Nashik, India

Demonstrating the Urban NEXUS approach to optimize water, energy and land resources in peri-urban agriculture

The Nashik Municipal Corporation adopted an Urban NEXUS approach to improve resource productivity at the local and regional level in India and to avoid unintended consequences of narrow sectoral approaches leading to unsustainable resources utilization. The Urban NEXUS pilot project introduced the collaborative design and implementation of a set of innovative solutions and programs for optimizing water, energy and land resources in peri-urban agricultural practices in Nashik.

Abstract

In order to improve the city's resource management, ICLEI South Asia supported by the German Development Cooperation and the Nashik Municipal Corporation (NMC), came together to implement pilot projects to demonstrate the Urban NEXUS approach. The pilot projects focused on the management and optimized utilization of energy and groundwater to limit the impacts of constrained resources on farmers and hence local food production. The Urban NEXUS innovation applies as much to the resource management as to the institutions and the community that shapes them. The successful implementation of pilot projects changed the mindset of institutions to favor cooperative and intersectoral planning approaches instead of traditionally "siloed" sectoral practices.

Date	Dec. 2013-present
Urban NEXUS Sectors	Water-Energy-Food
Urban NEXUS Innovations	Design & Technology, Communication and Users Behaviors, Delivery Models, Institutions
Scale	City-level
Budget	137,200 EUR

The challenge of water, energy and food management in Nashik, Maharashtra, India

Agriculture constitutes over 14 percent of Maharashtra's Gross Domestic Product (Census 2011). Nashik is one of the most important agricultural hubs in the State, contributing a major share towards the GDP. Farming in the city is precariously dependent on groundwater as a supplement to the supply from irrigation canals. However, the groundwater and acquifers with limited storage capacity have been depleted in the past few years due to over-exploitation. State energy policies have led to highly subsidized electricity, in order to boost agricultural production. This has led to the wastage of both energy and water, negatively impacting both the environment and the economy of the state. As a result, agriculture, groundwater and energy are bound in a "nexus" of mutual dependance where the growth of one sector (agriculture) is dependent on the unsustainable consumption of other two sectors (groundwater and energy), so much so that even food security and livelihoods are threatened. The significant drivers underlying Nashik's resource challenges are the siloed institutional departments in the city responsible for the diverse sectors and resources which manage them. Conventionally, resource planning and management in Nashik occurs in isolation with little to no involvement among relevant stakeholders, resulting in a disconnect between food, energy and water sectors, despite their complex and interlinked relationship.

Urban NEXUS Definition

The Urban NEXUS is an approach to the design of sustainable urban development solutions. The approach guides stakeholders to identify and pursue possible synergies between sectors, jurisdictions, and technical domains, so as to increase institutional performance, optimize resource management, and service quality.

It counters traditional sectoral thinking, trade-offs, and divided responsibilities that often result in poorly coordinated investments, increased costs, and underutilized infrastructures and facilities. The ultimate goal of the Urban NEXUS approach is to accelerate access to services, and to increase service quality and the quality of life within our planetary boundaries.

ICLEI / GIZ 2014

Urban NEXUS Case Study

Fragmented approaches leading to system inefficiency in Nashik

The Urban NEXUS project city, Nashik, is located in the north-western part of the state of Maharashtra. The city, also known as the 'Backyard of Mumbai' and the 'Wine Capital of India' contributes to the economy of the state through its vegetable and fruit supply to Mumbai and the rest of the globe. As an agro-intensive hub, the city consumes large amounts of pumped water (surface water as well as groundwater) for agriculture. Energy intensive groundwater pumping has led to a decreased water table and along with it increased energy consumption – a cycle which continues to prevail.

Additionally, land once allocated for agricultural use along Nashik's periphery and within the city, has been sold for residential purposes, thus reducing land available for food production. However, the majority of purchased land is not put to use for years, resulting in a large amount of idle land in the city. Gravity-fed irrigation from river tributaries has also decreased as result of the shifts in land use. With the increased urbanization, the NMC is confronted with the new challenge of maintaining urban-rural interdependencies and trade-offs in terms of energy, land and water consumption for agriculture and housing.

All three components of Urban NEXUS in Nashik – water, energy and agriculture (food) – fall under the competencies of the State Governments in India. The land use plan is developed by the city's town planning department while decisions regarding water supply for drinking and irrigation rest with the City Corporation and irrigation department. Traditionally, the three departments work in isolation and do not interact with each other before making any decision regarding resource uses. This fragmented approach has led to major inefficiencies.

