# FREE LAPTOPS AND INFORMATION SOCIETY: WILL COMPUTERS ALONE DO?

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**Abstract:**

Information and Communication Technologies (ICTs) are being touted as the panacea for social development and there are claims about the emergence of information societies. Developing societies are encouraged to transform themselves into information societies in the globalised economy to achieve rapid economic progress, triggering a host of ICT interventions in different sectors. This paper looks at providing millions of free laptops to students in Tamil Nadu, its usage among students, and argues for an eco-system to enable the students to capitalise on the technological access provided.

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Information and communication technologies (ICTs) have emerged to play a significant, pervasive and dominant role in our societies. One is able to accomplish many tasks using a computer or even a mobile phone, such as paying bills, ordering books, reading newspapers, communicating, writing, and being entertained. This facilitating nature of ICTs in all spheres of life has led to the claim that a new form of society, the information society is emerging.

The popular definition of 'information society', as stated in Wikipedia, is “a society where the creation, distribution, use, integration and manipulation of information is a significant economic, political, and cultural activity. Its main drivers are digital information and communication technologies, which have resulted in an information explosion and are profoundly changing all aspects of social

organization, including the economy, education, health, warfare, government and democracy. The people who have the means to partake in this form of society are sometimes called digital citizens. This is one of many dozen labels that have been identified to suggest that humans are entering a new phase of society".

India, though considered a fast growing economy, has its share of concerns in addressing widespread poverty and inequalities. ICTs are seen as facilitators of development in societies like India. Societies the world over are being persuaded to transform themselves into information societies. The World Bank's 1996 discussion paper strategizing information for development succinctly summarises the bank's outlook.

"Revolutionary advances in information technology reinforce economic and social changes that are transforming business and society. From this revolution emerges a new kind of economy - the information economy - in which information is the critical resource and the basis for competition. Old ways of doing business will be challenged and sometimes defeated. At the social level, a corresponding new society is also emerging. This society's information capabilities are pervasive, making it substantially different from an industrial society. It is much more competitive, more democratic, less centralized, less stable, more able to address individual needs, and friendlier to the environment. These changes dictate, for all countries, a major agenda of structural adjustment. Advanced countries are rapidly pursuing their version of the agenda, and developing countries must do so as well or risk exclusion from a global economy and severe disadvantage in the competitiveness of their goods and services." (Talero and Gaudette, 1996).

**The Quest for the Information Society:**

The evolving information society and the need for developing societies to integrate into the global information society by embracing digital technologies has triggered a host of initiatives in several sectors. Education is an important sector where ICTs have been implemented, on the assumption that future generations need to be equipped with the required ICT skills to enable them to effectively participate in the

information era (*T*he Hindu*,* 2011). On the international scene, the 'One Laptop Per Child' (One Laptop per Child, 2016), or what was famously known as the hundred-dollar laptop, from the prestigious Massachusetts Institute of Technology, was specifically developed to target developing societies. The initiative faced major challenges during its implementation. In Peru, problems related to infrastructure - chiefly electricity, technical support and maintenance, demand for content, lack of skilled teachers, training inadequacies, and a lack of involvement of the larger community comprising software developers and educationists - were reported (Santiago et al., 2010).

In India, too, there have been initiatives in many parts of the country to introduce ICTs in education. Some were led by the State at the curriculum level, others initiated by private sector players such as Intel, and many by civil society contributors at micro levels. It is worthwhile to note Kerala's IT@school programme in this context. It has its roots in Intel's "Teach to the Future" programme started in 2002, and teachers were trained on proprietary software. The State Government eventually decided to launch its own program and switched to Free/Open Source Software (FOSS) on 50000 computers in 2800 schools in 2006 and completed the migration by 2008. This resulted in an estimated savings of USD 10 million just out of licensing costs for operating system and desktop office automation applications, excluding recurrent anti-virus software subscriptions.

