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Research Brief

The Quality Bottleneck

Introduction

The significance of the quality of service (QoS)[1] for achieving the goals of the infrastructure development can hardly be overemphasized. Yet existing Information and Communication Technology (ICT) policies in Nepal have inadequate measures to ensure the delivery of the quality of service to the users. Motivated from the findings from the research elsewhere, these policies have put forward ICT as an enabler of national development. The ICT and Development (ICTD) research does suggest that investments in the sector have significant positive effects especially on economic growth. The Nepali policy makers, however, seem to have underappreciated several premises behind the correlation. These include the minimum thresholds of access, affordability and the service quality. The service quality of the Nepali ICT infrastructure at the present is, however, well below the standard required to implement development triggers such as e-Government or e-Education.

The ICT policies have specific targets for the quality though. Broadband Policy 2015, for instance, aims to make a 512 kbps Internet accessible to 45 percent of Nepali households by 2020.[2] Basic calculations, on the contrary, show these targets could remain unachievable due to extremely low and uneven household income across Nepal. The chronic energy supply deficit in the country creates a set of crucial challenges such as the low ICT usage and poor quality. These challenges, in turn, are likely to stifle the development of future infrastructure as envisaged by the policies. There is a need to re-frame the ICT policies and to rethink the current practices of allowing the providers and intermediaries to drive the policy making process.[3]

This brief also cautions the ICTD researchers and policy makers worldwide that a sole reliance on official statistics could be misleading in Nepal and countries with similar regulatory mechanisms and socioeconomic structures. The state regulator, Nepal Telecommunications Authority (NTA), publishes the statistics as exactly as provided to it by the telecom operators and Internet Service Providers (ISPs). Neither NTA

[1] Throughout this brief, we use the term 'quality' to refer a set of QoS parameters like speed for Internet, voice clarity for mobile/landline phones, and signal strength of mobile towers.

[2] Government of Nepal (GoN). 2071 v.s. Broadband Policy, 2071. GoN Ministry of Information and Communications (MoIC), Kathmandu. Available at: http://moic.gov.np/upload/documents/broadband_policy_2071.pdf; accessed 2 October 2016.

[3] See, Martin Chautari. 2015. *Stakeholders for Universal Connectivity in Nepal.* Research Brief No. 15. Kathmandu: Martin Chautari (MC). Available at: www.martinchautari.org.np/files/ResearchBrief12-UniversalConnectivityInNepal_APolicyReview.pdf; accessed 14 November 2016.

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nor Central Bureau of Statistics (CBS) has corroborated the ICT statistics through a census at the household level. There are contrastive images presented by the official statistics and the ground reality in the use and the quality of service of the Nepali ICT infrastructure. For instance, NTA claims that the mobile penetration in the country has exceeded a 100 percent mark, but Martin Chautari's survey on five location reports the only 72.36 percent of the respondents and 71.33 percent of the households owned mobile phones.[4] An earlier survey of 4,021 respondents in randomly selected 44 districts claim a similar value of 74 percent for the individual level mobile ownership.[5] Publicly available official reports and datasets only present the penetration statistics for the Internet and other ICT facilities. Moreover, the reports do not provide details like the penetration of mobile according to the income classes which would present more realistic picture of ICT adaption. NTA has set technical standards for a minimum acceptable mobile telecommunications and Internet quality in general. When examined from the users end, the actual quality of Internet and mobile telecommunications was not with accordance to even the minimal NTA standards.