Moving Towards Integrated Resource Productivity

Considering the strategic location and agricultural importance of Nashik, the proposed entry-point for the project was to bring the fallow or unutilized scrubland into urban and peri-urban agriculture (UPA) use. However, integrating private land into agricultural practices is complicated by the nature of its land ownership and the complex social and economic interrelations of its current use. Strategies to bring this land into agricultural purposes will require exploring legal prescriptions, financial incentives and participatory site selection approaches which demands a long-term commitment by stakeholders and concerned departments. Promoting productive UPA practices allows for improved resource utilization in various ways, e.g. the re-use of treated wastewater for ferti-irrigation, reducing transportation needs and fuel consumption for agricultural produce, reducing the overall input costs for agriculture and others.

From the four wards initially selected as pilot areas, the stakeholders decided to choose Makhmalabad (Ward No. 6) for the first pilot project due to the intensive agricultural practices in the ward, and because of the large amount of its agricultural land undergoing transformation.

The stakeholder group decided that the solutions to this challenge need to start on a small scale in a single ward to demonstrate short-term gains which can be scaled

up over time to change the forms of development across the city at large.

Breaking the Silos: forming the Stakeholder Group

Usually, most of India's municipal and state institutions are divided into 'silos' separated by thematic and technical boundaries and diverse practices. In order to break the ice between different departments and institutions, a stakeholder group was formed for the Urban NEXUS project. The stakeholder group consisted of more than 30 representatives from departments and institutions across the various levels of governance, vertically (institutions at district and state level) and horizontally (different departments within the Nashik Municipal Corporation). The stakeholders represented departments and institutions that are primarily involved in decision-making processes regarding the water, energy and food sectors.

The stakeholder group was formed with an aim of bringing together all the concerned officials from relevant departments on a common platform to initiate a dialogue and exchange with each other. For the first time, the departments came together to take decisions on the design and implementation of the Urban Nexus pilot project. The stakeholder group recognized the importance of urban and peri-urban agricultural practices and its associated benefits, and decided to demonstrate this with a set of solutions for optimizing water, energy and land resources in UPA in Nashik.

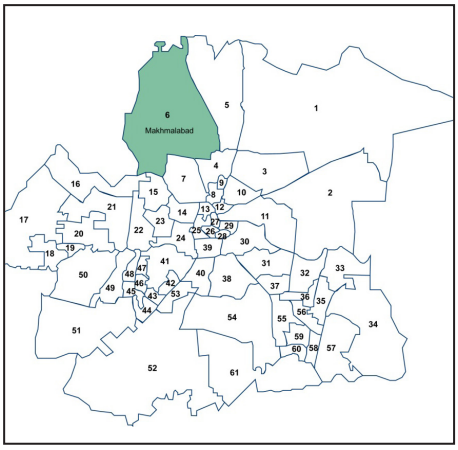
The stakeholder meeting facilitated the decision-making process between departments and created stronger alliances between all stakeholders for interdisciplinary collaboration and cross-sectoral knowledge exchange. Bringing together all the decision makers involved was imperative for the success of the project because Urban NEXUS implementation involves political decisions and commitment, along with changes in institutional cultures. This requires a higher level of flexibility, and cooperation across institutional boundaries.

Moving Towards Resource Efficiency

Considering the limited availability of time, funds and an uncertainity about the results of the pilot projects, the stakeholder group decided to focus on improving resource productivity through implementing four pilot projects in the Makhmalabad area. All four pilot projects are interlinked and demonstrated a successful example of well-coordinated planning and synergy that is required for efficient urban interventions.

(i) Evaluating the Performance of Agricultural Pump Sets: Agriculture remains one of the major and most inefficient energy consuming sectors in Nashik and provides an immense opportunity to save energy through better technological and management techniques. There are approximately 643 registered wells and 129 registered bore wells in the Makhmalabad ward. Only 787 pump connections are legally registered in the ward area, although many more are likely to exist. The irrigation pump sets installed by the farmers are generally inefficient with operating efficiency level of 20 percent or less. Improper selection and installation of pumps, high-friction pipes and the lack of proper maintenance are the main factors contributing to high energy consumption. With the decreased pump efficiency, farmers tend to use pumps for a longer duration, hence consuming more energy, with relatively smaller output of water.