The success of the programme is also attributed to its 'integrated approach' as against an externalised 'build, own, operate, transfer' (BOOT) approach within the education ecosystem. Intensive and decentralised training of teachers, provision of content in Malayalam, customisation or in some cases development of tools and applications around the existing curriculum, and the involvement of traditional teacher training institutions and teachers' unions in the training process are some of the key factors of this approach. The choice of FOSS made possible the involvement of local free software groups to contribute in terms of tool development, whenever there was a demand for one. Malayalam dictionaries for Open/LibreOffice suites, and Text-To-Speech engines, apart from the broader effort in localizing the operating system, are significant contributions of the free software

community. Effective training strategies have ensured that school teachers themselves could troubleshoot basic hardware problems as well as common problems in the Linux desktop environment. This approach implies that the pedagogic orientation of introducing computers in schools has helped, as against a technological orientation.

The 'hole in the wall' experiment ("Hole-in-the-Wall - Beginnings", 2016), set in the slums of Delhi, was initiated by the National Institute of Information Technology (NIIT), a leader in the information technology training industry and later supported by the Government of New Delhi. Slum children were given access to computers fit within a hole in the wall so only the screen was visible. A mouse and a joystick were provided to manipulate the computer. Soon the children learnt, without any assistance whatsoever, the basic manipulations of a computer, to open Microsoft Paint, and master games. But they did not get beyond that point, as no specific educational content was provided, coupled with a lack of Hindi as an interfacing language. The very design of the kiosk made supervision and collaboration difficult, and the parents resented the lack of organised instruction. Despite these issues, this experiment saw expansion and gained popular attention, demonstrating that the natural inquisitiveness of slum children (the social have-nots), given access to technology, guided or otherwise, can help them find their way into the information society.

Given such initiatives with varied experiences and levels of success in the backdrop, the Government of Tamil Nadu began to implement a slew of welfare schemes, including distribution of free laptops - for students of Classes XI, XII, and polytechnics, as well as for arts, science and engineering undergraduates of Government and Government-aided institutions - from late 2011. A dedicated 'Special Programme Implementation Department' with a minister-in-charge was created to oversee the implementation of these free schemes. The scheme was officially launched on 15 September 2011 and a total of around 6.8 million laptops were planned to be distributed by 2016 in a phased manner. The Electronics Corporation of Tamil Nadu (ELCOT) was appointed as the nodal (technical) agency for deciding on the specifications and procurement of laptops. The distribution was coordinated by the Departments of School Education, Collegiate

Education and Technical Education. By February 2016, a State Minister announced that 31,76,000 students had benefited at the cost of Rs 6456 crores, claiming that the scheme had reached its target completely ("Free Laptops Given to Over 3 Million Students", 2016).

From within the limited question of access to technology and its uses, this paper attempts to understand the inherent issues in such large-scale initiatives of providing access to technology by looking at the grassroot-level uses and practices of the final beneficiaries of the free laptop scheme.

**Methods:**

As the free laptop scheme has been widely implemented across Tamil Nadu, the laptops have reached a phenomenal number of students, necessitating a combination of quantitative and qualitative approaches in the methodology to address the objectives. Initially, a wide literature survey was conducted, covering aspects of Information and Communication Technology (ICT) initiatives in education to gain an understanding at the global scale. We focused on initiatives that aimed to provide individual access to computing devices for students, either in their classrooms or in an appropriate academic environment. This helped us narrow our focus down to the One Laptop Per Child (OLPC), Kerala's IT@school program, and the curious 'Hole-in-the- Wall' experiments in New Delhi. The study, conducted between June and July 2013, consisted of a broad survey of students with free laptops across the four villages of Melsurunai, Kizhsurunai and Muttavakkam from Kanchipuram District and Pidaramangalam from Trichy district, all predominantly agrarian villages. As the study focussed on the qualitative use of laptops in a student environment, a preliminary quantitative survey was made to help pinpoint cases throwing light on the effective use of laptops by students. The preliminary survey covered around 70 students, ranging from higher secondary school-leavers to undergraduates. The survey covered aspects such as the school grade at which the laptops were received, current education, parents' profession, prior computer knowledge, hours spent on the computer per day, applications used, internet use, support channels and software sources. We then narrowed our survey down to the undergraduates, and this resulted in the target group being restricted to