This brief summarizes Chautari's preliminary research on Nepali ICT infrastructure. The research was based on the analysis of available national and global statistics, field observations, sample survey, and interviews at the sites of Changu Narayan, Panauti, and Tangting.[6] We begin the next section by presenting the current landscape of Internet access and quality. The available statistics show a very low penetration of ICT facilities in the country, mobile phone being the exception. The field studies reveal the sub-standard quality of even the highly accessed mobile telecommunications services. Clearly, we should be wary of launching the bandwidth intensive e-government projects based on the existing infrastructure. In the subseqent section, we mention how the tradeoff between quality and affordability constrains the use of the mobile telecommunications infrastructure for the Internet based systems like e-education or e-government. We also link the dimensions of quality and affordability and describe how some quality related targets of the policies are challenged by Nepal's slow economic growth. We conclude that considering the low income and the deficit in the energy supply, the Nepali policies better focus on heterogeneous combinations of technologies and business models guided by the local contexts. This conclusion means that the policies do away with the present ambition of closing the capacity gap between Nepali ICT infrastructure and in the developing countries.

A Picture of Nepali Internet Infrastructure

Broadband Access and Quality

The figures in NTA MIS report suggest the total penetration of household broadband in Nepal as about six percent.[7] The National Population and Housing Census 2011 show a slightly lower broadband penetration of 3.33 percent, but the census also reveals that the penetration has been entirely Kathmandu centric. The Kathmandu metropolitan[8] has the household Internet penetration of 23.7 percent. Only eight Village Development Committees (VDCs) /municipalities[9] in Nepal have the Internet penetration level to 20 percent or more, but they are all inside the Kathmandu valley.[10] While only 4.7 percent of total households are in the metropolitan, they constitute one-third of all households with Internet connection in Nepal. Taken together, the number of households with internet connection in the three districts inside the valley makes two third of all Nepali household Internet. The Kathmandu centric growth in the Internet contrasts with radio, television and mobile phone, which are considerably less skewed. This distribution of Internet access has remained lopsided outside the valley since 2011.[11]

[4] The findings of Martin Chautari's research on Internet access and used is available online. See, http://www.martinchautari.org.np/index.php/projects/?pid=1

[5] Internews. 2014. Media Survey Findings Nationwide National Opinion Survey Wave-III. Internews. Available at http://www.internews.org/sites/default/files/resources/Internews_Nepal_MediaSurveyFindings_2015-06.pdf; accessed 28 March 2017.

[6] More detailed information of the project sites can be found in an earlier Chautari brief, see, Martin Chautari. 2015. *Deliver Through Mobiles First.* Research Brief No. 18. Kathmandu: Martin Chautari. Available at: www.martinchautari.org.np/files/ResearchBrief18ENGLISH.pdf; accessed 14 November 2016.

[7] We get the value for household penetration of Internet by taking total number of households (5,427,302) average household size (4.8) from National Population and Housing Census 2011 (see, cbs.gov.np), and taking the total number of household Internet users (340,712) from NTA MIS Report, 15 June–15 July 2016 (see, nta.gov.np).

[8] Kathmandu metropolitan should not be confused with Kathmandu district, the former being a part of the latter. Similarly, 'Kathmandu Valley' refers to the valley containing the three most populous districts of Nepal, Kathmandu, Bhaktapur, and Lalitpur.

[9] We have presented the statistics jointly for VDCs and municipalities because a separate presentation will not offer a new insight.

[10] These VDCs/municipalities are Lalitpur sub metropolitan, Sainbu, Balkot, Dhapasi, Kathamndu metropolitan, Khadka Bhadrakali, Kirtipur municipality, and Mahankal.

[11] A recent Chautari research estimates household Internet penetration at Panauti, a municipality, is 28.8 percent, and at Pragatinagar, a settlement sharing boundary with the Kathmandu metropolitan, is 7.1 percent. The

The quality of Internet used by an average Internet user is very low in Nepal. The International bandwidth[12] of Nepal, 2.9 kbps, is lower than the average value of the International bandwidth for the low income countries, 3.5 kbps. Nepal ranks 27 from the bottom among 224 nations in the World Bank dataset on information indicators.[13] The Nepali Internet users complain about not getting the Internet speed they pay for. Observations on a total of ten randomly chosen households in and around Kathmandu valley show that the household Internet subscribers get less than three fourths of the advertised speed on average.[14] This scenario of users getting Internet speed lower than that advertised or paid for is a worldwide problem. For example, European landline Internet users get about three fourths percent of the speed advertised by the ISPs.[15] However, while average download speed at peak hours in the Europe is 30.37 mbps, the average download speed in select research sites is no more than 300 kbps. This means, as 300 kbps is only sufficient for running basic Internet based applications, a slowdown of the speed by a factor of 75 percent would disturb even the basic Internet applications.