Inefficient water pumping also has an impact on global warming and climate



The Pilot Area (Makhmalabad) in the city context

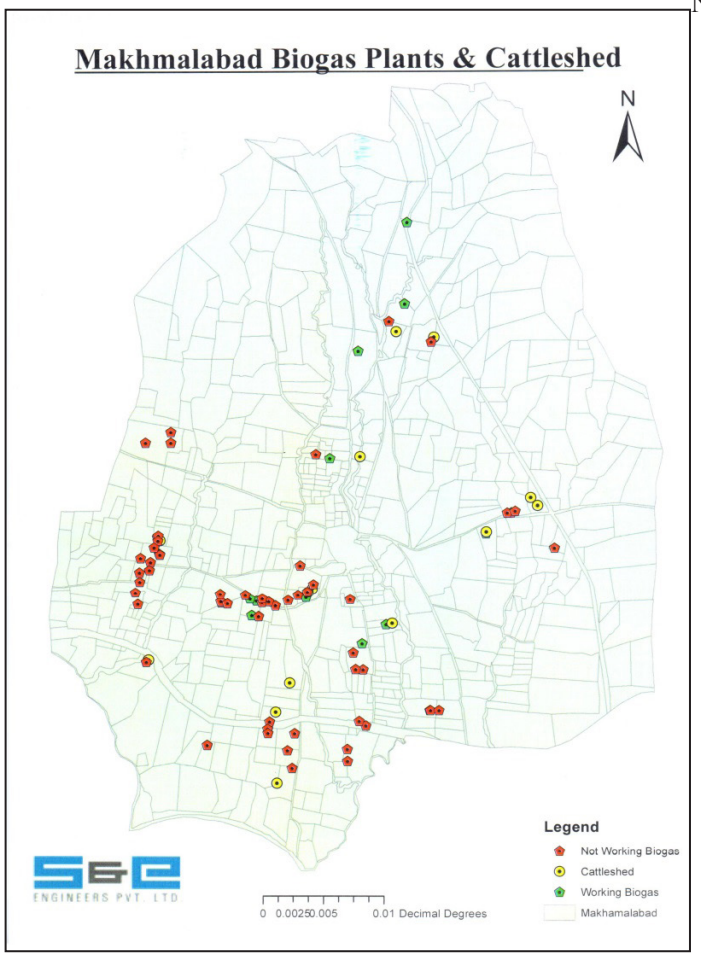
Nashik's Urban NEXUS Implementation Stakeholder Group

- Water Supply and Sewerage; Solid Waste Management; Environment; Town Planning Dept. Nashik Municipal Corporation (City level)
- Irrigation Department (District and State level)
- State Agriculture Department (State level)
- Maharashtra Engineering Research Institute (State level)
- Maharashtra Environmental Engineering Training and Research Academy (State level)
- Maharashtra State Electricity Distribution Company Limited (District level)
- Groundwater Survey & Development Agency (District Level)
- KK Wagh College of Agricultural Engineering and Technology (Academic)
- Agriculture Produce Market Committee (District level)

change through higher greenhouse gas emissions. (According to IFPRI, 2009, when the efficiency of pumps is increased from 20 percent to 30 percent, there is a 50 percent decrease in the associated carbon emissions.)

With this background, the Urban NEXUS stakeholder group decided to conduct a performance evaluation of agricultural pumps in the ward area with a view to implement the model in other areas of the city based on its success. The performance evaluation of pumps was followed by training and awareness-raising among farmers on the most appropriate selection of pumps, their operation and maintenance, and the economic gains from better energy efficiency resulting in lower utility bills.

(ii) Creating a Groundwater Recharging System: Groundwater has proven to be an invaluable source of irrigation in the area. However, the usage of inefficient pumps, highly subsidized electricity and lack of incentives has led to increased dependence on groundwater, thereby, resulting in a lower water table and risk to local water and food security. Moreover, acquifers in this geograpical region are primarily basaltic in origin with limited capacity. Furthermore, due to lack of awareness and incentives, local farmers have negelcted the importance of groundwater recharge and rainwater harvesting. As a result, a high percentage of the groundwater assessment blocks in the Nashik District have been classified as rapidly deteriorating as semi-critical, critical, or overexploited areas. Recharging of groundwater helps in maintaining the water table at minimum depth, hence making water available during long dry season for irrigation purposes at a lesser rate of energy consumption. Realizing the importance of groundwater recharging, Nashik Municipal Corporation (NMC), along with the Groundwater Survey & Development Agency (GSDA), came forward with the suggestion to create potential groundwater recharging structure in the city at identified areas. Subsequently, NMC undertook a study for the entire city and identified four sites for constructing a groundwater recharging system. The limited funds available for the pilot project implementation have allowed for the installation of one recharging system in the city. However, there is a need to implement a groundwater recharging system in the entire city to meet the future water demands of the growing population. While NMC is interested to invest, support will be required in terms of technical guidance and capacity building for a successful upscaling of the initiative.