29 students. Finally, for the case studies, we selected four students with the set criterion of picking only those who exploited their computers with relatively high intensity compared to the rest of the body of students from the villages in question. Unstructured interviews, coupled with observations on the laptop use of the selected four student cases from Kizhsurunai and Muttavakkam villages, were recorded to gain a deep qualitative understanding of their use of the computer at home and in college, in tandem with issues related to their regular use. These four student cases were investigated as individual cases, and a variety of methods including unstructured interviews, observations on when and how the laptops were being used for different purposes, the applications used, the difficulties faced at a general level as well as those with specific applications, were collected as part of the case study method.

**Analysis:**

The hardware configurations of the free laptops distributed varied greatly over the years of the scheme's implementation. The first batch of laptops distributed in September 2011 had the configuration of a Pentium Dual Core 2.4 GHz processor, 2GB of memory, a 320GB hard disk, a DVD-RW drive, a webcam, and a 14" display with a battery that served for around 3 hours. The laptops had both Microsoft Windows as the default boot and Boss Linux. Subsequently, as the processors evolved, later engineering students received laptops with the next generation Core2Duo processors with an enhanced memory of upto 4GB.

Within a few months of their distribution, most of the laptops were found to be infested with viruses, thanks to portable USB drives. The laptops needed a working internet connection to have the Avira anti-virus updated on MS Windows to clean it. On some, Windows had stopped working. Repeated calls to the service centre, usually a few kilometres away, proved unsuccessful. Those who could afford to paid 300-500 INR to get MS Windows reinstalled, along with pirated versions of Microsoft Office and games. Students primarily use their laptops to play games, listen to music and watch videos. As a consequence, shops selling music and movie CD-ROMs have sprung up adjacent to the schools. Because the laptops are largely used for

entertainment, most teachers have banned their use in class. Only computer science teachers insist that students bringing their laptops to school for practicals on programming, and reading from the pdf textbook respectively. Teachers maintain that they have received no directives from the authorities to insist on the use of laptops in schools, nor are they to question students on their use of it. This has resulted in teachers viewing the laptops as a personal gadget the pupil owns, causing a complete alienation from the academic environment.

According to the students, there are a couple of advantages in possessing a laptop. First, during power cuts, they can still continue to do their lessons on the laptop. Second, some have managed to make a little money by designing flex banners using Adobe Photoshop. But for others, keeping the laptops charged is an issue in itself. Some live with a single-bulb electricity connection and lack the facility to charge the laptop at home, relying on their friends or relatives to do so.

**Case Study 1:**

A second-year Mechanical Engineering student from Kizhsurunai received a Compaq laptop which he uses extensively every day. He spends at least two hours on his computer, for work or entertainment. He connects to the internet through his phone's Rs 98 data connection and browses the internet looking for academic resources online. At other times, he checks his email frequently; visits Facebook; and downloads songs, movies and games which he shares with friends. He has tried calling the authorized service centre for help, but to no avail, and managed to change the computer's operating system when it got corrupted by viruses. He is comfortable with Boss Linux, but on finding that connecting to the internet from Linux was not working too well, removed it to save disk space for movies. He feels that with appropriate training, Linux could become a good platform for student learning. His college does not allow students to bring their laptops with them as the devices might be a distraction. He has problems using the computer in English and relies on friends to fix problems.

**Case Study 2:**

A third-year Electronics and Communication Engineering student from Kizhsurunai, studying in a prominent engineering college in

Chennai, is an avid laptop user. He uses it to prepare for classes, take notes, and handle his coursework. He does not use the laptop for programming and occasionally works on Boss Linux. He knows that viruses seldom attack Linux and is comfortable with the look and feel of the Linux operating system. But eventually the Windows OS got corrupted, and when it was reinstalled, the computer's bootloader got erased and it became impossible for him thereafter to boot into Linux. He is unaware of support groups that offer technical support for Linux. He cares for his laptop, keeping it physically safe, and updates his Avast anti-virus through his 1 GB Vodafone pre-paid internet package. His college does not permit students to bring their laptops with them, fearing theft. Further, he is not particularly enthusiastic about seeking support from the faculty at his college.