The official statistics on the number and distribution of public Internet access centers in Nepal is not available.[16] Most centers are commercial cyber cafes located in the urban areas. At Tangting, the local Himalaya Milan Higher Secondary school served as a 'cyber', but its computers were rendered non operational without the regular electricity supply.[17] Public Internet infrastructure in urban areas face complex but equally dismal prospect. For instance, in Panauti, the cyber centers have Internet connection of 512 kbps which yields a very slow speed when divided to several users.[18] Such low Internet speed in the public centers restricts the end users to browse only a restricted type of web pages. The centers also lack power backup and are closed in the hours of power cut. The operators do not install power backups owing to the risks of no return to the investment. The underdeveloped public Internet access infrastructure at Panauti is embarrassing to many who see it as not so distant municipality from the capital and want to promote its centuries old delights for tourists. Clearly, public access points established by the government are non-functioning, whereas those operated privately have no incentives to invest due to the low affordability of their users.

Mobile Internet Access and Quality

As we argued earlier, the reach and geographical distribution of the mobile services makes it an appropriate platform for laying out solid foundations of a digital friendly social environment. The rapid expansion of mobile Internet services in Nepal has become synonymous for the Internet growth. As mentioned earlier, the claims that mobile penetration has crossed the 100 percent mark are erroneous and the actual penetration could be much lower because there could be multiple SIMs per persons. It is also debatable whether SIM ownership is same as mobile usership. More importantly, the existing mobile services lack quality to support even the Internet basic services like Skype conversation.

Technical evaluations show the quality of widespread mobile Internet is not up to the marks. [19] When compared to NTC, Ncell's network has a much better performance. Ping test statistics show that NTC mobile Internet does not offer the minimum QoS requirements for multimedia applications whereas Ncell's service is far better.[20] But there were locations in the test sites where even Ncell's Internet could not be connected. In many instances, despite the connected status, speed tests showed absolutely no response implying worst quality of service. In some test points in the sites, even the basic ping tests required multiple attempts or failed, which indicates extremely poor connectivity. A

estimated Internet penetrations at other three sites which happen to be rural, Changu Narayan, Dapcha Chatrebanjh, and Tangting, are 2.8, 0, and 0.8 percents, respectively. See, Martin Chautari. 2015. *Deliver Through Mobiles First*. Research Brief No. 18. Kathmandu: Martin Chautari. Available at: www.martinchautari.org.np/files/ResearchBrief18ENGLISH.pdf; accessed 14 November 2016.

[12] International bandwidth is the average speed through which data is transferred outside the national boundary by an Internet user.

[13] The World Bank. n.d. World Development Indicators: The Information Society. Available at: http://wdi.worldbank.org/table/5.12; accessed 23 November 2016.

[14] No houehold in Tangting had Internet access except one user subscribing Ncell's wifi service.

[15] SamKnows Ltd. 2013. The Quality of Broadband Services in the EU. Available at: www.broadbandmapping.eu/wp-content/uploads/2015/07/Quality-of-Broadband-services-in-the-EU_final-report_2013.pdf; accessed 30 September 2016.

[16] The Yellow Pages Nepal lists a total of 122 cyber cafes. See, www.yellopagesnepal.com; accessed 23 November 2016.

[17] The school has recently shifted towards laptops instead of desktop, and installed solar panel for the required electricity.

[18] We performed observations on selected schools, colleges, cyber centers, and a library at Panauti.

[19] The used indicators for quality were download/upload speed, packet loss and jitter. The tests were performed using Android mobile phones at Changu Narayan and Panauti. The observations were made at five test points at both of the sites representing localities with high and low household density, market place, fields, and roads.