(iii) Mapping local Biogas Potential: The National Biogas and Manure Management Programme (NBMMP), initiated in the 1980s, promoted family size biogas plants with the aim of replacing traditional fuels (wood and dung cakes) with cleaner and convenient low-cost fuel with additional benefits such as organic manure and improved sanitation. Realizing the potential of biogas, availability of huge cattle wealth and subsidies under the NBMMP, farmers in Nashik installed biogas plants in the 1980s. However, with the passing of time, the cultural change from manually based agriculture to mechanized farming, led to a reduction in the number of cattle, thereby reducing the raw material which is required for biogas production.

Stakeholder meeting and panel discussion in Nashik

The Urban NEXUS stakeholder group recognized the importance of biogas and decided to map the current biogas production potential in the Makhmalabad ward area. Online maps with basic attributes were thus developed with information regarding the location, capacity and usage of all existing biogas plants in the ward area. The study included semi-structured interviews carried out at the houshold level, which revealed that only 11 percent of the installed biogas plants are currently functional. According to the analysis of data collected, nearly 52 percent of biogas plants are non-functional due to a lack of raw material, and the rest are out of use because of various operation and maintenance issues.

Interestingly, all the biogas plants are toilet-linked, hence also providing a solution to sanitation issues. Further, slurry from the bio-digester can be used for ferti-irrigation thereby reducing the demand for fertilizer for farms. Inspite of these benefits, however, the community has resorted back to wood or dung cakes to meet its fuel requirements, thereby producing higher greenhouse gas emissions.

Study tour with school children on a farm in Nashik

The Urban NEXUS stakeholders proposed to the Nashik Municipal Corporation, to undertake a biogas mapping of the entire city, raise awareness and leverage funds from national programs to meet the future fuel requirements at the household level and take astep towards environmental sustainability. Recently, the Ministry of New and Renewable Energy (MNRE) of the Government of India has released revised NBMMP guidelines under the 12th Five Year Plan for all the State Governments to install a targeted number of 650,000 biogas plants in the year 2014-2015. The guidelines provide central financial assistance for the installation of new biogas plants and the repairment of non-functional plants (see box page 9).

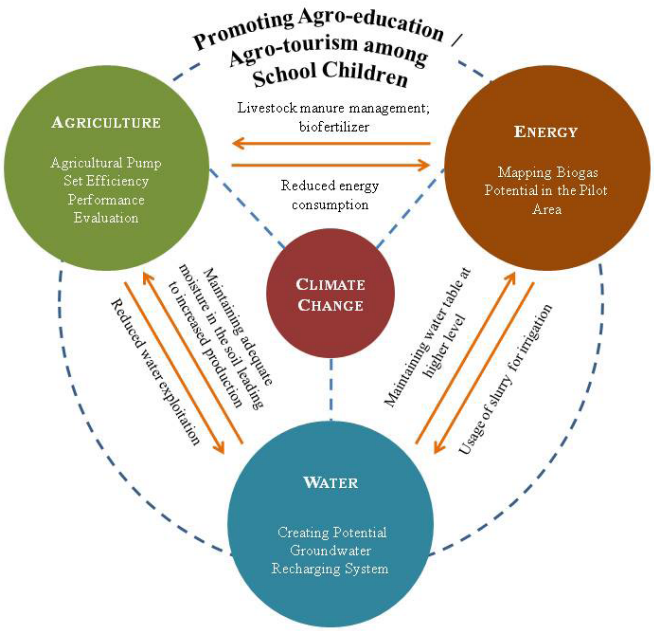
(iv) Promoting Agro-education among school children: Since one main focus of the Urban NEXUS approach is to change the mindset of the community, awareness raising about the important issues of resource efficiency was sought by involving primary and secondary school students who were taken around farms and practically introduced to important rural-urban interlinkages as well as water conservation techniques and organic farming practices. A group of 35 students and their teachers were taken to an organic farming site, where they were

taught about soil erosion, tillage and the negative impacts of pesticide usage. It is expected that the learnings adopted by the children will be passed on to their parents and society at large.