**Case Study 3:**

A second-year Bachelor of Computer Applications student from Kanchipuram uses his laptop daily, and mostly for entertainment. He listens to the commercial music streaming service, Gaana, and has a good collection of Tamil songs. He watches movies regularly, borrowing from friends or downloading them from the internet, to which he connects using his mobile prepaid Rs 120 connection. He is unaware of Boss Linux and seldom uses it for programming. Although his college does not encourage students to bring their laptops to college, he takes it along to listen to music. He avers that working through English as an interfacing language is not easy for him.

**Case Study 4:**

Another student from Muttavakkam, a II-year Electrical and Electronics Engineering student of Ranipettai Engineering College, stays on Windows as he feels that Linux is tougher to use than Windows. His college also does not permit laptops on the campus. He relies on his friends and brother to troubleshoot issues with the laptop, and is unaware of support groups. He connects to the internet using his Rs 120 Airtel pre-paid connection to download songs and log onto Facebook.

**Discussion:**

The beneficiaries of Tamil Nadu's free laptop scheme are students of Government and Government-aided institutions, and excludes those

in private institutions. This conscious bias shows that it is aimed to help students from the poorer sections of society. Tamil Nadu has been leading the way in India in formulating a series of social welfare schemes targeted at the marginalized. Looking at the free laptop scheme in this framework, while the State will benefit from the desired legitimacy it draws from such welfare measures, the inherent technological dynamics of such a scheme has its share of challenges. These could broadly be categorised into the level of integration of ICTs into the curriculum, and the training and support the students can expect to receive for an enhanced learning experience.

**Integration into the Curriculum:**

A stark finding of the study was that almost all colleges discourage their students from bringing their laptops to the campus. This is most disheartening, as the very purpose of the scheme was to help students take advantage of the latest technologies to better equip them for the future. As institutions responsible for inculcating technical education, it is disconcerting to learn that the engineering colleges themselves do not like their students bringing their laptops to class. Integrating the laptops into the academic curriculum through lectures and notes, with extended and adequate use during laboratory sessions, alongside satisfactory internet connectivity will ensure that students use the laptops productively.

**Training and Support:**

Most often, students fail to realise the power of the technical equipment they have been endowed with, in the form of a first-rate computer in their hands for their own personal use. Certain students, as is the nature of the young, try to tinker with the computer, which unwittingly exposes them to the brave new world of computing. Such innate abilities of our young students need to be nurtured and developed through appropriate mentoring by the teaching faculty or informal groups such as Linux User Groups.

One finds that invariably all our student cases have been facing technical issues such as virus infections, file corruption, and bootloading at some point. Clearly, there is a lack of technical support for students, who are forced to rely on friends and family to fix these

issues. The technical ability of these peer groups is also limited. The local service centres take the simplistic approach of destroying existing installations by formatting the hard drive and completely reinstalling the operating system. With adequate training and support, students can manage their laptop and its contents without difficulty. In particular, they could exploit Boss Linux with its wide variety of educational software applications and so improve their skills.

**Conclusion:**

Amidst felicitous claims being made of an emerging information society resulting in a fervour in grooming a workforce skilled in ICTs, the free laptop scheme for students perfectly fits this milieu. The scheme's implementation is claimed to be a success in terms of reaching out to a humongous number of students, all of whom have been provided with a personal computer of their own. This is indeed remarkable, as also the fact that the students did not forego or re-sell their laptops as was widely expected, which was precisely the case with the free television sets and home appliances. While this shows that the students value their laptops as worthy personal gadgets, the environment to exploit them to their advantage needs to become more conducive. As the paper argues, the equipment or device needs to be made available within an appropriate eco-system of enabling software applications, pedagogic integration and reinforcement, technical support, and mentoring, not to mention the larger socio-economic context within which such initiatives are firmly placed.