[20] A ping test is the simplest test for Internet connection and speed. Ping tests use very small data packets of size 32 kilobytes, thus ping test failures reveal the Internet connection is extremely poor.

comparison of mobile Internet quality at Changu Narayan and Panauti reveals less populous and comparatively rural areas have been overlooked by the telecommunication giants. There were two test points at Changu Narayan with extremely poor signal strength for both NTC and Ncell Base Transceiver Stations (BTS). Incidentally, these test points are located at areas with low household density. The maximum download speed for NTC's mobile Internet in Panauti was 107 kbps (average download speed 64 kbps). Ncell's Internet had better speed, but it is costly and to re-mention, has a poorer performance in the rural areas; for instance, Ncell's performance is much lower at less populous Changu Narayan in comparison to its own at Panauti.[21] Our findings thus imply that the quality of both mobile voice and data services provided by both of the telecom giants degrade more in the rural areas.

Users' perception suggests mobile phone users are more satisfied with voice services compared to data services.[22] It is better to interpret this perception with the main usage of Internet, which is for social networking and not for speed Intensive educational or creative applications.[23] A drop in Internet speed or even a connection loss does not significantly affect experience of social networking sites. There was a recurrent complain that the mobile Internet quality is inferior despite strong BTS signal. Such complains of the end users suggest the telecom companies have less interest on strengthening their Internet services due to low return on investment.

The Complications of Low per Capita Income

The low per capita income of Nepal has twofold negative impact on Internet diffusion. It has been restricting the adoption of household broadband on the one hand and constraining the data usage in the widely spread mobile based Internet on the other. The policies have an attitude of indifference towards the income bottleneck of an average Nepali and have focused on the building of broadband infrastructure. But there is an inherent tradeoff between quality and tariff in Internet services, and since Nepal has a very low and unsustainable economic growth, the tradeoff would remain relevant in years to come. The policy makers have an implicit belief on the potency of broadband infrastructure that it would boost the economic growth. Such beliefs are flawed, especially in the context of the lesser developed countries. This belief could be the reason why the policies have overlooked the affordability, speed and quality nexus.

The Tradeoff between Quality and Tariff

The ISPs appear somewhat helpless regarding the question of Internet tariff reduction. As the Internet is a network linking several networks, the links that connect such networks across different nations is the major determinant of Internet price. The Nepali ISPs and operators have been purchasing international connections chiefly from Indian companies. It has been reported that Nepali operators spent US$ 24.5 million in the fiscal year 2013/2014 in international connectivity,[24] which was about US$ 7.1 per Internet user and an average user consumed only 2 kbps of International bandwidth. It is obvious that the reduction of Internet tariff in Nepal is beyond the capacity of the local ISPs. There is a clear tradeoff between Internet price and speed.

ISPs worldwide adopt similar business strategies, termed as 'Fair Usage Policy', to minimize the burden of bandwidth costs. A commonly used strategy called throttling deliberately reduces the available bandwidth to a data consuming Internet user. From the users' perspective, throttling is an undesirable and unfair strategy. Moreover, the customers of private ISPs generally subscribe volume based Internet connection. In a volume based scheme, a user is allowed to access the Internet until a pre-specified data transfer limit is reached. The connection speed, after the usage of the pre-specified volume of data, is automatically reduced to a minimum level called as fall-back speed. A straightforward approach for quality assurance for Internet services would be to enforce that the ISPs should not throttle the bandwidth or set the fall-back speed below a specific limit, say 512 kbps, which is definition for an entry level broadband in Nepal. However, such an approach of enforcing minimum Internet speed is not plausible in low income countries as it would eventually raise the subscription tariffs. Even in India, Bharti Airtel

[21] The average download speed for Ncell's mobile Internet at Panauti and Changu Narayan were 2.94 mbps and 0.44 mbps, respectively. The speed tests for NTC could not be completed at Changu Narayan due to extremely poor Internet connectivity. At Panauti, the average download speed for NTC mobile Internet was 0.06 mbps.

