable sinks and are making significant contributions to sequestering atmospheric carbon, thus mitigating the impacts of climate change. To quantify the amount of carbon sequestered, temporal stocks of carbon within various forest strata need to be assessed.

Reducing emissions from deforestation and forest degradation along with conservation and sustainable management of forests in developing countries (REDD+) is emerging as an effective tool to mitigate and adopt the impacts of global climate change (Angelsen, 2008; FAO, 2011). The fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC) has estimated that the forest sector contributes 17.4% of all greenhouse gases from anthropogenic sources, most of which is due to deforestation and forest degradation (IPCC, 2007). Stern (2007) observed that controlling deforestation and forest degradation is a cost-effective way to reduce greenhouse gas emissions. Based on the scientific evidences, the Conferences of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COPs) after the 13th session (COP 13) in Bali, Indonesia outlined a long-term cooperative action and called for enhanced national and international actions for operationalizing REDD+ to reduce greenhouse emissions and address climate change adaptation and mitigation in developing countries.

Uncertainty in the forest biomass and carbon sequestration rates in the region is largely because average biomass values have been used in most calculations to estimate the carbon flux till date. The possibility that deforestation, chronic disturbances and topography will result in forest biomass that is significantly different from the average values, and linking specific locations of disturbance and topography with geographically specific estimates of biomass would improve estimates of carbon fluxes. Air pollution and greenhouse gas emissions due to the diverse anthropogenic activities have been a crucial issue at the present in mega cities like Kathmandu.

The transportation sector is one of the major energy consuming and global greenhouse gas emitting sectors (Bajracharya and Bajracharya, 2013). Fuel consumption has been increasing in the past few decades in Nepal, especially in Kathmandu Valley, due to rapid modernization and increasing population that have been causing various emissions in our surroundings and thus, creating various environmental problems. The principal emissions from vehicles are greenhouse gas i.e. CO_2, N_2O and CH_4. The main gas emitted is CO2 which is directly associated with the volume of fuel consumed and the type of fuel used (petrol and diesel). The major sources inviting the environmental pollutants can roughly be divided into stationary and mobile sources. Stationary sources include installations for the

industrial processes. Mobile sources include various means of transport such as city buses, trucks (heavy and mini), passenger cars, vans, motorbikes (bike and scooter). This study has focused on CO_2 emissions in Ring Road area transportation in Kathmandu Valley (KV).

In this context, an assessment of the biomass and carbon stock/sequestration potential of the road side avenue plantation in the Ring Road areas of Kathmandu Metropolitan City (KMC) seems very crucial to know how much biomass and carbon is being stocked and absorbed in these different types, aged, sized trees as well as how much carbon is being emitted per day in the same area by the vehicles. This will give an idea on how much carbon is emitted and how much is being sequestrated by the roadside trees/plants. This will provide an idea to the policymakers on whether these available trees are sufficient or not for balancing, neutralizing or offsetting the carbon emitted through different transport.

The roadside plantations are in the primitive phase and gradually increasing in Nepal, thus if this can be included in the Kyoto Protocol and other climate change adaptation and mitigation initiatives like REDD+, it will have great potential for development as a climate change project and can generate millions of dollars annually by charging the industrialized countries for the carbon they sequester in the plant biomass and soils. However, earning such money is not easy. Community and private forestry, roadside plantations should have scientific data on the amount of carbon sequestration and its systematic financial valuation. Thus, for an assessment of potential carbon stock and sequestration, the estimation and valuation of carbon content in forests, trees or any type of management regimes is very important.

Carbon sequestration is the removal of CO_2 from the atmosphere and its ultimate storage in the biosphere. About two-thirds of terrestrial carbon is sequestered in the standing trees, forest under canopy plants, leaf and forest debris, and in forest soils. Forests and wooded areas are natural carbon sinks. This means trees store carbon by sequestering atmospheric CO_2 in the growth of wood biomass through the process of photosynthesis and thereby increasing the soil organic carbon (SOC) (Brown and Pearce, 1994). Carbon sequestration in soils represents the most promising option for CO_2 mitigation. Carbon sequestration in soils is a climate change mitigation strategy based on the assumption that the movement or flux of carbon from the air to the soil can be increased while the release of carbon from the soil back to the atmosphere can be decreased. This transformation has the potential to reduce atmospheric CO_2, thereby slowing global warming and mitigating the impact of global climate change.

Forest vegetation (trees) are possible victims of the planet's figurative fever, and so without a greater understanding about specific ecosystems of the world, remedial action will be, at best, reliant on some guesswork. Site and vegetation mapping has shown that forests respond with great sensitivity to even minute differences in temperature and moisture regimes (Schoene, 1983). Modern technologies augment understanding of the globe's carbon cycle and the role of forests in it. However, forest inventories are indispensable to complement or substantiate estimates and models for quantifying vast carbon stocks and flows in forest ecosystems. Improved and more frequent inventories and forest assessments have become essential with the advent of obligatory carbon stock changes by countries (FAO, 2005). It is also not clear how much of the discrepancy is the result of omissions of management practices, induced by natural and human disturbances or the result of environmentally enhanced rates of tree growth.

1.2 Objective

The general objective of this research is to assess the biomass and carbon stocks and sequestration potential of the avenue plantation in the Ring Road area. The specific objectives are as follows:

- To quantify the above and below-ground biomass and carbon stock potential of the avenue plantation
- To quantify the amount of CO_2 emissions from different types of vehicle
- To analyze the amount of carbon release (emissions) and sequestration by the trees and vegetation
- To recommend the concerned authority for further improvements of roadside plantations and management.

1.3 Limitation of the Study

The study on assessment of biomass and carbon stocks/sequestration potential of the avenue plantation in the Ring Road areas of KMC was limited towards measuring the soil carbon pools and other vegetation near or associated with the Ring Road. Furthermore, the projections of tree carbon were based on the tree vegetation grown in a similar geographic area but not exactly in the avenue plantation sites.

2. Methodology

2.1 Desk Study

Numerous ecological studies have been conducted worldwide to assess carbon stocks based on carbon density of vegetation and soils (Atjay et. al., 1979; Olson et. al., 1983; Saugier and Roy, 2001). The results of these studies are not uniform and have wide variations and uncertainties probably due to the aggregation of spatial and temporal heterogeneity and adaptation of different methodologies. IPCC (2000) estimated an average carbon stock of 86 tons per hectare in the vegetation of the world's forests for the mid-1990s. The corresponding carbon in biomass and dead wood in forests reported in Forest Resource Assessment (FRA) in 2005 amounts to 82 tons per hectare for the year 1990 and 81 tons per hectare for the year 2005.

In addition, the following secondary sources were reviewed thoroughly: Forest Act 2076 of Government of Nepal, Emission Reduction Program Document (ERPD) documents of Government of Nepal, Nepal's MRV document, Forest Reference Level Documents 2000-2010 of Nepal, REDD+ strategy for Nepal, documents of the Department of Transport Management, TAL and CHAL carbon report, analytical study on assessing the value of forests, the political economy of land use and the carbon emissions from the drivers of deforestation, approved VCS Module VMD0008 Version 1.0 REDD Methodological Module: Estimation of baseline emission from forest degradation caused by extraction of wood for fuel (BL-DFW) Sectoral Scope 14, National Population and Housing Census 2011, Statistical Yearbook 2019, Environment Statistics of Nepal 2019, AFOLU Guidelines 2006, IPCC

Guidelines for National Greenhouse Gas Inventories, and State of Nepal's Forests- Ministry of Forest and Soil Conservation, 2015.

2.2 Theoretical and Analytical Framework

To assess the total biomass and carbon stock potential in the avenue plantation of the ring-road area of Kathmandu Valley and estimate the carbon dioxide emissions from various types of vehicles, we collected primary and secondary data related to the study. The detailed theoretical and methodological framework has been provided in Figure 1.

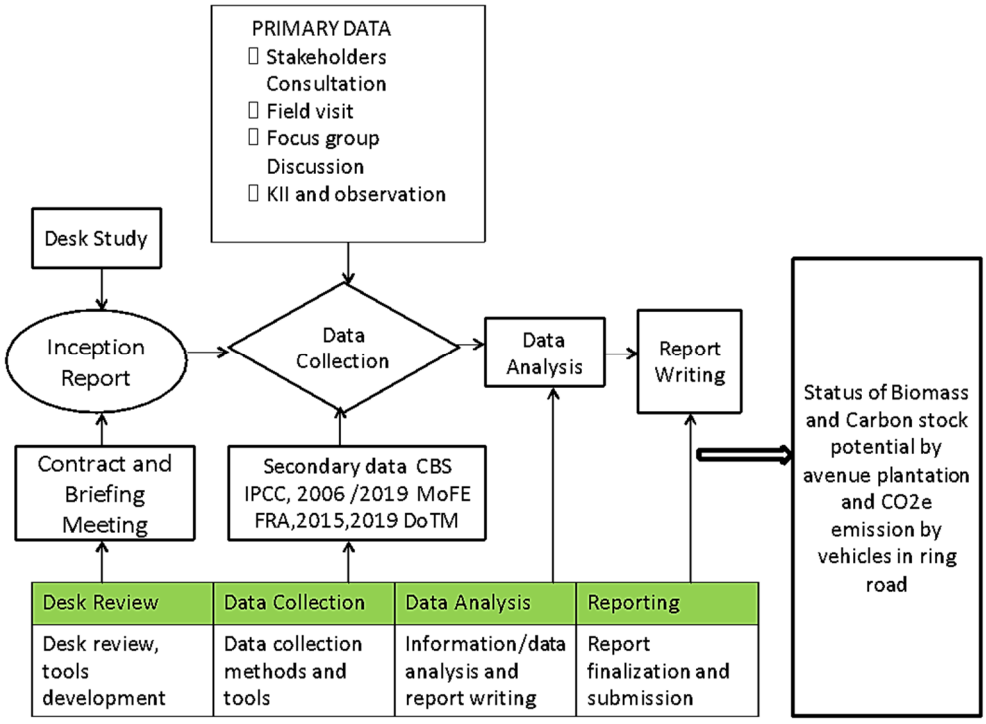


Figure 1: Theoretical and analytical framework

2.3 Study Site

This study was carried out in the avenue plantations of the Ring Road area that belongs in the Kathmandu and Lalitpur districts of the Kathmandu valley. The total length of the Ring Road is 27 km (17 miles). It has a right of way of 62m (with 31m on either side of the center line).

The Ring Road connects major places like Kalanki, Satdobato, Gwarko, Balkumari, Koteshwor, Tinkune, Gaushala, Sukhedhara, Maharajganj, Shamakhushi, Gongobu, Balaju, Swyambhunath, and Balkhu (Map 1).

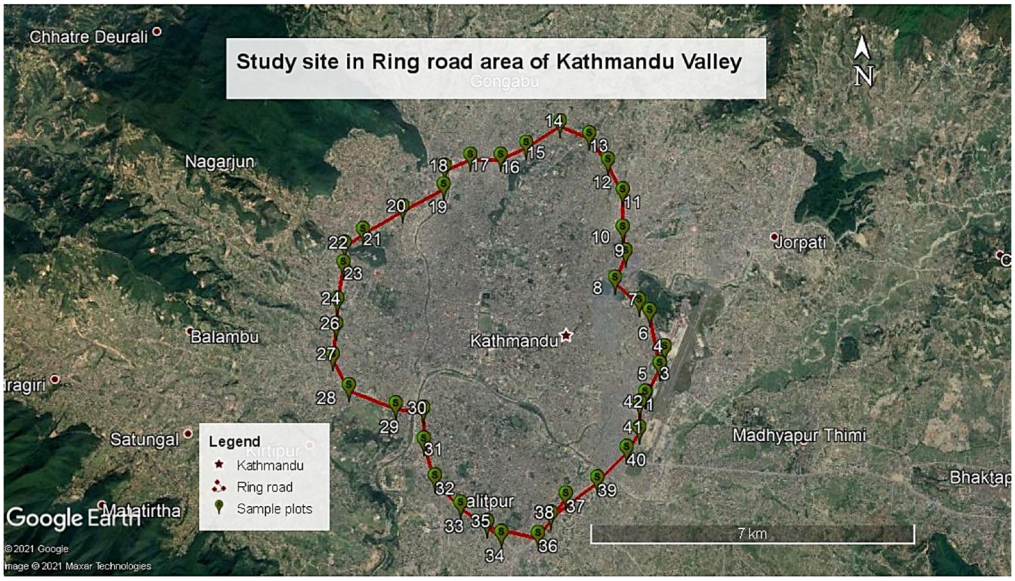
Map 1: Map of the study site

2.5 Sampling Design

2.5.1 Sampling Intensity

Firstly, the study team reviewed and identified the total roadside plantation area and then developed a map through consultations with the concerned local stakeholders and government staff. Secondly, based on the review and discussions, the roadside plantation area map was divided proportionally into blocks, the total area was calculated, and sampling was done following the Standard Forest Inventory Guideline, 2061 B.S.

After identifying the planted areas of different species in different blocks of the Ring Road, the study team adopted the sampling intensity of 0.5% to 0.1% in the potential planted areas. The nested sample plot method suggested by Ravindranath and Ostwald (2008) was used in the sampling design because of its simplicity. The random sampling method was adopted for this study, where the sample plots were established in both (left and right) alignments in 500-1000 m distance alternatively. A total of 42 sample plots were determined to capture the variance of different biophysical attributes (Map 2).



Map 2: Sample plot map in the Ring Road area

2.5.2 Design of Nested Circular Plots

As shown in Figure 2, concentric nested circular plots were used for the tree biomass and carbon assessment. This design also minimizes edge effects, which usually occur in rectangular plots. A circular plot of 500 m^2 with a 12.62 m radius was set up to measure the trees with a diameter greater than 5.1 cm, while an additional nested plot of 100 m^2 with a 5.64 m radius and 0.1-5.0 cm diameter was established for sapling measurement. In case of the smaller diameter class trees, the collar diameter and height were recorded.

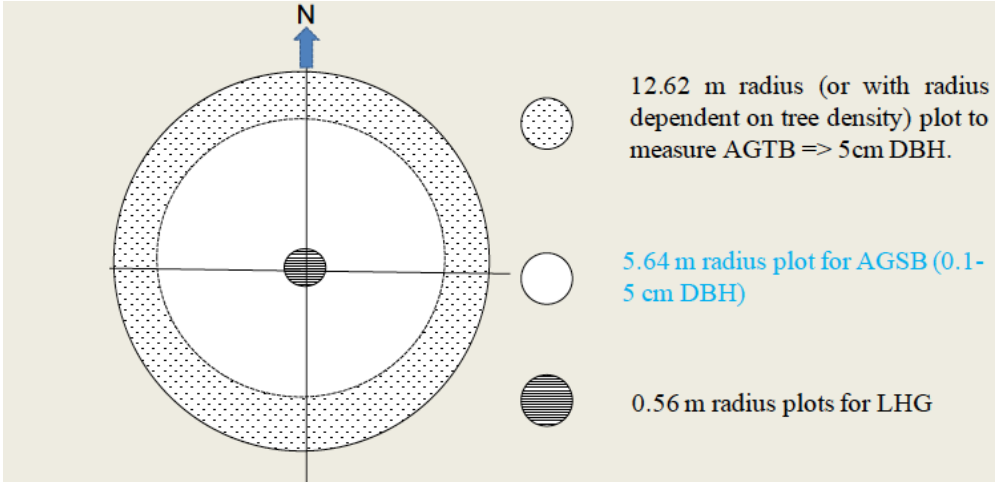


Figure 2: Shape and size of the concentric circular plot

2.6 Measurement of Above-Ground Tree and Sapling Biomass

2.6.1 Measurement of the Saplings

Saplings are those that have a height of more than one meter and diameter breast height (DBH) of less than 5 cm. The saplings were counted and measured in the nested plot with a 5.64 m radius. The first sapling was measured in the North direction from the center of the plot and gradually other saplings were recorded in a clockwise direction. The diameter of each sapling was measured to be exactly 1.3 m (at breast height) from ground level. The species of the individual sapling was also recorded.

2.6.2 Measurement of Trees

All the trees having a DBH equal or greater than 5 cm were considered for estimating above-ground tree biomass. These trees were counted and measured within the nested plot of 500 m^2 with a radius of 12.62 m. The tree height was measured using Vertex IV and transponder and the tree DBH was measured using a diameter tape. To collect height and diameter variables accurately and precisely, the survey team followed the standard principle of tree diameter and height measurements. Similarly, diameter and height of irregular trees were measured according to the principles.

2.6.3 Measurement of Herbs and Grasses

The circular sub-plot with a 0.56 m radius was established at the center of the plot to collect the sample of herbs and grasses. All the green grasses and herbs within the plots were collected and weighed. Likewise, herbs and grasses (all non-woody herbaceous plants) within the plots were collected by clipping all the vegetation down to the ground level in a destructive manner, then weighed and placed in a sample weighing bag which was brought to the laboratory to determine the oven-dry weight of the biomass.

2.6.4 Data Compilation, Entry and Analysis

After field measurement, all the data sheets were indexed and entered into a spreadsheet. Excel and R programs were used for analyzing and producing desired outputs in the form of tables and graphs. The above-ground biomass (sapling and trees) and below-ground biomass (root) carbon was analyzed using equations given below.

All the biomass and carbon pools were added to get total biomass and carbon in a particular plot, then in the stratum and finally in the area. The biomass value was converted into carbon and carbon dioxide using the fraction of 0.47 by IPCC (2006) and 3.67 by (Pearson *et. al*, 2007) respectively.

2.7 Data analysis of Above-Ground Biomass

2.7.1 Sapling Biomass

National allometric biomass equation (developed by the Department of Forest and Department of Forest Research and Survey, Nepal 2000) was used to determine the sapling

biomass (≤5 cm DBH). In the case of tree species (other than the equations provided in the biomass table), equations were applied according to the given associations of species.

The regression model below in eq. (i) will be applied to calculate sapling biomass:

$$log\ (AGSB)\ =\ a + b\ log(D) \quad \text{..... eq. (i)}$$

where,

$AGSB$ = aboveground sapling biomass (kg)

a = intercept of allometric relationship for saplings (dimensionless)

b = slope allometric relationship for saplings (dimensionless) and

D = diameter at breast height at 1.3 m above ground (cm).

Slope (a) and intercept (b) for saplings have been developed by the Department of Forest Research and Survey (DFRS) and the Department of Forest Tree improvement and Silviculture Component (TISC), Nepal (Tamrakar, 2000).

2.7.2 Above-Ground Tree Biomass

According to the ecological condition of the forest, the above ground biomass calculations were performed based on the appropriate equation eq. (ii) guided by the forest carbon measurement guideline suggested by Chave *et al.* (2005, p. 93) (for moist forest stand).

$$AGTB = 0.0509 *\ \rho\ D^2HAGTB = 0.0509 * \rho D^2H \quad \text{.....eq. (ii)}$$

where,

$AGTB$ = aboveground tree biomass (kg)

ρ = wood specific gravity (kg m-^{3});

D = tree diameter at breast height (DBH) (cm)

H = tree height (m)

Specific wood gravity (ρ), as mentioned in the Master Plan for Forestry Sector (MFSC), was used in the calculation. For the tree species without wood specific gravity, a general value was used according to associated forest types (MSFC, 1989).

2.7.3 Below-Ground Tree Biomass

Below ground biomass commonly known as root biomass will be estimated using the default root-to-shoot ratio value. According to Geider *et al.*, 2001, measurements of root biomass are indeed highly uncertain, and the lack of empirical values for this type of biomass has, for decades, been a major weakness in ecosystem models. In this study, below ground biomass will be calculated with the root-to-shoot ratio value of 1:5 as suggested by MacDicken (1997), which means that belowground biomass represents nearly (20%) of aboveground tree biomass.

2.7.4 Herbs and Grasses Biomass

For herb and grass, the amount of biomass per unit area was calculated by using the following eq. (iii):

$$HG = \frac{W_{field}}{A} \cdot \frac{W_{subsample,\ dry}}{W_{subsample,\ wet}} \times 10000 \quad \text{..... eq. (iii)}$$

where,

HG = biomass of leaf herb, and grass (t ha^{-1})

A = size of the area in which herb and grass were collected (m^2)

W_{field} = weight of the fresh field sample of herb, and grass, destructively sampled within an area of size A (gm)

$W_{subsample,\ dry}$ = weight of the oven-dry sub-sample of herb, and grass taken to the laboratory to determine moisture content (gm)

$W_{subsample,wet}$ = weight of the fresh sub-sample of herb, and grass taken to the laboratory to determine moisture content (gm).

2.7.5 Total Carbon Stock Calculation

The total biomass of each pool was converted into carbon by multiplying the default carbon fraction by 0.47 as recommended by the IPCC (2006). Then, eq. (iv) was used to estimate total carbon stock by summing up all carbon pools calculated to have total forest carbon stock (in ton) per unit area.

$$TC(LU) = C(AGTB) + C(SB) + C(BB) \quad \text{..... eq. (iv)}$$

where,

$TC(LU)$ = carbon stock for a land use category (tC ha^{-1})

$C(AGTB)$ = carbon stock in aboveground tree biomass (tC ha^{-1})

$C(SB)$ = carbon in sapling biomass (tC ha^{-1})

$C(BB)$= carbon in belowground biomass (tC ha^{-1})

The carbon stock will finally be converted into tons of CO_2 equivalent by multiplying it by 44/12, or 3.67 (Pearson *et al.* 2007).

2.8 Estimation of Carbon Dioxide Emissions from Vehicles

The statistics of the vehicle data provided by the Department of Transport Management, Nepal includes only the cumulative number of vehicles registered for the first time and therefore, does not represent the actual vehicle fleet existing and plying on the road each year. Every year, many vehicles are scrapped. The actual vehicle fleet plying on the road can be estimated by subtracting the scrapped vehicles from the annually registered vehicle

numbers. However, data for annual arguing rates do not exist in Nepal. So, the public vehicles older than 20 years, which are not allowed to run in Kathmandu Valley, are not included.

The choice of method depends on various factors such as the availability of data and the importance of the source category. Since there are no country-specific emission factors for emission assessment in Nepal, the default values provided by the IPCC (2006) guidelines were used either in the calculation of the net calorific value or in the CO_2 emission studies or in the carbon oxidation fractions. Methodologies for estimating national inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases are given in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The Tier 1 approach as per IPCC Guidelines for National Greenhouse Gas Inventories, 2006 was used for calculating CO_2 emissions, which is represented by eq. (v).

$$E = \sum_a Fuel\ (a)\ X\ EF(a) \quad \text{..... eq. (v)}$$

where,

E = CO_2e Emissions by road transport.

Fuel (a) = Total fuel consumed by vehicles by type.

EF(a) = Emissions Factor

a = Types of fuel (Petrol or Diesel)

Similarly, the energy demand and emission per mode of transportation can be calculated using eq. (vi).

$$ED = N * F \quad \text{..... eq. (vi)}$$

where,

ED = Energy Demand

N = Number of existing vehicles

F = Average fuel economy in liters per kilometer

Finally, the total emission from a vehicle is a function of energy consumed by it as given by eq. (vii).

$$\text{Emission CO2e} = ED * E \quad \text{..... eq. (vii)}$$

where,

Emission CO_2e = Emission from a vehicle

ED= Energy demand

E= Emission by road transport.

3. Results and Discussion

3.1 Avenues Plantation Area Carbon Baseline

3.1.1 Species of Seedlings, Saplings and Trees in Ring Road

Within the sampled plots in the Ring Road area, a total of 9 different species of seedlings, 19 species of saplings and 25 species of trees have been observed (Table 1).

Table 1: Different species of seedlings planted in Ring Road of Kathmandu valley

Types of plantation	Local name	Scientific name
Seedlings	Australian pine	*Araucaria heterophylla*
	Firfire	*Acer pictum*
	Gulmohar	*Delonix regia*
	Kapoor	*Cinnamomum camphora*
	Birendraphool	*Jacaranda oveliafolia*
	Living Fossil	*Ginkgo biloba*
	Mango	*Mengifera indica*
	Russian alne	*Elaeagnus angustifolia*
	Tejpat	*Cinnamomum tamala*
Saplings	Australian pine	*Araucaria heterophylla*
	Amba	*Psidium guajava*
	Asuro	*Justicia adhatoda*
	Kalki phul	*Callistemon citrinus*
	Rudrakshya	*Elaeocarpus ganitrus*
	Gulmohar	*Delonix regia*
	Hedgerow	*Boxus sempervirens*
	Ino	*Ricinus communis*
	Kaneur	*Cascabela thevetia*
	Firfire	*Acer pictum*
	Kapoor	*Cinnamomum camphora*
	Kimu	*Morus alba*
	Kuri	*Lantana camera*
	Laurus Nobilis	*Laurus Nobilis*
	Living Fossil	*Ginkgo biloba*
	Peepal	*Ficus religiosa*
	Morpankhi	*Thuja orientalis*
	Tejpat	*Cinnamomum tamala*
	Cupressus	*Cupressus torulosa*
Trees	Amba	*Psidium guajava*
	Apple	*Malus domestica*
	Bar	Ficus benghalensis
	Bhimal	*Grewia optiva*
	Kalki phul	*Callistemon citrinus.*
	Eucaluyptus	*Eucalyptus globulus*
	Kaiyo	*Grevillea robusta*
	Gulmohar	*Delonix regia*
	Ino	*Ricinus communis*
	Jacranda	*Jacaranda oveliafolia*
	Kaniur	*Cascabela thevetia*
	Kapoor	*Cinnamomum camphora*

Types of plantation	Local name	Scientific name
	Kimbu	*Morus alba*
	Kutmero	*Litsea polyantha*
	Pyramid tree	*Lagunaria Patersonia*
	Lapsi	*Choerospondias axillaris*
	Firfire	*Acer pictum*
	Morpankhi	*Thuja orientalis*
	Gulab jamun	Syzygium jambos
	Paiyu	*Prunus cerasoides*
	Mango	*Mangifera indica*
	Rubber Plant	*Ficus elastica*
	Bains	*Salix alba*
	Surai	*Cupressu torulosa*
	Bhogate	*Citrus grandis*

3.1.2 Tree Diameter and Height

In the scattered plot between tree height and diameter, a strong positive correlation was observed with an R^2 value of 0.6667, an adjusted R^2 value of 0.6628, an F–statistic of 159.3 on 1, degrees of freedom (DF) of 182 and a p-value < 0.001 (Figure 3).

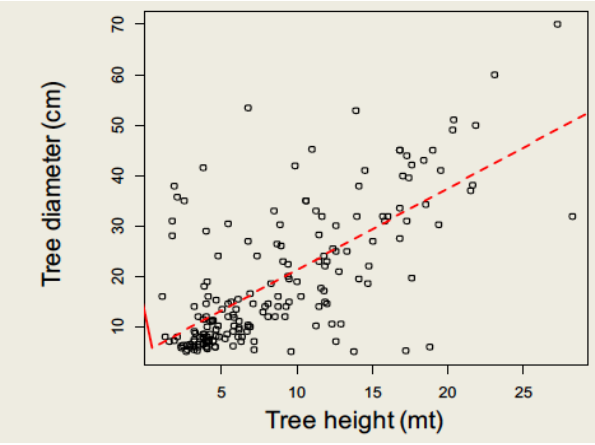


Figure 3: Scattered plot between tree diameter and height

3.1.3 Plot and Per Hectare Seedling, Sapling and Trees density

Based on the inventory of the avenue plantations in the Ring Road area of Kathmandu Valley, the mean tree density was calculated. The mean seedlings, saplings and tree density was found to be 9549, 585 and 194 trees per hectare respectively, as given in Table 2.

Table 2: Seedling, sapling, tree density per hectare basis

Variables	Seedling density (m^2 ha^{-1})	Sapling density (m^2 ha^{-1})	Tree density (m^2 ha^{-1})
Mean	2,149	585	194
Std. dev	1962	536	165

3.1.4 Tree Biomass, Carbon and Carbon Dioxide Stock in the Avenue Plantation

The inventory in the avenue plantation of Ring Road area has estimated that the mean tree biomass, carbon and carbon dioxide in the above and below ground pool was found to be 49.0t ha^{-1}, 22.98tC ha^{-1} and 84.3tCO2e as given in Table 3. The box and whisker plot plotted for tree carbon expressed that there is a huge potentiality of enhancing carbon upto 200 $tCha^{-1}$ in the future with better silviculture and management practices (Figure 4).

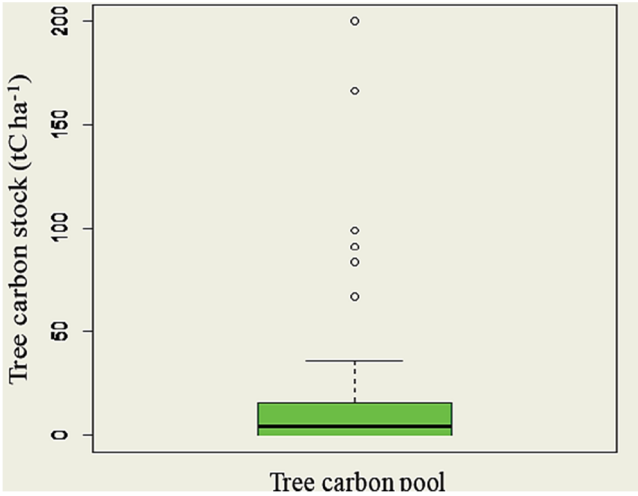


Figure 4: Box and whisker plot for tree carbon

Table 3: Tree biomass, carbon and carbon dioxide stock

Variables	Biomass stock (t ha^{-1})	Carbon (tC ha^{-1})	Carbon Dioxide (tCO2e)
Mean	49.0	22.98	84.3
Std. dev	34.6	15.3	66.2

3.1.5 Sapling Biomass, Carbon and Carbon Dioxide

The mean sapling biomass, carbon and carbon dioxide stock were found to be 1.75 tha-1, 0.82 tC ha-1 and 3.0tCO2e, respectively (Table 4). The box and whisker plot plotted for sapling carbon expressed that there is huge potentiality of enhancing carbon upto 2.4 $tCha^{-1}$ in the future with better silviculture and management practices (Figure 5).

Table 4: Sapling biomass, carbon and carbon dioxide

Variables	Biomass stock (t ha^{-1})	Carbon (tC ha^{-1})	Carbon Dioxide (tCO2e)
Mean	1.75	0.82	3.02
Std. dev	0.2	0.12	1.76

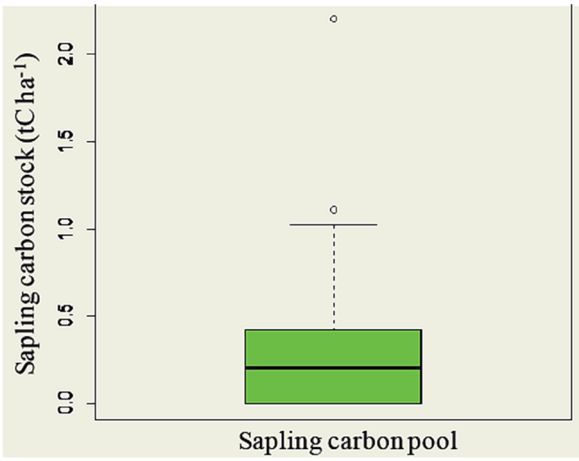


Figure 5: Box and whisker plot for sapling carbon

3.1.6 Herb and Grasses Biomass, Carbon and Carbon Dioxide

The mean herb biomass, carbon and carbon dioxide was found to be 0.48tha-1, 0.22tCha-1 and 0.8tCO2e. as given in Table 5. The box and whisker plot plotted for sapling carbon expressed that there is a huge potentiality of enhancing carbon upto 1.0tCha^{-1} in the future with better management practices (Figure 6).

Table 5: Herb biomass, carbon and carbondioxide

Variables	Biomass stock (t ha-1)	Carbon (tC ha-1)	Carbon dioxide (tCO2e)
Mean	0.48	0.22	0.8
Std. dev	0.2	0.12	0.60

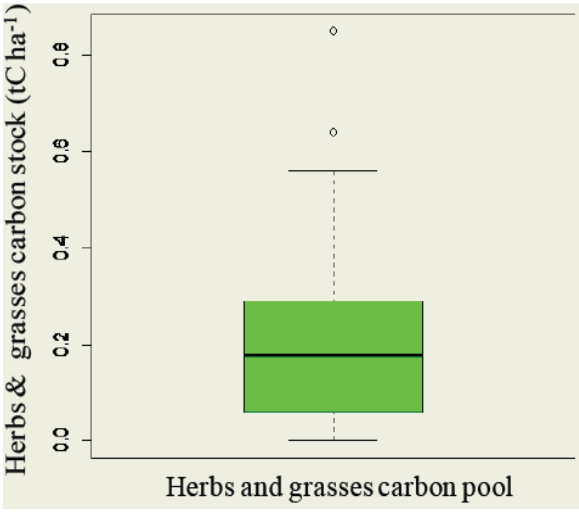


Figure 6: Box and whisker plot for herbs and grasses carbon pool

3.1.7 Mean Carbon and Carbon Dioxide Stock in the Avenue Plantation

The total forest biomass of each pool was converted into carbon multiplying by the default carbon fraction of 0.47 as recommended by the IPCC (2006). The carbon stock was then converted to tons of CO2 equivalent by multiplying it by 44/12 or 3.67. Table 6 provides the carbon in all three carbon pools measured in this study including above ground and below ground tree, saplings and herbs and grasses carbon pools. The mean carbon in all above and below ground pools was found to be 24.03tCha^{-1} and the mean tCO2e was found to be 88.18 (Table 6).

Table 6: Total and mean carbon in all the pools in the plantation site

Variables	Tree Carbon Stock (tC ha^{-1})	Sapling Carbon Stock (tC ha^{-1})	Herb Carbon Stock (tC ha^{-1})	Total Carbon Stock (tC ha^{-1})	Total tCO2e
Mean	22.98	0.82	0.22	24.03	88.18
Std. dev	45.2	1.0	0.2	45.2	165.9

Thus, based on Table 6, it can be concluded that avenue plantation in the Ring Road area of Kathmandu Valley has immense potential to store and sequester carbon. The forest resources assessment of Nepal has estimated that the total carbon stock in Nepal's forest is about 1,054.97 million tons with the mean carbon stock value of 176.95 tCha^{-1} (DFRS, 2015). Likewise, various studies in different physiographic regions and landscapes of Nepal show different facts and figures, for instance that the mean forest carbon stock of Chitwan Annapurna Landscapes (CHAL) was 197.80 tCha^{-1} (Subedi *et al.*, 2015).