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# GIS-BASED DATA SYSTEMS FOR THE DEVELOPMENT OF DECISION-MAKING: THE ROLE OF CONVERGENCE IN REMOVING INFORMATION ASYMMETRY

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**Abstract**

Information asymmetry is a well-researched topic in economics and its role in market failures documented. The issue of information asymmetry has relevance to our understanding of governance failures and gaps in public services reaching the last mile of citizens. We look at governance at the level of the government, government departments, and local bodies (municipalities and panchayats). In essence, any aspect of the public realm involving public finance is prone to inefficiencies to the extent that information asymmetries could result in gaps in achieving good governance. Lack of convergence of data and convergence of information systems are sources of information asymmetries affecting the outcome of development interventions. In our paper, we present instances of information asymmetry on different aspects of governance, and the convergence framework that can be achieved through Geographic Information System (GIS) technologies to eliminate asymmetries for effective planning and decision-making. We specifically look at four such instances:

- Policy: Instances of putting policy to action; gaps in achievement
- Delivery of public services: Gaps in achievement; unserviced and underserviced regions and population segments
- Inclusive growth: Optimising development interventions for livelihoods
- Environment: Monitoring water quality in rivers

We also present cases wherein the information systems that bring convergence of data can address the issue of information asymmetry.

**Keywords:** GIS, public administration, governance, development, information asymmetry, data

**An Evidence-based Development Policy**

Data and intelligence are inherent parts of evidence; and evidence is the cornerstone of effective policy and decision science. Across the world, multilateral institutions and other stakeholders in the development sector are investing heavily in building capacities to assimilate information that could be processed to be seen as evidence. Governments have also mandated conducting impact evaluation and periodic monitoring of the schemes being implemented.

An important aspect of the development impact is the cross-sectoral impact of interventions. Often, interventions and activities by different constituents of the economy create considerable externalities across different sectors that have a long gestational impact. These have far-reaching consequences and impact livelihoods, as also sustainability. This cross-sectoral correlation makes it imperative for information systems to be built that bring in data from different sectors to analyse the evidence. This has been recognised by practitioners of impact evaluation. An example of this cross-sectoral impact is in the area of child health. An evidence map by the 3ie shows that health interventions at a children's level has a greater or equal impact on education outcomes, compared to interventions on infrastructure or remedial education provision at schools. In effect, the intervention in fostering child health becomes a threshold condition for the impact of interventions in the education sector.

Across different sectors including urbanisation, livelihoods, financial inclusion, empowerment and environment, such cross-sectoral impact is to be monitored to achieve good governance. More importantly, such externalities impact the environment; as such, achieving environmental sustainability becomes an issue of managing the externalities.

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For instance, the "CLEAR" initiative by the World Bank's Independent Evaluation Group (IEG), in partnership with other multilateral funding organisations at www.theclearinitiative.org and the "3ie",the International Initiative for Impact Evaluation created by the Bill & Melinda Gates Foundation, UK Aid through the Department for International Development, and the William and Flora Hewlett Foundation.

http://gapmaps.3ieimpact.org/evidence-maps/water-sanitation-and-hygiene-evidence-gap-mapevidence-gap-map

To summarise, it is seen that information from different sectors has to be brought in to evaluate evidence; there is a large scope for externalities, which could be positive or negative. It is, therefore, imperative to create systems that bring in varied information collated on the same platform with adequate visualisation and interpretation facilities for decision-makers at different levels of the administration and the stakeholders involved. Such systems have to facilitate the convergence of technology and data and be built with interoperability. Indeed, convergence is considered the quintessential characteristic of any successful smart city programme. Along with convergence, interoperability is another characteristic for smart solutions in governance (Lee & Hancock). GIS technologies provide very useful and interactive ways of achieving the required convergence.

This paper showcases some examples of the GIS being used as a platform of convergence, from work done as pilot studies in the following sectors:

- Urban utilities and services,
- Water and sanitation,
- Rural development and livelihoods, and
- Environmental monitoring.