[22] The technical reason behind this observation is voice require lower transmission speed than data services. The user perception survey was done on a total of 120 mobile phone users at Panauti, Changu Narayan, and Kathmandu.

[23] Pandey, Shailesh B. and Yogesh Raj. 2016. Free Float Internet Policies of Nepal. *Studies in Nepali History and Society* 21(1): 1–59.

[24] Economic and Social Commission for Asia and the Pacific (ESCAP). 2014. *An In-depth Study on the Broadband Infrastructure in South and West Asia*. ESCAP. Available at: www.unescap.org/sites/default/files/Broadband_Infrastructure_South%26West_Asia.pdf; accessed 27 February 2017.

has argued that the minimal broadband speed should not be set higher than 64 kbps.[25]

The quality-tariff tradeoff is clearly guiding the usage pattern of the mobile Internet users too. Facebook users spend 1 to 2 megabytes of data per minute.[26] Though there are various data schemes, one minute of Facebook usage roughly converts to Rs. 1 to 2 per minute for both NTC and Ncell mobile Internet. The quality of NTC's mobile Internet in the test sites is not suitable enough for video conferencing applications such as Skype.[27] On Ncell's mobile Internet, an hour of Skype video conference with the minimum quality would require 56.25 megabytes of data, roughly a rupee per minute. Since Ncell provides much faster mobile Internet, a high definition Skype conference would consume about 176 megabytes per hour for the minimum requirements, roughly 3 megabytes per minute. Unaware, its users may use the default settings and spend 3 megabytes per minute, which converts to Rs. 3 per minute. This is cheaper than the cost of international calls via a landline telephone which ranges from Rs. 3 to Rs. 60 per minute. But, the cost of mobile Internet is still prohibitive for bandwidth demanding e-education, e-health, or e-land administration services.

The Economic Constraint on Internet Adoption

There are some quality related targets in the Nepali Internet policies. For instance, the Broadband Policy 2015 has set target of increasing broadband penetration to 45 percent household at a minimum download speed of 512 kbps by 2018.[28] There are several doubts regarding the realization of these targets.[29] First, deadline of 2018 is surely to be missed as the Broadband Masterplan 2016–2020 has not been implemented. Second, even if all the districts would have sufficient broadband infrastructure, it is doubtful that a majority of population will subscribe to a broadband connection. Calculations show a basic level Internet is not affordable to a vast majority of the Nepali population. The International Telecommunications Union (ITU) considers a broadband connection as affordable if its tariff is within 5 percent of per capita income.[30] According to this criterion, even the 192 kbps ADSL connection provided by NTC is not affordable for an average Nepali. The trend of economic growth shows the 192 kbps ADSL will remain unaffordable for an average Nepali for decades to come if the tariffs do not reduce drastically.[31]

The constraint of low per capita income on Internet diffusion in Nepal is much stronger than one would speculate. Table 1 shows the income and expenditure pattern of various economic groups of the Nepali population. The lower income groups have relatively lower expenditure on recreation, communication and miscellaneous activities. This implies the low income groups have little flexibility to save on this category and allocate the surplus amount towards an Internet connection. Suppose the householders could totally cut expenses on this category and acquire Internet connectivity. Under such a highly improbable assumption, the 192 kbps ADSL would be affordable to the poorest 20 percent of population, but a 384 kbps ADSL would still remain unaffordable for them. Including monthly depreciation for computer (Rs. 1,000),[32] even the 192 kbps

[25] In January 2016, the Telecommunications Regulatory Authority of India (TRAI) floated a draft directive to set ensure minimum broadband speed as 512 kbps which was opposed by the leading Indian telecommunication companies. See Bharti Airtel's response to TRAI on this issue; available at: www.trai.gov.in/sites/default/files/Bharti_Airtel_20_Jan_2016.pdf;acceesed 21 February 2017. TRAI's draft direction is available at: www.trai.gov.in/sites/default/files/Draft%20Direction%2020.1.16.pdf; accessed 21 February 2017.