Similarly, the forest carbon stock for the seven Central Himalayan Forests of Hindu Kush Himalayan region was between 166.8 and 440tCha-1 (Rana *et al.*, 1989), whereas the mean forest carbon stock in the Central Himalayan Forest of India ranged between 250 and 300tCha^{-1} (Singh and Singh, 2006). The mean forest carbon stock in the world's tropical forests was 285.82tCha^{-1} (Malhi *et al.*, 2002). The forest carbon stock estimated for Terai forests was 124.14tCha^{-1} and for Churia forests was 116.94tCha^{-1} (FRA, 2014) and the forest carbon stock in the Terai Arc Landscape of Nepal was 237.74tCha^{-1} (WWF Nepal, 2011).

Compared to these above figures, the mean forest carbon stock in the avenue plantations in the Ring Road area of Kathmandu valley is extremely lower than above forest types at this stage, however forest carbon stock can be enhanced to that optimal level if the avenue plantation area is managed in a sustainable manner with appropriate silvicultural operation and treatment.

3.1.8 Carbon Sequestration Potential in the Ring Road Avenue Plantation

The box and whisker plots show the visual pattern of mean carbon stock of different pools and their potentialities in the plantation sites where large datasets in terms of mean and median values have been presented. In addition, the extreme values that the tree carbon pool showed were also plotted, indicating potentiality of productivity of the particular pool up to that optimum level if the plantation area is managed in a sustainable manner and due protection has been done from the concerned departments and authorities.

3.1.9 Total Carbon Stock in the Ring Road Avenue Plantation

The mean carbon stock per hectare in the avenue plantation of Ring Road area was found to be 24.03tCha^{-1} and the total carbon stock was found to be 7785.72tC on a yearly basis. Likewise, the total baseline tCO2e stock in the avenue plantation of the Ring Road was found to be 28,573.60tCO_2e as given in Table 7.

Table 7: Total baseline carbon stock and CO2e in avenue plantation area of Ring Road

Total area of avenue plantation (ha) in Ring Road	Baseline Mean carbon stock (tC ha^{-1})	Total carbon stock (tC Year)	Total carbon dioxide equivalent (tCO2e)
27	24.03	7,785.72	28,573.60

3.2 Carbon Emissions from Vehicles

This study assumed that the vehicles moving around the Ring Road area do not travel along the entire 27km. Thus, we asked the key informants through a survey and based on that, estimated that only 1% vehicles (all types-motorbike, scooter, car, van, bus, mini-truck and heavy truck) traveled throughout the entire Ring Road.

Likewise, 2% of the vehicles (all types) traveled half-way of the Ring Road. A total of 3% of vehicles (motor bike, scooter, car, van) and 5% of these vehicles - bus, mini-truck and heavy truck - traveled along one-third of the Ring Road. Also, a total of 5% of vehicles (motor bike, scooter, car, van) and 10% of the vehicles - bus, mini-truck and heavy truck - moved along one fourth of the Ring Road.

Thus, the net emissions per year due to these vehicles on the Ring Road is about 42,547.4tCO_2e, the carbon dioxide emissions per month was found to be 3548tCO_2e, the carbon dioxide emissions per day was 118.26 tCO_2e and the carbon dioxide emissions per hour was 4.93tCO_2e (Table 8).

Table 8: Total carbon dioxide emissions in Ring Road per unit time

Vehicle type	Total tCO2e emissions in Ring Road (Per year)	Full way (1%) vehicle movement-1	Half way (2%)-2	One third (3-5%)-3	One fourth (5-10%)-4
Bike	123,987	1240	2480	3,720	6,199
Scooter	50,076	501	1002	1,502	2,504
Car	22,280	223	446	668	1,114
Van	9,732	195	195	292	487
Bus	8,361	167	167	418	836
Mini-Truck	49,891	998	998	2,495	4,989
Heavy truck	48,561	486	971	2,428	4,856
Total	**312,888**	**3,809**	**6,258**	**11,523**	**20,985**
Grand total emissions (tCO2e/yr) (1+2+3+4) in the Ring Road=42,574.4*					

*Per month: 3,547.86, per day: 118.26, per hour: 4.93, per minute: 0.08 tCO2e.

The present study estimated a total of 312,888 tCO_2e carbon dioxide emissions from vehicular movement only (in full movement scenario) in the Ring Road area of Kathmandu Valley. A study conducted by Poudel *et al.* (2021) on comparison of vehicular fuel consumption and CO_2 emission before and during the Covid-19 pandemic in Kathmandu Valley has found that the road transport for fiscal year 2019-2020 produced 914,352 tCO_2e from the transportation sector by consuming 292,260 kiloliters of fuels (diesel and petrol).

The tCO_2e emissions value of our study can be compared with the study conducted by Poudel *et al.* (2021) as the value of the emissions falls within the similar range. Our study showed 312,888 tCO_2e covering maximum parts of the Ring Road area within the Kathmandu district.

3.2.1 Carbon Dioxide Removals and Emissions in the Ring Road

Based on the inventory of above and below ground carbon pools (tree, saplings and herbs), the baseline mean carbon stock per hectare in the avenue plantation of the Ring Road area was found to be 24.03 $tCha^{-1}$ and the total carbon stock in the above and below ground parts of the avenue plantations was found to be 7,785.72 tC.

Likewise, the total baseline tCO2e stock in the avenue plantation in the Valley's Ring Road area was found to be 28,573.60 tCO_2e. On the other hand, based on the sampling of the total number of the vehicle movement in the Ring Road area per unit time (per minute, per day, per month and per year), the total carbon dioxide emitted by the vehicles run in the area has been estimated to be a total of 312,888 tCO_2e. Similarly, the net emissions due to these vehicles in the Ring Road per year was found to be 42,547 tCO_2e (Table 9).

Also, from Table 10, it can be interpreted that the total carbon dioxide emission due to the vehicles is higher than that of the total carbon dioxide stock by the avenue plantation in the Ring Road area of Kathmandu Valley. The avenue plantation is not able to balance/cut the total carbon dioxide emissions due to the large number of vehicles emitting the higher carbon dioxide. The deficit of stock of carbon dioxide by avenue plantations is around 14,000.8 tCO_2e. This means the existing plantation in the Ring Road area is not able to sequester/offset the carbon dioxide that is emitted through the vehicles or any other means of the transportation in Kathmandu Valley.

Table 9: Total tCO_2e stocked by avenue plantations and emitted by vehicles in Ring Road

Carbon stock by avenues plantation (tCO_2e)		Carbon emission by vehicles (tCO_2e)		Carbon stock-Carbon emission (tCO_2e)
Total carbon stock (annual tC)	Total carbon dioxide equivalent (annual tCO_2e)	Total emission by vehicles (tCO_2e per month)	Total emission by vehicles (annual tCO_2e)	
7,785.72	28,573.60	3547.83	42,574.40	14,000.80 (Deficit)

3.2.2 Carbon and CO2e Stock Projection for 30 years in the Avenue Plantation

Projection of the carbon and carbon dioxide in the avenue plantation area and emission from vehicles has been provided in Table 10.

Table 10: Projection of the carbon and carbondioxide in the plantation area and emissions from vehicles

Year	Carbon stock in avenues plantation (tC ha^{-1})	Total carbon (tC) in the plantation area	Total tCO_2e stock by avenues plantations	Total tCO_2e emission by transportation sector (vehicles)	Deficit (tCO_2e)
1	24.0	7,786	28,574	42,574	14,000
2	26.7	8,644	31,725	48,961	17,236
3	29.3	9,503	34,876	55,347	20,471
4	32.0	10,362	38,027	61,733	23,706
5	34.6	11,220	41,178	68,119	26,941
6	37.3	14,316	52,538	74,505	21,967
7	39.9	15,333	56,273	80,891	24,618
8	42.6	16,351	60,007	87,277	27,270
9	45.2	17,368	63,742	93,664	29,922
10	47.9	18,386	67,476	100,050	32,574
11	50.5	22,435	82,338	106,436	24,098
12	53.2	23,612	86,656	112,822	26,166
13	55.8	24,789	90,974	119,208	28,234
14	58.5	25,965	95,292	125,594	30,302
15	61.1	27,142	99,610	131,981	32,371
16	63.8	32,145	117,973	138,367	20,394
17	66.4	33,481	122,874	144,753	21,879
18	69.1	34,816	127,776	151,139	23,363
19	71.7	36,152	132,678	157,525	24,847
20	74.4	37,488	137,579	163,911	26,332
21	77.0	43,445	159,443	170,298	10,855
22	79.7	44,940	164,928	176,684	11,756
23	82.3	46,434	170,413	183,070	12,657
24	85.0	47,929	175,898	189,456	13,558
25	87.6	49,423	181,384	195,842	14,458
26	90.3	56,335	206,748	202,228	-4,520
27	92.9	57,988	212,817	208,614	-4,203
28	95.6	59,642	218,886	215,001	-3,885
29	98.2	61,296	224,955	221,387	-3,568
30	100.9	62,949	231,023	227,773	-3,250

Note: (1) The mean carbon increment rate in the similar geography, vegetation types with assisted strict conservation efforts in Nepal (ICIMOD's Godavari Knowledge Park site of Nepal) has an annual increment of 2.65 tC ha-1yr-1)-ICIMOD, 2014. (2) The plantation area will have increased from 27 hectares to 52 hectares–upto 30 years of projection. (3) The total carbon stock was converted into tons of CO_2 equivalent by multiplying it by 44/12, or 3.67.

4. Policy Recommendations

Several efforts have been made to promote the urban and peri-urban forests (UPF) in Nepal. However, we have not been able to achieve the expected results in UPF development successfully because cities have been built haphazardly and in a piecemeal approach, rather than through planned and holistic approaches. With rapidly growing land prices in the urban areas, private interests have played a key role in city planning, and so, allotting spaces for trees have rarely been considered. Second, the open spaces like riverbanks and other public lands, in which urban forests could be developed, have been encroached for gray infrastructure. Third, the distinct value of forests in and around urban areas has been hardly recognized, i.e. no specific policies and plans have been in place for the management of urban and peri-urban forests.

Based on the study findings, the following recommendations are made for KMC:

- Safeguard urban plantations,
- Promote multiple species for carbon benefits,
- Conduct periodic monitoring, reporting and documentation of the carbon measurement in the avenues plantation,
- Carry out silviculture prescriptions,
- Provide information display board,
- Conduct public awareness campaigns for tree plantation and environmental conservation,
- Mobilize eco clubs/youth clubs to conserve plantations,
- Manage/update data and information, and
- Conduct periodic measurement and monitoring of the biomass and carbon in the Ring Road area.

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Non-Communicable Disease Risk Factors Survey and Policy Research for Suggesting Healthy Behavior in Schools in Kathmandu Metropolitan City

Pratik Khanal

Abstract

Most of the non-communicable diseases (NCDs) have a causal link with behavioral and metabolic risk factors. The objective of this study is to assess the prevalence of behavioral risk factors (tobacco use, alcohol use, physical activity, and dietary habit), mental health problems (depression, anxiety, insomnia) and internet addiction. The study also aims to explore the perception, contributing factors and strategies to reduce the burden of NCD risk factors and mental health problems. This study used mixed methods. Survey was conducted among 415 students studying in four higher secondary schools of Kathmandu Metropolitan City. Four focus group discussions with students and seven in-depth interviews with different stakeholders comprising NCD and mental health experts, parents, teachers, and education experts were conducted. As per the findings, the proportion of current alcohol and tobacco users was 8% and 7.2% respectively. Nearly three out of five students did not consume fruits and vegetables as per the WHO recommendation. One in three students was physically active. The prevalence of symptoms of depression, anxiety, insomnia, and internet addiction was 41%, 62.7%, 47.5% and 48.2% respectively. This study found a considerable proportion of students with inadequate fruit/vegetable intake and physical activity, and a higher proportion of students with mental health problems and internet addiction symptoms. Interventions suggested for the reduction of NCD risk factors and mental health problems focus largely on the change in the environmental factors. These include strict regulation of tobacco and alcohol controls, regulation of the price of fruits and vegetables, restriction on the use of junk foods, establishment of parks for promoting physical activities, creation of a support mechanism at the family, school, and community level, increasing availability of mental health services, and interventions for reducing screen time of teenagers and young adults.

Keywords: Non-communicable disease, mental health, internet addiction.

1. Introduction

1.1 Background

Non-communicable diseases (NCDs) refer to those conditions which are chronic, evolve slowly, and progress relentlessly. The World Health Organization (WHO) defines NCDs as chronic diseases which primarily include cardiovascular, chronic respiratory, mental health diseases, diabetes, cancer, and injuries (World Health Organization, 2018). They are commonly thought of as "disease of affluence", but in reality, four fifths of deaths in low- and middle income countries are from NCDs (Ghaffar *et al.*, 2004). Ischemic heart disease, chronic obstructive pulmonary disease (COPD) and stroke are the leading causes of NCD related deaths, while the leading risk factors of NCDs are raised blood pressure, high blood glucose levels, obesity, physical inactivity, indoor pollution, smoking, and alcohol use (Vaidya, 2018).

The NCDs are the leading cause of mortality as they account for 71% deaths globally. Most of these deaths - 31.5 out of 40.5 million - occur in low and middle income countries (World Health Organization, 2016). In Nepal, the mortality rate due to NCDs is increasing. NCDs were responsible for 60% deaths in 2014 and 66% deaths in 2016 (Nepal Health Research Council & Nepal, 2017).

Health system of Nepal is traditionally capacitated to deal with communicable diseases. Thus, there is a strong need to build the health system for prevention, diagnosis, treatment and management of NCDs. The consequences of NCDs can be life threatening to individuals, leading to impoverishment of households that would affect the entire national economy (World Health Organization, 2011). In countries like Nepal where financial protection against health expenditures is minimal, NCDs will contribute to an increase in poverty. Kathmandu Metropolitan City (KMC) is the largest city of Nepal. It is densely populated (above 1 million) and has a high influx of migrants from other districts.

The increasing population, urbanization, trade, limited open spaces, unhealthy foods, work stress, limited physical activity, internet dependency, and air pollution in the city can influence the burden of NCDs among the residents. The cost of managing consequences of NCDs is huge and hence, prevention of NCD risk factors is required as they could be more cost-effective than curative measures.

Evidence has shown that school based policies are beneficial for initiating healthy behaviors among students (Singh *et al.*, 2017). People spend a crucial phase of their life in school and school experiences strongly influence the personality, and behavioral, social and cognitive development of the young (Bay *et al.*, 2017). The socio-demographic characteristics of students and their families, the learning resources available in schools as well as the environmental settings and policy environment at the macro context affect the behaviors of students. Thus, this study is conducted in school settings with a specific focus on students in higher secondary schools with the main aim to generate evidence on the burden of NCD risk factors and to suggest policy interventions to KMC through the survey and careful evaluation of the school and community environment.

1.2 Objectives of the Study

The specific objectives of the study are to:

- Assess the prevalence of behavioral risk factors (tobacco use, alcohol use, physical activity, and dietary habit)
- Measure the prevalence of mental health problems (depression, anxiety, insomnia) and internet addiction.
- Explore the perception, contributing factors and strategies to reduce the burden of NCD risk factors and mental health problems.
- Suggest policy recommendations for the reduction of NCD risk factors and mental health problems in KMC.

1.3 Limitation of the Study

The study does not measure some risk factors of NCDs such as overweight/obesity status, blood pressure, impaired blood glucose and cholesterol level. Similarly, it does not actively develop an intervention package. However, the study findings will be conducive for the development of important intervention packages.

2. Methodology

2.1 Sampling Method and Sampling Strategy

For the selection of participants for this study, a multi-stage random sampling was carried out. The sample size was calculated using the following formula for cross-sectional survey ($n= z^2pq/d^2$) where n = sample size, z = reliability level (1.96), p = estimated proportion in population = 0.41 (prevalence of at least one risk factor, taken from STEPS study 2013 (Nepal Health Research Council and World Health Organization, 2013), q = 1 - p = 1 - 0.41 = 0.59 and d = maximum tolerable error (0.05). The calculated sample size was 372 and considering the non-response rate of 10%, the minimum final sample size required for the study was 410.

During the data collection process, we recruited 415 study participants. Two wards (ward number 3 and 28) were randomly selected out of 32 administrative wards of KMC. Thereafter, one public school and one private college was randomly selected from each ward. In this way, four schools were selected which included Shivapuri secondary school and Canvas international college of ward 3, and Padomodaya public school and Kathmandu model college of ward number 28. After selecting the higher secondary schools, one of the academic streams was randomly selected. From each of the randomly selected streams, two sections were selected, again at random, and all the students available at the day of data collection were recruited for the study.

This study used mixed-methods (explanatory sequential) study design. Firstly, a survey was conducted among 415 students studying in four higher secondary schools of KMC. Based on the preliminary survey findings, four focus group discussions (FGDs) with students and seven in-depth interviews (IDIs) with different stakeholders comprising of

NCD and mental health experts, parents, teachers, and education experts were conducted to explore the perception, contributing factors and role of individuals, family, school, and community/metropolitan for the prevention of NCD risk factors and promotion of mental health status.

This study used NCD STEPS survey, Hospital Anxiety and Depression Scale, Insomnia Severity Index and Young's Internet Addiction Test as data collection tools to measure the NCD risk factors, mental health, and internet addiction status. Data collection was done between February-April 2021. For data analysis, both descriptive and inferential analysis was conducted for quantitative data while thematic analysis using a deductive approach was done for analyzing qualitative data. Ethical approval of the study was obtained from Nepal Health Research Council (NHRC).

2.2 Interpretation of Psychometric Scores

The interpretation of psychometric tools related to depression (HADS-D), anxiety (HADS-A), insomnia (ISI) and internet addiction test (IAT) is shown in Table 1.

Table 1: Interpretation of psychometric tools

Mental health and internet addiction status	Interpretation
Depression status (HADS-D)	Normal (0-7) Borderline (8-10) Abnormal (11-21) There are 7 items, and the response options are on a four-point scale (0-3). Greater than score of 7 is considered as the presence of depression symptoms.
Anxiety status (HADS-A)	Normal (0-7) Borderline (8-10) Abnormal (11-21) There are 7 items, and the response options are on a four-point scale (0-3). Greater than score of 7 is considered as the presence of anxiety symptoms.
Insomnia status (ISI)	Not clinically significant (0-7) Subthreshold insomnia (8-14) Moderate (clinical insomnia) (15-21) Severe (clinical) (22-28) There are 7 items, and the response options are on a five-point scale (0-4). Greater than score of 7 is considered as the presence of insomnia symptoms.
Internet addiction test (IAT)	Normal or average online users (0-39) Problematic online users (40-100) There are 20 items and response options are on a range of 1-5. A score of 40 and above is considered as the presence of addiction symptoms.

3. Results and Discussion

3.1 Socio-Demographic Characteristics

Out of the 415 study participants, 53% are male, 41% belong to Brahmin/Chhetri ethnic group and 53.7% are from public school. Most of the study participants (91%) have an intact family as three out of four students are currently living with their family members. The proportion of students whose father and mother had no schooling is 14.9% and 30.1% respectively.

Table 2: Socio-demographic characteristics of the study participants

Characteristics	Categories	Frequency	Percentage
Age group (in years)	14-16	86	20.7
	17 and above	329	79.3
	Mean ±S.D.= 17.53±1.34 years		
Gender	Male	222	53.5
	Female	193	46.5
Ethnicity	Brahmin/Chhetri (hill)	168	40.5
	Janajati (excluding Newar)	157	37.8
	Newar	34	8.2
	Madeshi	30	7.2
	Dalit	26	6.3
Type of family	Both parents	375	90.4
	Only father or mother	38	9.2
	No parents	2	0.5
Father's occupation	Agriculture	114	27.5
	Business	84	20.2
	Government service	65	15.7
	Non-government service	42	10.1
	Unemployed	25	6.0
	Father not alive	22	5.3
	Household works	22	5.3
	Foreign employment	15	3.6
	Self employed	15	3.6
	Retired	4	1.0
	Teacher	4	1.0
Mother's occupation	Household works	232	55.9
	Agriculture	82	19.8
	Business	29	7.0
	Government service	18	4.3
	Non-government service	17	4.1
	Unemployed	17	4.1
	mother not alive	10	2.4
	Others	10	2.4
Father's education	No schooling	62	14.9
	Less than primary	68	16.4

Characteristics	Categories	Frequency	Percentage
	Primary	71	17.1
	Secondary	125	30.1
	Higher secondary	27	6.5
	Bachelor and above	40	9.6
	Father not alive	22	5.3
Mother's education	No schooling	125	30.1
	Less than primary	88	21.2
	Primary	58	14.0
	Secondary	94	22.7
	Higher secondary	15	3.6
	Bachelor and above	21	5.1
	Mother not alive	14	3.4
Current living arrangement	With family members	319	76.9
	At hostel	20	4.8
	With friends in rented place	47	11.3
	Alone in rented place	29	7.0
Type of school	Public	223	53.7
	Private	192	46.3

3.2 Tobacco and Alcohol Use

The proportion of current alcohol users and tobacco users is 8% (10.8% among men and 4.7% among women) and 7.2% (11.7% among men and 2.1% among women) respectively (Table 3). The mean age (SD) of initiation of tobacco use and alcohol use is 14.3 (3.0) and 14.9 (3.2) years respectively. Gender, ethnicity, current living arrangement and occupation of mother are significantly associated with current tobacco use while gender is significantly associated with current alcohol use.

Table 3: Tobacco and alcohol use among the study participants

Characteristics	Categories	Total N (%) (n=415)
Tobacco use	Never smoked	372 (89.6)
	Ever use of cigarette smoking	43 (10.4)
	Current use of cigarette smoking (in the past 30 days)	30 (7.2)
	Daily use of cigarettes	13 (3.1)
	Age of initiation of smoking among ever users (mean±SD, years)	14.28±3.0
Alcohol use	Ever use of alcohol	65 (15.7)
	Current use of alcohol (in the past 30 days)	33 (8.0)
	Daily use of alcohol	1 (0.2)
	Age of initiation of alcohol among ever users (mean±SD, years)	14.86±3.3

The proportion of current tobacco use is more in men than women, Dalit ethnic group, those living without family members and students whose mother had no schooling. Similarly, the proportion of alcohol use is more in men compared to women.

3.3 Fruit and Vegetable Intake

Nearly three out five (56.5%) students do not consume fruits and vegetables as per the WHO recommendation (5 servings per day). In total, 24.8% consume fruits daily while 31.1% consume vegetables daily. Mother's occupation and type of school are significantly associated with fruit and vegetable intake.

Inadequate fruit and vegetable intake is higher among students whose mothers are involved in household works (61.5%), followed by agriculture (53.4%) and business (32.1%). The proportion of inadequate fruit and vegetable intake is higher among students studying in private schools (68.0%) as compared to those in public schools (46.2%).

Table 4: Frequency of fruit and vegetable consumption in last week

Number of days in past week	Fruit intake (n=415)		Vegetable intake (n=415)	
	Frequency	Percentage	Frequency	Percentage
0	14	3.4	5	1.2
1	31	7.5	11	2.7
2	45	10.8	37	8.9
3	59	14.2	72	17.3
4	37	8.9	58	14.0
5	9	2.2	29	7.0
6	6	1.4	19	4.6
Daily	103	24.8	129	31.1
Do not remember	111	26.7	55	13.3

Table 5: Number of servings of fruit and vegetable intake

Number of servings	Total fruit and vegetable intake*	
	Frequency	Percentage
Less than 5 servings per day	213	56.5
5 or more servings per day	164	43.5

*Note: Those students whose response was missing or do not remember their fruit and vegetable intake are excluded from the analysis. Similarly, if the response was missing as a result of a remembrance bias, then the fruit or vegetable intake was counted as zero.

3.4 Physical Activity

One in three students (32.5%) are physically active, that is they spend at least 60 minutes doing moderate to vigorous intensive exercise every day. Nearly one in five students (17.6%) do not spend any day doing moderate to vigorous physical activity within the duration of a week.

Type of family is significantly associated with physical activity. Students belonging to intact families (69.9%) have a higher proportion of inadequate physical activity as compared to those having a broken family (45.0%)

Table 6: Number of days spent on moderate to vigorous intensity

Number of days spent on moderate to vigorous intensive activities	Frequency	Percentage
0	73	17.6
1	26	6.3
2	32	7.7
3	35	8.4
4	36	8.7
5	29	7.0
6	49	11.8
7	135	32.5

3.5 Depression, Anxiety, and Insomnia Status

Overall, 41% of study participants have symptoms of depression, 62.7% have symptoms of anxiety and 47.5% of the students have symptoms of insomnia. Parent's education and type of school are significantly associated with depression. Those students whose father and mother had no schooling and who studied in public school have a higher proportion of depression.

Gender is significantly associated with anxiety with women having a higher proportion. No variables are significantly associated with insomnia.

Table 7: Depression, anxiety, insomnia, and internet addiction status among the study participants (n=415)

Mental health and internet addiction status	Frequency	Percentage
Depression:		
Normal (0-7)	245	59.0
Borderline (8-10)	119	28.7
Abnormal (11-21)	51	12.3
Anxiety:		
Normal (0-7)	155	37.3
Borderline (8-10)	138	33.3
Abnormal (11-21)	122	29.4
Insomnia:		
No clinically significant (0-7)	218	52.5
Subthreshold insomnia (8-14)	161	38.8
Moderate (clinical insomnia) (15-21)	32	7.7
Severe (clinical) (22-28)	4	1.0
Internet addiction:		
Normal users or users without problems (<40)	215	51.8
Problematic internet users (≥40)	200	48.2

3.6 Internet Addiction Status

In this study, 48.2% of the study participants have symptoms of internet addiction. Gender, mother's occupation, and tobacco use are significantly associated with internet addiction. Internet addiction is also found higher in men, in students whose mother's occupation is related to business and those who are current smokers.

3.7 Relationship between Depression, Anxiety, Insomnia and Internet Addiction

Pearson's correlation coefficient test was done between depression (HADS-D), anxiety (HADS-A), insomnia (ISI) and internet addiction (IAT). A significant relationship (positive weak correlation) is observed between depression and anxiety (r=0.360, p<0.001), depression and insomnia (r=0.170, p=0.001) as well as between depression and internet addiction (r=0.174, p=0.001) (Table 8).

Similarly, a significant relationship (positive weak correlation) is observed between anxiety and insomnia (r=0.306, p<0.001) as well as between anxiety and internet addiction (r=0.230, p<0.001). There is, however, a positive moderate correlation between insomnia and internet addiction (r=0.518, p<0.001).

Table 8: Correlation between different psychometric scales (n=415)

Scales	Variables	HADS A	HADS D	ISI	IAT
HADS A	Correlation coefficient	1	0.360**	0.306**	0.230**
	p-value		0.000	0.000	0.000
HADS D	Correlation coefficient	0.360**	1	0.170**	0.174**
	p-value	0.000		0.001	0.000
ISI	Correlation coefficient	0.306**	0.170**	1	0.518**
	p-value	0.000	0.001		0.000
IAT	Correlation coefficient	0.230**	0.174**	0.518**	1
	p-value	0.000	0.000	0.000	

Note: ** Correlation is significant at the 0.01 level (2-tailed). 0=no correlation, <0.4: weak, 0.4-0.6: moderate and >0.6: strong correlation

3.8 Barriers and Challenges for the Prevention of NCD Risk Factors

3.8.1 Tobacco and Alcohol Use

Contributing factors for tobacco and alcohol use encompassed both individual and environmental factors. The individual factors were identified as curiosity to taste, thrill-seeking behavior, adventure, peer pressure, imitation, perceived self-image, or personal choice. The environmental factors included the attitude of family members towards smoking and alcohol use, traditional social norms, cultural shift towards acceptance of smoking and drinking habits, and equating use of tobacco and alcohol as a source of recreation.

Similarly, aggressive advertisement and sponsorship of different events that cater to a young audience by tobacco and alcohol companies, including sports and YouTube channels, policies favoring tobacco and alcohol products as a source of revenue, an easy availability of these products and their haphazard sale, the enhanced role of celebrities in films, and parents asking children to buy cigarettes were also identified as barriers for the prevention of tobacco and alcohol use.

Moreover, normalization of consumption of alcohol and tobacco during stress and family problems as well as cultural values (especially on indigenous ethnic groups), provoke higher consumption of these products among college students.

"*Ek sarko, tespachi duniya arko* (One puff, and you are in a different world)." – Girl, Private college, FGD IV.

"My friends from village used to pressurize me to have cigarette. They even used to forcefully keep in my mouth. I used to run away and later left their circles." – Boy, public school, FGD I.

"Smoking is prohibited in public places as per our law. However, Police in duty is also not responding to such actions in public places." – Girl, public school, FGD I.

Teachers of both public and private colleges reported that there were no health guidelines or policies at the school level that focused on the promotion of healthy behaviors. However, health education classes and some relevant sessions from experts and the local police were regularly conducted. School health nurse was available at the public college who was recruited by Bagmati province. On observation, there was a restriction on sale of tobacco and alcohol products inside the school premises.

Teachers also reported doing regular checks of students' pockets and bags. School authorities requested the nearby shops and police offices to ban the sale of tobacco and alcohol products near school premises. However, not much support was received from their end as there was little care regarding the consequences.

"All alcohols are bad to health regardless of the amount (latest evidence), same in tobacco use. But in case of alcohol, there is no clear sanctions." – NCD expert, IDI IV.

"We need to save youths and adolescents, as they may not be in a position of decision making, overall system should be designed to enable the prevention of tobacco and alcohol use." – NCD expert, IDI V.

"College students enjoy more freedom than those studying in school. They get exposure to new friends from different backgrounds, share interests and college do not supervise students as school, especially outside college hours." – Education expert, IDI VII.

NCD experts mentioned that alcohol and tobacco sale is haphazard and alcohol use is more rampant than tobacco use. Furthermore, there is limited stakeholder's involvement in alcohol control advocacy compared to tobacco use.

There was a mixed response among the FGD participants regarding the legal restrictions on tobacco and alcohol use. Few of the participants mentioned that they were not aware of the existing legal measures, while most of them mentioned that although there are legal measures, they are not implemented properly. Students particularly mentioned that minors (less than 18 years) are not allowed to purchase cigarettes and alcohol as per the law.

However, they are easily available in different brands. They also expressed that the use of alcohol and tobacco is not illegal in Nepal, and thus their use is common in public places. An education expert expressed that college students were more vulnerable to tobacco and alcohol consumption than those studying in schools.

3.8.2 Fruit and Vegetable Intake

The contributing factors for the low fruit and vegetable intake among college students were - low purchasing capacity, high price of fruits and vegetables in the market (partly explained by storage problems and the role of middle-men), low production of fruits and vegetables in urban areas, limited choice in local markets for healthy foods, and junk foods that are cheap, easily available, taste good and are ready to use. Additionally, parental influence, aggressive promotion of junk foods by food industries and low literacy in the family regarding the importance and constituents of healthy diet are also important contributors.

> "Students love fried food and junk foods as well as sugary drinks like Coke, Fanta, litchi juice., Taste matters more for children." – Education expert, IDI VII.
>
> "As students love fried food and canteen is rented by outsider, selling of such food is highly prevalent in our canteen." – Teacher, private school, IDI II.
>
> "What constitutes healthy diet is not clear: there is a feeling that expensive vegetables and fruits are only good for health; any vegetables that is leafy and low-cost nutritious fruit is beneficial." – NCD expert, IDI IV.

An education expert stressed that an attitude of only stomach-filling among students needs to be replaced by an attitude of consuming a balanced healthy diet as students prefer noodles to roti and fried potato chips to green leafy vegetables. Experts also stressed on the inadequate monitoring of quality of fruits and vegetables, specifically whether they are chemical free and consumable, as a barrier for consumption of adequate fruits and vegetables.

Experts also expressed the need to change the opinion regarding the consumption of fruits and vegetables.

3.8.3 Physical Activity

The contributing factors for inadequate physical activity among college students in their academic institutions were lack of time due to academic pressure, over-emphasis on classroom learning in school, decrease in active commuting, and limited or no playground in school premises.

Similarly, some other general contributors to inadequate physical activity were lack of adequate parks and exercise spaces, unsafe roads, fear of pollution, and mismanaged concrete structures causing injury risks.

At the household level, change in occupation patterns of family, lack of promotion of physical activity in the family and schools, lifestyle changes due to technology, and overuse of gadgets and peer influence for playing mobile games were a few of the contributing factors. Finally, failing to explain the importance of physical activity in schools and to allocate sessions for physical activity, including the absence of physical education curriculum in grades higher than the lower secondary levels and lack of community gyms were also identified as barriers for the promotion of the physical activity. In the current context, fear of COVID-19 was also perceived as a barrier to continuing physical activity.

"There is a general opinion that talent students should not be involved in sports. We need to move out of this concept and advocate that it is important for everyone." – NCD expert, IDI IV.

"There is no enabling environment for physical activity in school due to limited space and lack of grassy playgrounds. Education regulation is not much followed, structural changes are required." – Education expert, IDI VII.

3.9 Barriers and Challenges for the Promotion of Mental Health

The barriers and challenges for the promotion of positive mental health among students were overthinking, personal insecurities, fear of physical punishments at school, academic stress, results oriented teaching-learning environment that overexerts physical and mental health of students, favoritism by teachers, and bullying.

Similarly, lack of interest in studies, lack of trust in sharing problems with school teachers, high family expectations, fear of failure, lack of encouragement from parents and school teachers, low cohesion among peers, and family and relationship problems were some of the other challenges faced by students.

"Students do not get much support from both sides (family and school) which might contribute to mental health problems." – Education expert, IDI VII.

"When a bus continues to travel without stopping at point, there will be heat, wear, and tear. It is similar in the human body, due to lack of rest or sleep, our body cannot perform work and there will be problems of eyes, headache, sprain on muscles stye on eye, chance of being internet addict." – Mental health expert, IDI VI.

Mental health experts argued the need to focus on the bio-psycho model while describing the contributing factors for mental health problems. Genetics, transition from childhood to adolescence, hormonal changes, high family expectations, peer and family conflicts, and harassment in the school and community, either because of ethnic groups or language fuel mental health problems among college students. Mental health experts also stressed the importance of sleep to having a stable mental health.

Education experts shared that there is limited discussion on mental health problems and unavailability of mental health services at school and community level. They further added that there is a practice of treating mental health problems with *jharpukh* (traditional methods).

Coping strategies by students during stress were listening to music, dancing, sleeping, engaging in hobbies, reading books, travelling, playing games, watching movies, not relying on others for happiness, and spending time with family and friends while taking their suggestions. One of the male students mentioned tobacco use and drinking as a common coping strategy among his age group.

"During the lockdown, I was suffering from depression, I overcame it by sharing problems with my closed ones who motivated me and accepted my flaws as well as ups and downs." – Girl, private college, FGD IV.

"The major reason of mental issues among our students is because of unpeaceful relation with parents. Even our 6 to 7 students had suicidal attempts due to reasons like parents' divorce, parents not fulfilling their desire etc. In such cases, we consult those students with psychiatrist." – Teacher, private college, IDI II.

Mental health experts expressed their dissatisfaction over the almost non-existence of mental health services in Nepal. In the context of Kathmandu, there is only one mental hospital. Provision of mental health services is lacking at the community level.