Since the visit, numerous municipal schools have requested that the Nashik Municipal Corporation may upscale and undertake similar activities regularly.

Results

The project implementation of the Urban NEXUS approach resulted in the adoption of basic measures in an integrated manner with the aim to address multiple issues in one go. Thus, an interlinked systemic approach included the installation of energy efficient pumps to reduce electricity consumption, groundwater recharging to maintain the water table, and the development of biogas to reduce a dependence on fossil fuels and energy inputs for agriculture in the ward area. The importance of resource efficiency was propagated to a wider public through the involvment of school children. The project implementation fed into the larger goal of promoting urban and peri-urban agriculture in Nashik to meet food security issues along with the minimization of required resource inputs such as energy, water, fertilizer, transportation fuel and others.



Moving Towards Resource Efficiency: The Urban Nexus in Nashik

During the project implementation, stakeholders have realized that further collaboration between them is required and that the Urban NEXUS approach has great potential to truly address and change the way institutions and society conceive its water usage, energy and food production. While change is often slow to happen, initial results of understanding the Urban NEXUS approach can be demonstrated to motivate the community and institutions to adopt the change. After six months of project implementation the results are as follows:

The Urban NEXUS brought about improved inter-departmental coordination. The founding of an Urban NEXUS stakeholder group led to increased interaction among all concerned stakeholders and "ice breaking" between departments. This ensured a transparent and well-informed decision making process regarding the

design and implementation of the four main activity areas. The project was so successful that the stakeholders have since decided to form similar Urban NEXUS task forces to ensure the participation from all relevant departments in future activities.

Multi-level governance was achieved through the involvement of stakeholders from the district and state level. As mentioned, such a large array of insitutitions have never come together to make joint decisions regarding resource usage. The stakeholders realized that resource and ecosystem boundaries transcend administrative boundaries and hence require intensive coordination across actors and institutions.

Energy efficiency was improved by the replacement of inefficient pump sets with more efficient, right sized pumps and the installation of low-friction valves and piping. The energy consumption for irrigation was thereby reduced by about 25-30 percent, translating into considerable savings in the longer run. Not only does the initiative lead to a lower energy use for water pumping, it also implies a higher food production per drop of water and thus an increased water use efficiency.

Resource efficiency is an important objective of the Urban NEXUS approach and was met through promoting the revival of non-functional biogas plants. Biogas plants can play an important role in reducing the dependency on traditional fuel sources such as wood, dung cakes and liquid petroleum gas for domestic purposes and hence reduce greenhouse gases being emitted into the environment. Slurry, a bi-product which is very high in nutrient content, is used for ferti-irrigation, thus reducing the input cost of agriculture and promoting organic agriculture practices. Moreover, since most of the biogas plants are toilet-linked, issues of sanitation are addressed simultaneously.

Conservation of natural resources was achieved through groundwater recharging of the hard rock acquifers in the city. Part of the funds available under the project implementation were allocated as a seed for a groundwater recharging project undertaken by the Nashik Municipal Corporation. The total value of the project is estimated to be €73,200 Euros which indeed is a considerable amount to be allocated from municipal budget.

Mitigation measures towards climate change were developed as more efficient groundwater pumping and biogas utilization for cooking purposes reduce the amount of greenhouse gases being emitted into the environment. Groundwater recharging also serves as an adaptive mesaure to reduce the impacts of climate change by maintaining water table balance. Moreover, all these measures after being tested for technical feasibility and implemented on a pilot basis will feed into the detailed Sustainable Urban Habitat Action Plan (SUHAP) being prepared for Nashik City and will have the potential for replication on a larger scale in a phased manner.

Awareness Raising of students from municipal schools helped in exposing them to practical applications of resource efficiency and organic farming while it also transmitted the message on a larger scale within the community.

Demonstration of the new punps to local farmers

Nashik's experience with the Urban NEXUS approach put to words:

"The Nexus project was crucial for Nashik Municipal Corporation to address the challenges our city faces with an integrated approach. By moving at the same time towards water, food and energy security, we have already managed to improve our resource productivity and system efficiency. The project has also helped us establish institutional linkages that were previously missing and create as well as build on synergies between different departments. We are leaving behind a centralized way of working and looking ahead towards a more integrated and resilient future."