These have relevance to researchers addressing the issues of monitoring and impact evaluation from a system perspective. It is also vital to bring, by presenting these pilot studies to the larger research and academic communities, a system-management perspective for adopting standards and benchmarks. This is relevant in the context of public investments in the area of a smart cities project, where information from multiple sectors has to interact for enabling decision-making. The Government of India has recognised the importance of these issues and formed the National e-Governance Service Delivery Gateway (NSDG) under the aegis of the National e-Governance Plan (NeGP), with the key objective of creating a core infrastructure "for achieving standards-based interoperability between various e-Government applications implemented at various levels and geographically-dispersed locations".

**Urban Utilities and Service**

The work executed was a pilot georeferenced database on urban properties, utilities and services. These are under different administrative domains in most cities. There is little coordination and control on activities, resulting in delays, citizen inconvenience, reduced coverage of tax collection, and, most importantly, gaps in achieving service-level benchmarks. The platform met the following objectives:

a) Streamline the processes of maintaining records of properties and utilities in towns, and standardize them across all municipal bodies in the State.

b) Roll out a standardized database and software solution covering all the ULBs.

c) Digitize records and make them available to all stakeholders online (Keerthana Srinivasan, Karnataka).

d) Query features to understand the reach of civic services.

e) Use MapView to facilitate understanding of the reach and clustering of services against properties (Figure 1 provides a snapshot of a map view).

Figure 1: A snapshot map of town assets and utilities management solutions with data convergence (partial) for the Directorate of Town Panchayats, Government of Tamil Nadu. Project executed at Ponneri Town, Thiruvallur District.


The map view is a simple tool showing the parameters chosen for viewing, individually or with an overlay of other parameters, and helps examine unserviced locations

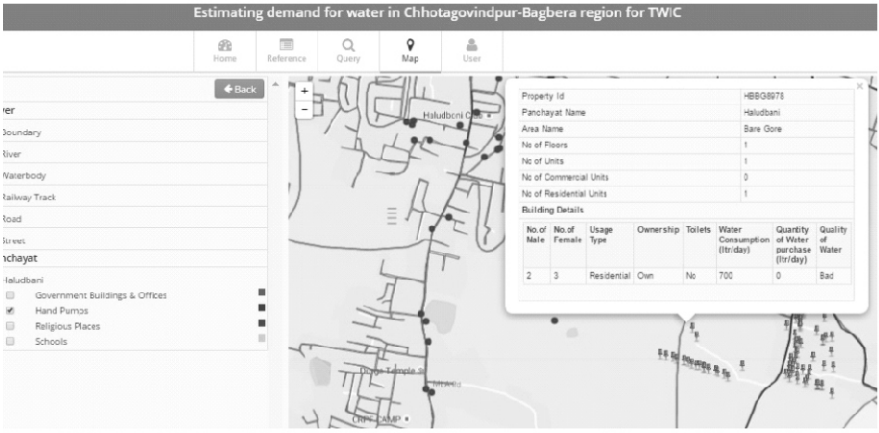
Smart Cities - Seoul: A Case Study. ITU-T Technology Watch Report, February 2013.
Ministry of Electronics and Information Technology, Government of India.

## Water and Sanitation

### *Drinking Water:*

The project created a georeferenced database of household water consumption; prepared the data capture modules in Android and a web application to query and view data on tables and maps. Water-related assets for each household were also mapped, with capacity, to provide an estimate of increased water demand when additional assets are created in the households concerned. The system provides a better understanding of the existing water consumption at the start of the project (baseline data), identifies regional differences at a granular level, and determines clusters of usage groups (Figure 2).

Figure 2: Snapshot of a map view of the query result: "Show households where toilets are not constructed in the <Bare Gore> Region of <Haludbani> Panchayat in Purbi Singhbum District".




The map shows households (blue pins) which have no toilets. The map can be overlaid with other parameters, such as hand pumps and water bodies, in a converged system of information on an administrative unit's assets and utilities.