Regarding internet addiction, excessive social media use, availability of age-inappropriate materials on the internet, new trends of being popular or viral, or searching for shortcut ways of success, sleep problems and lack of personal interactions were identified as contributing factors of internet addiction. Mental health experts opined that internet addiction can harm students' investment in long term goals, create difficulties with face-to-face interactions, and lead to sleep problems, mental health problems, bullying and physical fights.

4. Policy Recommendations

This study found a considerable proportion of students with inadequate fruit/vegetable intake and physical activity, and a higher proportion of students with mental health issues and symptoms of internet addiction. Based on the survey findings and qualitative research findings, the following policy recommendations are provided:

1. Develop and implement an interactive school-based educational intervention package incorporating contents on the prevention of NCD risk factors. The educational intervention package should focus on the consequences of tobacco and alcohol consumption, strategies for reducing tobacco and alcohol intake among peers and during stress as well as in recreational/cultural events, decreasing the intake of junk foods and replacing it with healthy food options, increasing consumption of fruits and vegetables as a part of regular diet and encouraging ways to remain physically active at both indoor and outdoor settings.

Similarly, the package should focus on the burden of chronic diseases and its effect on people's health and socio-economic potential. For the development of this package, different departments of KMC, especially the health and education departments need to take a leading role with support from experts in fields related to health and education (dieticians, sports trainers, behavioral experts, etc.). The frequency and strategies for implementation of this package should also be determined, possibly once a month and through a peer-to-peer education approach.

2. Encourage schools for the promotion of healthy food options in school cafeteria. Cafeteria interventions such as updating the food menus with healthy options, replacing junk foods and soft/carbonated drinks with various low cost, highly nutritious meals, increasing access to safe drinking water, and promoting the nutritional value of healthy

foods through various mechanisms, such as the use of wall posters and through trained canteen operators can encourage students to adapt to healthy food behavior. Thus, a guideline on the proper operation of school cafeterias could be instrumental.

3. Promote interventions that encourage physical activity among students. Additional interventions such as conducting sessions on the importance of physical activities, actually organizing sports activities either before, during or after school hours, as well as directing targeted interventions among overweight/obese students, installing low-cost physical activity instruments, promoting yoga, dancing and martial arts, and regularly monitoring the weight and height of students is recommended to improve physical activity among the students.

4. Develop and implement a mental health promotion educational package in schools. With the help of psychological and counseling experts, KMC in compliance with the health and education departments needs to develop and implement an educational package that can help in preventive and curative measures of mental health problems. This should include identification of possible stressors at individual, family, and school settings, steps on stress management, promotion of meditation, breathing and relaxation exercises, as well as psychological and emotional support to the students through teacher and peer networks, reduction of academic stress through proper teacher guidance, life skills sessions that enhance positive thinking, reduction of self-destructive behaviors and encouragement to seek help from professionals.

The package should also include interventions for the reduction of screen hours, reiterating the importance of adequate sleep, creating a platform for fostering the creativity and talents of students, and encouraging the involvement of students in physical activities and social works.

5. Provide psychological counseling training to teachers and set up support mechanism at the school level for addressing mental health problems. As the availability of psychological counseling services at the school level is the most cost-effective intervention to promote mental wellbeing among students, KMC needs to coordinate with organizations working on mental health for providing training to school teachers on psychological counseling. Regular screening of the mental health status of students with the use of appropriate screening tools can help in the early identification of mental health problems.

Similarly, activities that increase school-student-parent interaction for addressing grievances related to personal, family life and studies, sessions related to stress management and coping strategies, and setting up confidential helplines will also help to reduce mental health problems among students. Linkage of school mental health services with trained psychologists and psychiatrists will also help to better address the mental health problems among students.

6. Seek options such as recruiting human resources, such as psychological counselors and school health nurses, to introduce and implement health promoting interventions at the school level. KMC needs to consider options such as recruiting school health nurses and psychological counselors at the metropolitan or school level for the improvement of the health and well-being of students. Such human resources can guide

schools to implement intervention packages related to healthy behaviors and the promotion of mental health.

7. Develop mid-term and long-term strategies to foster health and productivity of adolescents and young people. As a local government, KMC should intervene in the social health environment for which it needs to develop mid-term and long-term strategies and build capacities for developing it as a health-promoting city. Departments of KMC related to urban development, public infrastructure, environment, education, and health should jointly initiate activities as follows:

- Enforce strict implementation of Tobacco Products Control and Regulatory Act 2011 (2068 B.S.), Alcohol Control Policy and Regulations 2017, and Public Health Service Act 2018 (2075 B.S.).
- Discourage smoking and drinking in public places through appropriate reinforcement measures, intensifying community awareness activities regarding the harmful effects of tobacco and alcohol use through active media campaigning (including social media) and community events, and promoting the involvement of adolescents and youth-led groups in the social works.
- Restrict easy availability of tobacco and alcohol products and limiting such products to licensed shops that aren't in close proximity to the school premises.
- Regulate promotion, advertisement, and sponsorship of tobacco and alcohol products as well as junk and health-harming foods.
- Promote shops or providing subsidies for the sale and purchase of fruits and vegetables, promoting commercial farming, and preparing geographically appropriate food atlas considering the nutritional value and purchasing capacity of the inhabitants.
- Invest in the establishment and renovation of community parks and community gyms, developing safe pavement for walking, installing cycle lanes, and creating more open spaces in the city.
- Support schools in the organization of sports activities and physical activity sessions, encouraging schools to monitor the physical activity of students and provide options for schools to recruit sports teachers.
- Ensure basic minimum standards for schools, including the availability of proper playgrounds, sports instruments, sports teachers, making sure that the school infrastructure does not make the students vulnerable to physical injuries, and also regularly monitor school environment to make it conducive to healthy behaviors.
- Guide schools to improve teaching-learning environment, revising curriculum to address physical and mental health needs of students, reforming education practice that puts undue pressure on students, making learning resources for improving health and mental well-being available, banning addictive apps, and funding activities that promote the creativity and talent of students.
- Ensure availability of mental health services at the community level and set up helplines.

Acknowledgment

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The Urgency of STEAM Education for Driving KMC as an Innovation Hub

Manish Man Shrestha

Abstract

STEAM (Science, Technology, Education, Art and Mathematics) education is based on modern technologies. Solving problems and creating solutions are skills critical to all businesses, and STEAM-based education tends to tackle these challenges. STEAM-based education helps students understand the content of the syllabus more profoundly. This research is focused on finding the readiness of Kathmandu Metropolitan City (KMC) to implement STEAM-based education. We focused on the five significant stakeholders regarding STEAM-based education: schools, teachers, parents, students and STEAM service providers. Questionnaire was developed to find the understanding and readiness of these stakeholders. The survey results showed that most schools and teachers acknowledge the importance of STEAM-based education, but they lack the confidence to implement it. Most of the parents do not fully understand the concept of STEAM-based education. Most of the STEAM providers find it relatively harder to manage the necessary equipment for STEAM-based education. Most of the students showed enthusiasm towards STEAM-based education. Besides the survey, a literature review of the implementation of STEAM-based education in countries like South Korea and China was done. We reviewed how they have implemented STEAM-based education in their countries and the steps to implement it. We also reviewed the education policies of the Government of Nepal and KMC. We conclude that although KMC acknowledges the need for a STEAM-based education system and is taking steps to implement it, more preparations are needed to fully implement it. Strong policies to increase participation and maintain quality and standards need to be made to implement STEAM-based education system successfully. Based on the findings, appropriate policies have been proposed.

Keywords: STEAM-based education, education policy, technology in education.

1. Introduction

1.1 Background

Innovation is the key to sustainable development of a city. Research culture is one of the fundamentals that drive people towards innovation, creativity, and responsibility awareness for humanity's well-being. Today, the world stands on the brink of the Fourth Industrial Revolution – "Industry 4.0". Industry 4.0 will merge the physical, digital, and biological worlds using devices that sense and interact with humans, machines, and environments in new ways, making informed, rapid decisions autonomously.

Producing innovators, visionaries, creative thinkers, and dreamers for Industry 4.0 cannot be imagined without a relevant education system. The major technological revolution demands human resources equipped with Science, Technology, Engineering, Arts and Mathematics (STEAM) knowledge, skills, and capabilities committed to producing technical sophistication and interdisciplinary thinking.

Rather than teaching Science, Technology, Engineering, Arts and Mathematics as separate and discrete subjects, STEAM integrates them into 'interdependent' learning units based on real-world applications. The leaders of tomorrow are the children of today. Hence, without equipping today's children with STEAM knowledge, the growth of individuals and consequently sustainable development of the city and country is impossible. Since 2010, developed countries and city-states like the USA, Republic of Korea, China, Singapore, Hongkong have rigorously implemented STEAM-based education systems to fulfill the need and thirst for industrial evolution 4.0 and further. The impact of it is seen in every aspect of life.

Nepal falls far behind Industry 4.0 despite abundant natural and human resources which is a result of incoherence between education, engineering, technology, entrepreneurship, policy-making, and development activities in Nepal. For scientific and technological progress, it is imperative for developing countries like Nepal to generate STEAM-qualified human resources and create STEAM-related jobs in the near future. To keep pace with the world, the reformation of education system of Nepal is urgent.

As the capital of Nepal, Kathmandu, bears more responsibility towards its country and citizens to be the leader in every aspect. Implementation of STEAM-based education plays a vital role in developing the city through its regard to citizens' welfare, economics, innovation, and creativity to tackle future needs. With groundbreaking innovations and the industrial revolution, the future we are shaping is challenging to project. Thus, a massive challenge for the city lies in transforming its citizens to become competitive enough in such an evolutionary environment. This challenge will be overcome if we address the following:

- **Lack of innovation and entrepreneurial culture.** Students completing formal education are adept in theoretical knowledge. But, they are inept at dealing with real-world problems. This has resulted in the lack of innovation and entrepreneurial culture in Nepal, one instance of which has led to a shortage of manufacturing industries, thus causing a huge trade deficit.
- **Brain drain.** When provided with opportunities abroad, Nepalese are excelling in their respective fields, however they cannot reach similar heights within a nation.

To fulfill the requirement, the technical workforce often has to be hired from other countries.

- **Broadening digital divide.** Currently, only a limited number of skilled individuals have access to some form of technical and computer knowledge. Individuals without such skills are at a disadvantage, especially while competing in the job market. In the future, these problems will be further compounded if this form of digital divide is not curtailed. Other cities worldwide are seeking STEAM education to bridge this divide.
- **Traditional education system.** The job market is quickly shifting as traditional jobs like accountants and radiologists are threatened to be rendered obsolete by AI and robots. Advances in automation technology will handle many tasks that people currently do. The impact AI and robots will have on the job market is a hot topic among every stakeholder. Discussions are being guided on both sides - on one hand, AI and robots displace many jobs, and on the other, AI and robots create as much as it displaces jobs. From the observed impacts, we can ascertain that the future jobs will be vastly different from what we are doing today. Thus, the most pressing problem for today is to make our education system compatible with tomorrow's world.

The STEAM-based education system tends to overcome the challenges mentioned above by integrating technology into the education system.

1.2 Objective

The main objectives of this research can be summarized as below:

1. Explore and examine the willingness and readiness of the schools, teachers, students, parents, and STEAM providers to implement STEAM education within KMC.
2. Identify the policy gaps in education by comparing developed and developing cities where STEAM education is already promoted.
3. Provide recommendations on the implementation model for STEAM-based education in schools of KMC.

1.3 Limitations of the Study

The limitation of this research can be summarized as below:

- Data could not be collected across all schools within KMC.
- The recommendation submitted for the implementation model will only be replicable outside KMC after modifications.

Additionally, due to the ongoing COVID-19 pandemic, the following limitations were further met:

- Access was limited to students, parents, schools and teachers.
- Frequent travel amidst the pandemic was challenging.

- Online meetings were not possible for some potential respondents.
- Using an online platform resulted in limited interaction with the respondents.

2. Methodology

STEAM-based education can be successfully implemented within the Kathmandu valley when all the stakeholders in STEAM education are willing and ready to accept it. This research measures the willingness and readiness of the five key stakeholders (schools, school teachers, school students, parents and STEAM providing institutes) that embrace STEAM-based education in the schools of KMC.

To fulfill these objectives, we have conducted both quantitative and qualitative analyses and provided recommendations which are detailed in the following steps (see Table 1):

a. Primary data collection from teachers, students, and principals from the community and private schools within KMC.

b. Primary data collection from individuals and firms actively engaged in providing education service regarding implementing STEAM education.

c. Analysis of primary data received from teachers, students, schools, parents, and STEAM providing institutes.

d. Comparison with international findings and literature with the current education policy of Nepal and making suggestions accordingly to minimize the policy gaps in the education act.

e. Recommendation of the appropriate policies based on the findings.

Table 1: Methodology for the research

Data	Analysis Type	Outcome
From teachers in school	Quantitative	Teachers' willingness and readiness to implement STEAM education
From school administrations	Quantitative	Schools' willingness and readiness to incorporate STEAM curriculum in the existing lesson plan
From students in school	Quantitative	Students' willingness and readiness to learn STEAM education
From parents	Quantitative	Parents' willingness and readiness to involve their child/children in STEAM education
From STEAM education provider	Quantitative	STEAM providing institutions' readiness to implement STEAM education
From literature review	Qualitative	Overall, STEAM education in the education system around the globe and the policy gap of the education system of Nepal with the global education system
From Nepal and KMC education policy document	Qualitative	Global Trend and importance of STEAM in KTM; Policy gap in implementing STEAM at national level

3. STEAM Education in South Korea, Hong Kong, and Nepal: A Brief Review

3.1 STEAM in South Korea

The South Korean Government has continually driven STEAM education policy as a solution for empowering their future workforce with the required set of skills. The Korean Ministry of Education, Science, and Technology in 2011 included STEAM education as a plan to foster and support their human resources in science and technology.

As the most representative national institute for STEAM education, the Korea Foundation for the Advancement of Science and Creativity (KOFAC) has managed systematic STEAM education programs at the national level. To help STEAM education become more well established, KOFAC cultivates and supports leading groups, reinforces teachers' capabilities, develops and distributes content, promotes interactive and exploratory activities for students, and institutionalizes and builds infrastructure (Hong, 2017).

South Korea revised its national curriculum in 2015, intending to cultivate creative talents with integrative thinking and problem-solving. STEAM education will thus continue to be emphasized and promoted as an educational strategy to meet the requirements of the future generation.

Similarly, teachers' capabilities in promoting and implementing STEAM education across the schools are of great importance. According to the research conducted in South Korea by Park *et al.* (2016), out of the total 11,526 elementary, middle, and high schools in South Korea, 6,743 were sampled. The research found that 56.8% were implementing STEAM education in their institutes. This research also discovered that the most critical factor in implementing STEAM education was the voluntary efforts of the teachers. And the main reason for not implementing STEAM education in other schools was also because of difficulty in drawing a consensus from teachers regarding STEAM education. This result shows how important the role of teachers is for the implementation of STEAM education. This research also provides a limelight on the fact that teachers' willingness and readiness to incorporate STEAM education in their teaching methods can have a considerable influence in promoting STEAM education at the national level (Park *et al.*, 2016).

South Korea undertook three steps of teacher training programs to support STEAM professional development for teachers. First, 'Introductory Training' focused on helping teachers understand the concepts, policies, and representative content of STEAM education. Second, 'Basic Training' involved a 15-hour online program focused on sharing best practices, such as organizing STEAM educations suitable for the school curriculum and implementing STEAM education for after-school programs. Third, 'Intensive Training' provided a mixture of online and offline programs focused on improving teacher's capabilities to develop and implement their educational materials for STEAM classes.

Despite these professional development programs aimed at teachers, many of them still faced difficulty selecting appropriate topics, integrating two or more subjects, developing educational materials, and evaluating classes (Noh & Paik, 2014). Considering these difficulties, the teachers face, STEAM research groups of teachers in South Korea developed and applied STEAM education materials that can be imitated at schools all over the country.

According to international evaluation programs such as TIMSS (Trends in international mathematics and science study) and PISA (Program for international student assessment), Korean students demonstrated high performance but low interest in science and mathematics. However, a study conducted by KOFAC showed students who participated in STEAM classes showed higher 'science preference' than students who did not participate. Students participating in STEAM classes also showed higher levels in terms of 'ability to perform self-directed learning,' composed of the ability to lead learning, cognitive strategy, learning motivation, the will to solve problems, use tools, and cooperate (Park *et al.*, 2016).

Continuing with these positive impacts of STEAM education, the authorities implemented policies to promote interactive and exploratory activities for students, such as STEAM Research and Education (R&E). STEAM R&E aims to enhance student's research capabilities and encourage an atmosphere of spontaneous inquiry by supporting student-led research activities on integration-based themes. Students participating in STEAM R&E come up with their problems from daily life, define research problems, design research methods, and then submit their research proposals. Research projects are selected for funding through expert reviews, and the results are published at R&E festivals.

As per a study conducted by Mun *et al.* (2017) on the effects of STEAM R&E, students' creative leader competencies, consisting of cognitive, effective, and societal domains improved after participating in STEAM R&E. In addition, STEAM R&E has positive impacts on students' creative thinking by providing students with experience related to research field careers and collaborative research activities carried out with friends.

According to the analysis of 821 STEM/STEAM-related research papers published in South Korea over the last ten years, the most frequently researched topic was "program/ instruction materials", which accounted for 72% of the total topics. Kim & Kim (2017) show that studies in STEAM education have been focused on developing diverse educational materials and programs that promote STEAM education.

The Korean Ministry of Education and KOFAC are continuing to develop four types of STEAM programs to be used in schools:

a. Integration-based programs for each theme of STEAM (e.g., biotechnology, global environment, and appropriate technology)

b. Programs to utilize up-to-date products (e.g., up-to-date ICT, up-to-date medical appliances, and up-to-date vehicles)

c. Integration-based programs in science and arts (e.g. topographical maps in science and art, creative activities in manufacturing, and world-changing designs)

d. Design-based programs connected to promising future jobs (e.g. cognitive engineers, robot engineers, and information system professionals)

3.2 STEAM Education in Hong Kong

The Hong Kong Education Development Board administered questionnaires to participants in various symposia from November 2015 to January 2016 as well as all primary and secondary schools to collect views on the promotion strategies (see Education Bureau, 2016). Through various consultation events, mass media, and written submissions, helpful

feedback was extracted from stakeholders and the public. The schools' response has documented a general agreement for strengthening students' capability to integrate and apply their skills and knowledge across various subject disciplines. Regarding the renewal of the school curriculum, the overwhelming majority of respondents (>90%) emphasized STEAM education promotion.

Hong Kong Education Development recommended five-pronged guiding principles for promoting STEAM education and adopting a holistic approach at the system and the school levels for implementation. These principles are as follows:

a. Adopting a learner-centered approach focusing on facilitating learners to obtain the skills on how to learn through STEAM-related activities, diversified learning, education and evaluation strategies that suit the needs and interests of students.

b. Enhancing STEAM-related learning opportunities to form part of the essential learning experiences, inclusive of learning opportunities beyond the classroom.

c. Balancing between students' interests and needs, teachers' views and partnerships with other stakeholders.

d. Building on schools' past experiences and other conducive factors for the promotion of STEAM education.

e. Promoting STEAM education as a continuous and dynamic improvement process, preferably starting from small-scale curriculum development projects, allowing tolerance of ambiguity and room for further advancement.

3.3 STEAM Education in Nepal

In recent years, many institutes in Nepal, such as Karkhana, STEM foundation, RAN, Samadhan Engineering, and Redshift, have collaborated successfully with schools to provide STEAM-based education. However, each of them has used their own platform to implement the program. The most common platform used is Arduino and Raspberry pi. With these platforms, students were successfully able to grasp the idea of IoT and modern technologies.

The common practice in Nepal regarding STEAM-based education is to provide the platform to a specific number of students for the projects, making it difficult to blend the curriculum to STEAM education. Hence presently, STEAM education is limited to project works rather than providing the platform for understanding the basic knowledge and complementarity of the curriculum. To tackle this, an institute like Samadhan Engineering Pvt. Ltd. has developed a program to include all students and developed a curriculum for every standard based on the understanding and interpretation of the subject matter. This curriculum helps students to understand the concept and parents to be convinced and accept STEAM education as necessary for children's education.

Current government policy has several points that ensures that the STEAM-based education is included in Nepal's education system (नेपाल सरकार, २०७६). The strategy that ensures the inclusion of STEAM education can be summarized as:

- To ensure sustainable investment in the participation and partnership of various stakeholders in technical and vocational education and training.

- To provide relevant, quality and competitive technical and vocational education and skill development opportunities according to the qualifications and capabilities based on the needs and priorities of the labor market.
- To make competency testing and training of teachers compulsory
- To integrate information and communication technology as an integral part of the teaching-learning process to make it technology-friendly, practical and result-oriented
- To make science, technology, engineering and mathematics education (STEM education) an integral part of the curriculum in all levels of education.

The policies to include STEAM education in the education sector of Nepal can be summarized as below:

- A well- run and well-equipped national science school to expand the opportunities of science and technology education.
- Establishment of research laboratories, including thematic laboratories for technical and vocational education and skill development.
- Cooperation from the educational institutions, including sharing the cost with the workplace and community, and among industry, trade, association and institutions in order to make technical education practical and timely.
- Development of direct and online teaching and training systems in technical and vocational education programs using modern information technology in line with international experience and national standards.
- Increasing the use of technology.
- Development of print, multimedia and online-based learning materials targeting the students of open schools and universities.
- In addition to developing school curriculum-based teaching and learning methods, development of techniques and thinking with the direct participation of the students, focusing on the creative aspects such as teaching, project work, and experimental practice based on the educational curriculum.
- Enhancement of teachers' professional skills to teach subjects related to science, technology, engineering, and mathematics through teacher training and capacity-building programs.
- At the local level, organization of continuous professional development programs of teachers (customized training, workshops, seminars, observation visits, reflection, teacher network, collaborative research, mentoring, coaching, etc.) with the schools as the focal point.
- By integrating information and communication technology as an integral part of the education system, the development of technology infrastructure to make the teaching-learning process information technology-friendly in schools and educational institutions.

- Development of digital technology (developing virtual teachers, professors, trainers, monitors, inspectors and supervisors) at the federal and state level to develop effective teaching, learning, training, monitoring, evaluation and supervision systems.
- Emphasizing ubiquitous learning and easy-to-use materials such as tablets, smartphones, mobiles, etc. to effectively conduct learner-centered learning, as well as the opportunity to learn closely with an experienced and skilled personnel.
- Use of Information and communication technology to teach and learn from the elementary level in school education.
- Development and expansion of STEAM education as an integral part of the overall education system by modernizing appropriate policies, investments, workforce development, curriculum adjustment and teaching methods.
- Improvement of the teaching and learning process by digitizing the curriculum and incorporating STEAM as subjects during curriculum development.
- Giving due space to STEAM subjects while modifying and updating the curriculum and textbooks relative to the environment.
- Promotion of STEAM, educational institutions in collaboration with the community, organizations, industry and mass media in the organization of literacy programs related to science and technology.
- Development of children's interest, participation, involvement, and ability in subjects related to STEAM from the earliest levels, with the potential of increasing its extent up to fifty percent in the curriculum depending on the class and level.
- Integration of the concept of STEAM into school education (language, literature, art, culture, history, geography, etc.).
- Development of curriculum-based on STEAM by identifying the areas required for the state at the undergraduate and postgraduate level.
- Construction of Science and Technology Centers, Museums, Research and Innovation Centers, and Planetariums at the federal and provincial levels to promote STEAM education.

KMC has integrated many innovative plans to improve its education systems (काठमाडौं महानगरपालिका, २०६६). One step taken by the KMC to elevate its education system is to plan in the policy to start a STEAM club and introduce technical education to school students. According to the policy, KMC has started conducting civil engineering classes in three of its community schools targeting students from class 9 to 12 to implement the aspiration of "expansion of technical and vocational education, basis for building a prosperous metropolis." Under this, 514 students are studying. The education policy of KMC that directly impact STEAM-based education can be summarized as below:

- To improve the quality of schools in the metropolis and make it timely, an education plan will be formulated by forming a committee consisting of educationists to formulate an integrated education management plan. Child education, primary level education, basic level education and secondary level

education will be specialized.

- A child-friendly teaching method will be adopted by constructing the necessary infrastructure to raise the morale of the students who dropout of school. Providing guardianship to the local poor, destitute, Dalit and disabled children by providing textbooks, textbooks and uniforms as per the need will be continued.
- Science and computer laboratories will be established and upgraded in all community secondary schools. STEAM Club will be established in the selected schools, and various innovation programs based on science, technology, engineering, art and mathematics will be conducted. Students' creativity will be encouraged by organizing annual invention competitions among schools.
- Students of the 9th to 12th classes of three community schools are being taught in civil engineering. In 2077/78, computer, electrical and electronics subjects will also be taught in 3 more community schools. Thus, the students studying engineering will be mobilized in the programs run by KMC as per the need.
- The educational information system will be organized to implement one model school program by establishing an electronic recording and reporting system of teachers, staff and students of all community schools.
- Thematic teachers will be provided to make the community schools teaching friendly, and infrastructure improvement will be emphasized.
- Cooperation will be made with the Nepal Academy of Science and Technology to establish a science and technology-based innovation center and science park.

4. Results and Discussion

4.1 Factors Affecting Willingness to Implement STEAM Education

Figure 1 compares the four main factors that describe the willingness of the five key stakeholders in implementing STEAM education. These four factors are as follows:

(1) STEAM helps in effective learning: Figure 1 shows that STEAM-providing institutions firmly believe STEAM education will help students learn effectively. However, other stakeholders - students, teachers, parents, and schools do not agree completely but still believe that STEAM education can be effective in the learning process.

(2) STEAM makes student competitive: The figure shows that the STEAM providers highly believe STEAM education can prepare students to become competitive once they complete their schooling. Moreover, students, teachers and parents moderately believe that STEAM education can help students become competitive. However, schools lack some consensus in believing STEAM education to make students competitive.

(3) Availability of STEAM materials: Interestingly, all five stakeholders share a similar view on this variable. They believe there is no proper availability of STEAM materials in the Nepalese market. The existing materials that the teachers are using in schools are also not appropriate or enough for STEAM education. STEAM providers also agree that they do not have enough STEAM materials and resources to implement STEAM education effectively within the Kathmandu Valley.

(4) Need for professional development training: All asked stakeholders (teachers, schools, and STEAM providers) responded almost to the same degree that the teachers providing STEAM education require professional development training to implement STEAM education effectively. All the questioned stakeholders agree that this area needs a vast improvement to make the STEAM approach of learning effectively.

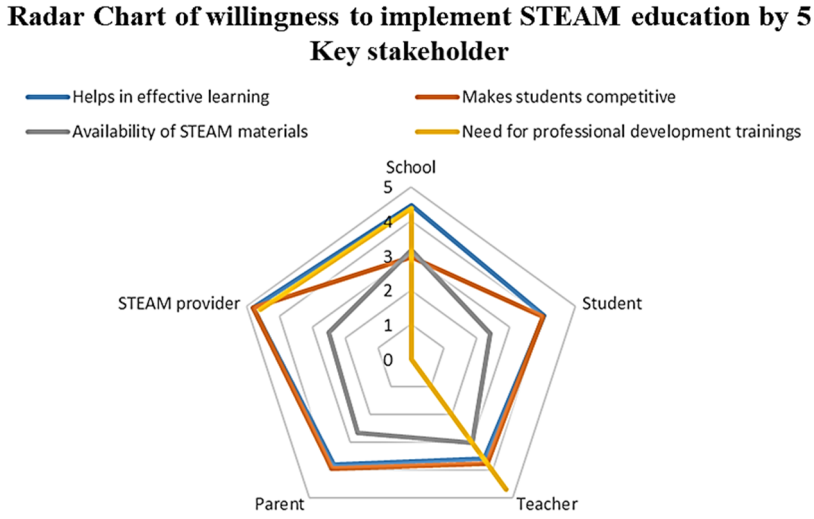


Figure 1: Willingness of five key stakeholders to implement STEAM education

4.2 Analysis of School's Readiness

Nineteen schools from Kathmandu were provided with the survey form. The established years of surveyed schools range from 5 to more than 25 years, with students ranging from less than 300 to more than 5000. The fee range for the grade 8 of the surveyed school ranges from less than Rs. 1000 to Rs. 18000 per student. Figure 2 shows the responses from these schools.

The findings from this survey with regards to schools' readiness can be summarized as below:

- Almost all the participating schools have recognized the necessity of the STEAM program in the curriculum. However, not many schools are capable of promoting the STEAM-based education system.
- Almost all schools need technical support to implement the STEAM-based education.
- Most of the schools are inclined towards project-based activities to make students understand the current curriculum.
- A small percentage of schools could not grab the concept of integrating STEAM-based education into the subject's curriculum.

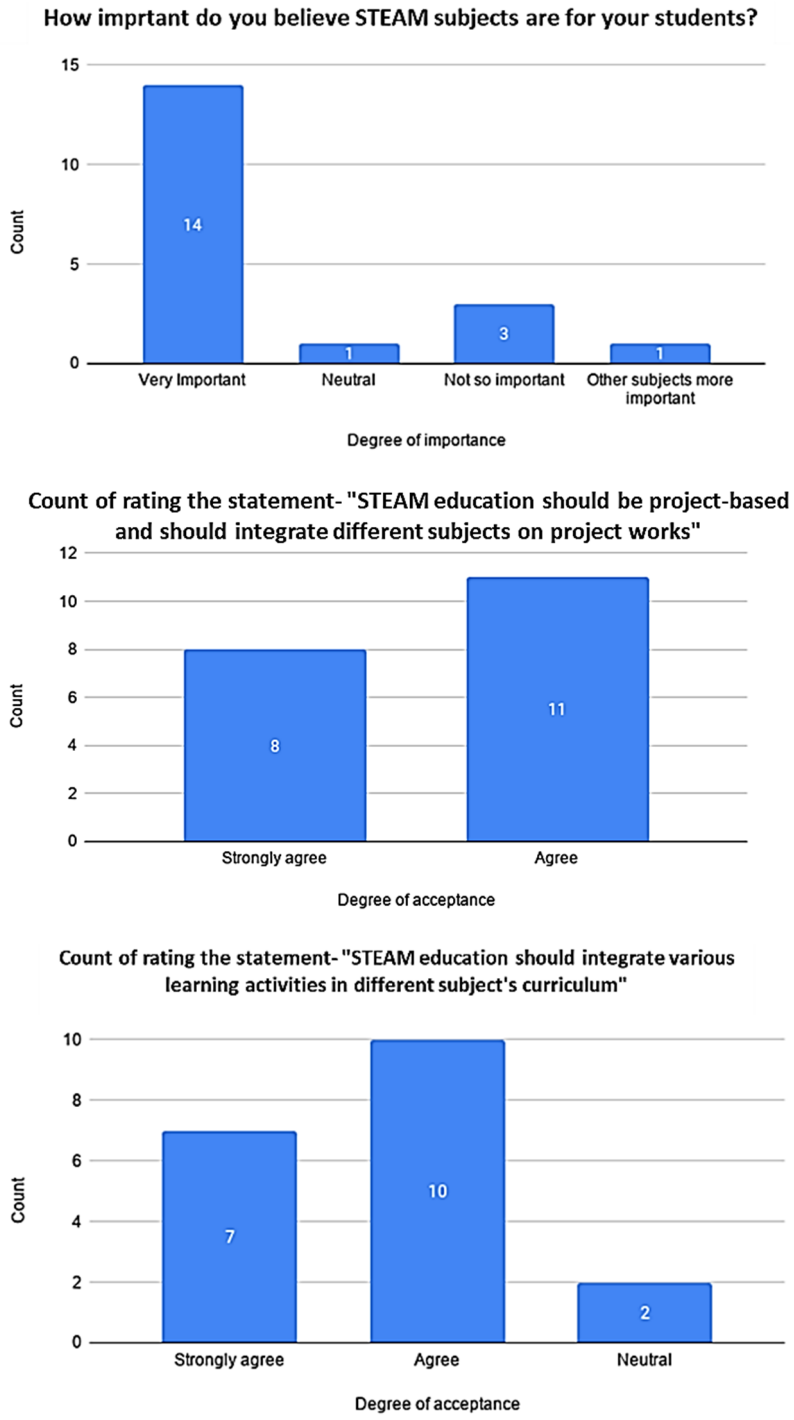
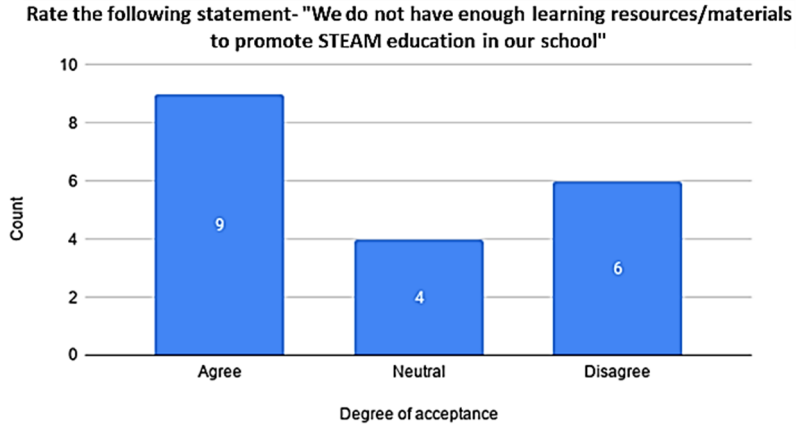
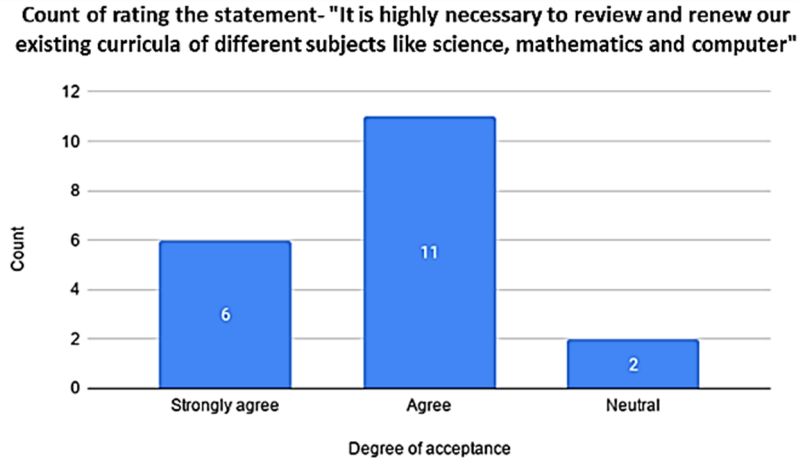


Figure 2: Response from the schools





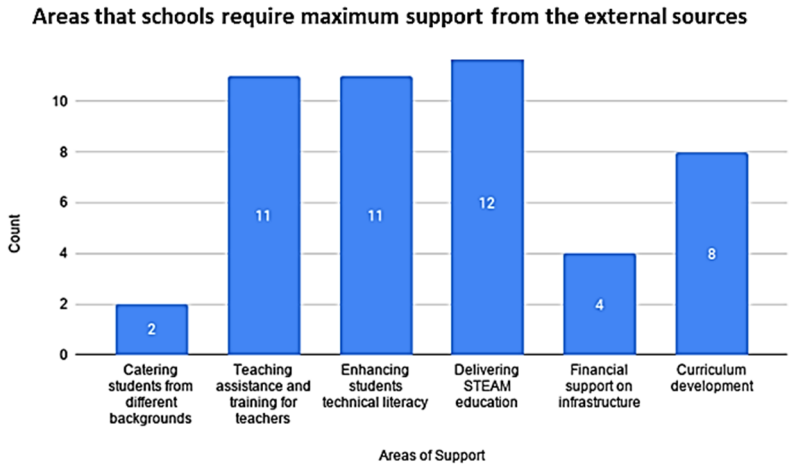


Figure 2: Response from the schools (cont.)