[26] See, Choros, Alex. 2017. How Much Mobile Data Do You Need? *WhistleOut*. Available at: www.whistleout.com.au/MobilePhones/Guides/Mobile-broadband-usage-guide; accessed 26 February 2017.

[27] The maximum download speed for NTC's mobile Internet noted during this study was 107 kbps, which is less than minimum download speed for Skype (128 kbps).

[28] The declarations are complexly stated. Article 8.1 of the policy mentions about providing a 512 kbps Internet accessible in all areas, and article 8.2 mentions about providing Internet to 45 percent household without specifying the speed. We interpreted these articles jointly as a declaration of providing 512 kbps Internet to 45 percent of Nepali households. See, GoN. 2071 v.s. Broadband Policy, 2071. Ministry of Information and Communications, Kathmandu. Available at: http://moic.gov.np/upload/documents/broadband_policy_2071.pdf; accessed 2 October 2016. http://moic.gov.np/upload/documents/broadband_policy_2071.pdf; accessed 26 February 2017.

[29] This target is itself fuzzy as it is not clear whether this 512 kbps refers to a dedicated, a shared, or a volume based connection. Moreover, a 512 kbps Internet is not a broadband, and is only suitable for basic Internet browsing. See, Singleton, Micah. 2015. The FCC has changed the Definition of Broadband. *The Verge*, 29 January. Available at: www.theverge.com/2015/1/29/7932653/fcc-changed-definition-broadband-25mbps; accessed 23 November 2016.

[30] ITU's target 2.3B for 2020 mentions broadband services should cost no more than 5 percent of average monthly income in developing countries by 2020. See, ITU. 2015. *Measuring the Information Society Report 2015*. Geneva: ITU, p. 6. Available at: www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2015/MISR2015-w5.pdf; accessed 27 February 2017.

[31] NTC's ADSL connection together with minimum telephone tariff costs Rs. 1,217 per month. Taking real GDP growth rate of Nepal as 5 percent per annum, this connection would be affordable in 29 years. Even after considering growth rate for nominal GDP (as 15%), the 192 kbps connection would be affordable after 10 years.

[32] The annual depreciation rate for computer is 24.2 percent. See, CBS. 2011. *Nepal Living Standard Survey III*. Kathmandu: CBS. We get the estimate of monthly depreciation by assuming a computer costs Rs. 50,000. The global estimate for computer depreciation rate lies between 20 to 40 percent per year.

Table 1: Internet Affordability by Quintile Groups of Nepali Population

	Poorest 20%	Second Poorest 20%	Middle 20%	Second Richest 20%	Richest 20%
Quintile group	1	2	3	4	5
Monthly household income	18,338	23,739	24,516	32,042	53,578
Household expenses on recreation, communication, and miscellaneous activities.	1,218	1,909	2,312	3,710	8,315
Broadband affordability(as per ITU's criterion; adjusted by taking average family size as 5)	183	237	245	320	536

Source: Household Budget Survey, 2015[33]

ADSL Internet remains unaffordable for the poorest 40 percent of Nepali population.