### *Sanitation: Public Toilets*

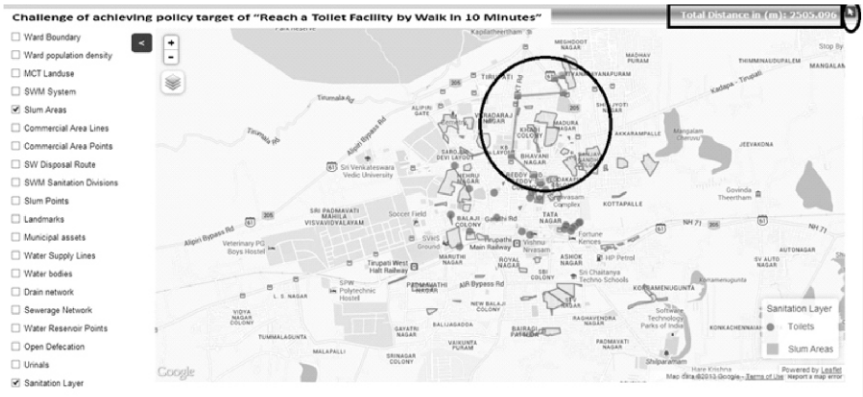
The project has two components. The first is the database of public sanitation inventories in the municipalities linked to the map. The second is an Android-based application which the field-level staff (sanitation inspectors) could use to report inadequacies from the field on a time-to-time basis. This is also linked to online maps in Opensource, which is presented as a dashboard in the website.

Figure 3 presents the map from the project, showing the challenges in achieving a specific policy target in urban sanitation. The objectives met by the project are:

- Managing the sanitation sector better,
- Understanding the demand side of the sector (hitherto most solutions were focused on creating supply),
- Apprehending and acting upon the exact location where demand gaps are felt,
- Planning gender-specific interventions based on the system, and
- Overseeing contractual obligations, monitoring and evaluation.

Figure 3: A snapshot of a map view from the Public Toilet Management System, with converged information and planning tools such as a distance calculator.

**CAUTION:** The caption below should rightly read as follows: The challenge of achieving the policy target of "Reach a Toilet Facility **on foot / by foot** in 10 Minutes"




The map shows the distance travelled by a hypothetic user from a slum location in Tirupathi town (green boundaries), to the nearest public toilet facility (blue dots), most of which are clustered around the bus station. The convergence of various types of public sanitation users (markets, slums)

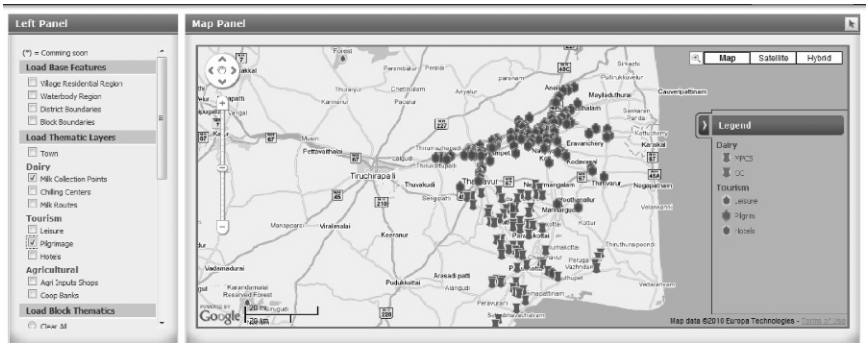
## Rural Development and Livelihoods

Miscellaneous government departments have been working towards providing better livelihood opportunities in rural areas. Cooperative societies are one such intervention, particularly in the dairy sector, which has succeeded in many locations. However, there are several

regions in different states which could optimise the value addition within the region, if better-targeted interventions based on a converged data showcasing opportunities are made. In a systematic approach, the author brought in data on the milk collection points of sundry registered societies under the Aavin (Union of Tamil Nadu Milk Producers' Cooperative Society) brand in Thanjavur and Tiruvarur districts. There is absolutely no value addition in the region as the milk production in the district is skewed towards the northern region, where no societies are registered and producers cater to the huge floating population of pilgrims - thronging about 50 to 60 major temples in the districts - without depending on the societies as a source of markets. However, in the southern region, there is very little production, yet the region seeks to create societies with suboptimal infrastructure and operate under a loss, without sufficient volumes of milk collection.