4.3 Analysis of Students' Readiness

Twenty students were surveyed from the interviewed schools to find their perspective regarding STEAM-based education. The responses of the students can be summarized below (see Figure 3):

- Most of the students are excited about the STEAM-based education.
- Although many students do not want to pursue career in the STEAM field, they acknowledge that STEAM-based education is helpful.

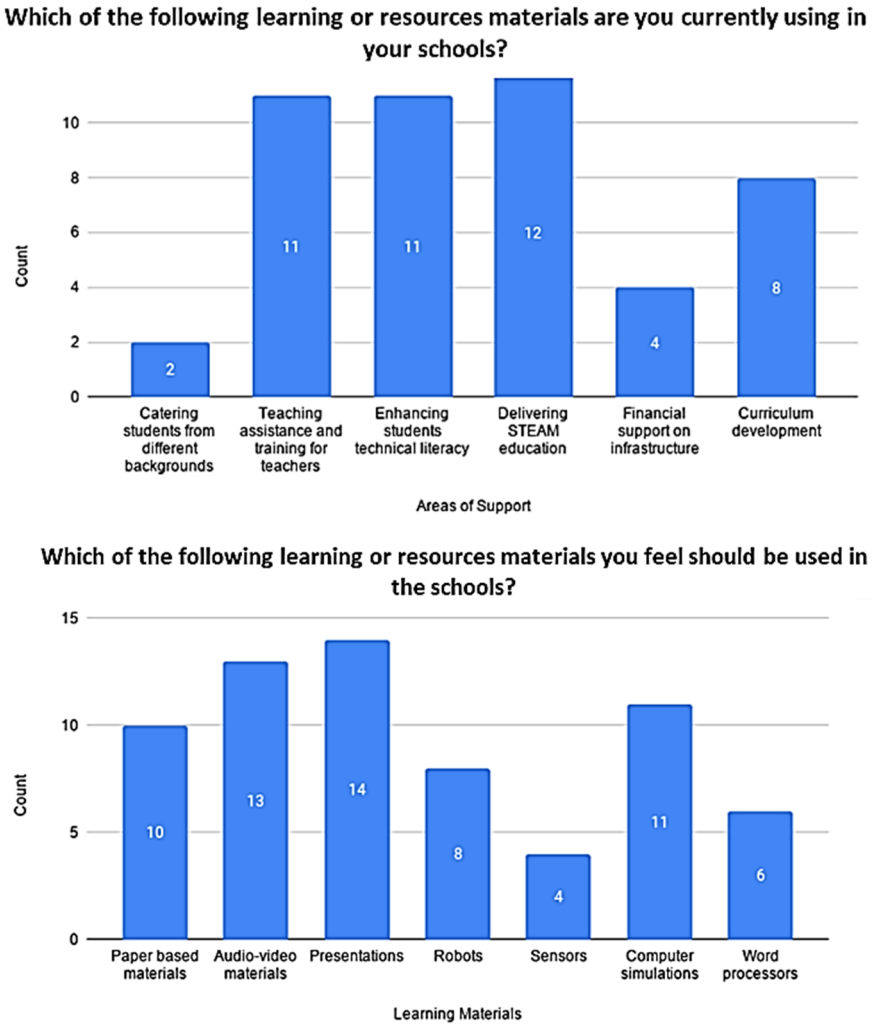


Figure 3: Response from students

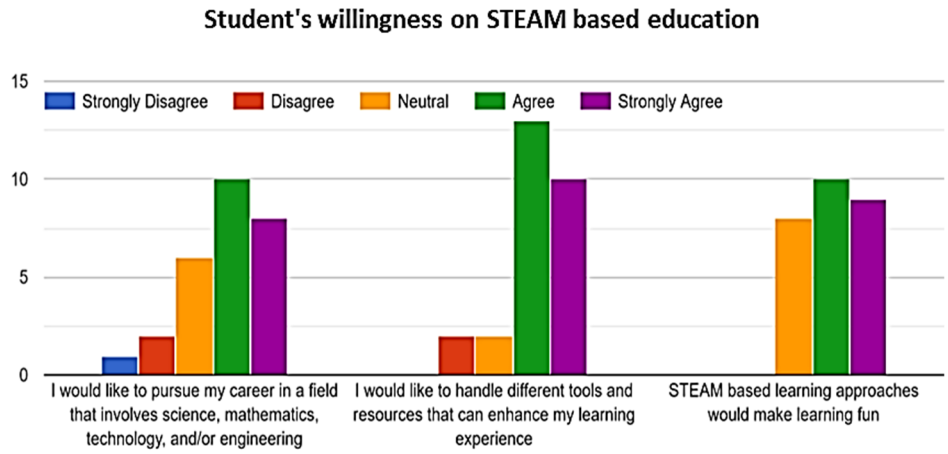


Figure 3: Response from students (cont.)

4.4 Analysis of Teachers' Readiness

Twenty-four teachers from the schools were surveyed to find out the readiness of the teachers. The response of the teachers can be summarized as follows (see Figure 4):

- The teachers are not entirely ready to incorporate modern learning tools.
- They frequently use different pedagogical approaches and technologies.
- They are eager to implement a new methodology to the teaching methods.
- They understand the need for STEAM-based education.
- They need training programs to integrate STEAM education.

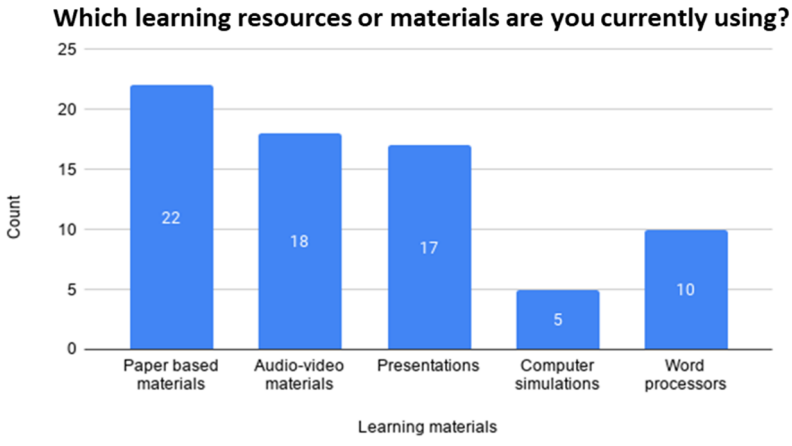
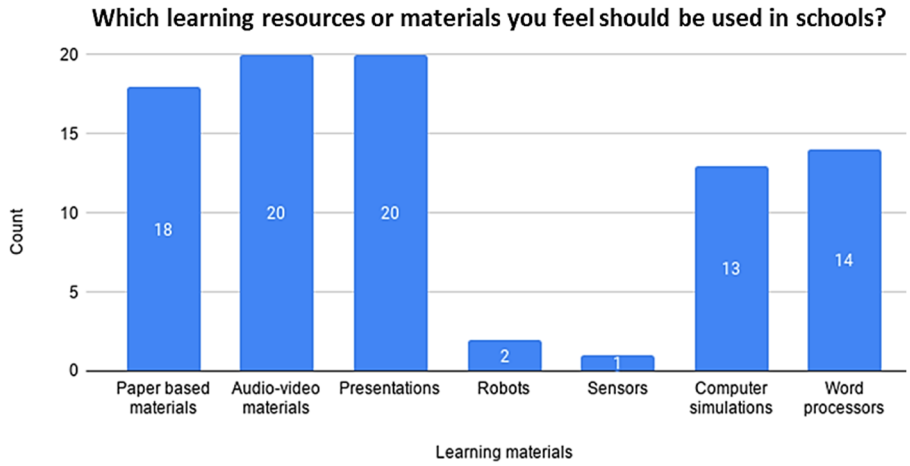


Figure 4: Response from teachers



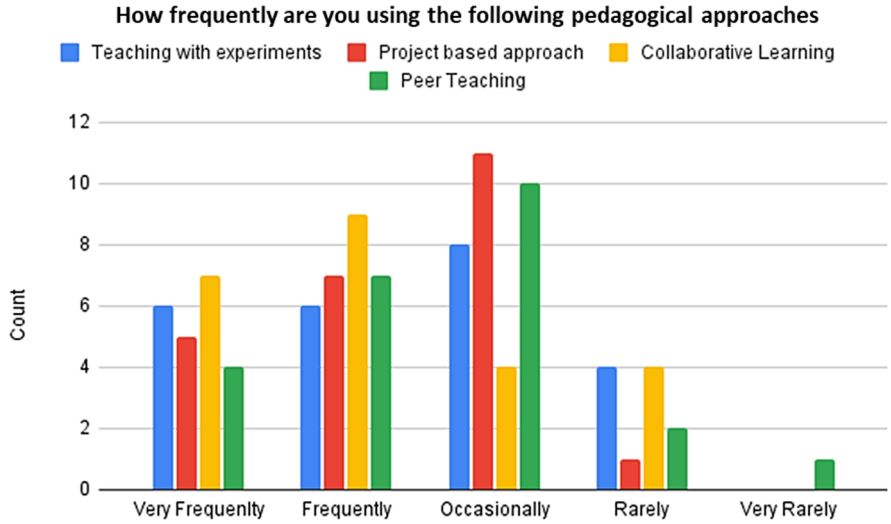
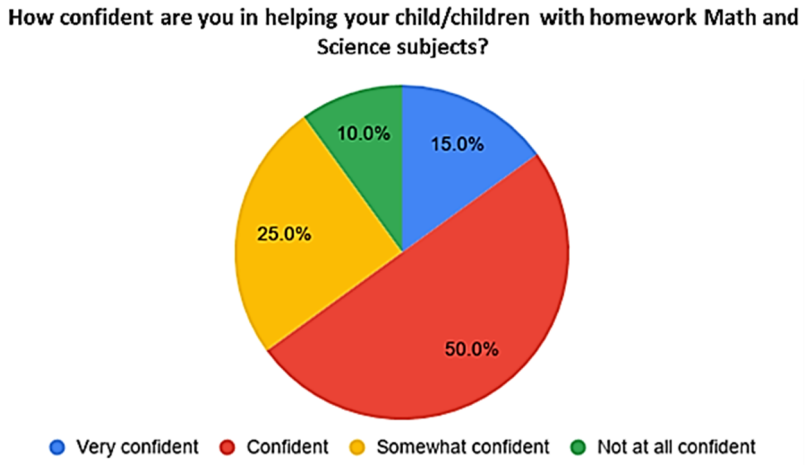


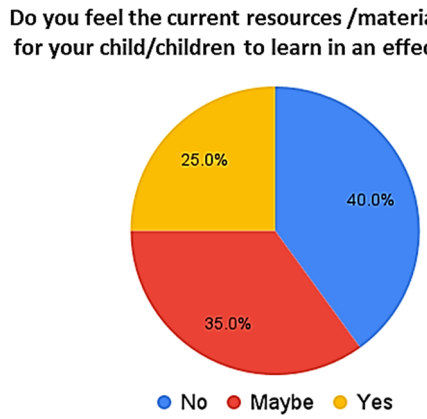
Figure 4: Response from teachers (cont.)

4.5 Analysis of Parents' Readiness

Twenty parents with their children in the schools mentioned above were surveyed. The response from the teachers can be summarized as follows (see Figure 5):

- The majority of parents feel the need to implement STEAM-based education.
- Few are willing to spend extra money on STEAM-based education.





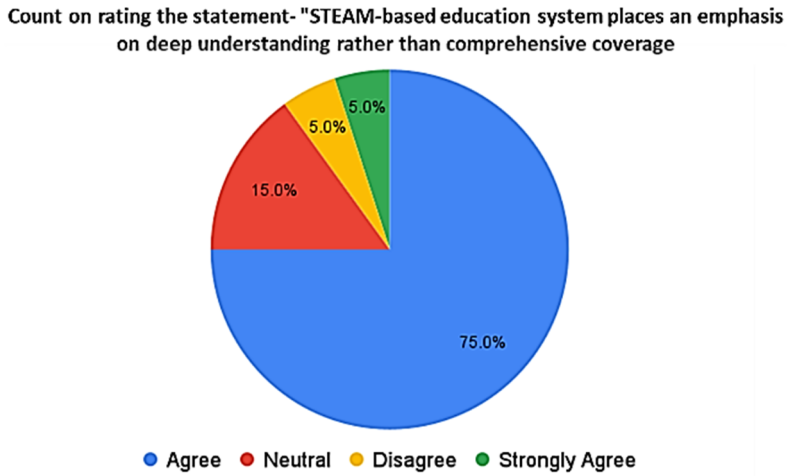
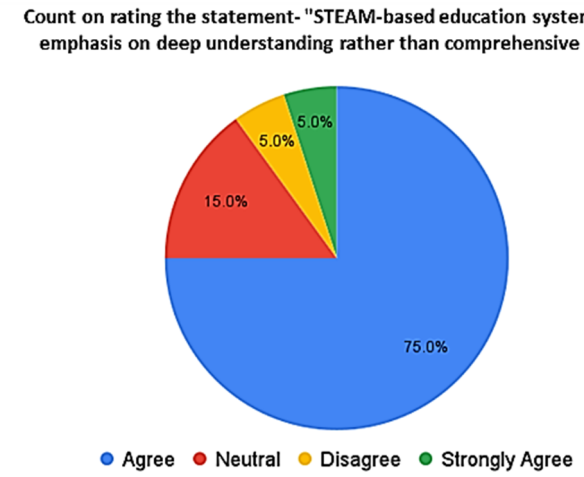
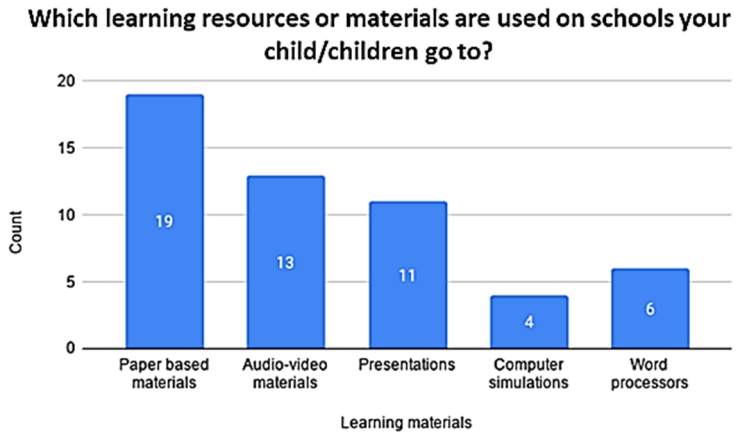


Figure 5: Response from parents





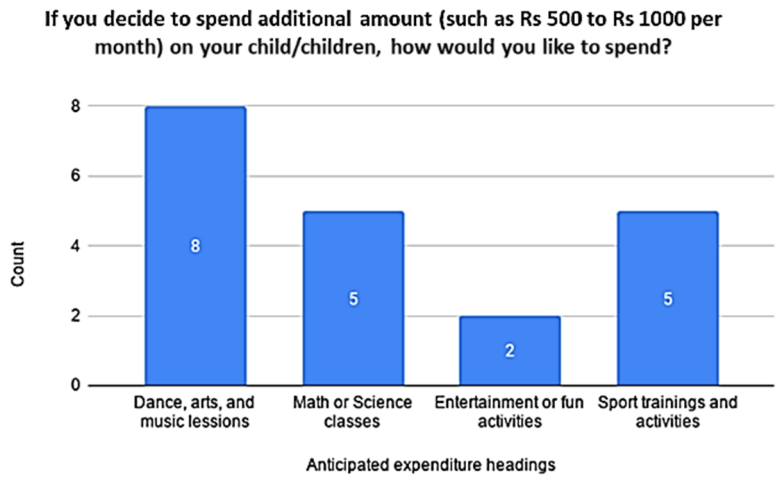
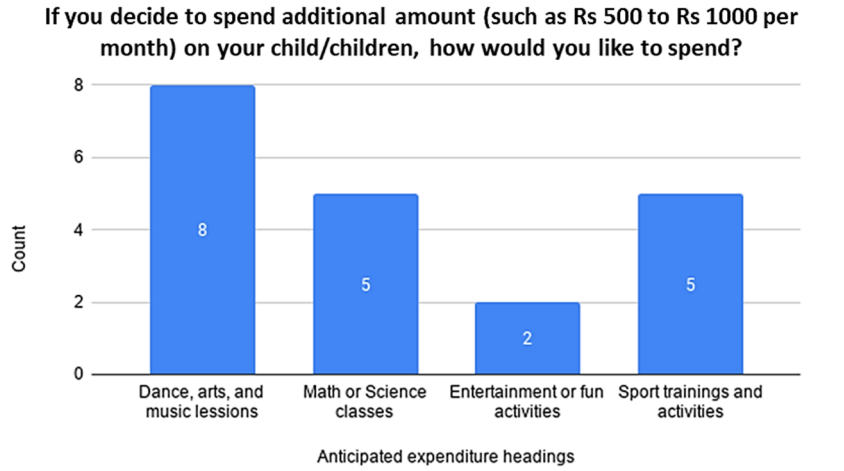


Figure 5: Response from parents (cont.)



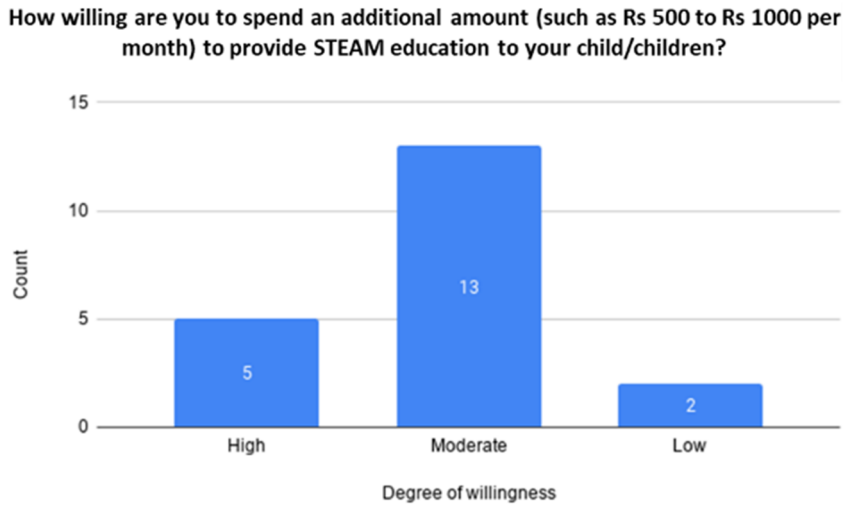
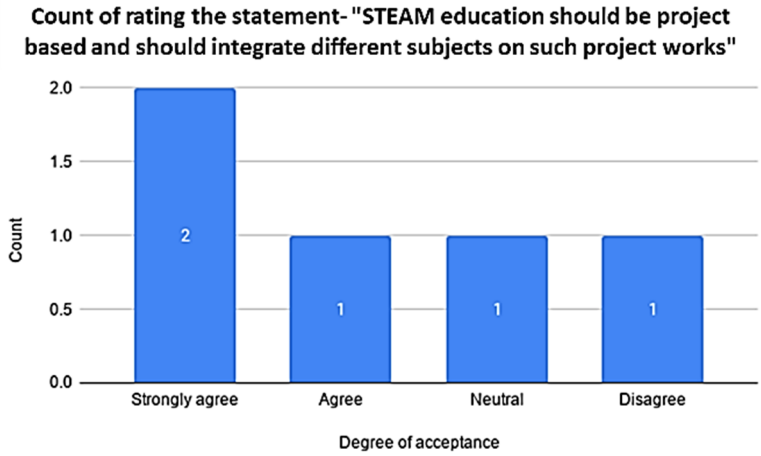


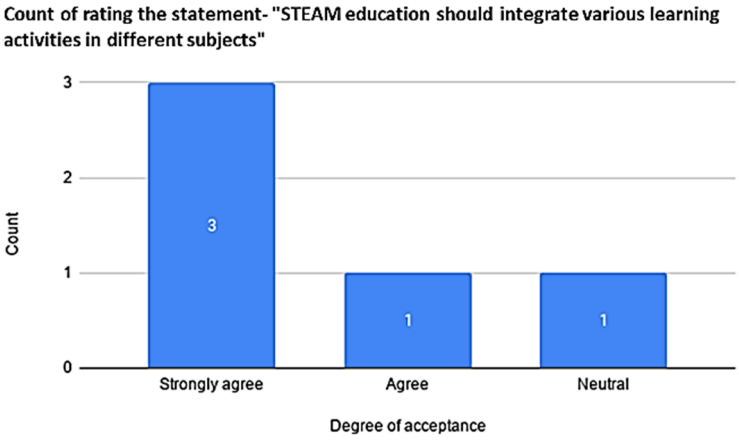
Figure 5: Response from parents (cont.)

4.6 Analysis of Readiness of the STEAM-providing Institutes

Five STEAM-providing institutes were surveyed to find the readiness of the institutes. The response from the STEAM providers can be summarized below (see Figure 6):

- It is hard to give service solely based on Nepal's market.
- There is a need for more awareness programs in schools.
- It is better to not use school teachers for STEAM-based education.





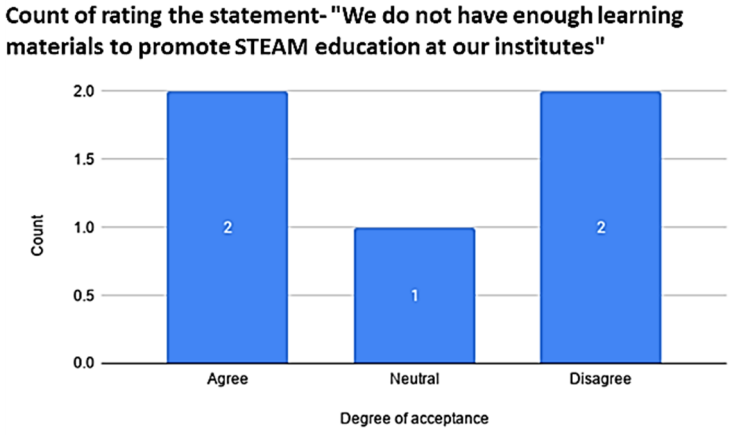


Figure 6: Response from the STEAM service providers (cont.)

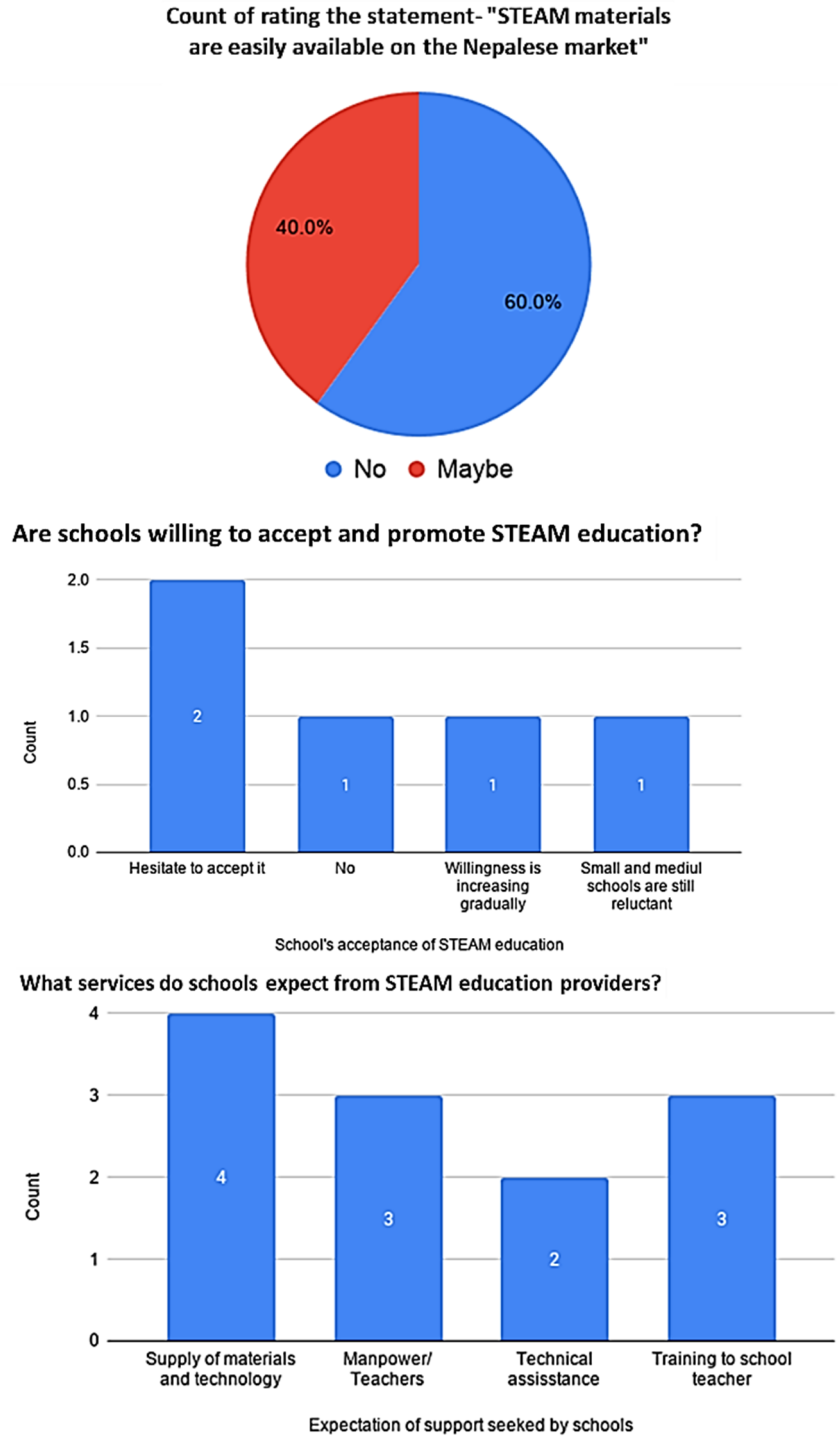


Figure 6: Response from the STEAM service providers (cont.)

4.7 Analysis of Readiness of the Schools funded by KMC for STEAM Education

The responses from nineteen government schools that introduced STEAM education in collaboration with KMC were collected and analyzed. All schools conducted programs from classes 6 to 8, whereas only twelve conducted programs for classes 5 and 9, and only three schools conducted the programs for class 10. About 90% of the sampled schools were collaborating with Karkhana to provide STEAM education in their institutes. The remaining 10% of the schools have worked with the STEAM foundation. Figure 7 shows the impact and overall experience of the schools regarding the program.

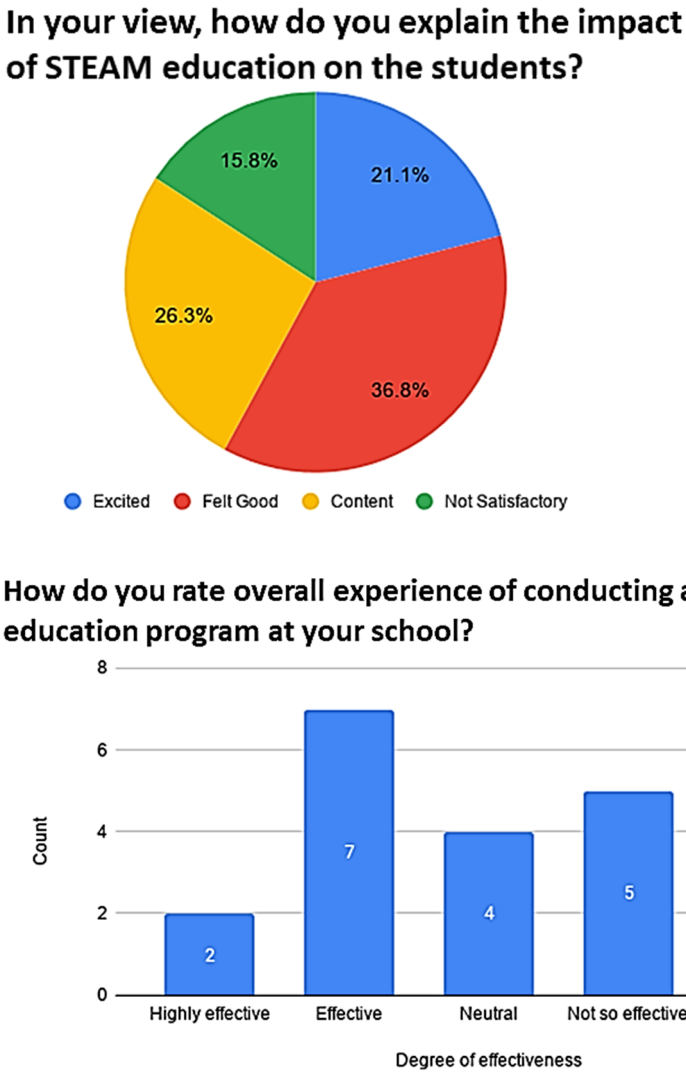


Figure 7: Impact and overall experience of the schools

The survey results from these schools can be summarized as follows:

- There is a need for a higher level of collaboration between STEAM providers and schools.
- There is also a need for more support and engagement from STEAM providers.

Furthermore, the school provided some recommendations that would be conducive in implementing STEAM education, which are listed below:

- STEAM-providing institutes need to be in regular touch even after the completion of their training. Regular follow-ups and technical support are expected from the school administration of the STEAM providers.
- STEAM training or orientation programs need to match with the school curriculum.
- Such training or orientation programs should not be limited to 3-4 days. It should be extended to at least a week.

The STEAM education program did not help students regarding the school's current curriculum and is organized as an extra-curricular activity. Thus, the program should be based on the school curriculum.

5. Conclusion and Policy Recommendations

5.1 Conclusion

In the surveyed schools, teachers, students and parents, most schools and teachers recognize the importance of STEAM-based education. Still, they need training sessions as well as technical support to implement it. Most of the parents, however, prefer other activities to the STEAM-based education system. Students are attracted to the STEAM-based education system.

Survey also showed that two of the most challenging hurdles in implementing and promoting STEAM education are the unavailability of the modern and advanced tools or the reluctant teachers in using those tools, and the outdated curriculum of subjects like science and mathematics to meet the current requirements.

The school with the pilot program regarding STEAM education organized by KMC showed that it needs more regulation, although the program positively impacted the students and schools. The program should be embedded in the curriculum to make it more effective. Based on the study of various developed and developing countries that have adopted STEAM-based education, the following suggestions could be put forth for KMC:

- Provide a common platform where multiple stakeholders can meet and integrate.
- Provide a platform for stakeholders to develop educational materials and allow students to observe and solve real-world problems.
- Organize necessary and systematic training programs for teachers.

KMC has adopted policy to implement STEAM education in its jurisdiction. Based on the survey findings and literature review, following policy gaps have been identified and recommendations proposed to promote a STEAM-based education system:

- The education policy of KMC has many strategies to integrate STEAM education into the curriculum. However, it does not have any strategy to create a common platform to implement a STEAM-based education system. Thus, a platform should be developed where multiple stakeholders like teachers, research organizations, STEAM providing institutions, and industry experts can develop educational materials, teach students, and collect and analyze data on students.
- KMC also has the policy to implement a STEAM club. However, the policy should be developed to make STEAM a part of the curriculum and should not be treated as an extracurricular activity.
- KMC policy includes training programs and opportunities for teachers. However, systematic step-by-step educational opportunities should be provided so that teachers can smoothly bridge the gap between education and our changing world.
- KMC policy does not provide a specific plan to involve students in STEAM-based activities. KMC has started conducting civil engineering programs in schools and has a plan to introduce other engineering fields. The number of schools and students is limited, and the policy does not plan to involve students in any activities.

  The policy should be developed so that the students can have more experience in participating in social problem-solving subjects to recognize or focus on social problems and try to solve them through STEAM education as a part of their curriculum.
- The government policy has plans to make universities research-oriented and to integrate technologies in education. However, it does not have any plan to integrate a STEAM-based education system in the university. STEAM education should not be limited to primary, secondary and higher schools and should be extended to university education.

  If STEAM education is implemented in university education, then realistic projects dealing with problems in real industries and communities will be pursued based on the ideas of university students and student-led research and development activities.
- Although the KMC policy has included a local curriculum, the overall curriculum must be revised to integrate STEAM-based education to a higher degree.
- The policy should be developed to develop a technology to help students understand the current curriculum more profoundly.

5.2 Policy Recommendations

5.2.1 Macro-level Policy Components and Practices to Support STEAM Education

By 2030, Institute for the Future estimates that 85 percent of the jobs that today's K-12 learners will be doing have not been invented – demanding a creative and prepared workforce to respond innovatively to real-world problems (Henriksen, 2017). The STEAM-based education system can further enhance teaching and student achievement and eventually encourages students to apply creativity to solving real-world problems. As a response to changing workforce demands, policymakers from all over the globe have turned their focus on STEAM education to believe that integration of science, mathematics, technology, engineering, and arts can empower the future workforce with all the skills required. Macro-level policy components that the policymakers need to consider supporting STEAM education are as follows:

(1) Access and Participation: To accomplish the increase in access and participation in STEAM-based programs, educational institutes need to provide STEAM certification for the students who have completed the STEAM curriculum. Few considerations in the application of STEAM certification can include:

- Goals for student participation, including access for traditional and non-traditional students.
- Plans for public-private partnerships.
- Plans for teacher professional learning and training programs to ensure that the teachers are well equipped to deliver STEAM education.
- Curriculum guidance.

(2) Quality and Relevance: Policymakers need to ensure that a certain standard of STEAM education has been maintained throughout the country. Thus, the public sectors need to work actively to develop a curriculum for STEAM education and then implement the developed curriculum throughout the country. A STEAM-based education should be applied by integrating both methods - developing a STEAM curriculum and organizing various project-based learning activities.