The quality-tariff tradeoff is undermining Internet usage in Nepal. Specifically, the Internet based applications that are believed to be development invoking, like the e-government, e-education or e-health, would be of no avail to the lay users because of the fundamental constraint of low income. The policy makers have an implicit belief that the construction of Internet infrastructure would by itself cure the pitfalls of national economy and support other development activities. This is a faulty assumption which builts up on a hasty interpretation of the ICTD research. Nepali ICT policies build their optimism on familiar statistical results such that the one that suggests a 10 percent of increase in broadband penetration leading to GDP growth by 1.38 percentage points,[34] without careful assessment of the premises and methodological challenges. Apart from the factor of affordability, the ICTD literature has also pointed towards a minimum level of threshold required for observing ICTs positive effects on development,[35] and the role of ICT quality.[36] The World Bank, in a recent report, mentions that the effect of ICT is not observed in the countries that lack favorable business environment, strong human capital, and strong governance.[37] Though these terms are imprecise, the report nonetheless reinforces our assertion that the phenomenon of ICT leading to development is not universal and may not be observed in the lesser developed countries. The major findings of ICTD research, like the contribution of ICT infrastructure on economic growth, are often misinterpreted as causal explanations, while in actuality they only describe statistical associations between the variables. The findings linking the investments in ICT infrastructure on economic growth are generally based on aggregate data and have not considered the role of usage pattern. Moreover, important publications in the ICTD literature have relied on the statistical concept of p-values to assess relative importance of various socio-economic factors of development. However, the American Statistical Association has recently warned that policy level decisions should not be based on the findings that solely rely on the p-values.[38] The policy makers therefore need to acknowledge the limitations of the ICTD research and make decisions based on local level studies rather than resorting to the findings of aggregate studies.

Conclusions

The policy targets of building an optical fiber backbone network will almost certainly miss the proposed deadline of 2020. The fundamental objective of the appropriate infrastructure development for the universal connectivity is more important than the deadline. For, a proper functioning of the proposed ICT infrastructure would be

[33] Nepal Rastra Bank. 2016. *Household Budget Survey 2015*. Kathmandu: Nepal Rastra Bank.

[34] Qiang, Christine Zhen-Wei and Carlo M Rossotto. 2009. Economic Impacts of Broadband. *Information and Communications for Development 2009: Extending Reach and Increasing Impact* 3: 35–50.

[35] For example, it has been estimated that that broadband will be supportive to economic growth when its household penetration will cross the threshold of 20 percent, the penetration of broadband in Nepal is far below this mark. See, Koutroumpis, Pantelis. 2009. The Economic Impact of Broadband on Growth: A Simultaneous Approach. *Telecommunications Policy* 33(9): 471–485.

[36] For instance, a study suggests that the doubling of broadband speed could add 0.3 percent to GDP growth in the OECD countries. See, Rohman, I.K. and Erik Bohlin. 2012. Does Broadband Speed Really Matter as a Driver of Economic Growth? Investigating OECD Countries. *International Journal of Management and Network Economics* 2(4): 336–356.

[37] The World Bank. 2016. *World Bank Development Report 2016: Digital Dividends*. Washington, D.C.: The World Bank.

[38] It is generally misunderstood that the p-value describes the validity of a hypothesis. But correctly, p-values can only indicate how incompatible data are with a hypothesis. Because of the massive misuse of p-values in the empirical researches, the American Statistical Association has floated its opinion about the use of p-values. See, Wasserstein, Ronald L., and Nicole A. Lazar. 2016. The ASA's Statement on p-values: Context, Process, and Purpose. *The American Statistician* 70(2): 129–133. DOI:10.1080/00031305.2016.1154108.

hindered by electricity crisis. The energy requirement of a 'digital Nepal' would be much beyond the current electricity production.[39] Moreover, the promised broadband service of 512 kbps would remain unaffordable to the majority. Since existing infrastructure is of substandard quality from the users' perspective, it is hardly convincing that future ICT infrastructure would meet any quality of service targets.

The gap between official statistics and the ground level reality as indicated in this brief have important implications. Statistics that describe the usage pattern and service quality are more important; an exclusive reliance on the penetration statistics will yield faulty conclusions. Similar disparities exist in the official statistics for other infrastructures and their actualities. For instance, it is claimed that more than 76 percent population has access to electricity.[40] Hidden from the view is a chronic supply shortage, often balanced by several hours of power cuts daily, especially in the non-monsoon seasons.[41] The road density statistics do not speak of the durability, reliability and the dangers during rainfall. Conclusions of ICTD research drawn from the official statistics are dubious for countries where ICT development is a matter of top-down and presumptive policy.