A solution could be to provide livelihood options with dairy value-added produce catering to the floating population and augment employment/entrepreneurship (Figure 4).

Figure 4: A map depicting the spread of dairy collection points (green icons) with very little daily milk production, spread in two districts - Thanjavur and Tiruvarur - in Tamil Nadu, along with tourist locations (pilgrim spots) in a circuit with about 1 lakh visitors per day. The panel on the left shows layers with other key livelihood aspects

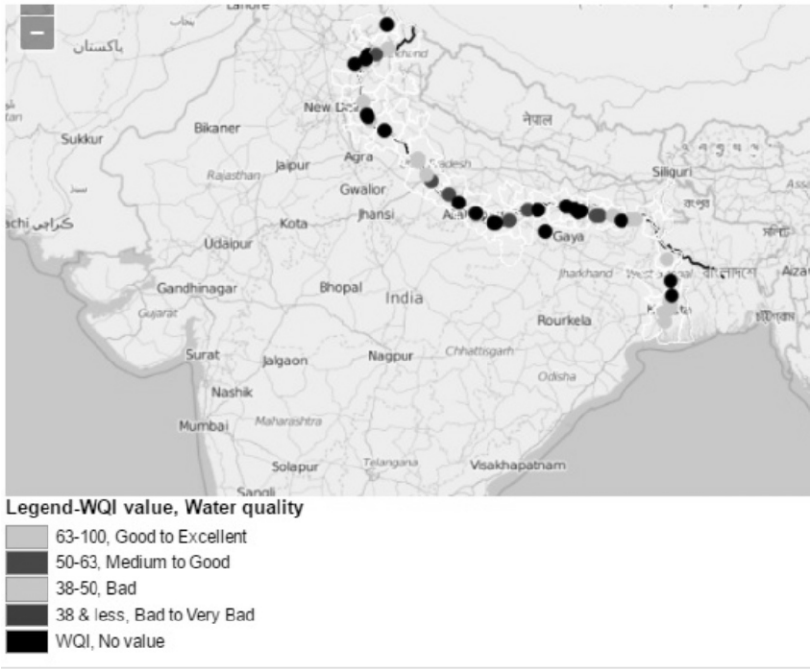



Value-added livelihood interventions are possible with converged information on various sectors on a single platform.

**Environmental Monitoring**

A GIS-based management information system (MIS) for monitoring information on water quality from river water quality testing stations on the Ganga river revealed not only the risk profile of the water quality in different locations, but also in regions where data is not regularly measured or reported for action. In this regard, the key stakeholders are well informed about the risk profile index numbers represented in the colour codes show the immediate risk and the points of intervention targeted (Figure 5). An extension being planned now is to portray (as in other maps shown above) different economic activities such as industries, as well as social and environmental issues such as sanitation, open defecation, and seasonal festivals along the rivers. A crucial aspect of this tool was the system to bring in standardised data in terms of the accepted methodology of computing the water quality index from parameters that are recognised to be used in water quality studies.

Figure 5: Water quality testing stations with a legend



## Conclusion

A large proportion of public spending is being earmarked for a slew of activities aimed at easing decision-making in the development sector, particularly by the Governments at the national and state levels. Investments are also being made in creating systems for governing these schemes. These systems need to focus on achieving convergence. It is imperative that the necessary metadata, data standards, measurement standards and reporting formats be devised and implemented. It is seen that such systems bring about an impact that is measurable and can go a long way in ensuring evidence-based policy making. Along with the metadata, it is essential that the government at all levels invests in GIS technologies through creating appropriate maps that can be immediately brought into the information system for analytical rigour and to enable decision-making.

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