(3) School Governance and Management: Leaders from local, provincial and central levels should contribute to implementing STEAM-related policies across the country. A central government should develop policies to govern STEAM education and a task force should be initiated, which shall be responsible for improving students' educational achievement through STEAM learning. Policymakers also should come up with an alliance of representatives from education, business and industry, community-based groups, non-profit organizations, funding agencies and government offices. For STEAM application, an implementation continuum should be developed to provide province-wide guidance and consistency for STEAM education in elementary, middle, and high schools.

(4) Sustainable Financing: Limited funding for STEAM education can create barriers that hamper program offerings, student participation, and staffing, professional development, access to resources or after-school programs. A sustainable source of funds will be required to implement STEAM education at a national level.

(5) Research and Innovation: A culture of research and innovation should be introduced to students at all levels. With this objective, local, provincial, and central levels need to allocate research funds that actively support and engage students in research activities. Events, competitions, fairs and exhibitions, and other programs directed at encouraging students on research and development activities can be facilitated. Students outshining such programs and competitions should also be provided with career opportunities to excel in this field.

These components and practices do not represent a complete set of policies but provide examples of support that the local, provincial, and central Government can provide to promote STEAM education. There is no universal or standard way of implementing STEAM education. But, through these policies, public sectors can encourage private sectors to provide and promote STEAM education.

5.2.2 Road Map to Implement STEAM-based Education

The roadmap can be mapped as follows:

1) Allocate budget to -
   - Form a task force.
   - Implement technologies.
   - Organize training programs.
2) Form a task force of experts (teachers, STEAM providers, policymakers) and -
   - Decide a common platform including technology.
   - Develop/use technology to help understand the current contents of the curriculum.
   - Integrate STEAM-based education into the curriculum.
   - Set the standard for STEAM-based education.
3) Select pilot schools to implement STEAM-based education.
4) Organize teacher training programs to provide -
   - Introductory Training: Understanding the concepts, policies, and representative content of STEAM education.
   - Basic Training: Sharing best practices to implement STEAM education.
   - Intensive Training: Improving teacher's capabilities to develop and implement their educational materials for STEAM classes.
5) Implement STEAM-based education in selected schools.
6) Regularly monitor and acquire feedback from schools and students.
7) Involve students in social problem-solving activities.
8) Organize exhibitions and competitions.

Acknowledgment

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नेपाल सरकार, २०७६ । राष्ट्रिय शिक्षा नीति, (नेपाल सरकार, मन्त्रीपरिषद्बाट मिति २०७६।७।१८ मा स्वीकृत) । नेपाल सरकार, शिक्षा, विज्ञान तथा प्रविधि मन्त्रालय, सिंहदरबार, काठमाडौं ।

काठमाडौं महानगरपालिका, २०६६ । आर्थिक वर्ष २०७७/०७८ को नीति तथा कार्यक्रम, "साँस्कृतिक शहर, काठमाडौं महानगर" । काठमाडौं महानगरपालिका, नगर कार्यपालिकाको कार्यालय, बाग्मती प्रदेश ।

Laws, Policies and Evidence on Quality of Life of Senior Citizens of Kathmandu Metropolitan City

Kripa Sigdel

Abstract

The pace of aging around the world is faster than ever. Understanding the various aspects of quality of life including physical, social, psychological and environmental is crucial in today's world where longevity is increasing more than ever. This study aims to assess the quality of life of the elderly population and to evaluate the role of legal documents and policy on quality of life. This study also contributes to the understanding of the correlation between literacy, family structure and quality of life. In order to achieve that, this research primarily adopts a quantitative and cross-sectional research design. It also includes a text review of the laws, policies, directives and programs which have implications on the quality of life of senior citizens. For this study, 206 samples are collected from Ward no. 9 and 12 of Kathmandu Metropolitan City (KMC). The research finds that the quality of life of the majority of the senior citizens of KMC is good. Around 14-18% of the sample participants are found to have poor quality of life in physical health, psychological, social relationship and environmental domains. Moreover, gender, age, education status and health status are found to be the predictors of quality of life. Significant positive correlations are found between and with all four domains of quality of life, overall quality of life and health satisfaction. Although the policy of KMC is commendable in prioritizing the formulation of the plans, policies and programs concerning senior citizens, some gaps have been identified which require KMC to focus on the qualitative aspect by being oriented in a 'Wellbeing approach' and enhance the capacity and competency of geriatric health care professionals.

Keywords: Aging, senior citizens, quality of life.

1. Introduction

1.1 Background

The World Health Organization's Quality of Life Group (WHOQOL-Group) defines quality of life (QOL) as "an individual's perception of their position in life, in the context of the culture and value systems in which they live in relation to their goals, expectations, standards and concerns" (WHO, 1998). This concept has covered all aspects of a person's physical, psychological health, social interactions and their relationship with the corresponding environment they live in.

The total number of people aged 65 years and above was 703 million in 2019 and this number is projected to double to 1.5 billion in 2050 (United Nations, 2019). The global population is aging, and so is the population in Nepal. The population of the elderly, defined by the Nepali Senior Citizens Act as individuals aged 60 years and above, constituted 2.1 million people in 2011 (CBS, 2012). Understanding the various aspects of QOL including physical, social, psychological and environmental is crucial in today's world where longevity is increasing more than ever.

QOL gives an idea about the perceived physical health and psychological conditions, and at the same time reflects the social life and various environmental factors such as economics, home environment, health care, etc. that impacts the life of senior citizens. It is stated in the Constitution of Nepal to provide essential health care services free of cost to the ultra-poor, vulnerable, poor, senior citizens, people living with physical and psychological disabilities, and women. Nepal has developed various policies and programs to expand health care services to its population. However, the government does not have enough resources to address the issues concerning the psychosocial aspects of the elderly. In this context, it is essential to evaluate the implications of national policies and laws on the QOL of senior citizens in order to highlight the possible gaps in law and policies.

1.2 Objectives

The objectives of this study are:

- To assess the quality of life of senior citizens,
- To find out the correlation between physical, social, psychological and environmental predictors of quality of life,
- To assess the effects of gender, age, education and health conditions on the quality of life of senior citizens, and
- To evaluate and find gaps in policies, plans and programs of Kathmandu Metropolitan City (KMC) in the quality of life of senior citizens.

1.3 Limitations of the Study

Very few studies have been initiated concerning the Nepali elderly population, despite the increase in their number and in the pace of aging. This study aims to explore different perspectives regarding the QOL of the elderly population in Nepal. The findings of the study

will add knowledge and information about the livelihood status of the elderly as very limited research has been conducted around this topic in the context of Nepal. However, the measure used in this paper is based on self-reporting which reduces the possibility of cross- checking. Thus, the data reported here can have a positivity bias. Although purposive sampling was used as a sampling method, the study will not represent all senior citizens of Nepal.

2. Methodology

The research primarily adopts a quantitative and cross-sectional research design. It also adopts a text review of the laws, policies, directives and programs which have implications on the quality of life of senior citizens. Purposive sampling was used as the main sampling technique. The World Health Organization Quality of Life Bref (WHOQOL – BREF) Manual was used for the survey. This adaptive tool was used for collecting the data from 206 participants from Ward no. 9 and 12 of KMC. This study adopts a desk research method in reviewing and analyzing the laws, policies, programs and directives in relation to the QOL of senior citizens.

This research abides with and ensures the ethical standards and protocols such as informed consent, confidentiality, right to withdraw and protection from any sorts of harm. The scoring of the participants in WHOQOL Bref is done as per the scores obtained by the participants in the five likert scale of 1 to 5 (World Health Organization, 1996). The raw scores are added for each domain and transformed to the range of 0 to 100 as per the instruction provided in WHOQOL Bref manual (World Health Organization, 1996). This is done in order to make the scores of each domain standard and comparable.

The text review of the legal documents is analyzed to find their scope and limitations in relation to the QOL of senior citizens. KMC's policies and programs are also analyzed in the context of national and international documents and provisions. At the same time, the policies are matched with the qualifying indicator of QOL.

3. Results and Discussion

3.1 General Results

The research aims at studying the ways of improving the QOL of the senior citizens and to evaluate the legal documents and policies on QOLof the senior citizens of KMC. This research has found out that the majority of the senior citizens of KMC have a good QOL as per their subjective experiences and evaluation. Around 14-18% of the participants were found to have poor quality of life in the physical health, psychological, social relationship and environmental domains. It was found out that the majority of the participants spent most of their allowance money on food, medicine and treatment. Overall quality of life, health satisfaction and all the four domains of QOL have been found to be significantly positively correlated with each other. Comparatively, female, older and illiterate senior citizens were found to have lower QoL.

The textual analysis of the legal documents and policies of KMC finds that KMC has made efforts in improving the lives of senior citizens and has formulated important policies and programs to address the issues of senior citizens. However, the analysis also finds that

these policies and programs are rather distribution-oriented with more focus on quantity over quality. At the same time, the policies are opting to manage the senior citizens rather than engage them in the cultural, economic, political, and social facets of life. Similarly, health services for the senior citizens were more intervention-focused with little emphasis on promotion and preventative measures. The policies are found to be silent on geriatric care capacity building among health professionals.

3.2 Insights from Demographic Characteristics

The demographic characteristics provide some important insights (Table 1). The gender ratio of the participants is more or less similar. The age of the participants varied and ranged from 60 to 94 years of age. The collectivistic value of the society has been reflected in the living arrangement of the senior citizens. Majority of the participants were still found to be living with family members up to three generations. This shares similarity to the outcome of Chalise (2012). This shows that the care of the senior citizens has been delegated primarily to other members of the family.

Table 1 : Demographic characteristics of the participants

Characteristics	N	%
Gender		
Male	97	47.1
Female	109	52.9
Age		
60 – 74	116	56.3
75 and above	90	43.7
Marital Status		
Unmarried	2	1
Married	141	68.4
Widow/widower	61	29.6
Divorced	2	1
Living Arrangement		
With Children (3 generations)	130	63.4
With Children (2 generations)	38	18.5
Husband/wife only	24	11.7
Alone	5	2.4
Old Age Home	8	3.9
Ethnicity		
Dalit	11	5.4
Janajati	103	50.5
Brahmin / Kshetry	80	39.2
Others	8	3.9
Education Status		
Literate	126	61.2
Illiterate	80	38.8
Educational Level		
General Literacy	43	34.4

Characteristics	N	%
Primary Education	22`	17.6
Secondary Education	14	11.2
Higher Secondary Education	13	10.4
University Education	33	26.4

Note: N denotes number of participants; % denotes the percentage of the participants.

Family, rather than the state, is the major reliable source of care and support for the senior citizens. The government, both central and local, has to realize this demographic reality as this can be a great burden-sharing opportunity for the government. Instead of focusing on an individual, policies have to be made that recognizes family caregivers' special role and help them with enough information and support to take care of their older relatives and also to maintain their own QOL (National Academies of Sciences, 2016).

Policies and programs that assess the family caregiver's capacity to take care of the elderly and guide them with information, incentives, facilities, training etc. is necessary. At the same time, the family caregivers' own wellbeing and QOL deserve a mention in the policies and programs.

3.3 Expenditure Pattern

The nature of the expenditure by senior citizens gives us some important insights that can have important policy implications. Majority of the participants spent most of their senior citizens' allowance money on procuring food, medicine and health care facilities. The investment on health care facilities has been a major focus of KMC. This coupled with social allowance schemes works effectively as both of them complement each other. The bigger proportion of expenditure on health care also requires more subsidies and affordable access to health care.

Table 2: The participants' expenditure from the allowance provided by the central and local government (Total valid response: 160)

Expenditure Head	Level of Expenditure		
	Highest	Second highest	Third highest
Food	68	48	2
Medicine and Treatment	59	49	5
Family Expenses	3	11	24
Saving	12	0	1
Total	**142**	**108**	**32**

3.4 Quality of Life of Senior Citizens

As shown in Table 3, more than two thirds of the participants evaluated their overall QOL to be good. Domain wise also, around 14.07-18.9% of the participants scored lower than the cut off standard (i.e. one SD below the calculated mean) which indicates a relatively poor score. The result is similar to that of Wong et al. (2018) and D'mello and Devraj (2019). Among the domain scores, the environmental domain has the highest mean score of 70.82 (SD=12.63) and the lowest in the physical health domain with the mean score of 60.92 (SD=

19.53). The results are quite contradictory to Onunkwor *et al.* (2016). Majority of the participants have health problems which can be attributed to relatively lower QOLin the physical health domain. The highest mean score in the environmental domain can be due to the direct impact of collectivistic family values and the effects of different policies and programs.

Approximately 18.9% of the participants reported poor physical health QOL followed by 18% of the participants who reported poor psychological QOL. These figures demand more policies and programs from KMC to be dedicated to the enhancement of the physical and psychological wellbeing of the senior citizens.

Table 3: Mean and SD in the four domains of Quality of Life and participants with poor scores (N =206)

Domains	Mean	SD	Number of participants with poor scores (Mean< 1 SD)
Physical Health QOL	60.92	19.53	39 (18.9%)
Psychological QOL	67.37	17.01	37(18 %)
Social Relationship QOL	66.94	13.53	29 (14.07%)
Environmental QOL	70.82	12.63	30 (14.56%)

3.5 Association between the Four Domains of QOL, Overall QOL and Health Satisfaction

As shown in Table 4, there are significant positive correlations between and with all the domains of QOL, overall QOL and health satisfaction. The correlation strength varies from moderate (r = 0.48) to strong (r= 0.78) (Ratner, 2009). The significant result signifies that this relationship is strong. The positive correlation in all the areas and domains of QOL suggest that the domains are interrelated with each other and that the subjective experience in each domain has an influence in other domains of QOL.

The positive correlation between the domains of quality of life has greater implications on policymaking for KMC. Notably, there is a strong association between physical health and psychological QOL meaning that better physical health can possibly lead to greater subjective experience of happiness and the people experiencing greater psychological wellbeing can induce better physical health (Dale *et al.* 2014; De Neve *et al.* 2013). Other empirical evidence has also strongly demonstrated that increased physical activity improves the wellbeing of people, particularly the elderly (Craft & Perna, 2004; Department of Health, 2014). This has a wider implication. For example, KMC can devise policies and programs targeting the least active senior citizens to increase their physical activity through exercise programs in public spaces such as parks and community centers.

From this study, there is strong evidence which documents the positive effect of psychological wellbeing on physical health. Good psychological wellbeing predicates reduced inflammation; improved cardiovascular health, immune and endocrine system; and lowered risk of heart disease and stroke which ultimately increases survival and longevity. KMC can bring programs that help in alleviating loneliness as well as increasing interconnectivity and understanding the problems of the senior citizens. Access to geriatric psychosocial counseling can be one such program which helps to decrease the distress of senior citizens and increase psychological wellbeing. For example, a program called

Silverline was initiated in the UK to provide 24 hr free and confidential helpline to the ageing population. Around 70% of the service users reported that it increased their happiness along with the feeling of interconnectedness (Trudel-Fitzgerald *et al.*, 2019).

Similarly, there's a strong positive correlation between environmental QOL and psychological QOL. Housing improvements and refurbishment has been linked with improved physical and mental health (Thomson *et al.*, 2001; Guite *et al.*, 2006) found the association between physical environment (neighbor noise, sense of overcrowding in the home, escape facilities such as green space and community facilities and fear of crime) and mental health. Especially when planning for urban spaces, this research suggests that there is a need to intervene on both design and social features of residential areas to improve mental well-being.

Likewise, there is a moderate association between social relationship QOL and physical health QOL as well as psychological QOL. Older people with strong attachment to local areas and social networks are found to have higher resilience (Cooke *et al.*, 2011). Similarly, access to proper health care facilities and controlling pollution enhances people's mental health.

Table 4: Correlation coefficient between the four domains of QOL, Overall QOL and Health Satisfaction (N= 206)

Domains	Physical Health QOL	Psychological QOL	Social Relationship QOL	Environmental QOL
Physical Health QOL	1	.783**	.489**	.623**
Psychological QOL	.783**	1	.579**	.731**
Social Relationship QOL	.489**	.579**	1	.549**
Environmental QOL	.623**	.731**	.549**	1

Note: ** p <0.01.

3.6 Socio-demographic and Health Predictors of Quality of Life

Table 5 shows that male participants have significantly higher scores in health satisfaction, physical health, psychological, social relationship, and environmental domains. These findings are similar to Adhikari *et al.* (2018); Bilgili and Arpaci (2014); Lee *et al.* (2006); and GC *et al.* (2017). This can be attributed to the lower status of women and the patriarchal mindset of the Nepali society. Women senior citizens should be given more attention and preference in framing policies and programs.

The elderly participants or specifically those participants aged 75 years and above have significantly lower quality of life in physical health, psychological and social relationship domains of QOL than the participants of lower ages, specifically the age group 60-74. Similar findings are reported by Adhikari *et al.* (2018); GC *et al.* (2017); and Bhandari *et al.* (2016). This could be a result of deteriorating health conditions due to increasing age. This can also be justified with the finding that shows that participants reporting health problems have significantly lower quality of life in all the domains of QOL, overall QOL and health satisfaction compared to the participants with no health problems.

Furthermore, illiterate participants have significantly lower quality of life in all the four domains of QOL and health satisfaction when compared to the literate participants. This

demonstrates that education is an important predictor of QOL. Similar results have been reported by Gobbens and Remmen (2019); Adhikari *et al.* (2018); and Joshi *et al.* (2018). With education, one has more accessibility to information and higher awareness about the issues as well as the facilities and opportunities provided by the government and different agencies. Education would help the elderly to adapt to the changing conditions and uplift their QOL by increasing the sense of agency in the areas of physical, psychological and social relationships (Boulton, 2010).

Table 5: The mean differences in Overall QOL, Health Satisfaction and four domains of QOL on the basis of demographic characteristics – gender, age and education level and health problems

Variable	Domains					
	Overall QOL	Health Satisfaction	Physical Health	Psychological	Social Relationship	Environmental
Gender:						
Male	3.76 ± 0.70	3.70 ± 0.90	64.51 ± 19.8	69.97 ± 16.59	69.32 ± 13.29	72.69 ± 12.59
Female	3.72 ± 0.66	3.39 ± 0.89	57.72 ± 18.8	64.81 ± 13.44	64.81 ± 13.44	69.16 ± 12.50
p-value	0.690	0.015	0.012	0.038	0.016	0.045
Age:						
60-74	3.73 ± 0.71	3.58 ± 0.90	63.88 ± 19.67	69.5 ± 17.44	69.62 ± 13.97	71.30 ± 13.13
75-94	3.76 ± 0.64	3.49 ± 0.91	57.1 ± 18.76	64.63 ± 16.11	63.48 ± 12.16	70.21 ± 12.01
P Value	0.813	0.488	0.013	0.041	0.001	0.540
Education Status:						
Literate	3.81 ± 0.70	3.70 ± 0.88	64.81 ± 18.25	70.8 ± 16.04	69.65 ± 13.93	73.51 ± 12.31
Illiterate	3.64 ± 0.64	3.29 ± 0.88	54.78 ± 2 0.01	61.98 ± 17.18	62.66 ± 12.61	66.58 ± 12.03
p-value	0.078	0.001	0.000	0.000	0.000	0.000
Health Problems:						
With Health Problems	3.64 ± 0.66	3.35 ± 0.87	56.69 ± 18.76	64.51 ± 16.56	65.70 ± 13.47	69.61 ± 12.93
Without Health Problems	4.11 ± 0.61	4.23 ± 0.67	76.5 ± 13.6	77.93 ± 14.41	71..47 ± 12.88	75.27 ± 10.44
p-Value	0.000	0.000	0.031	0.000	0.012	0.008

Gender, age, health problems and education stand out as the predictors of QOL. KMC can use this knowledge to bring special provision to female senior citizens, citizens aged 75 years and above, the chronically ill and the illiterate to compensate for and uplift the relatively lower QOL and to make the services and programs equitable across all the sections of population. These results also imply the need to bring plans and programs focused on gender (female senior citizens), age (75 years and above), health (chronically ill senior citizens), and education (illiterate senior citizens).

3.7 Gaps in Laws and Policies

Here, we present the possible gaps in local level laws and policies in Nepal in order to align them with the international conventions and best practices to achieve a higher level of QOL. The gaps presented in the document do not carry a scope of evaluation in terms of implementation and budgetary allocation. The following gaps are identified for stressing on the shift on the focus and perspective:

- As recommended by Vienna International Plan of Action of Ageing (1982*),* the policies and programmes should equally have the qualitative and quantitative content so that senior citizens can lead a meaningful and dignified livelihood till the end of their life. In this regard, the KMC's policies and programs are seen to be more distribution-oriented. There is a heavy focus on free services and distribution of social security and allowances. By no means should such policy be discontinued, but a balance between formulation of policies that utilizes the expertise and skills of the senior citizens and provides them with more opportunities for community engagement and participation in cultural, economic, political and social life is required. Examples of such programs can include the opportunities for retreat and travel, learning through formal and informal methods, community engagement works, part-time works, religious and spiritual activities, etc.
- KMC's health care policies and programs focus more on interventions than on the promotion of good health. Future policies should be more oriented towards the overall well-being of the elderly. For example, one such policy can focus on the promotion of physical activity such as light exercise, walking, jogging, etc. The other major determinant of well-being, as found in the earlier section, is psychosocial well-being. The psychological and emotional well-being of the senior citizens can be a major issue and a challenge due to many changes that occur during ageing (World Health Organization, 2017). Psychosocial well-being can be enhanced through programs such as mental health awareness programs, resilience building programs, emotion management and expressions programs, and so on. It is also possible to provide the elderly with the opportunities to express their emotions and a platform for them to listen to their and others' emotions empathetically.
- KMC's policy lacks the provision of geriatric care capacity building among health professionals. Thus, KMC can put this as a long term strategy or bring programs that pull resources to equip health professionals with necessary skills and expertise.

3.8 Implication of Policy Analysis

The policies of KMC regarding senior citizens have several important provisions that have important effects on QOL. It is notable that senior citizens have been given emphasis and their own space in the policy. However, the policy also has plenty of room for improvements.

The gaps found by the textual analysis of the several international, national and local legal documents will have far reaching implications if incorporated in KMC's policy making. One of the important implications will be the shift in the perception concerning the elderly. The senior citizens are generally perceived as passive who demand lots of care and assistance from others. This kind of perception devalues the contributions and individuality of the elderly, and also creates the tendency to view them as societal burdens.

If we consider the senior citizens as productive people with the repository of knowledge and wisdom which can be utilized and exploited, then the senior citizens and elderly will not be left out from community engagement and participation in different social and community activities. For this reason, senior citizens need to be included in policy formulation and decision making processes.

At the same time, the policies and programmes should be balanced both in the qualitative and quantitative content. The distribution-oriented programs should be balanced with the formulation of policies that utilizes the expertise and skills of the senior citizens and provides them with more opportunities for community engagement and participation in cultural, economic, political and social life. The examples of such programs can be the opportunities for retreat and travel, enhancing the learning through formal and informal learning, community engagement works, part-time work, religious and spiritual activities etc.

As evidenced by the findings of this study and various other studies, we can state that health conditions are a great predictor of QOL. Through this study, we also find two major policy gaps that need to be addressed. The current policy is almost singularly focused on interventions and treatment of health conditions which is expensive and burdens the KMC. Along with this, the KMC should focus on a policy that covers the 'well-being' aspect in 'disease treatment'. Hence, the plans and programs that focus on overall well-being, including the psychosocial aspect of well-being, should be introduced. The other gap is in the manpower of geriatric care. It is in the best interest of the KMC to prepare and enhance the capacity among the health professionals regarding geriatric care.

4. Policy Recommendations

Following recommendations are suggested to the concerned authority of KMC on the basis of the empirical evidence found from this study:

- Since majority of the participants still live with family members upto three generations, it is essential to plan out policies and programs that assess the family caregiver'.s capacity to take care of the elderly and that facilitates them in taking care of the elderly with proper information, incentives, facilities, training, etc. At the same time, the family caregiver's own well-being and QOL deserve proper mention in the policies and programs.
- A large proportion of the senior citizens' allowance is spent on health care. Thus, KMC should focus on policies and programs that provide subsidies for health care treatment and focus on affordable access to health care systems.
- Although the participants had good overall QOL, they had relatively poor scores in the physical health and psychological domain. So, the policies and programs

focusing on physical health and psychological well-being need to be charted out. Such programs can be promotional, preventative and interventional.

- The strong association between physical health and psychological QOL has wider policy implications. For example, KMC can come up with policies and programs that target the least active senior citizens in order to increase their physical activity through exercise programs in public spaces such as parks and community centres. KMC can also bring programs that help in alleviating and increasing interconnectivity between senior members and understanding their problems. Access to geriatric psychosocial counseling can help to decrease the distress of senior citizens and improve their psychological well-being.
- There is a strong positive correlation between environmental and psychological QOL. In urban planning, it is important to consider both design and social features of residential areas (e.g., neighbor noise, sense of overcrowding in the home, escape facilities, green space and community facilities, and fear of crime) in order to promote mental well-being.
- The presence of low QOL among women, older, chronically ill and illiterate senior citizens gives a rise to the need to bring special provision to senior citizens specifically those who are women, or aged 75 years and above, or are chronically ill, and illiterate such that they are compensated for the relatively lower QOL by making QOL-uplifting services and programs equitable across all the sections of the population.
- The policies and programs should equally have both the qualitative and quantitative content so that senior citizens can lead meaningful and dignified livelihoods. The policy should acknowledge the productivity of senior citizens rather than just perceiving them as the stagnant population. The formulation of policies that utilizes the expertise and skills of senior citizens and provides them with more opportunities for community engagement and participation in cultural, economic, political and social life are required.
- The policy should also be more 'well-being' oriented. The policies should also focus on health and well-being promotion, with special inclusion of psychosocial well-being.
- The KMC should chart a long term strategy to prepare the necessary geriatric care capacity building among the health professionals.

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A Qualitative Examination of the Experiences of Female Principals in Community Schools of Kathmandu

Samrat Basyal

Abstract

Kathmandu's data from District Education Office show that out of 92 community schools in Kathmandu Metropolitan City, only 25 have female principals, making it only a 27% representation. This study employed qualitative and quantitative methods to better understand the experiences of female school principals in the community schools of KMC. Out of 25 identified female principals, 24 were interviewed using the KII questionnaire. The examination of the multiple case study method was added to generate answers for research questions that required a detailed understanding of the process of women leadership in the community schools of Nepal. The study found three major interrelated aspects within the experiences of female principals - personal, socio-cultural and political. The personal factors that hinder women leadership are; family and household responsibilities, lack of self-esteem and biological challenges such as menstruation and child-birth. The socio-cultural factors are patriarchal mindset/culture and language barrier, especially for Newar women. The political factors are weak women's social networks compared to men's, administrative burden as a principal and political influence against them. This study concludes that there is a lack of critical discourse/research relating to how female school principals in Nepal should lead effectively and bring forward a wide range of experiences they endure in the course of their leadership journey. The study recommends capacity building for female school leaders including mentoring and coaching programs. The study also recommends developing performance indicators, outreach programs for family members, better incentives for school leaders and nondiscriminatory implementation of policies.

Keywords: Female principals, school leadership.

1. Introduction

1.1 Background

This study explores the lived experiences of women in leadership positions in community schools in Kathmandu Metropolitan City (KMC) to better understand how their perspective informs the way they lead. The central research question guiding this study is: why are there fewer women as school principals in community schools of Kathmandu? An equally significant sub-question is: what kind of experiences do female principals in the community schools of Kathmandu gather in the course of their leadership journey?

The knowledge base in educational leadership has mainly been developed in Anglo English and American countries, as such it lacks context, specificity and relevance for educational systems in developing countries (Walker & Dimmock, 2002). In particular, related literature that does exist does not adequately represent women's roles as educational leaders in developing countries and even less is known about their experience of leadership (Oplatka, 2006). In public education, it is established that there are fewer women high school principals than there are men. As easy as the question 'where are the women school administrators' sounds, the answer requires a lot of digging into what goes in the minds and lives of these women educators who are in abundance in the classrooms but absent in school leadership roles.

The lack of research on women in educational leadership is evident in the South Asian region, mostly pertaining to a lack of statistical data on women and leadership, with most countries failing to keep or report systematic staff data (Morley & Crossouard, 2015). A British Council-commissioned research in 2015 revealed that gender as a category of analysis was absent in most of the higher education policy documentation in the South Asian region while existing gender studies concentrated mostly on students, and not on staff.

The bulk of South Asia is driven by a patriarchal culture, one that has its due impact on education and educational leadership. Although women are in classrooms and, thus, visible in teaching, there are not as many women in school administration positions (Morley & Crossouard, 2015). In the British Council-commissioned research (2015), which was based on six countries across South Asia (Afghanistan, Bangladesh, India, Nepal, Pakistan and Sri Lanka), it was discovered that many women academics in the region are reluctant to aim for senior leadership and to perceive it as an attractive career option.

The report also highlighted that Nepal had no female Vice-Chancellors in universities until 2015 after the first Nepalese university was established in 1959. The findings of the research cited in this study show complex barriers to women's leadership in higher education in the South Asian context. These barriers, range from social, cultural and economical in each country, including the organizational culture in universities, discrimination in recruitment and selection, and unequal power relations.

Looking at the number of female school principals in Kathmandu, the District Education Office's data shows that out of 92 community schools in KMC, only 24 have female principals, making it a representation of only 27%.

The situation is not very encouraging for the private schools either. According to Kathmandu PABSON (Private and Boarding Schools Organization Nepal), only 101 out of 649 school principals in the private/institutionalized schools in Kathmandu Metropolitan City are women. That is only about 15% of the total number of school principals in private schools of Kathmandu.

Given the striking outnumbering of women from the community/private school leadership in Kathmandu and lack of research on the topic of women and school leadership in Nepal, the need for a study that delves deeper in to understanding the experiences of Nepali women when it comes to undertaking the school leadership roles and the different factors (such as socio-cultural, political, economic and others) within those experiences becomes potent.

1.2 Objective

The purpose of this study is to explore the interrelated aspects of women's experiences of serving as leaders (principals) in public schools of Kathmandu to better understand the factors that influence their decisions about pursuing leadership positions.

1.3 Study Limitation

Due to the COVID-19 situation, in-person interviews were difficult to organize, so most of the interviews were conducted via telephone.

2. Methodology

The study uses qualitative methods with limited quantitative methods to gather and analyze the data. The quantitative data was collected and analyzed for the purpose of interpretation and guidance to the analysis. Therefore, the primary focus of this study's research design remained within a qualitative paradigm. Certain findings were quantified to correlate the data and obtain more reliable data. Qualitative research allows an understanding of the experiences of participants from different perspectives.

The other specific characteristics of qualitative research include thinking, flexibility, inquisitiveness, reflective listening and insight analysis. Qualitative research aims to capture the experiences of people themselves, how they act, how they think about themselves and the world surrounding them. More specifically, this research process employed following process:

(1) Literature Review: This step involved a detailed literature review on women leadership in schools and academia. In terms of secondary data, review of the existing literature (national and global) relating to the research topic was conducted. Collection of secondary information from published literature using Google search engines like google scholars using keywords such as women leadership, women leadership in academics, was also done.

(2) Semi-structured Interviews: The target population were interviewed using semi-structured questions. The reason for selecting the interview method was to uncover a subjective assessment of different aspects of leadership of the schools. The interviews were

conducted mostly through telephonic conversations because of the prevailing COVID-19 pandemic situation. The interview process usually began with a briefing on the purpose of this study and a short conversation about the research objectives. By listening carefully to participants and allowing for questions, the researcher ensured that participants were ready for the interview. Nepali language was used to communicate during the interviews. These semi-structured interviews were used to fully understand the additional dynamic that may emerge during the research period to fully understand the factors affecting the women leading to leadership positions of principal and vice-principal.

KMC's City Planning Commission (CPC)'s records suggest that 25 out of 91 school principals in KMC are women. Almost 100% of the total population was taken as survey sample size because of the small population size of the target groups. Out of 25, 24 identified female principals were interviewed using the KII questionnaire. The length of the interviews ranged from 30 minutes to 60 minutes.

(3) Case Study: A case study was also carried out for selected female school principals in the public schools of Kathmandu. This multiple case study method was added to generate answers for research questions that required a detailed understanding of the process of women leading to leadership positions in the community schools in Nepal.

(4) Data Analysis: Data collection through interviews and case studies were first documented and transcribed. The transcribed data was then cleaned to consider for data processing and analysis. The data were then coded using manual coding processes. Reference to literature was made during the coding process to find the leading results.

The coding process attempted to answer the following questions:

- Why are there fewer women as school principals in community schools of Kathmandu?
- What kind of experiences do female principals in the community schools of Kathmandu gather in the course of their leadership journey?

The first step in the data analysis process was to read through each participant's interview in its entirety and code keywords, phrases and ideas. A coding system was established in which broad or general keywords and phrases were coded in red; specific or clarifying statements were coded in purple; cause and effect statements and ideas were coded in green; and direct responses to the research questions were coded in blue. The color coding scheme allowed the researcher to better organize the data so that the themes as well as the cause and effect relationships could be easily identified.

The data processing involved content analysis and identification of major themes and areas. According to Papa (2018), content analysis identifies themes, patterns, and describes situations, while open coding distinguishes concepts and categories in the data, breaking down the data into level one primary headings and then second level sub-categories or characteristics for deriving the final results. Therefore, the qualitative content analysis involved identifying coherent data information by identifying similar quotes or similar ideas across the organizations. By grouping the set of identified categories of ideas, the thematic statements were derived.

3. Result and Discussion

Under the qualitative findings, three major interrelated aspects within the experiences of female school principals emerged during the interviews and these were influential in their decision to take up the role of a principal. They are personal, socio-cultural and political. The personal factors that hinder women leadership are family and household responsibilities, lack of self-esteem and certain biological challenges such as menstruation and child-birth. The socio-cultural factors are patriarchal mindset/culture and language barrier especially for Newar women. The political factors are less social networks compared to men, administrative burden as a principal and political influence. Some of these barriers are explained in detail below:

(1) Personal barriers:

- **Family/household responsibilities:** Out of the female principals who were interviewed, 21 mentioned that responsibilities in the family were a significant barrier that prevented women from taking up leadership roles. Almost every principal interviewed responded that they were responsible for all the household chores such as cooking, cleaning, taking care of children and elderly while also fulfilling their leadership duties in the school. A primary school principal said, "*I am not just the principal but the accountant, janitor and also the teacher whenever needed. Not to forget I am also a full-time housewife."*
- **Lack of self-esteem:** Out of the female principals who were interviewed, 22 remarked that they never aimed at becoming a principal either because they didn't think they were capable enough to lead or their appointment happened mostly either by chance or in need by the institution. A female principal said, *"Women in general don't perceive themselves as leaders due to which they tend to shy away from taking leadership roles in schools."*

(2) Socio-cultural barriers:

- **Patriarchal culture and mindset***:* Out of the 24 female principals interviewed, 19 (79%) mentioned that Nepalese society is male dominated and women as leaders is not something that is accepted very easily. One of the interview respondents stated, *"If a man and women are vying for the same position, the first choice will most likely be a man. I guess the works of a male principal are more visible to the society and the higher authorities."* Another female principal spoke on the patriarchal culture, *"Men don't like being led by women. I have felt that a lot with the male teachers at my school."* Another female principal, when asked on how she felt being a female on the job, said, *"I've felt a kind of domination because I am a woman. Some people think that they can manipulate and dominate a woman very easily. "*

(3) Political barriers:

- **Weak social networks:** The 13 female principals interviewed agreed that they have a very small social circle and that they participate in fewer social or networking events outside of school hours compared to their male contemporaries. One of the female principals mentioned, "*Life of a woman principal revolves only around her school and her family. The moment we are finished*

with school work, we have to run straight to our husband, kids and in-laws. We do not have time for social gatherings."