The development processes in Nepal has always been linear in the sense that they do not review and assess the efficacy of earlier efforts. Planners appear happy with the exaggerated statistics that match their futuristic agenda formulated to race ahead and to quickly graduate Nepal into a developing country. More realistic policy would use measures to increase efficiencies of existing service delivery. We have been arguing that ICT development cannot be isolated from the concrete realities of energy shortage and slow economic growth. A straightforward top-down process, like the implementation of a nationwide optical fiber network, will hardly alter the picture of the Internet access in Nepal, and will not make the proposed infrastructure conducive to development activities in general. National investment in the sector without realistic approaches to increase quality access and use would only make the ICT infrastructure unsustainable.

This short study is clearly insufficient to propose and alternative approach to ICT development in Nepal. Nonetheless, any alternative would require dropping the ambition to quickly close the capacity gap between Nepali ICT infrastructure and that in the developing countries. Realities of low per capita, energy supply deficit and regional variations in other infrastructural development imply that a more robust ICT policy has to be heterogeneous in terms of technologies and business models. The structure and characteristics of an Internet infrastructure for Nepal will manifest from the pluralistic vision of a knowledge society.

[39] The electricity consumption of the ICT infrastructure negligible at the user end devices, but the power requirements at networks, data centers, and base transceiver stations is enormous. The challenges of energy shortage in the development of ICT infrastructure in Nepal has been discussed in an earlier Chautari research. See, Regmi, Nischal and Shailesh B. Pandey. 2015. A Regression Analysis into Nepali ICT's Energy Consumption and Its Implications. 9th International Conference on Software, Knowledge, Information Management and Applications (SKIMA). DOI: 10.1109/SKIMA.2015.7400034. Draft version available at: www.martinchautari.org.np/files/ARegressionAnalysisintoNepali ICTs EnergyConsumptionAndItsImplications.pdf. The electricity shortage is also seen on the quality of Internet. Recent news claims non-functioning of BTS towers due to electricity shortage deteriorated telecommunications quality in a rural area. See, My Republica. 2016. Ten Nepal Telecom Towers Remain out of Service. Available at: www.myrepublica.com/news/3451; accessed 13 November 2016.

[40] The World Bank. n.d. Global electrification database. Available at: http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS; accessed 13 November 2016.

[41] See, Sharma, Raj Hari and Ripendra Awal. 2013. Hydropower Development in Nepal. *Renewable and Sustainable Energy Reviews* 21: 684–693.

Martin Chautari (MC) began as an informal discussion group in Kathmandu in 1991, allowing development professionals and academics to meet every two weeks to share insights and experiences. In 1995, the name 'Martin Chautari' was adopted after the late Martin Hoftun, one of the founders of the original discussion group. After being managed by the Centre for Social Research and Development for six years, in 2002 MC became registered as a separate non-government organization in Kathmandu.

Since its inception, MC's core objective has been to enhance the quality of public dialogue and the public sphere in Nepal. Started at a time in which Nepal had little, if any, culture of informed public discussion, MC is now nationally known for its discussions which are held two times a week. Chautari also conducts research focused on governance and democracy, media, education, health and livelihoods with cross-cutting themes of gender and social inclusion. A rigorous mentoring program of young researchers is in-built into MC's work.

Till date MC has published eighty-eight books. MC is also the editorial home of the journals *Samaj Adhyayan* [formerly *Media Adhyayan*, established in 2006], and *Studies in Nepali History and Society* [SINHAS, published by Mandala Book Point since 1996]. Since 2006, MC has opened its research library and media documentation centre to the public. The library's holdings total more than 22,000 books, a quarter of which focuses on the media.

All five components – the discussions, research, mentoring, publications and library – feed into each other and form an intrinsic part of MC's primary objective: strengthening the social contract between the state and citizens and expanding and making inclusive the public sphere by promoting informed dialogues and analytically rigorous research.

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