- **Administrative burden:** Given the fact that becoming a principal meant more administrative responsibilities without any additional benefits, most women don't want to bear that extra burden. Out of the 24, 13 principals mentioned the administrative burden of being a principal as a significant barrier for female leaders. On the issue of administrative burden, a secondary school principal said - *"The demands of the principal's job can be intimidating to a lot of women. Not everyone is ready to face that. So, the easy way out is to just stay away from the race."*

Dual roles and responsibilities towards family and family members were regarded as the major reason for women deciding not to pursue leadership. Additionally, it is not always easy for women to secure leadership as there are forces that restrict them despite them being qualified. Patriarchy and power relations in the Gender and Development of Bureaucracy Theory came to the fore as a lot of women admitted to the preference given to male administrators over females, thus limiting them to teaching roles, which is clearly visible in female teachers outnumbering the males by a huge margin. Therefore, it was very important to maintain a fair and non-discriminatory implementation of the process of choosing a principal.

Female principals agreed that patriarchy produces a range of socio-cultural practices and a belief system that sees women transcending the domestic boundaries as a major threat to the status quo and thus, women are not very easily accepted as leaders. This was the second most cited reason that women thought was limiting their leadership goal.

While all the women principals interviewed were the rightful ambassadors of women leadership, they also did not hesitate to mention that a big population of women educators lack the self-belief that they can lead. That lack of self-belief is again a culmination of different factors while also spiraling into some socio-cultural as well as political factors. They further added that women are not being identified and prepared for leadership. Also, the administrative workload that comes with the position was also considered to be a deterring factor for the women educators who were already performing all the household duties. Limited social networks outside of work and the inability of playing the so-called 'political games' were also named as factors that influence a woman's decision of pursuing leadership.

Moreover**,** financial incentives do not match up to the effort put in by the women principals. A principal has less authority at work, especially regarding hiring and dismissal of teachers and staff. The absence of fear of losing their jobs tends to make some teachers and staff less concerned about the job they do. This is an issue that women don't want to undertake. Majority of female principals were against reservation and thought that women were capable enough to become principals on their own merit. Out of the 24 principals, 16 were not in favor of having leadership quotas to support women in leadership, while 8 of them said that there needed to be a reservation of some kind as it was not always easy for women to secure leadership positions.

Under the quantitative findings, male principals outnumber females by a big margin in the community and private/institutionalized schools of Kathmandu. The male to female ratio among school principals in the community schools of Kathmandu is 25 to 67. In private

schools, the ratio is even low as only 101 out of 548 private school principals are women. This shows a disparity of almost 50% in the total composition of male to female school principals by gender.

Out of 24 female principals, 12 were aged over 50 while 10 were between 41 and 50 years of age. Only 2 of them were between ages 30 and 40. The maximum age among the female principals interviewed is 59 while the youngest principal interviewed is 38. The mean age of the participants is 49.91. The average time women have worked as a teacher is 24.6 years while the time they've worked as a principal is only 6.5 years, showing that female teachers spend a lot of years teaching before they become a principal.

Around 83% of the principals interviewed said that they never inspired to become a principal and interestingly, all of them considered themselves successful in that role. The total number of teachers in the 24 schools led by female principals was 474. Out of the 474 teachers, 340 were women which is almost 72% of the total number.

A key finding from the interviews with the female principals was that a lot of community schools (mostly primary) need help in terms of physical infrastructure as well as quality of education. Those principals firmly believed that only by becoming success stories, they could inspire more women to get into school leadership. Therefore, investment in the capacity building of female leaders is essential. Establishing coaching, mentoring and networking programs that are geared towards women's unique needs not only provide opportunities to broaden their professional exposure, but also to raise the profile of female leaders.

According to the female principals, despite all the barriers they experience in educational leadership or any other field for that matter, it is not all gloomy or hopeless for women. Times have certainly changed and women are making their marks in climbing up the leadership ladder slowly yet persistently as expressed by a female principal, "*Times have changed now. In the past, it was very difficult for girls to receive education. I consider myself very fortunate to be one of those who did receive education. The current number of women principals is way more than when we entered this profession. It is different now and with the upcoming generation of women educators, the number will certainly go higher provided that there is enough encouragement from our society and the government.*"

4. Policy Recommendations

The following recommendations were formulated based on the feedback provided by the female principals on educational leadership roles, their experiences and gender disparity in community schools. These strategies can be useful in addressing gender equality and assisting school boards in developing representations that reflect the composition of those that are qualified to assume leadership positions.

In addition to policy implications, this study can be used as an opportunity by female school leaders to reflect critically on their own experiences as well as the experiences of others to promote a positive working environment. These can be useful in ensuring a greater representation of women in educational leadership in community schools.

- **Performance indicator to assess the performance of female leaders compared to male leaders and link them to incentive provisions:** Since female

principals reaffirm that they are contributing meaningfully to the overall school performance, it is recommended that some kind of school performance indicators be put in place which would later be compared with male principals. Some of the indicators are indicators concerning growth, status, academic gaps, family and student engagement, post-secondary readiness, and more.

- **Capacity development for female school leaders:** Given that the majority of the female principals never aspired to become a principal in their early working days calls for more mentoring and coaching programs. Most of the principals reported that they had participated in just one training related to leadership which represents a serious dearth of capacity building programs for women. Establishing coaching, mentoring, and networking programs that are geared towards women's unique needs not only give women opportunities to broaden their professional exposure, but can also raise the profile of female leaders, thus contributing greatly in leadership building. Also, these capacity development programs should be designed keeping the principals of special schools in mind in order to make them more inclusive. Society of Women Teachers that was founded by the female principals in Kathmandu can be a good stakeholder for KMC to partner with for the effective implementation of these capacity development programs.
- **Outreach programs for family members of female school principals:** Dual roles and responsibilities towards family and family members are identified as one of the major reasons for women deciding to not pursue leadership. Therefore, at a policy level, programs targeting the family members of school principals should be included so that the members of the family are more equipped in supporting women as principals.
- **Making the position of a principal more lucrative:** While none of the female principals interviewed considered financial benefits as a deterring factor in their leadership journey, many of them suggested that a principal's position was not lucrative enough to attract women who already had the burden of their household/family. Therefore, following recommendations are proposed:
  - **Financial Incentives:** As per the existing provisions regarding financial benefits for a community school principal, a higher secondary level principal receives 500 Nepalese Rupees (NRs) in addition to their regular teacher's salary. Similarly, the same benefit was 300 NRS for a lower secondary level principal and 200 NRs for a primary level principal. Given that there were extra work responsibilities associated with a principal's job, the financial incentives do not match up to the effort put in. This certainly turns women away from taking up extra responsibility that provides no extra benefits. Therefore, financial incentives are recommended to be included within the institutional system itself as a basic package.
  - **Autonomy at work:** Female principals interviewed stated that a principal has less authority at work especially regarding hiring and dismissal of teachers and staff. That absence of fear of losing their jobs tends to make some teachers and staff less concerned about the job they do. Thus, revisions can be considered to also incorporate the voices of principals in

order to form a strong team of teachers and staff for the school they're leading.

- **Reservations for women as principals:** The current educational policy does not provide reservations for women as principals. The viewpoint of the interviewees remained divided as to whether the reservation policy in school leadership, and for women in particular, should be in place or not. Although, majority of them were against reservation and thought that women are capable enough to become principals on their own merit, some quota for the disadvantaged groups can be considered and recommended to be pilot tested if these policy changes can favor bringing more women from different social groups to leadership positions.
- **Nondiscriminatory implementation of policies:** As mentioned in the literature review, there are no policies that restrict women to assume leadership. It is very clearly provisioned that the School Maagement Committee (SMC) selects principals based on the educational qualification of the candidates and years of experience as a teacher. Still, some of the female principals responded that it is not always for women to secure leadership the easy way and there are forces that restrict them in spite of their qualifications. There it was very important to maintain a fair and nondiscriminatory implementation of choosing a principal. Therefore, it is recommended that the recruitment follows a transparent process to maintain belief in the system and encourage more women to come forward in achieving leadership positions in various community schools.

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काठमाडौं महानगरपालिकाको शहरी विकास व्यवस्थापन (योजना तर्जुमादेखि कार्यान्वयनसम्म)मा प्रभावकारी सञ्चार प्रक्रियाको महत्व

गोपीकृष्ण ढुङ्गाना

सारांश

एक्काइसौँ शताब्दी सूचना-प्रविधि र सञ्चारको युग हो । विकासका आयामहरूसँग नागरिकलाई जोड्न विभिन्न आमसञ्चार माध्यमले आवश्यक भूमिका खेलेका हुन्छन् । मुलुककै संघीय राजधानी समेत रहेको काठमाडौं महानगरपालिकाको विकास मुलुकभरका गाउँपालिका र नगरपालिकाका लागि सिकाइ हुने भएकाले काठमाडौं रोल मोडल हुनुपर्ने देखिन्छ । शहरी विकास योजना तर्जुमा सम्बन्धी विधिमा निर्वाचित जनप्रतिनिधिले नगरवासीको सामाजिक, आर्थिक र भौतिक विकासका लागि तयार गर्ने अल्पकालीन, मध्यकालीन र दीर्घकालीन योजना नै विकासको मार्गचित्र हो भनी उल्लेख गरिएको छ । सामाजिक-आर्थिक विकासको पूर्वशर्त नै पूर्वाधार विकास भएकाले महानगरपालिकाले सोही अनुरूपका योजना छनोट र कार्यान्वयन गर्नुपर्ने हुन्छ । काठमाडौं महानगरपालिकाको लक्ष्य पनि आर्थिक-सामाजिक विकास, गरिबी निवारण र दिगो शान्तिका लागि पूर्वाधार विकास नै हो । यसका लागि महानगरपालिकाले आमसञ्चार माध्यममार्फत् महानगरवासीसँग सहकार्य गर्नुपर्ने देखिन्छ । यस अनुसन्धानमा काठमाडौं महानगरपालिकामा हुने विकासका योजनामा आमसञ्चार क्षेत्रको भूमिका केलाउन महानगरपालिकाका पदाधिकारी, जनप्रतिनिधि, कर्मचारी र वडावासीबीच आमसञ्चार माध्यममार्फत् हुने सार्वजनिक संवाद सञ्चार प्रक्रियाको प्रभावकारिताको मूल्यांकन गरिएको छ । यसमा महानगरका विभिन्न वडाका ३०० बासिन्दासँग भेटघाटका साथै अनलाइनबाट सर्वेक्षण गरिएको छ । रानीपोखरी र काष्ठमण्डप पुनर्निर्माण थाल्नुअघि र कार्य भइरहँदा आमसञ्चारले खेलेको भूमिका वा जनप्रतिनिधि वा कर्मचारी र सरोकारवालाबिच सञ्चार नहुँदा वा पूर्ण रूपमा नहुँदा केकस्ता समस्या देखिए भन्ने कुरा घटना अध्ययनमा समेटिएको छ । अनुसन्धानमा सञ्चारका श्रोत, सन्देश, माध्यम र प्रापकबीचको सम्बन्ध र अर्थ ग्रहण वा बोधगम्यताको प्रकृयालाई महानगरपालिका र यहाँका मतदाताबीचको अन्तरसम्बन्धमा परीक्षण गर्न खोजिएको छ ।

सूचक शब्द : सञ्चार प्रक्रिया, शहरी व्यवस्थापन ।

१. परिचय

१.१ पृष्ठभूमि

काठमाडौं महानगरपालिकाको शहरी विकास व्यवस्थापन (योजना तर्जुमादेखि कार्यान्वयनसम्म)मा प्रभावकारी सञ्चार प्रक्रियाको महत्वबारे विस्तृतमा यस अनुसन्धानमा समेटिएको छ । विकासमा आमसञ्चार माध्यमको भूमिका र महत्व के कस्तो छ, सकारात्मक, नकारात्मक वा तटस्थ छ र विकासमा नागरिकसँगको सार्वजनिक सञ्चार/संवाद कस्तो छ भन्ने विषयमा अनुसन्धान केन्द्रित छ । काठमाडौंले पनि दिगो विकासका लागि आमसञ्चार माध्यममार्फत सूचना तथा सञ्चारको प्रभावकारी प्रयोग गर्न सके शहरी विकास योजना तर्जुमा समयमै प्रभावकारी ढङ्गले र पारदर्शी रूपमा छनोट गर्ने प्रयोजनका लागि आमनागरिकको मत, अवधारणासमेत आत्मसात गर्दै सहभागितामूलक ढङ्गले तर्जुमा र कार्यान्वयन गर्न सहज हुने देखिएको छ ।

शहरी विकासका क्रममा हुने सबल र दुर्बल पक्ष थाहा पाउने र सोहीअनुसार सुधार गरेर सही गन्तव्यसम्म पुग्न सक्ने बाटो पनि यो अनुसन्धानले देखाएको छ । महानगरपालिका र महानगरवासीबीच शहरी विकासमार्फत सुसम्बन्ध कायम गर्न आमसञ्चारका माध्यममार्फत निर्वाध सूचना र संवादको माध्यमले बलियो बनाउँदै निरन्तर विकास गर्न महानगरपालिकालाई सहज हुनेछ । निरन्तर विकास गर्न हरेक विकाससम्बन्धी योजना/आयोजनामा नागरिकहरूको सहभागिता बलियो बनाउन पनि अनुसन्धानले सहयोग गर्नेछ ।

मुलुकको राजधानीसमेत रहेको काठमाडौं ऐतिहासिक नगरी हो । हालको काठमाडौं महानगरपालिका सुरुआतमा काठमाडौं (भोटाहिटी) म्युनिसिपालिटी थियो । काठमाडौं (भोटाहिटी) म्युनिसिपालिटीको गठन सवाल सनदमार्फत १९७६ पुस २ गते भएको देखिन्छ (नेपाल : २०७२) । यो महानगर धरहरा, रानीपोखरी, काष्ठमण्डप लगायतका दर्जनौं सांस्कृतिक सम्पदाहरूले भरिपूर्ण रहेको छ । यी सम्पदासँगै काठमाडौंको अतीतको परम्परालाई पुनर्जागृत एवम् संरक्षण गरी शहरी विकासमा टेवा पुऱ्याउन आमसञ्चार प्रक्रियाको महत्वपूर्ण योगदान रहन्छ ।

काठमाडौं महानगरपालिकाभित्रका मूर्त र अमूर्त सम्पदासँगै परम्परालाई संरक्षण र संवर्द्धन गर्दै समग्र शहरी विकास गर्न प्रतिनिधिमूलक निकाय र नागरिकबिच आमसञ्चारमार्फत निर्वाध रूपमा सञ्चार हुनु आवश्यक देखिन्छ । सार्वजनिक सञ्चार, संवाद र त्यसपछि हुने सहकार्यका माध्यमबाट प्राचीन काठमाडौंको इतिहासलाई जीवन्त राख्न आमसञ्चार माध्यमले विगतदेखि वर्तमानसम्म सर्वोपरि रूपमा भूमिका निर्वाह गर्दै आएको पनि छ । यी र यस्तै समग्र विषयलाई अझ जीवन्त बनाउन आमसञ्चार माध्यमको थप र प्रभावकारी भूमिका देखिएकोले यो अनुसन्धान गरिएको हो । यस अनुसन्धानमा विकास र निर्माणका तीन प्रमुख वाहकहरू- महानगरपालिकाको राजनीतिक नेतृत्व, विकास प्रशासन वा विज्ञ र मतदाता वा नागरिक (वडावासी) बीच कुन अवस्थामा आमसञ्चार माध्यमहरू जीवन्त र निरन्तर संवाद कायम गर्न सहयोग प्राप्त हुन सक्दछ भन्ने विषयमा विद्यमान अभ्यासलाई सैद्धान्तिक अवधारणाको कसीमा घोटेर बताउन खोजिएको छ ।

तत्कालीन अवस्थासमेतलाई जीवन्त बनाइराख्न आमसञ्चार माध्यमले एकातिर पटकपटक घच्घच्याइरहेका छन् भने अर्कोतिर समयसापेक्ष जनअपेक्षालाई महानगरपालिकाका जनप्रतिनिधिसँग र जनप्रतिनिधिले यस सम्बन्धमा गरेका कार्यहरू जनमानसमा पुऱ्याउने अहम् भूमिका खेलिरहेको पाइन्छ । साथै समग्र शहरी विकास व्यवस्थापनमा पनि समयमै कार्य थाल्नेदेखि समयमै कार्यसम्पन्न गर्नेसम्म र सो क्रममा सम्बन्धित निकाय र नागरिकले खेल्नुपर्ने भूमिका, निभाउनु पर्ने उत्तरदायित्व र देखाउनुपर्ने पारदर्शिता सबै सबैमा निगरानीको काम पनि आमसञ्चार माध्यमले गरिरहन्छ ।

१.२ अनुसन्धानको उद्देश्य

प्रस्तुत अध्ययनका उद्देश्यहरू निम्नलिखित रहेका छन् :-

- महानगरको योजनाबद्ध शहरी विकास व्यवस्थापनसम्बन्धी विषयमा आमसञ्चार माध्यममार्फत अभ्यास भइरहेको नागरिकसँगको सञ्चार प्रक्रिया पत्ता लगाउनु
- महानगरको शहरी विकासमा आमसञ्चार माध्यमको प्रस्तुतिको तरिकाको अध्ययन गर्नु
- महानगरको शहरी विकास व्यवस्थापनका सवालमा सञ्चार प्रक्रियालाई सहज बनाउँदै आमसञ्चार माध्यमको सहयोगले नागरिकसँगको संवाद वा सार्वजनिक संवाद प्रभावकारी रूपमा स्थापित गर्ने उपायको खोजी गर्नु ।

१.३ अध्ययनको सीमाङ्कन

प्रस्तुत अनुसन्धान काठमाडौं महानगरपालिकाको शहरी विकास व्यवस्थापन (योजना तर्जुमादेखि कार्यान्वयनसम्म) मा सञ्चार प्रक्रियाको महत्वसम्बन्धी अनुसन्धान आमसञ्चार माध्यममार्फत महानगरपालिकाको राजनीतिक नेतृत्व, विकास प्रशासन वा विज्ञ एवं सेवाग्राही (आमनागरिक) बीच हुने सार्वजनिक संवादको लेखाजोखा हो । महानगरपालिकामा हुने योजना र विकासमा आमसञ्चार क्षेत्रको भूमिकालाई केलाउन महानगरपालिकाका पदाधिकारी, जनप्रतिनिधि एवम् योजनाकर्ता, प्रवक्ता, सूचना अधिकारी, कर्मचारी एवम् योजनाकर्ता र वडावासीका बीच आमसञ्चार माध्यममार्फत हुने सार्वजनिक संवाद सञ्चार प्रक्रियाको प्रभावकारिताको मूल्यांकन गरिएको छ। यसका साथै विभिन्न वडाका ३०० जना बासिन्दासँग भेटघाटका साथै अनलाइनबाट सर्वेक्षण गरिएको छ ।

रानीपोखरी र काष्ठमण्डप पुनर्निर्माण थाल्नुअघि र कार्य भइरहँदा आमसञ्चारले खेलेको भूमिका वा जनप्रतिनिधि वा कर्मचारी र सरोकारवालाबिच सञ्चार नहुँदा वा पूर्ण रूपमा नहुँदा केकस्ता समस्या देखिए भन्ने कुरालाई पनि घटना अध्ययनले समेटेको छ । यस अनुसन्धानमा यी र यस्तै अन्य थुप्रै सन्दर्भमा आमसञ्चारको प्रयोगलाई हेरिएको छ । अनुसन्धानमा 'इलिमेन्टस् अफ कम्युनिकेसन प्रोसेस' लाई आधार बनाएर महानगरपालिकाले रेडियो, टेलिभिजन, अनलाइन वा छापा बुलेटिनजस्ता आफ्नै माध्यमद्वारा गर्ने प्रत्यक्ष सञ्चार होइन, सार्वजनिक आमसञ्चार माध्यमहरूमार्फत गर्ने सञ्चारको अवस्थाका बारेमा अध्ययन गरिएको छ ।

२. अध्ययनको विधि

२.१ समग्र विधि

यस अनुसन्धान कार्यलाई वैज्ञानिक र व्यवस्थित रूपमा अघि बढाउँदै निश्चित गन्तव्यमा पुऱ्याउने क्रममा सर्भेक्षण, अन्तर्वार्ता, घटना अध्ययनजस्ता परिणात्मक र गुणात्मक सूचना सङ्कलनका वैज्ञानिक विधिको प्रयोग गरिएको छ। अनुसन्धेय विषयको उचित विश्लेषण गरी सार्थक निष्कर्षमा पुऱ्याउने पद्धति शोधविधि नै भएकाले अध्ययन विश्लेषणको सैद्धान्तिक आधार, सामग्री सङ्कलन र त्यसको परीक्षण एवम् सत्यापानको समग्र प्रक्रिया अपनाइएको छ । अध्ययनका क्रममा सान्दर्भिक तथ्य तथ्याङ्क सङ्कलन गर्न गुणात्मक र परिमाणात्मक दुवै विधिबाट प्राप्त सूचनालाई निष्कर्षको आधार बनाइएको छ । सामाजिक र वैज्ञानिक अनुसन्धान पद्धति अनुकूल प्रश्नावलीमा आधारित सर्वेक्षण, केन्द्रीकृत अन्तर्वार्ता र घटना अध्ययन विधि अपनाइएको छ ।

२.२ सर्वेक्षण

प्रस्तुत अध्ययनमा प्राथमिकका साथै द्वितीयक स्रोतबाट सामग्री सङ्कलन गरी त्यसको सत्यतथ्य रूपमा विश्लेषण गरिएको छ । यो अनुसन्धानलाई प्रामाणिक रूपमा पूरा गर्न सरोकारवाला र त्यससँग सम्बन्धित ज्ञान भएका व्यक्तिसँग सर्वेक्षण, अन्तर्वार्ता र घटना अध्ययन गरिएको छ । यसमा पनि डोमिनिकको सञ्चार सिद्धान्तलाई आधार बनाइएको छ । यसरी प्राप्त तथ्य-तथ्याङ्कलाई विश्लेषण गरिएको छ । यस सर्वेक्षणमा परपोसिभ च्यान्डम स्याम्पलिङ विधि प्रयोग गरिएको छ । स्याम्पल साइज ३०० वडावासी सहभागी हुने गरी लिइएको छ ।

२.३ अन्तर्वार्ता

प्रस्तुत अध्ययनलाई पूरा गर्नका लागि महानगरपालिकाका पदाधिकारीहरू, जनप्रतिनधिहरू, वडावासी, आमसञ्चार माध्यमका सम्पादक र संवाददाताहरूलाई विषयगत र वस्तुगत गरी दुई खाले प्रश्नहरू निर्माण गरी सोधिएको थियो । अन्तर्वार्ता लिँदा वडावासीलाई सञ्चार प्रविधि (सामाजिक सञ्जाल) को प्रयोग गरी भर्चुअल माध्यमबाट अन्तर्वार्ता लिइएको थियो भने अन्य व्यक्तिहरूलाई प्रत्यक्ष भेटघाट गरी कुराकानी र लिखित प्रक्रियाका माध्यमबाट अन्तर्वार्ता लिइएको थियो । अन्तर्वार्ता लिने क्रममा 'इलिमेन्टस् अफ कम्युनिकेसन प्रोसेस' का आठवटै तत्वहरूलाई आधार बनाएर प्रश्न सोधिएको थियो । अन्तर्वार्ताबाट प्राप्त तथ्य-तथ्याङ्कको अध्ययनबाट प्राप्त परिणामका आधारमा यो अनुसन्धान पूरा गरिएको छ । यस अनुसन्धानमा कूल २० जनासँग अन्तर्वार्ता लिइएको छ ।

२.४ घटना अध्ययन

प्रस्तुत अध्ययनमा महानगरभित्रको विशेष ऐतिहासिक एवम् पुरातात्विक सम्पदा रानीपोखरी र काष्ठमण्डप निर्माणका क्रममा देखिएका समस्याहरूको अध्ययन अनुसन्धान गरिएको छ । प्रस्तुत घटना अध्ययनलाई पूरा गर्नका लागि सरोकारवाला संस्था, व्यक्ति, सम्बन्धित क्षेत्रका विज्ञ, जनप्रतिनिधि र कर्मचारीहरूलाई प्रत्यक्ष भेटघाट गरी लिखित र मौखिक अन्तर्वार्ता लिइएको थियो । उक्त अन्तर्वार्ताबाट प्राप्त निष्कर्षका आधारमा यस अनुसन्धानमा रानीपोखरी र काष्ठमण्डपसम्बन्धी घटना अध्ययन गरिएको छ । यसमा पनि डोमिनिकको सञ्चार सिद्धान्तलाई आधार बनाइएको छ । घटना अध्ययनबाट समस्या समाधानका लागि उपयुक्त उपायसमेत खोजिएको छ । जसमा महानगरपालिका र नागरिकबिच हुने संवादमा के कुराको कमी भएर समस्या देखिएका हुन् र अब के गरे ती खालका समस्या दोहोरिँदैनन् भन्ने कुरालाई पनि अध्ययनमा समावेश गरिएको छ । तीनवटै तरिकाबाट सङ्कलन गरिएका सूचना, धारणालाई विश्लेषण गरी अनुसन्धान प्रश्नहरूको उत्तर खोजिएको छ ।

३. अध्ययनको परिणाम तथा छलफल

३.१ वडावासीसँग गरिएको सर्वेक्षणबाट प्राप्त सूचना

काठमाडौं महानगरपालिकाको विकासमा आमसञ्चार माध्यमको के कस्तो भूमिका र प्रभावकारिता रहेको छ भन्ने समस्यामा आधारित रहेर यो अनुसन्धान पूरा गर्न ३०० वडावासीसँग १७ वटा वस्तुगत प्रश्न समेटेर सर्वेक्षण गरिएको थियो ।

महानगरपालिकालाई विकाससम्बन्धी योजनाबारे सूचना दिनु पर्दा तपाई कुन माध्यममार्फत सूचना दिनुहुन्छ भन्ने प्रश्नको उत्तरमा ४५ प्रतिशतले आमसञ्चार माध्यम, ३५ प्रतिशतले मौखिक, १४ प्रतिशतले चिठीपत्र

र ६ प्रतिशतले अन्तर्क्रियामार्फत सूचना दिने गरेको कुरा बताए । वडामा महानगरपालिकाले योजना तर्जुमा गर्दा कुनै सूचना प्रवाह गर्छ कि गर्दैन भन्ने प्रश्नको उत्तरमा ३८ प्रतिशतले थाहा छैन, २४ प्रतिशतले कहिलेकाहीँ गर्छ, २२ प्रतिशतले गर्छ र १६ प्रतिशतले गर्दैन भनेका छन् । वडामा महानगरपालिकाले योजना तर्जुमा गर्दा आमसञ्चार माध्यमको उपयोग गरेको छ कि छैन भन्ने अर्को प्रश्नमा ३५ प्रतिशतले छ, ३५ प्रतिशतले बेलाबेला, २० प्रतिशतले छैन र १० प्रतिशतले थाहा छैन भनी उत्तर दिए ।

महानगरपालिकाले सञ्चार उपयोग नगरे कसरी थाहा पाउनुहुन्छ ? यसमा ६५ प्रतिशतले व्यक्तिबाट, २५ प्रतिशतले आमसञ्चार माध्यमबाट थाहा पाउने गरेको कुरा बताए । यसैगरी १० प्रतिशतले अन्तर्क्रियात्मक कार्यक्रमबाट थाहा पाएको कुरा उल्लेख गरेका छन् भने कर्मचारीबाट सूचना आउने गरेको कुरा कसैले बताएनन् ।

महानगरपालिकाको शहरी विकास व्यवस्थापनमा नागरिकसँगको सञ्चार प्रक्रिया कस्तो छ भनी गरिएको प्रश्नमा आमसञ्चार माध्यममार्फत भन्नेमा ५० प्रतिशत, चिठीपत्र र अन्तर्क्रियामार्फत २५ प्रतिशत, सिधा सम्पर्कमार्फत २० र प्रयोगमा कुनै छैन भन्नेमा ५ प्रतिशतले मत जाहेर गरेका छन् ।

योजना तर्जुमाका क्रममा नागरिकलाई चित्त नबुझेका विषयमा आमसञ्चार माध्यमले समाचार बनाएका छन् ? यो प्रश्नमा ७० प्रतिशले कहिलेकाहीँ बनाउँछन्, १२ प्रतिशतले मुख्य विषयमा बनाउँछन्, १० प्रतिशतले बनाउँदैनन् र ८ प्रतिशतले सबै विषयमा बनाउँछन् भनी बताए । महानगरपालिकाको योजना कार्यान्वयनमा चित्त नबुझे त्यसबारे आमसञ्चार माध्यमबाट कुनै समाचार प्रकाशन भएका छन् भनी सोधिएको प्रश्नमा ४५ प्रतिशतले अलिअलि मात्र बनाउँछन्, ३० प्रतिशतले समाचार बनाएका छन्, १५ प्रतिशतले समाचार बनाएका छैनन् र १० प्रतिशतले चाहिँ अहिलेसम्म बनाएकै थाहा छैन भनी उत्तर दिएका छन् । आमसञ्चार माध्यमबाट प्रकाशित समाचारलाई लिएर महानगरपालिकाकाले विकासका योजनामा पुनरावलोकन गरेको थाहा छ भनी सोधिएको प्रश्नमा ५५ प्रतिशतले कहिलेकाहीँ थाहा पाउँछु, ३० प्रतिशतले छैन, १० प्रतिशतले छ र ५ प्रतिशतले मतलबै नराख्ने जवाफ दिएका छन् । विकासमा चित्त नबुझ्दा आमसञ्चार माध्यमबाट समाचारहरू प्रसारण भएका छन् भनी सोधिएको प्रश्नमा ७० प्रतिशतले बेलाबेला, २० प्रतिशतले छैन, १० प्रतिशतले छ र सधैँभरि भन्ने उत्तर कसैले नदिएको पाइयो ।

शहरी विकास व्यवस्थापनमा सञ्चार प्रक्रियाको भूमिकालाई कसरी प्रभावकारी बनाउन सकिएला भनी सोधिएको प्रश्नमा ५० प्रतिशतले सञ्चारकर्मीलाई आवश्यक सूचना दिएर, ३० प्रतिशतले अन्तर्क्रिया गरेर, १५ प्रतिशतले नियमित रूपमा पत्रकार सम्मेलन गरेर अनि ५ प्रतिशतले सामान्य सूचना दिएर सञ्चार प्रक्रियालाई प्रभावकारी बनाउन सकिने धारणा व्यक्त गरेका थिए । वडाका विकाससम्बन्धी योजनाका अनुगमन समाचार (फलोअप न्युज) कत्तिको सम्प्रेषण हुन्छन् भन्ने प्रश्नको उत्तरमा ६० प्रतिशतले कहिलेकाहीँ हुने गरेको बताए भने २५ प्रतिशतले हुँदैनन् भने । यसरी नै १० प्रतिशतले अहिलेसम्म भएकै छैनन् र ५ प्रतिशतले हुन्छ भनी जवाफ दिए ।

महानगरको शहरी विकासमा आमसञ्चार माध्यमले केकस्ता परिवर्तन ल्याउन सकेको छ भनी सोधिएको प्रश्नमा ७० प्रतिशतले अलिअलि मात्र, १५ प्रतिशतले छैन, १० प्रतिशतले छ र ५ प्रतिशतले थाहा छैन भनी उत्तर दिएका छन् । जनताका गुनासा आमसञ्चार माध्यमबाट सुनेपछि महानगरपालिकाले विकाससम्बन्धी योजनामा फेरबदल गरेको छ कि छैन भनी सोधिएको प्रश्नमा ५० प्रतिशतले छैन, ३० प्रतिशतले थाहा छैन, १५ प्रतिशतले कहिलेकाहीँ र ५ प्रतिशतले छ भनी जवाफ दिएका छन् ।

समाचारको के कुरामा तपाईं सन्तुष्ट हुनुहुन्छ भनी सोधिएको प्रश्नमा ७५ प्रतिशतले समाचारले विकासमा निगरानी गरिरहेको छ भनी उत्तर दिएका छन् भने १५ प्रतिशतले आफ्नो गुनासो योजनाकर्तासम्म पुगेको कुरा बताएका थिए । त्यसैगरी १० प्रतिशतले समाचारबाट विकासमा सहयोग पुगेको छ भनी जवाफ दिए ।

आमसञ्चार माध्यमबाट प्रसारण हुने महानगरपालिकाबारेका समाचारलाई कसरी हेर्नुभएको छ भनी सोधिएको अर्को प्रश्नमा ७० प्रतिशतले आक्रोश र सुझाव दुवै पोख्ने काम भएको भनी उत्तर दिए भने २० प्रतिशतले सुझाव दिने काम भएको छ भनेका छन् । यसरी नै १० प्रतिशतले आक्रोश मात्र पोख्ने काम भएको छ भनी उत्तर दिए ।

तपाईंले महानगरपालिकाको विकाससम्बन्धी कुनै गुनासा आमसञ्चार माध्यममा पोख्नुभएको छ भनी सोधिएको प्रश्नमा ५५ प्रतिशतले छैन, २५ प्रतिशतले कहिलेकाहीँ, १० प्रतिशतले छ र १० प्रतिशतले गुनासा नै छैनन् भनी उत्तर दिए । योजना तर्जुमादेखि कार्यान्वयनसम्म वडा कार्यालयले नागरिकसँगको संवादलाई कसरी प्रभाकारी बनाउन सक्छ भन्ने प्रश्नको उत्तरमा ६५ प्रतिशतले आमसञ्चार माध्यमको प्रयोग गरेर, २५ प्रतिशतले अन्तर्क्रिया गरेर, ६ प्रतिशतले चिठीपत्र वा अनलाइनबाट सूचना दिएर र ४ प्रतिशतले योजना तय हुनु अघि र पछि सिधैँ सूचना दिएर नागरिक संवादलाई प्रभावकारी बनाउन सकिने कुरा बताए ।

महानगरको विकासमा आमसञ्चार माध्यमको भूमिका कस्तो देख्नुहुन्छ भनी सोधिएको अन्तिम प्रश्नमा ८० प्रतिशतले सकारात्मक, २० प्रतिशतले तटस्थ भनी उत्तर दिएका थिए भने नकारात्मकमा कसैको मत परेको थिएन । यसरी वडावासी नागरिकको धारणालाई हेर्दा महानगरको शहरी विकासमा आमसञ्चार माध्यमको भूमिका सकारात्मक देखिएको छ । त्यसैले यसको उपयोग धेरैभन्दा धेरै गर्नु श्रेयस्कर हुने देखिन्छ । विकासका काममा समाचारले निगरानी गरेको तर कतिपय आमसञ्चार माध्यमले सुझावसँगै आक्रोशसमेत पोखेको पनि देखिएको छ ।

विकासका लागि साझेदार आमसञ्चार माध्यम पनि हो । यसको प्रयोग नगर्दा विकाससम्बन्धी योजना/आयोजना पारदर्शी बन्न सक्दैनन् र समयमै काम सम्पन्न हुँदैनन् भन्ने मूलधारणा नै महानगरवासीको रहेको पाइयो । वडावासीलाई आधार मान्ने हो भने आमसञ्चार माध्यमले महानगरका आमचासोका विषयमा समाचार लेखे पनि अनुगमन समाचार (फलोअप न्युज) नलेखेको देखिन्छ । महानगरवासीहरूले पत्रकारहरूलाई समयमै र पूर्ण सूचना दिएर नागरिकलाई सुसूचित गर्नुपर्नेमा जोड दिएको सर्वेक्षणबाट प्रस्ट हुन्छ ।

३.२ अन्तर्वार्ताबाट प्राप्त नतिजा

३.२.१ उपप्रमुखसँगको अन्तर्वार्ता

महानगरपालिकाको शहरी विकास व्यवस्थापनमा सञ्चार प्रक्रियाको भूमिका र प्रभावकारितासम्बन्धी अध्ययनका क्रममा महानगरपालिकाका उपप्रमुखसँग लिएको अन्तर्वार्ता र सोको निष्कर्ष यसप्रकार रहेको छ ।

उपप्रमुखको भनाइ अनुसार विकाससम्बन्धी कार्यका लागि नागरिकसँग भेटघाट तथा आमसञ्चारको प्रयोग गर्ने गरिएको छ । साथै कार्यक्रमहरूमा जानकारी दिने र कार्यकर्तामार्फत कुराकानी गर्ने पनि अर्को तरिका हो । मिडियामा आउने धेरैजसो सामग्रीमा नागरिकको आवाज पाउने गरेको छ । आफूले भनेका कुरा आमसञ्चार माध्यममा जस्ताको तस्तै सम्प्रेषण हुने गरेको छ । आमसञ्चार माध्यमलाई नागरिक र आफूबीचको साझा प्लेटफर्ममा पाएको अवस्था छ । जनभावनाअनुरूप विकास प्रक्रिया सञ्चालन गर्दा आमसञ्चार माध्यममा जनताका धारणाले ठाउँ पाउने गरेको छ । महानगरको विकासमा आमसञ्चार माध्यमले जनताका कुरा दिँदा पूर्वाग्रह नथोपरेको देखिन्छ । विकास प्रक्रियामा सही मार्ग पहिचान गर्न सहयोग पुग्ने भएकाले आमसञ्चार माध्यमको सकारात्मक आलोचना आवश्यक भएको उपप्रमुखको भनाइ छ ।

विकास योजना कार्यान्वयनका क्रममा आमसञ्चार माध्यमका सामग्रीमा अध्ययन कम हुने गरेको पाइएको छ । योजना बनाउँदा नागरिकको धारणा बुझ्न पत्रकारसँग अन्तर्क्रिया गर्ने गरिएको छ । विकास योजनाका बारेमा आमसञ्चार माध्यमले गरेको टिप्पणी सङ्ख्यात्मक र गुणात्मक हिसाबले अलि कम रहने गरेको छ । योजना छनोटमा आमसञ्चार माध्यमले खेलेको भूमिका तटस्थ देखिन्छ । आमसञ्चार माध्यमले शहरी विकासको गतिलाई न्यून मात्रामा सहयोग गरे पनि गरेका काम भने सकारात्मक छन् । शहरी विकासका लागि आमसञ्चार माध्यमबाट खोजमूलक र अनुसन्धानमूलक समाचारको अपेक्षा गरिएको छ । आमसञ्चार माध्यमको हालको भूमिका पर्याप्त नभएको उपप्रमुखको भनाइ छ ।

योजना छनोटमा आमसञ्चारको हालको भूमिका अपर्याप्त देखिन्छ । आमसञ्चार माध्यममा आएका सुझावलाई मनन् गरी महानगरपालिकाले रानीपोखरी र काष्ठमण्डप पुनर्निर्माणलाई योजनामा राखेको छ । महानगरको विकासमा सञ्चार प्रक्रिया मार्फत नागरिक बहसले पर्याप्त स्थान पाउनुपर्छ । महानगरपालिकाले आफ्ना आमसञ्चार माध्यम परिचालन गर्ने सन्दर्भमा बृहत् सञ्चार नीति तर्जुमा गरी सोअनुरूप उल्लेखित आमसञ्चार माध्यमको उपयोग गर्ने प्रबन्ध मिलाउनुपर्छ । महानगरपालिका र आमसञ्चारबीचको सम्पर्क र अन्तर्क्रियामा कमी नै भएको उपप्रमुखको बुझाइ छ ।

३.२.२ प्रवक्ता (वडाध्यक्ष)सँगको अन्तर्वार्ता

नागरिक र महानगरपालिकाबीच सन्देश आदानप्रदान गर्न आमसञ्चार माध्यमलाई साझा प्लेटफर्मको रूपमा पाएको प्रवक्ताको भनाइ छ । उनले जनताका समस्याका विषयले आमसञ्चार माध्यममा ठाउँ पाउने गरेको बताएका छन् । विकास प्रक्रियामा आमसञ्चार माध्यमले गर्ने सकारात्मक र आलोचना दुवै स्वीकार्य भएको उनले बताए । रानीपोखरीमा सिमेन्टको पर्खाल लगाउँदा आमसञ्चार माध्यमले मौलिक कार्य भएन भनेपछि मेयरले समाचारकै आधारमा विशेषज्ञको कार्यदल बनाएर काम गर्नुभएको थियो । विकास योजना तर्जुमाका क्रममा आमसञ्चार माध्यमबाट सेवाग्राहीका धारणा थाहा पाउन आमसञ्चार माध्यम प्रभावकारी र महत्वपूर्ण भएको प्रवक्ताको भनाइ छ ।

विकासका लागि आमसञ्चार माध्यमका सामग्री धेरै हदसम्म उपयोगी भएको बुझाइ प्रवक्ताको छ । केही सामग्री भने भ्रम छर्ने प्रकृतिका पनि छन् । आमसञ्चार माध्यमका समाचार र टिप्पणी वस्तुनिष्ठ रूपमा आउनुपर्ने भनाइ प्रवक्ताको छ । कमीकमजोरी भए त्यो पनि आउनुपर्ने तर नभएका कुरा र बङ्ग्याएर आउनु नहुने उनले बताए । समाचार असल र खराब दुवै कामका बारेमा आउनुपर्छ तर राम्रो कार्यलाई नराम्रो भनेर गलत रिपार्ट गर्नु नहुने उनको भनाइ छ । प्रवक्ताले हातहातमा मोबाइल हुने भएकाले अनलाइन पत्रकारिताबाट बढी सन्तुष्ट भएको पनि बताए ।

आमसञ्चार माध्यमले शहरी योजना निर्माणको गतिमा नागरिकलाई सुसूचित गर्ने भएकाले सहयोग गरेको प्रवक्ताको बुझाइ छ । उनले सञ्चारको सहयोग भएन भने नगरपालिकाले काम गरे पनि नागरिकलाई थाहा नहुने विचार पनि राखेका छन् । आमसञ्चारबाट शहरी विकासमा सकारात्मक माहोल ल्याउने राम्रो भूमिकाको अपेक्षा गरेको प्रवक्ताको भनाइ छ । उनले योजना छनोटका लागि आमसञ्चार माध्यमको भूमिका सकारात्मक रहेको बताए ।

प्रवक्ताले आमसञ्चार माध्यममा आएका सही र उपयुक्त सुझावलाई महानगरपालिकाको योजनामा समावेश गर्ने गरेको बताए । उनले नागरिकसँग बारम्बार अन्तर्क्रिया गरेर शहरी विकासमा सञ्चार प्रक्रियालाई प्रभावकारी बनाउन सकिने बताए । महानगरपालिकाले सञ्चालन गरेका आमसञ्चार माध्यमले महानगरका गतिविधिमा बढी दायित्वबोध गरेको प्रवक्ताको भनाइ छ ।

३.२.३ वडाध्यक्षद्वयसँगको अन्तर्वार्ता

जनघनत्व, भूगोल र जनसंख्या आदि फरक आधार बनाएर महानगरपालिकाका वडा नम्बर ७ र १८ का वडाध्यक्षलाई १९ वटा प्रश्न तयार पारी सोधिएको थियो । सर्वेक्षणबाट प्राप्त धारणा यसप्रकार रहेको छ ।

नागरिकसँग कसरी संवाद गर्नुहुन्छ भन्ने पहिलो प्रश्नमा एक वडाध्यक्षले भेटघाट र वार्तालापका माध्यमबाट र अर्का वडाध्यक्षले कार्यक्रममार्फत भनेका छन् । आमसञ्चार माध्यममा आउने सामग्रीमा नागरिकको आवाज समेटिएको दुवैजना वडाध्यक्षको भनाइ छ । एक जनाले आमसञ्चार माध्यममा आफूले भने जसरी नै र अर्काले कहिलेकाहीँ मात्र आफूले भनेजस्तो गरी समाचार सम्प्रेषण हुने बताए । एक जनाले आमसञ्चार माध्यमहरूलाई नागरिक र आफूबीच सन्देशको आदानप्रदान गर्ने साझा प्लेटफर्मका रूपमा पाएको बताए भने अर्काले अलिअलि मात्र पाएको बताएका छन् । शहरी विकास प्रक्रियाका सम्बन्धमा आमसञ्चार माध्यममा जनताका धारणाले ठाउँ पाएको र सुधारको मौका पनि मिलेको एक वडाध्यक्षको भनाइ छ । अर्का वडाध्यक्षले सम्बन्धित ठाउँमा पुगेर भनेअनुसार र प्राविधिकसँग कुरा गरेर योजना बनाउने गरेको जानकारी दिए ।

महानगरको शहरी विकाससम्बन्धी सामग्रीको मामिलामा आमसञ्चार माध्यमले जनताको भन्दा पनि आफ्नै पूर्वाग्रह थोपरेको छ कि भनेर वस्तुगत प्रश्न सोधिएकोमा एकले छ र अर्कोले छैन भनी जवाफ दिए । विकास प्रक्रियामा आमसञ्चार माध्यमले गर्ने आलोचना विपक्षीको जस्तो भएको बताउने एक वडाध्यक्षले यस्ता आलोचनामा सेवाग्राहीको पक्षमा उभिएर कमी कमजोरी औँल्याइएको स्वीकार्ने र उक्त विषयमा सरसल्लाहबाट अघि बढ्ने बताए । अर्का वडाध्यक्षले आलोचना गर्नासाथ के बिग्रिएको हो सच्याउने, त्यसले आफूलाई सही काममा झकझक्याउने, सत्यतथ्यका आधारमा बुझाइ हुने र कसैले भन्दैमा भइहाल्छ भन्ने नभएको बताए ।

विकासका योजना तर्जुमाका क्रममा आमसञ्चार माध्यमबाट नागरिक वा सेवाग्राहीका धारणा थाहा पाउन पत्रपत्रिका, रेडियो, टेलिभिजन, अनलाइन समाचार पोर्टलहरू उपयोगी भएको एक वडाध्यक्षले बताए भने अर्कोले खासै नभएको जवाफ दिए । विकास योजना कार्यान्वयनका क्रममा आमसञ्चार माध्यमका सामग्री उपयोगी भएको र सोबाट कामको प्रचारप्रसार भइरहेको दुवैको भनाइ छ । योजना बनाउँदा आमसञ्चार माध्यमबाट जनताको धारणा बुझ्न सहज भएको बताउँदै एकले आमसञ्चार माध्यमभन्दा प्रत्यक्ष सरसल्लाह गर्ने र अर्कोले योजनास्थलमै जाने बताए । विकास योजनाका सम्बन्धमा आमसञ्चार माध्यमबाट आउने समाचार वा टिप्पणी आधा मात्र वस्तुनिष्ठ हुने गरेको एक वडाध्यक्षले बताए भने अर्कोले वस्तुनिष्ठ थोरै र अरूले भनेका कुरा एकोहोरो रूपमा धेरै आउने गरेको बताए ।

वडा नम्बर १८ का वडाध्यक्षले रानीपोखरी बनिसकेपछिको समाचार र रानीपोखरी बनाउन सुरु गर्दाको समाचारको उदाहरण दिँदै शहरी विकासका क्रममा आमसञ्चार माध्यमले सम्प्रेषण गरेको क्रमशः असल र खराब समाचार भनी बताएका छन् । वडा नम्बर ७ का वडाध्यक्षले राहत बाँड्दा राम्रो सूचना प्रवाह गरेको तर सडक विभागले गरेको काममा वडाध्यक्षले भ्रष्टाचार गरे भनी आधारहीन समाचार प्रस्तुत गरेको जानकारी दिए । समाचार सम्प्रेषणमा कुन आमसञ्चार माध्यमबाट बढी सन्तुष्ट हुनुहुन्छ भन्ने प्रश्नमा दुवैजनाले अनलाइन र एकजनाले टेलिभिजन पनि भनेका छन् । एक वडाध्यक्षले शहरी विकासको गतिलाई आमसञ्चार माध्यमले धिमा गतिमा र अर्कोले सञ्चारमाध्ययमको भूमिका एकदमै धेरै हुने बताए । धेरै हुने भए पनि आफूले प्रचारप्रसार गर्न नसकेको उनको भनाइ छ । शहरी विकासका लागि आमसञ्चार माध्यमबाट सत्यतथ्य समाचारहरू बेलाबेलामा दिनुपर्ने एक वडाध्यक्षले बताए भने अर्कोले यथार्थपरक भूमिका हुनुपर्नेमा जोड दिए ।

एक वडाध्यक्षले योजना छनोटका लागि आमसञ्चार माध्यमले वडाहरूमा खासै भूमिका नखेले पनि महानगरपालिकाका सन्दर्भमा सहयोगी भूमिका खेलेको बताए भने अर्को वडाध्यक्षले एकदमै न्यून भूमिका

निर्वाह गरेको बताए । योजना तर्जुमादेखि कार्यान्वयनसम्मका महानगरपालिका र वडा कार्यालयका योजनाबारे आमसञ्चार माध्यमबाट राम्रोलाई राम्रो भन्ने नभए नराम्रो भनेर विकृतिलाई उजागर गर्नुपर्ने धारणा एक वडाध्यक्षको छ भने अर्काको प्रचारप्रसार नै मुख्य कुरा भएको बुझाइ छ । महानगरपालिकाले आफ्ना आमसञ्चार माध्यमहरू टेलिभिजन, एफएम, अनलाइन र राष्ट्रिय आमसञ्चार माध्यमहरूलाई कार्यक्रमहरूमा बोलाएर सही सूचना दिनुपर्ने एकको र सकारात्मक सोचका साथ कामको मूल्याङ्कन तथा प्रचारप्रसार गर्नुपर्ने अर्को वडाध्यक्षको धारणा छ ।

३.२.४ सूचना अधिकारी (कर्मचारी)सँगको अन्तर्वार्ता

महानगरपालिकामा योजना बनाउने कर्मचारीलाई सोधिएको प्रश्नावलीबाट प्राप्त तथ्याङ्कको विश्लेषण यसप्रकार छ । १६ वटा प्रश्नहरूमा उनको धारणा यस्तो छ ।

योजना बनाउने कर्मचारीले आमसञ्चार माध्यमलाई नागरिक र महानगरपालिकाबिचको सन्देश आदानप्रदानको साझा थलोको रूपमा पाएका छन् । शहरी विकास प्रक्रियाका सम्बन्धमा आमसञ्चार माध्यममा जनताका धारणाले ठाउँ पाएको र सोबाट सुधारको मौका प्राप्त भएको छ । सार्वजनिक सुनुवाई, सामाजिक परीक्षण र टोलसुधार संस्थाहरूको सहभागिता आदि र विभिन्न दलहरूले सार्वजनिक गरेका घोषणा र कार्यक्रमहरूलाई मुख्य आधार बनाएर योजना तथा कार्यक्रम छनोट गर्दा तल्ला तहका निकायमार्फत गरिने हुँदा सुधारको मौका प्रशस्त पाएको देखिन्छ ।

विकास प्रक्रियामा आमसञ्चार माध्यमले सेवाग्राहीको पक्षमा उभिएर गरिएका आलोचनालाई स्वीकार गर्ने र अनुगमन तथा मूल्याङ्कनका विभिन्न चरणहरू समावेश हुने भएकाले सो प्रक्रियामा नागरिकको धारणा बुझ्न आमसञ्चार माध्यमको भूमिका सही छ । महानगरपालिका क्षेत्र, सङ्घीय राजधानी, व्यापार व्यवसायको केन्द्र, शिक्षा स्वास्थ्यको केन्द्र र वैदेशिक रोजगारीसहित अन्तर्राष्ट्रिय शहर भएका कारण सेवाग्राहीका धारणा थाहा पाउन आमसञ्चार माध्यमहरू नै प्रमुख हुने गरेको र उपयुक्त विकासका लागि तिनको बहुपयोगी प्रयोजन भएको छ । विकास योजना कार्यान्वयनका क्रममा आमसञ्चार माध्यमका सामग्री विशेष उपयोगी भएको देखिन्छ । योजना बनाउँदा नागरिकको धारणा बुझ्न कस्तो आमसञ्चार माध्यमको उपयोग गर्ने गरेको छ । जसमा सार्वजनिक सूचना र प्रविधिको प्रयोग गरेर योजनाको खाका नागरिकसमक्ष पुऱ्याउने र धारणा लिने तथा आमनागरिकका चासो र जिज्ञासा बुझ्न भेला र अन्तर्क्रिया गर्ने जस्ता प्रक्रिया अपनाउने गरेको पाइएको छ ।

शहरी विकास योजनाका सम्बन्धमा आमसञ्चार माध्यमबीचको समाचारमा विषयवस्तुको कम ज्ञान हुने र आवश्यक सूचना तथा तथ्याङ्क नबुझेका जस्ता समाचार ७० प्रतिशत आएका छन् । केही समाचार योजनाकर्ताभन्दा बढी बुझे जस्ता पाइएका छन् । केही टिप्पणी वा समाचारहरू भने यथास्थितिमै आएका छन् । आमसञ्चार माध्यमले शहरी हरियाली प्रवर्द्धन, सरसफाई, आकासे पुल, सेवा प्रवाहलाई प्रविधिकरण गरिएका, सडक मानवको उद्धार र साझा यातायातसँगको सहकार्यमा सञ्चालित सार्वजनिक यातायातसम्बन्धी समाचारहरू असल समाचारका रूपमा दिएका र गलत समाचारहरूको सङ्ख्या पनि त्यत्तिकै छन् । अखबार, अनलाइन र टेलिभिजन योजना कार्यान्वयनमा बढी प्रभावकारी लाग्छन् । महानगरले के गर्दैछ र के गर्नुपर्छ भन्ने विषयमा आमनागरिकको धारणा र मत समग्र रूपमा आमसञ्चार माध्यमबाट प्राप्त हुने हुँदा कार्यान्वयनसम्म त्यसको निगरानीमा समेत उचित सहयोग पाउने गरेको छ । नागरिक र महानगरलाई जोड्ने आमसञ्चार माध्यम भएकाले यसको भूमिका अत्यन्त महत्वपूर्ण रहेको छ । अन्य देशका र देशभित्रका समान खालका योजनाहरूको तुलनात्मक अध्ययन समाचार सम्प्रेषण भए भोलिका दिनमा योजना निर्माणमा अझ सहयोग पुग्नेछ ।

३.२.५ सम्पादकहरूसँगको अन्तर्वार्ता

महानगरपालिकाको विकास तथा योजना तर्जुमामा आमसञ्चार माध्यमको भूमिका र प्रभावकारिता सम्बन्धी अध्ययनका क्रममा महानगरसम्बन्धी समाचारलाई आफ्ना आमसञ्चार माध्यममा के कसरी सम्प्रेषण गर्नुहुन्छ लगायतका एक दर्जन वस्तुगत र विषयगत प्रश्नहरू सञ्चार माध्यमका सम्पादकहरूलाई सोधिएको थियो । राष्ट्रिय दैनिक अखबारका दुई, टेलिभिजनका दुई र अनलाइनका दुई गरी ६ जना सम्पादकलाई लिएको अन्तर्वार्ताबाट प्राप्त परिणाम निम्नानुसार छ ।

तपाईंले प्रस्तुत गर्ने समग्र समाचार र विचारको अनुपातमा काठमाडौं महानगरपालिकासम्बन्धी सामग्रीको परिमाण कति हुन्छ भन्ने प्रश्नमा २ जना सम्पादकले अत्यधिक, एकले करिब पाँच प्रतिशत, दुईले नगण्य मात्रामा र एकले १० प्रतिशतभन्दा माथि भएको बताए । महानगरका विकाससम्बन्धी समाचारलाई विशेष प्राथमिकता दिनुहुन्छ वा दिनुहुन्न, सामान्य प्राथमिकता दिनुहुन्छ वा कुनै प्राथमिकता दिनुहुन्न भनी सोधिएको थियो । देशसञ्चार डटकम अनलाइनका सम्पादकले महानगरका समाचारलाई विशेष प्राथमिकता दिने गरेको बताए । पालिकाखबर डटकमका सम्पादकले देशकै ठूलो स्थानीय सरकार भएकाले प्राथमिकता पाउने बताए । इमेज च्यानलका सम्पादकले विकास निर्माणभन्दा पनि सम्पदासम्बन्धी समाचारलाई बढी प्राथमिकता दिने गरिएको र महानगरको सञ्चार सम्पर्क कमजोर भएकाले यसलाई अझ बढाउने कुरा बताए । एपीवान् टेलिभिजनका सम्पादकले भने सामान्य प्राथमिकता दिने गरेको र महानगरका गराइ र भनाइमा एकरूपता नभएको बताए । अन्नपूर्ण पोस्टका सम्पादकले सङ्घीय स्वरूपको संरचनामा विकास निर्माणको जग भनेकै स्थानीय सरकार भएकाले समाचारमा पनि स्थानीय तहले विशेष प्राथमिकता पाउने गरेको बताए । राजधानी दैनिकका सम्पादकले काठमाडौं महानगरपालिका देशको राजधानी भएको र धेरै जनसङ्ख्या भएकाले यहाँका विकास निर्माणले मुलुकका अन्य पालिकाहरूलाई उत्प्रेरित गर्न सक्ने भएकाले समाचारलाई सकेसम्म विशेष प्राथमिकता दिने गरेको बताए ।

देशसञ्चारका सम्पादकले महानगरपालिकाका जनप्रतिनिधि वा कर्मचारीले संवाददाताले मागेको सूचना सहजै दिए पनि महानगरका कमजोरी बारेका समाचार भने लुकाउने गरेको बताए । इमेजका सम्पादकले महानगरबाट सूचना पाउन सहज नभएको बताए । पालिकाखबरका सम्पादकले सूचना पाउन सहज नभएको र पालिका सूचनामैत्री नभएको कुरा बताए । एपीवान्का सम्पादकले पनि सूचना प्राप्त गर्न सहज नभएको बताए । अन्नपूर्ण पोस्टका सम्पादकले आफूलाई अनुकूल हुने सूचना दिन आफैं अग्रसर हुने तर आर्थिक अनियमितता र बेथितिका सूचनाहरू लुकाउने प्रवृत्ति रहेको बताए । यस्तै आर्थिक पक्षसँग जोडिएका, अनियमितता र बेथितिका सूचनाहरू लिन सञ्चारकर्मीले अझै पनि निकै ठूलो सास्ती व्यहोर्नु पर्ने अवस्था रहेको उनको भनाइ छ । यस प्रश्नको उत्तरमा सबै सम्पादकले महानगरबाट सूचना प्राप्त गर्न त्यति सहज नभएको कुरा बताएका छन् ।

समाचार सम्प्रेषण गरेपछि त्यसको प्रभाव मध्यम ढङ्गले पर्ने गरेको राजधानीका सम्पादकले बताए । अन्नपूर्णका सम्पादकले पाठकहरूबाट अनियमितता र बेथितिका समाचार मात्र होइन, महानगरपालिकाले गर्ने र गर्दै आएका राम्रा कामहरूको पनि तत्काल प्रतिक्रिया आउने गरेको जानकारी दिए । एपीवान्का सम्पादकले प्रभाव ठिकठिकै परेको र महानगरले गरेका केही गलत कामहरू सच्याउन बाध्य भएको छ भनी बताए । पालिकाखबरका सम्पादकले सामान्य रूपमा परेको बताए । इमेज च्यानलका सम्पादकले महानगर भएकाले स्वभावत: प्रभाव पर्ने बताए । महानगरले सकारात्मक समाचार प्रकाशित भएमा विरलै प्रतिक्रिया दिने भए पनि अनियमितता र बेथितिका समाचार प्रकाशित भए तत्काल नकारात्मक प्रतिक्रिया जनाउने गरेको बताए । कुनै समाचार प्रकाशित गरेपछि महानगरपालिकाका पदाधिकारी वा जनप्रतिनिधिले सकारात्मक भए तारिफ गर्छन् र नकारात्मक भए आक्रोश व्यक्त गर्छन् र संवाद नै बन्द गर्न खोज्ने कुरा सबै सम्पादकले बताए ।

तीन सम्पादकले महानगरपालिकासँग सम्बन्धित कुनै घटना वा विषयमा एजेन्डा सेटिड नै गर्ने गरी लगातार प्रश्न उठाएको बताए भने बाँकी तीनले विषय उठान गरे पनि एजेन्डा सेटिङ भने नगरेको बताए । समाचारको प्रभाव परेपछि महानगरपालिकाले कुनै योजनामा गुनासो सम्बोधन गरी निर्णयमा फेरबदल गरेको छ भनी तीन र छैन भनी तीन सम्पादकले बताए । वडावासीका मागलाई महानगरपालिकाले कत्तिको समेटेको पाउनुहुन्छ भनी गरेको प्रश्नमा अन्नपूर्णका सम्पादकले यो सम्पादकलाई सोध्नु पर्ने प्रश्न नभएको जिकिर गरे । राजधानीका सम्पादकले त्यति संवेदनशीलतापूर्वक समेटेको नदेखिएको र महानगरपालिकाका जनप्रतिनिधि तथा कर्मचारी दुवै पक्ष जनता र विकास निर्माणप्रति चिन्तित र गम्भीर नभएको उत्तर दिए । पालिकाखबरका सम्पादकले सामान्य रूपमा समेटेको र इमेजका सम्पादकले वडा तहको काममा आफ्नो मिडियाले चासो दिने नगरेको बताए । देश सञ्चारका सम्पादकले पनि वडाका विषयमा धेरै प्राथमिकता दिन नपाएको बताए भने एपीवान्का सम्पादकले पनि खासै समाचार सम्प्रेषण नगरेको बताए । अधिकांश सम्पादकले जनप्रतिनिधि र कर्मचारीले प्रचार गर्नुपर्ने विषयमा बोलाएर समाचार लेख्न आग्रह गर्ने गरेको बताए भने केही सम्पादकले आकलझुक्कल बोलाउने गरेको बताए ।

महानगरपालिकाका समाचारका सम्बन्धमा केकस्ता विषय समाचार बनाउने वा केकस्ता विषयलाई प्राथमिकतामा पार्ने भन्ने विषयमा लिखित नीति नभए पनि सम्पादकीय बैठकमा यस विषयमा छलफल भने गर्ने गरेको सबै सम्पादकहरूले बताए । महानगरको विकासमा आमसञ्चार माध्यमको भूमिका सकारात्मक रहेको सबै सम्पादकहरूको दावी रह्यो । महानगर स्रोतबाट प्राप्त समाचारमा कसैका भनाइलाई तोडमोड गरेर छाप्न हुँदैन र मिल्दैन भनी सबै सम्पादकले बताए । 'आमसञ्चार माध्यमले महानगरका विकासबारेका समाचार सम्प्रेषणलाई उचित स्थान नदिएको गुनासो छ नि' भन्ने प्रश्नमा अन्नपूर्णका सम्पादकले गलत र नकारात्मक कुरा मात्र समाचार हुन् भन्ने मान्यता नै गलत भएको र विभिन्न निकायले गर्ने विकास निर्माणको कार्य र सकारात्मक कुराहरू पनि समाचारका विषय हुने कुरा बताए । इमेजका सम्पादकले गुनासो होला तर गुनासो गरेर मात्र बस्ने कि परिचालन गर्ने कुनै संयन्त्रको विकास गरेर समाचारलाई सम्प्रेषण गर्ने, त्यो भने महानगरले सोच्नुपर्ने बताए ।

सोही प्रश्नमा पालिकाखबरका सम्पादकले आफू स्थानीय तहका खबर प्राथमिकतामा सम्प्रेषण गर्ने मिडिया भएकाले विकासका मामिलामा खबरदारी, प्रशंसा र आलोचनासँगै बेलाबेलामा हस्तक्षेप नै गर्ने बताए । हस्तक्षेप र आलोचना गरेका समाचारमा महानगरपालिकाले गुनासो हुन सक्ने उनको भनाइ छ । देशसञ्चारका सम्पादकले भने विकासबारेका समाचार नै कम भएर महानगरपालिकालाई त्यस्तो लागेको हुनसक्छ भन्ने कुरा बताए । एपीवान्का सम्पादकले राम्रो काम नगरेपछि समाचार सकारात्मक ढङ्गले सम्प्रेषण नहुने बताए । राजधानीका सम्पादकले महानगरले विकासमा छलाङ मार्ने हो भने आमसञ्चार माध्यम समाचार खोज्दै महानगर पुग्ने बताए । अन्नपूर्णका सम्पादकले महानगरका विकासबारे दीर्घकालीन महत्व राख्ने विकास निर्माणका कामहरू भएमा त्यसले बिनापूर्वाग्रह सम्पादकीयमा स्थान पाउने बताए । राजधानीका सम्पादकले महत्वपूर्ण विषयमा सम्पादकीय लेखिने बताए । एपीवान्का सम्पादकले उचित स्थान दिने गरेको बताए भने इमेज च्यानलका सम्पादकले महानगरको विकासबारे कमै मात्रामा स्थान दिने गरेको बताए । देशसञ्चारका सम्पादकले कहिलेकाहीं र पालिकाखबरका सम्पादकले पर्याप्त स्थान दिने गरेको बताए ।

विषयगत संवाददातालाई महानगरका विकासबारेका कस्ता समाचार लेख्न भन्नुहुन्छ भनी प्रश्न सोधिएको थियो । राजधानीका सम्पादकले महानगरका समस्या र राम्रा कामहरूका बारेमा तथा अन्नपूर्ण पोस्टका सम्पादकले भने राम्रा र नराम्रा दुवै पक्षलाई समेटेर समाचार तयार पार्न भन्ने गरेको बताए । एपीवान्का सम्पादकले महानगरले अघि सारेका योजना र कामका बारेमा तथा पालिकाखबरका सम्पादकले पूर्वाधार विकास, जनजीविकाका सवाल, महानगरका नीतिगत निर्णय र कार्यान्वयन पक्ष, जनप्रतिनिधिको जनताप्रतिको लगाव र जवाफदेहिताबारे समाचार लेख्न लगाउने बताए । देशसञ्चारका सम्पादकले

महानगरका लागि विषयगत संवाददाता नराखेको र इमेजका सम्पादकले आवश्यकताअनुसार समाचार लेख्न लगाउने गरेको कुरा बताए ।

महानगरको विकासमा सञ्चार प्रक्रियालाई नागरिकसँगको संवाद प्रभावकारी बनाउन के गर्नुपर्ला ? यस प्रश्नमा इमेजका सम्पादकले महानगरले मूलधारका आमसञ्चार माध्यमका विषयगत संवाददातालाई बोलाएर बेलाबेलामा अन्तर्क्रिया गर्ने, स्थलगत अवलोकन गराउने र निरन्तर सूचना सम्प्रेषण गर्ने संयन्त्रको विकास गर्नु प्रभावकारी हुने सुझाव दिए । देश सञ्चारका सम्पादकले नियमित कार्यक्रम र अन्तर्क्रिया गर्नुपर्ने साथै नागरिकमैत्री कार्यक्रम ल्याएर त्यसमा आमसञ्चार माध्यमलाई जोड्नुपर्ने बताए ।

सोही प्रश्नमा राजधानीका सम्पादकले महानगरका जनताका वास्तविक समस्यालाई उजागर र सम्बोधन गर्दै महानगरपालिकाले सञ्चार जगत्सँग सुमधुर सम्बन्ध राखी प्रभावकारी बनाउनुपर्नेमा जोड दिए । अन्नपूर्णका सम्पादकले सम्बन्धित संवाददातालाई न नजिक न टाढाको सम्बन्ध राखेर सूचना दिनुपर्ने बताए । एपीवान्का सम्पादकले महानगरपालिका आफैँमा पारदर्शी हुने गरी सूचना दिनुपर्ने, जनप्रतिनिधिले कमजोरी स्वीकार गरेर अगाडि बढ्नुपर्ने र हिजो अगाडि सारेका योजना र अहिले गरेका कामबारे आमसञ्चार माध्यममार्फत सम्प्रेषण गराउनुपर्ने बताए । पालिकाखबरका सम्पादकले आमसञ्चार माध्यमलाई सूचनामा महानगरपालिकाले सहज पहुँच दिनुपर्ने, नियमित सूचना प्रवाह गर्नुपर्ने, रचनात्मक सुझावलाई जस्ताको तस्तै ग्रहण गर्नुपर्ने भनेका छन् ।

३.२.६ संवाददाताहरूसँगको अन्तर्वार्ता

महानगरपालिकाको शहरी विकास व्यवस्थापनमा सञ्चार प्रक्रियाको भूमिका र प्रभावकारितासँग सम्बन्धित रहेर संवाददाताहरूलाई प्रश्न सोधिएको थियो । जसमा दुईवटा दैनिक अखबार, दुईवटा अनलाइन, एउटा सरकारी समाचार संस्था राष्ट्रिय समाचार समिति (रासस) र एउटा काठमाडौं महानगरपालिकाकै टेलिभिजन कार्यक्रम 'हाम्रो काठमाडौं' गरी ६ वटा आमसञ्चार माध्यमका संवाददाता थिए । उनीहरूलाई वस्तुगत र विषयगत १७ प्रश्नहरू समेटेर प्रश्नावली तयार पारी सोधिएको थियो । ती प्रश्नावलीहरूबाट प्राप्त परिणाम यसप्रकार छ ।

शहरी विकासबारे योजना तर्जुमादेखि कार्यान्वयनसम्मका समाचार लेख्नका लागि कुन स्रोत प्रयोग गर्नुहुन्छ ? उत्तरमा ५ जना पत्रकारले जनप्रतिनिधि, कर्मचारी र वडावासीबाट सूचना प्राप्त गर्ने कुरा बताए, एक जनाले अन्य (गोप्य) स्रोतबाट समाचार लिने गरेको बताए । पालिकाखबरका संवाददाताले महानगरपालिकाबाट समाचारका लागि सूचना पाउन गाह्रो हुने, प्रवक्ताले पत्रकारको फोन बिरलै उठाउने, जनप्रतिनिधि बोल्न मिल्दैन भनेर पन्छिने र मेयर, उपमेयरलाई भेट्नु देउता भेटेजस्तै गाह्रो हुने बताए । महानगरको टेलिभिजनका संवाददाताले भने सूचना पाउन सहजै भएको बताए ।

स्थानीयखबरका संवाददाताले प्रक्रियासम्मत भएका विकासका काममा समस्या नभएको तर त्रुटिपूर्ण योजना/ आयोजनाबारेका सूचना पाउन मुस्किल भएकाले गोप्य स्रोतको प्रयोग गर्ने गरेको बताए । नयाँ पत्रिकाका संवाददाताले पनि सूचना पाउन सहज नभएको प्रतिक्रिया दिए । कान्तिपुरका संवाददाताले समाचार पाउन सहज नभएको मात्र होइन, सूचना लुकाउने प्रवृत्ति रहेको बताए ।

सोही प्रश्नमा रासका संवाददाताले पछिल्लो समय सूचना प्राप्त गर्न निकै कठिन भएको साथै प्रवक्ताबाट पनि सबै सूचना नपाइने अनि अधिकांश विभागीय प्रमुखले त फोन नै नउठाउने गरेको प्रतिक्रिया दिए । समाचार सम्प्रेषण गरेपछि त्यसको प्रभाव कत्तिको पर्ने गरेको छ भन्ने जिज्ञासामा तीन संवाददाताले कहिलेकाहीँ पर्ने गरेको र दुईले कुनै कुनै समाचारको मात्रै पर्ने गरेको बताए । स्थानीयखबरका संवाददाताले भने वित्तीय अनुशासन, कर्मचारीको नैतिक आचरण र स्रोत दुरूपयोगजस्ता समाचार प्रकाशित भएपछि अख्तियार दुरूपयोग अनुसन्धान आयोग र महालेखा परीक्षकको कार्यालयजस्ता संवैधानिक निकायले चासो

देखाएपछि मात्र महानगरपालिकाले कदम चालेको देखिन्छ भने अन्यथा समाचार प्रकाशित भए पनि महानगर चुपचाप बस्ने गरेको कुरा बताए ।

समाचारको प्रभाव परेपछि महानगरपालिकाले कुनै योजनामा गुनासो सम्बोधन गरी निर्णयमा फेरबदल गरेको छ भन्ने प्रश्नमा दुई जना संवाददाताले गरेको र दुई जनाले नगरेको अनि दुई जनाले कहिलेकाहीँ गर्ने गरेको बताए । शहरी विकासका योजनाहरूबारे कत्तिको समाचार लेख्नुहुन्छ र योजनामा वडावासीका मागलाई महानगरपालिकाले कत्तिको समेटेको पाउनुहुन्छ भन्ने प्रश्नमा सबै संवाददाताले समाचार लेख्ने गरेको बताए ।

नगरपालिकाले वडावासीका मागलाई कत्तिको समेटेको छ भन्दा पालिकाखबरका संवाददाताले वडावासीका माग सुनिए पनि योजनामा नगण्य परेको, स्थानीयखबरका संवाददाताले महानगरको योजना तर्जुमा र बजेट विनियोजन प्रणाली विकेन्द्रित संरचनामा आधारित भएकाले वडामै योजना छान्ने हुँदा वडावासीको मागलाई सम्बोधन गरेको देखिएकोले यो महानगरपालिकाबाट सबै पालिकाले पाठ सिक्नुपर्ने कुरा बताए । नयाँ पत्रिकाका संवाददाताले ठिकै मात्रामा समेटेको बताए भने महानगरकै टेलिभिजन संवाददाताले वडावासीकै मागका आधारमा योजना बनाउने गरेको बताए । कान्तिपुर र रासकका संवाददाताले यस्ता समाचार लेखे पनि सबै योजनामा वडावासीलाई समेटेको नदेखिएको जानकारी दिए ।

महानगरपालिकाका जनप्रतिनिधि र कर्मचारीले बोलाएर समाचार लेख्न आग्रह गर्ने गरेको छ कि छैन भनेर सोधिएको प्रश्नमा चार जनाले प्रचारप्रसार गर्नुपर्ने विषयमा मात्र बोलाउने गरेको, एक जनाले छैन र एक जनाले आकलझुक्कल बोलाउने गरेको बताए । महानगरपालिकाले गरेका गलत योजना वा कार्यान्वयनबारे समाचार लेखेपछि कस्तो प्रतिक्रिया आउने गरेको छ भनी गरेको प्रश्नमा सबै संवाददाताहरूले सबैतिरबाट प्रतिक्रिया प्राप्त हुने, महालेखा र अख्तियारजस्ता निकायले चासो देखाउने तर सम्बन्धित अधिकारीले प्रतिक्रिया नजनाएर बस्ने गरेको बताए ।

महानगर स्रोतले भनेका कुरा पत्रिकामा तोडमोड भएर छापिएका पनि छन् भन्ने जनप्रतिनिधि र कर्मचारीको भनाइसम्बन्धी प्रतिक्रियामा कान्तिपुर संवाददाताले यसमा सहमति नभएको र रासस संवाददाताले यस्तो अवस्था व्यहोर्नु नपरेको जानकारी दिए । टेलिभिजनका संवाददाताले तोडमोड नगरी सत्य, निष्पक्ष समाचार प्रसारण गर्ने गरेको बताए । नयाँ पत्रिकाका संवाददाताले तोडमोड गरिएको भन्नु गलत रहेको बताए । पालिकाखबरले समाचार लेख्दा आग्रह पूर्वाग्रह नदेखाएको, तथ्य गल्ती भएमा सच्याएको विचार व्यक्त गरे । स्थानीयखबर संवाददाताले महानगरभित्रका कर्मचारी र जनप्रतिनिधिबीच स्वार्थ, समूह र गुटहरू रहेकाले सबैको चित्त बुझाउन नसकेको प्रतिक्रिया दिए । कतिपय समाचार एकपक्षीय र स्रोतको पुष्टि नभई सम्प्रेषण गरिएको भन्ने पनि छ नि, के यो सही हो भनी जिज्ञासा राख्दा कान्तिपुरका संवाददाताले स्रोत पुष्टि नगर्दा समाचार सन्तुलित नहुने भएकाले पुष्टि नगरी आफूले नछापेको तर्क गरे ।

रासस संवाददाताले स्रोतको अभाव वा माग गरिएको सूचना समयमै नदिँदा कहिलेकाहीँ एकपक्षीय समाचार सम्प्रेषण हुने गरेको स्वीकार गरे । स्थानीयखबर संवाददाताले कहिलेकाहीँ यस्तो देखिन्छ किनकि पत्रकारले लेखेका समाचार सबै सही हुन्छन् भन्ने छैन भनी बताए । पालिकाखबर संवाददाताले समाचार अनिवार्य रूपमा सन्तुलित बनाउनुपर्छ तर सबैले सही गरेका होलान् भन्न सकिन्न । टेलिभिजन संवाददाताले डिजिटल पत्रिका (अनलाइन) लाई हेर्ने हो भने ६० प्रतिशत समाचार एकपक्षीय रहेका हुन्छन् र पत्रकारिताभन्दा बढी विज्ञापनको झकझल्को आउने समाचार दिन्छन्, जुन आचारसंहिता विपरीत भएको उनको भनाइ छ । नयाँ पत्रिका संवाददाताले समाचार एकपक्षीय नभएको र स्रोतको पुष्टि गरेको बताए ।

महानगरपालिकासँग सम्बन्धित कुनै घटना वा विषयमा तपाईंको माध्यमले एजेन्डा सेटिङ नै गर्ने गरी लगातार प्रश्न उठाएको छ कि छैन भनी वस्तुगत प्रश्न राखेकोमा ५० प्रतिशत संवाददाताले छ र ५० प्रतिशत संवाददाताले छैन भनेर बताए । आमसञ्चार माध्यम (संवाददाता) र महानगर (जनप्रतिनिधि वा

कर्मचारी) बीच के कुरामा समस्या (ग्याप) भएर नियमित समाचार लेखनमा कमी भएजस्तो लाग्छ भन्ने प्रश्नमा कान्तिपुर र राससका संवाददाताले कर्मचारी र जनप्रतिनिधिले समाचारको महत्व नबुझ्ने र उहाँहरूबीच तालमेल नमिल्दा समाचार लेखनमा समस्या र कमी आएको बताए ।

टेलिभिजन संवाददाताले सही समयमा कार्यक्रमबारे जानकारी नहुनु र तथ्याङ्क पनि फेला पार्न गाह्रो भएकाले समाचार लेखनमा समस्या रहेको बताए । पालिकाखबर संवाददाताले महानगरले गरेका काम र योजनाबारे जनप्रतिनिधि वा सम्बन्धित कर्मचारीले जसले र जहिले सोधे पनि सूचना दिनुपर्ने भए पनि महानगरमा त्यस्तो प्रवृत्ति नभएको कुरा बताए । उनले सूचनामा एकद्वार प्रणाली लागू गर्नु नै महानगरको कमजोरी रहेको पनि बताए । स्थानीयखबर संवाददाताले आमसञ्चार माध्यमको प्राथमिकताको क्षेत्र महानगर मात्रै नभई देशैभरका समाचारहरू समेट्नु पर्ने भएकाले र विग्रेभत्केका कुरा सबैको चासोमा पर्ने भएकाले महानगरका समाचारहरू थोरै समेटिने कुरा बताए । नयाँ पत्रिका संवाददाताले यस प्रश्नमा केही नबोल्ने बताए ।

सम्पादकले महानगरपालिकाका कस्ता समाचार ल्याउन सुझाव दिन्छन् भनी राखिएको जिज्ञासामा नयाँ पत्रिका संवाददाताले भ्रष्टाचारमा केन्द्रित हुनुपर्ने कुरा बताए । स्थानीयखबर संवाददाताले पनि भ्रष्टाचार, शक्ति दुरूपयोग, अनियमितताजस्ता विषयलाई प्राथमिकता दिनुपर्नेमा जोड दिए । पालिकाखबर संवाददाताले स्वभावैले लुकाउन खोजिएका विषय समाचार हुने भएकाले त्यस्तै विषय खोज्न निर्देशन दिने गरेको बताए । टेलिभिजनका संवाददाताले पनि भ्रष्टाचारमा केन्द्रित हुन र सकारात्मक समाचारमा पनि दिनुपर्छ भनेको बताए । कान्तिपुर संवाददाताले पनि भ्रष्टाचार केन्द्रित समाचार नै बढी जोड दिनुपर्छ भनेको बताए भने राससका संवाददाताले सबै थरीका समाचार प्रकाशित गर्नुपर्छ भन्ने सम्पादकको भनाइ रहेको बताए । महानगरका विकाससम्बन्धी समाचारका स्रोत के हुन् भनी सोधिएको वस्तुगत प्रश्नमा चार जनाले जनप्रतिनिधि र कर्मचारीसँगको कुराकानी भने भने दुई जनाले चाहिँ यसका अतिरिक्त महालेखा, अख्तियार र महानगरपालिकाकै प्रतिवेदन भनेका छन् ।

महानगरको विकासमा आमसञ्चार माध्यमको भूमिका कस्तो छ भनी सोधिएको वस्तुगत प्रश्नमा पाँच जनाले सकारात्मक र एक जनाले तटस्थ भनेका छन् । यस प्रश्नावलीको अन्तिममा महानगरको विकासमा सञ्चार प्रक्रियालाई नागरिकसँगको संवाद प्रभावकारी बनाउन के गर्नुपर्ला भनी सोधिएको थियो ।

स्थानीयखबरका संवाददाताले महानगरभित्र कर्मचारी र जनप्रतिनिधिबिच गुटबन्दी वा पार्टीकरण नगर्ने, पत्रकार हुँ भन्दै विज्ञापन माग्न आउनेलाई निडर भएर जवाफ दिने र गलत कामको पनि सूचना दिन नहिच्किचाउने काम गर्नुपर्छ भनी बताए । पालिकाखबर संवाददाताले महानगरका जनप्रतिनिधि र कर्मचारी सञ्चारमैत्री हुनु पहिलो सर्त भएको र सूचनामा एकद्वार प्रणाली खारेज गरी भनेको बेला सबै सूचना दिनुपर्ने बताए । टेलिभिजनका संवाददाताले समयसमयमा नागरिक सुनुवाई गर्ने र जनप्रतिनिधि, सेवाग्राही, महानगरवासी र सञ्चारकर्मी एकै थलोमा बसेर छलफल गर्नुपर्छ भनी सुझाव दिए । नयाँ पत्रिकाका संवाददाताले बेलाबेलामा भेटघाट गर्नुपर्ने कुरा बताए भने राससका संवाददाताले सञ्चारकर्मीलाई सूचनाका लागि सहज पहुँच हुनुपर्ने कुरा बताए । कान्तिपुर संवाददाताले भने महानगरले आफ्ना सबै कुरा खुलस्त रूपमा राख्नुपर्ने सुझाव दिए ।

३.२.७ महानगरपालिकाका आमसञ्चार माध्यमका प्रधान सम्पादक, स्टेसन म्यानेजर, कार्यक्रम निर्माता एवम् प्रस्तोता तथा सम्पादक एवम् संवाददातासँगको अन्तर्वार्ता

महानगरपालिकाद्धारा सञ्चालित आमसञ्चार माध्यमका प्रधान सम्पादक, स्टेसन म्यानेजर, कार्यक्रम निर्माता एवम् प्रस्तोता तथा सम्पादक एवम् संवाददाताबाट प्राप्त परिणाम यहाँ प्रस्तुत गरिएको छ । महानगरपालिकाले सञ्चालन गरेका आमसञ्चार माध्यमका प्रधान सम्पादक, स्टेसन म्यानेजर, कार्यक्रम

निर्माता एवम् प्रस्तोता तथा सम्पादक एवम् संवाददातालाई समेत ११ वटा प्रश्नहरू निर्माण गरी सोधिएको थियो । उक्त अनुसन्धानमा नेपाल टेलिभिजनमा प्रस्तुत गरिने 'हाम्रो काठमाडौं' टेलिभिजन कार्यक्रम निर्माता तथा प्रस्तोता, मेट्रो एफएमका स्टेसन म्यानेजर, काठमाडौं अनलाइनका सम्पादक एवम् संवाददाता र महानगर बुलेटिनका प्रधान सम्पादकबाट प्राप्त परिणाम निम्नानुसार प्रस्तुत गरिएको छ ।

शहरी विकासबारेको योजना तर्जुमादेखि कार्यान्वयनसम्मका समाचार लेख्न कुन स्रोतको प्रयोग गर्नुहुन्छ भन्ने प्रश्नमा हाम्रो काठमाडौंको प्रस्तोताले वडावासी, कर्मचारी, जनप्रतिनिधि र सरोकारवाला निकायको प्रयोग गर्ने बताए भने मेट्रो एफएमका स्टेसन म्यानेजरले वडावासी र कर्मचारी रहेको बताए । अनलाइन समाचारदाताले जनप्रतिनिधि, कर्मचारी र वडावासी नै समाचारका स्रोत रहेको बताए भने महानगर बुलेटिनका प्रधान सम्पादकले जनप्रतिनिधि, कर्मचारी र वडावासीसँग सूचना लिने बताए ।

महानगरपालिकाका कस्ता समाचारलाई बढी प्राथमिकता दिनुहुन्छ भनी सोधिएको प्रश्नमा चारै जना पत्रकारले महानगरका विकास निर्माण, भौतिक संरचना, शिक्षा, स्वास्थ्य, शहरी सुशासन, फोहोर व्यवस्थापनलगायत जनचासोका विषयहरूलाई प्राथमिकतामा राख्ने गरेको बताए ।

समाचार सम्प्रेषण गरेपछि त्यसको प्रभाव कत्तिको पर्ने गरेको छ भनी सोधिएको प्रश्नमा तीन जना पत्रकारले व्यापक प्रभाव गर्ने गरेको बताए भने एक जनाले आफ्नोभन्दा राष्ट्रिय आमसञ्चार माध्यमको प्रभाव बढी रहेको बताए । समाचारको प्रभाव परेपछि महानगरपालिकाले कुनै योजनामा गुनासो सम्बोधन गरी निर्णयमा कहिलेकाहीँ फेरबदल गरेको हाम्रो काठमाडौंका प्रस्तोताले बताए भने मेट्रोका स्टेसन म्यानेजरले मेट्रो एफएमभन्दा राष्ट्रिय आमसञ्चार माध्यमबाट आएको समाचारको प्रभावले चाहिँ निर्णय फेरबदल हुने गरेको बताए । अनलाइन समाचारदाताले योजनामा सहजता बनाउने गरेको बताए । चारै जनाले शहरी विकासका योजनामा महानगरपालिकाले वडावासीकै मागका आधारमा कार्यक्रमहरू तय गर्ने गरेको बताए ।

महानगरपालिकाले सञ्चालन गर्ने आमसञ्चार माध्यम र महानगरपालिकाबीच के कुरामा सञ्चारसम्बन्धी समस्या छ भन्ने प्रश्नमा हाम्रो काठमाडौंका प्रस्तातले सही समयमा कार्यक्रमबारे जानकारी नपाइने र तथ्याङ्क फेला पार्न गाह्रो हुने गरेको बताए भने मेट्रो एफएमका स्टेसन म्यानेजरले कर्मचारीको वेवास्तापन र सेवा सुविधा राम्रो नभएर समस्या बताए । अनलाइन समाचारदाताले भनेको समयमा भने जसरी समाचार नपाउने कुरा बताए भने बुलेटिनका प्रधान सम्पादकले जनप्रतिनिधि र कर्मचारीबिच संवाददाताको राम्रो तालमेल भएकाले समस्या नरहेको बताए ।

महानगरको विकासमा आमसञ्चार माध्यमको भूमिका कस्तो छ भन्ने प्रश्नमा दुई जनाले सकारात्मक, एकले नकारात्मक र एकले तटस्थ रहेको बताए । महानगरको विकासमा सञ्चार प्रक्रियालाई प्रभावकारी बनाउन के गर्नुपर्ला भनी सोधिएको प्रश्नमा हाम्रो काठमाडौंका प्रस्तोताले समयसमयमा नागरिक सुनुवाइ गर्नुपर्ने, सञ्चारकर्मी, जनप्रतिनिधि, सेवाग्राही र महानगरवासीसँग एकै थलोमा बेलाबेला छलफल गर्नुपर्ने बताए । एफएमका स्टेसन म्यानेजरले नागरिकसँग जनप्रतिनिधिले नियमित भेटघाट गर्नुपर्ने बताए । अनलाइन समाचारदाताले महानगरपालिकाले यस सम्बन्धमा ऐन तर्जुमा गर्नुपर्ने, कार्यविधि तयार पार्नुपर्ने साथै सूचना-प्रविधि र सूचना सञ्चारलाई अन्तर्सम्बन्धित बताउनुपर्ने बताए । बुलेटिनका प्रधान सम्पादकले सञ्चारकर्मीले महानगरका प्रवक्ता र सूचना अधिकृतसँग निर्धक्क सम्पर्क राखी समाचार लिनुपर्ने बताए ।

३.३ घटना अध्ययन

प्रस्तुत अनुसन्धानमा स्थानीयवासीसँग जोडिएका योजनाहरूमा आमसञ्चार माध्यमको भूमिका कस्तो रहेको छ भन्ने कुरालाई दर्साउन दुई वटा घटनाहरूलाई अध्ययन गरिएको थियो । यसमा रानीपोखरी र

काष्ठमण्डपको निर्माण सम्बन्धी विवादको समाचारका सन्दर्भमा सरोकारवालासँग गरिएको प्रत्यक्ष भेटवार्ताको निष्कर्ष यस प्रकार रहेको छ ।

रानीपोखरी

वि.सं. २०७२ सालको भूकम्पले क्षतिग्रस्त रानीपोखरी पुनर्निर्माण गर्ने विषय विवादित बन्न पुगेको थियो । रानीपोखरी पुनर्निर्माण शुरु हुँदा यसको चर्चा सँगसँगै केही गुनासाहरू सुनिए । वि.सं. २०७४ जेठमा निर्वाचित मेयर विद्यासुन्दर शाक्यले यसमा काम अघि बढाएका थिए । शुरुमा सिमेन्ट प्रयोग भएको कुरामा विवाद भयो । पछि रानीपोखरी बीचको मन्दिर ग्रन्थकुट शैलीमा बन्ने कि गुम्बज शैली बन्ने भन्ने कुरामा विवाद देखियो । यसमा मेयर शाक्यको ग्रन्थकुट शैलीमा अडान लिए भने पुरातत्व विभागका प्रतिनिधिहरूले पूर्ववत् गुम्बज शैलीको पक्ष लिए । अन्ततः सरकारले २०७५ फागुनमा राष्ट्रिय पुनर्निर्माण प्राधिकरणलाई रानीपोखरी पुनःनिर्माणको जिम्मा दियो। प्राधिकरणले ग्रन्थकुट शैलीमै रानी पोखरीको पुनर्निर्माण सम्पन्न गऱ्यो । यसरी अनेकौँ कठिनाइ पश्चात रानीपोखरीले एकातिर प्राचीन सम्पदा बचाएको छ भने अर्कोतिर काठमाडौं नगरपालिकाको सौन्दर्यलाई बढाउन सफल भएको छ । शुरुमा आमसञ्चार माध्यमले महानगरपालिका, त्यहाँका जनप्रतिनिधि र कर्मचारीको कदमबारे नकारात्मक समाचार लेखे पनि स्थानीयवासी, सम्पदाप्रेमी र विज्ञ समितिको सुझावअनुसार काम थालेपछि भने सकारात्मक समाचार सम्प्रेषण भएको पाइन्छ । आमसञ्चार माध्यमको निगरानीले रानीपोखरी पुनःनिर्माणको कार्यले अन्ततः सही मार्ग समातेको र सम्पदा पुनर्निर्माण र संरक्षणमा अहम् भूमिका खेलेको देखिन्छ ।

काष्ठमण्डप

२०७२ सालको भूकम्पपछि पुनर्निर्माण गर्नुपर्ने काष्ठमण्डप पनि स्थानीयवासी र महानगरपालिकाबीच समयमै सही सञ्चार हुन नसकेर लामो समयसम्म विवादित बन्यो । दुवै पक्ष आआफ्नै अडानमा रहेपछि आमसञ्चार माध्यमले यसलाई पटकपटक समाचारको विषय बनाए । शुरुमा काष्ठमण्डप जनस्तरबाटै निर्माण गर्न एक समिति बनेको थियो । स्थानीय तहको निर्वाचन पछि काठमाडौं महानगरपालिकामा आएको नयाँ नेतृत्वले त्यसमा आफू पनि सहभागी हुने इच्छा व्यक्त गरे । अन्तमा त्यही क्षेत्रका प्रदेश सभा सांसदको अध्यक्षमा पुनर्निर्माण समिति गठन गरी कार्य अघि बढाइयो । यसरी आमसञ्चार माध्यमले केही आफूअनुकूल र केही आवश्यकताले समाचार, लेख, आलेख र सम्पादकीय लेखे पनि अन्ततः महानगरपालिकालाई काष्ठमण्डप पुनर्निर्माण गर्न प्रत्यक्ष/अप्रत्यक्ष सहयोग पुगेको देखिन्छ । समयमै निर्माण गर्नुपर्छदेखि स्थानीयको सहभागिता र चासो, सामग्री अभाव आदि हुँदै विविध समस्याबारे झक्झक्याइरहनुले आमसञ्चार माध्यम सरोकारवाला सबैको साथी बनेको देखिन्छ ।

४. नीतिगत सुझाव

काठमाडौं महानगरपालिकाको शहरी विकास व्यवस्थापनमा आमसञ्चारको भूमिकाले सकारात्मक प्रभाव पार्ने अनुसन्धानले देखाएको छ । यसका लागि महानगरपालिकाले सञ्चारकर्मीको साथ र सहयोग ग्रहण गर्दै सहकार्य गरिरहनुपर्ने पाइएको छ । अनुसन्धानले महानगरपालिकाका जनप्रतिनिधि र कर्मचारी दुवै पक्षको सञ्चारकर्मीसँगको सम्बन्धमा केही अभाव रहेको देखाएको छ । समयमै र भने जसरी सूचना नपाइने गुनासो सञ्चारकर्मीको छ भने नभएको घटना र सूचनालाई समाचार बनाउनेदेखि भनेका कुरा तोडमोड गर्ने जनप्रतिनिधि र कर्मचारीको भनाइ छ । महानगरपालिका आफूले गरेका विकास निर्माणका योजनामा सकारात्मक समाचार सम्प्रेषण होस् भन्ने चाहन्छ भने आमसञ्चार माध्यमहरू विकृति, विसङ्गति, बेथिति, अनियमितता आदिको आशङ्का वा भएको पुष्टिसहित समाचार खोजी खोजी जनसमक्ष पुऱ्याउन तल्लीन भएको देखिन्छ ।

शहरी विकास योजनामा आमसञ्चार माध्यमको भूमिका सकारात्मक रहे पनि वर्तमानमा जेजति भूमिका निर्वाह भएको छ त्यो अपर्याप्त देखिन्छ । त्यसैले यसलाई पर्याप्त मात्रामा बढाउँदै प्रभावकारिता र गुणात्मकतामा ध्यान दिनुपर्ने देखिन्छ । योजना छनोटदेखि सम्पन्न हुँदासम्म महानगरपालिकाले वडावासी/नागरिकलाई सुसूचित गरिरहनुपर्ने तर्क वडावासीको छ । यसको अभावमा पनि कतिपय योजना बिचैमा रोकिने वा सुरु नहुँदै विवाद आउने र बनेका योजना पनि पारदर्शी नदेखिने वा एकोहोरो सही ढङ्गले काम गरिरहँदा पनि बुझाइमा फरक आउनेसमेत देखिएको छ । जुन कुरा यसै अनुसन्धानको घटना अध्ययनमा रहेको रानीपोखरी र काष्ठमण्डप पुनर्निर्माणको सन्दर्भले पुष्टि गरेको छ । समग्रमा महानगरपालिकाले विकास निर्माणका क्रममा आमसञ्चार माध्यमको प्रयोग गरी अघि बढे सहज, प्रभावकारी र उपलब्धीमूलक हुने अनुसन्धानले देखाएको छ । निम्न सल्लाह र सुझावलाई महानगरपालिकाले कार्यान्वयन गरे व्यवस्थित शहरी विकास तीव्र रूपमा अगाडि बढ्ने देखिन्छ :

- महानगरवासीसँग शहरी विकास व्यवस्थापनका क्रममा सञ्चार संवाद निरन्तर राखेर अघि बढ्नका लागि काठमाडौं महानगरपालिकाका जनप्रतिनिधि र कर्मचारीहरूले आमसञ्चार माध्यमका सञ्चारकर्मीसँग कसरी सूचना सम्प्रेषण गर्ने र सोका लागि कसरी सहकार्य गर्ने भन्ने आमसञ्चार नीति निर्माण गर्नुपर्ने देखिन्छ ।

- महानगरपालिकाको विकास निर्माणसम्बन्धी नीति तर्जुमा एवम् कार्यान्वयनसम्बन्धी सूचना वा धारणा आधिकारिक रूपमा प्रवाह गर्न तथा विभिन्न आमसञ्चार माध्यमहरूबाट माग भई आउने सार्वजनिक महत्वका सूचना सहयोगी भावका साथ उपलब्ध गराउन जरुरी देखिएको छ । यसका लागि विभिन्न आमसञ्चार माध्यमका सञ्चारकर्मीसँग सहकार्यका लागि सम्पर्कमा रहिरहने र सूचना उपलब्ध गराइरहने वातावरण महानगरपालिकाले गर्नुपर्ने देखिन्छ । यसका लागि प्रवक्ताका साथै जिम्मेवार जनप्रतिनिधि र विभागीय प्रमुख आदिलाई पनि आवश्यकता अनुसार परिचालन गर्नुपर्ने देखिएको छ । कतिपय विषयमा मेयर वा उपमेयरबाटै सूचना लिनुपर्ने हुँदा सोका लागि पनि सहज विकल्प हुनुपर्ने देखिएको छ ।

- काठमाडौं महानगरपालिकाले विकासका हरेक योजनाहरूमा वडावासी/नागरिकसँगको बहस पर्याप्त नहुनुले नागरिकहरूले महानगरपालिकाप्रति औंला ठड्याउने गरेको पाइन्छ । त्यसैले विकासका हरेक कार्यक्रममा महानगरपालिकाले वडावासीहरूसँग व्यक्तिसञ्चार, अन्तरव्यक्तिसञ्चार, समूहसञ्चार हुँदै मुख्य गरेर आमसञ्चार माध्यममार्फत पर्याप्त रूपमा बहस गरेर मात्र विकासका योजनाहरू तर्जुमा र कार्यान्वयन गर्नुपर्ने देखिन्छ ।

- महानगरपालिकाले आमसञ्चारको उपयोग कम मात्रामा गरेकाले नागरिकहरूले महानगरका विकास कार्यक्रमहरूबारे थाहा नपाएको स्थिति देखिन्छ । महानगरपालिकासँग भएका सञ्चार माध्यमहरू महानगर बुलेटिन, टेलिभिज, एफएम र अनलाइन माध्यमलाई प्रभावकारी सञ्चालन गर्न महानगरपालिकाले सञ्चार नीति नै बनाई कार्य गर्नुपर्ने देखिन्छ । साथै महानगरपालिकाले राष्ट्रिय आमसञ्चार माध्यमहरू र त्यसमा पनि दैनिक अखबार, रेडियो एफएम, टेलिभिजन र अनलाइनहरूको प्रयोग अत्यधिक मात्रामा गर्नुपर्ने देखिन्छ ।

- महानगरपालिका र आमसञ्चार माध्यमबीच सम्पर्क र अन्तर्क्रियामा खाडल रहेको पाइयो । काम गरे पनि सोबारे सुसूचित नहुँदा कामको जस नपाउने अवस्था रहेको देखिन्छ । त्यसैले महानगरपालिकाले विकासको गतिलाई तीव्रता दिन यस्ता खाडल पुनुपर्ने देखिन्छ ।

- महानगरपालिकाले पर्याप्त बहस, अन्तर्क्रिया र छलफललाई पनि प्रभावकारी रूपमा सञ्चालन गरी यस्ता कार्यहरूबाट आएको परिणामका आधारमा विकास योजना बनाउन सकेमा विरोध र

गुनासा आउँदैनन् भन्ने देखिएको छ। यस्ता कुरामा पनि महानगरपालिकाले ध्यान दिनुपर्ने देखिन्छ ।

- महानगरपालिका के गर्दैछ भन्ने प्रश्न आमनागरिकका मनमा उब्जने अवस्था जनप्रतिनिधि र कर्मचारीले सिर्जना हुन दिनु नहुने अनुसन्धानको निष्कर्ष छ। यदि आइहाले हरसवालको जवाफ प्रत्यक्ष वा अप्रत्यक्ष रूपमा महानगरपालिकाले आमसञ्चार माध्यमको प्रयोग गरी दिनुपर्ने देखिन्छ । यस्तो सन्दर्भमा सञ्चारविज्ञको सानो समूह बनाएर रणनीतिक रूपमै जान सके आमसञ्चार माध्यमहरूको सही परिचालन हुने देखिन्छ।
- महानगरपालिकाका योजनाहरू र विकाससम्बन्धी सूचनाहरू प्राप्त गर्न कठिन रहेको सञ्चारकर्मीहरूको टिप्पणी रहेकोछ। सही स्रोत र सूचनाविना सम्प्रेषित समाचारले दुर्घटनासमेत हुन सक्ने भएकोले काठमाडौं महानगरपालिकाले सूचनामाथिको पहुँच सहज बनाउनु आवश्यक देखिन्छ । मागेको सूचना समयमै दिए वास्तविकताको चित्रण हुन र समाचार पनि सन्तुलित आउन सहयोग पुग्ने हुन्छ।
- हरेक विकासमा नागरिकले अपनत्व खोज्ने देखिएकाले उनीहरूलाई कुनै न कुनै माध्यमबाट जोडेर सहकार्य गर्ने वातावरण प्रदान गर्नुपर्ने र सोका लागि पनि सञ्चारको कुनै न कुनै माध्यम प्रयोग गर्नुपर्ने देखिन्छ।

कृतज्ञता ज्ञापन

यस अनुसन्धानका क्रममा प्राप्त मार्गनिर्देशनकालागि अनुसन्धानकर्ता डा. कुन्दन अर्यालप्रति आभार व्यक्त गर्दछ। साथै, अनुसन्धान अवसर प्रदान गर्नु भएकोमा काठमाडौं नगरपालिकाका प्रमुख विद्यासुन्दर शाक्य तथा काठमाडौं नगरपालिकाको शहरी योजना आयोगप्रति अनुसन्धानकर्ता विशेष आभारी रहेको छ । अनुसन्धानको क्रममा यथोचित निर्देशन, सुझाव तथा हौसला दिई उत्प्रेरित गर्नु हुने आयोगका उपाध्यक्ष सरोज बस्नेत, सदस्य एवम् मेयर्स रिसर्च फेलोसिप कार्यक्रमका संयोजक डा. कीर्ति कुसुम जोशी, आयोगका पूर्व सदस्यसचिव रविनमान श्रेष्ठ, डा. कमल फुयाल, वीरेन्द्र नेपाल, चेतनाथ कँडेल, बसन्त आचार्य, मोहन बास्तोला, कमलादेवी गौतम, अञ्चित ढुंगाना लगायत प्रति अनुसन्धानकर्ता हार्दिक कृतज्ञ रहेकोछ। आयोगका सबै पदाधिकारी र कर्मचारीलाई पनि अनुसन्धानकर्ता हार्दिक धन्यवाद व्यक्त चाहन्छ।

सन्दर्भ सामग्री

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