Mr. Yatin Wagh

Mayor, Nashik Municipal Corporation

Training and capacity building of local farmers helped in sensitizing them to the utilization of energy efficient pumps, adopting efficient irrigation techniques such as drip and sprinkler in order to save energy and water, and thereby propagating the idea of "more crop per drop".

Community ownership of the project was achieved through a tripartite agreement between the farmers, the NMC and ICLEI South Asia where each individual farmer committed to undertake the operation and maintenance of new agriculture pumps to be installed over the next few years. According to local officials, this was also the first time in Nashik that the community realized its joint responsibility and took collective action. This is a clear positive indication of society realizing the importance of resource efficiency and simultaneously ensuring the sustainability of the project.

Lessons Learned

The project implementation provided critical learning experiences of managing several institutions and simultaneously working together with different stakeholders as well as the local community. Some of the major challenges faced during project implementation include:

Bringing together multiple levels of governance requires considerable time. The Urban NEXUS stakeholder group consisted of representatives from different institutions at various levels – local, district and state levels, as well as non-governmental organizations and academia. Significant time is required for coordinating with all the stakeholders to bring them together at one place at a time. A local official based in the city could facilitate this process to a great extent.

Limited time and human resources can shape an Urban NEXUS outcome. Surveys of agricultural pumps and biogas plants at the household level required a considerable amount of time and human resources. This was difficult to provide in a short-term project. Under projects with a similarly tight timeframe, an option to improve this process could be the hiring of an external consultant to carry out such an extensive survey and analysis.

Creating openness to the Urban NEXUS approach is crucial. Efficient resource usage depends on the cooperation of all departments that use the given resource or are related to its management. But since each institution is traditionally used to work in isolation, without considering the repercussions or possibilities of collaboration with other departments or actors, efforts were needed to engage them in fruitful discussions. However, after some initial one-on-one discussions all stakeholders could be engaged more meaningfully in making better informed and integrated decisions on issues affecting everyone.

Building trust with communities is a make or break factor. Interaction and building trust with the community is important for the successful implementation of projects on the ground. In order to generate a sense of ownership among the community towards the project, it was necessary to involve the local citizens (e.g. through the farmers and school children) and interact with them, so that they could better understand the benefits of the project.

Political will and commitment ensure that an Urban NEXUS project will take flight. Political commitment along with the support of the City Corporation is essential for any project implementation at the local level in India. To ensure successful implementation of the project, it was necessary to involve the political and administrative wings of the municipal corporation in all major decisions of

the project. This will ensure their continuous support to the activities as well as provide critical practical local knowledge about implementation potentials and pitfalls in different places in the city.

Building awareness is a continuous process. Given the project's limited timeframe, it was only possible to bring stakeholders together twice to give them a taste of collective decision making. The officials at the City Corporation lacked awareness and information on the Urban NEXUS approach to efficient resource management. Although the pilot project gave officials a first taste of the approach, further training and capacity building is required at all the levels to be successful on a larger scale and to guarantee the long-term institutionalization of such reforms. Awareness raising and incentives for the efficient usage of resources can make communities more responsive to challenges.

Budget and Finances

The Urban NEXUS project with its four main activity areas was implemented with modest funds under the Urban NEXUS project supported by the German Development Cooperation. Additionally, there were significant in-kind contributions from the NMC and other partners and institutions that ensured the success of the project:

- **Recharging the groundwater table:** using the pilot project implementation funds as a seed, the NMC has invested an additional €73,200 for developing the groundwater recharging system in the city.

Experts from **Groundwater Survey and Development Agency (GSDA)** supported the project through their technical expertise in the sector, e.g. by reviewing and providing suggestions to the NMC groundwater recharging proposal.

- **Promoting agro-education among school children:** the **NMC**, through its Department of Education, released circulars for municipal schools to involve their teachers in organizing students to participate in the educational tour.

KK Wagh Agricultural College of Engineering and Technology provided technical support and staff capacity for facilitating the entire tour for students. The college also gave permission to visit their agricultural farm for the purpose.

- **Capacity building and training of farmers:** officials from the **NMC** were present during the capacity building and provided support in terms of time and staff. **KK Wagh Agricultural College of Engineering and Technology** provided technical support for facilitating capacity building and training program for farmers. Experts from the college also helped in finalizing contents of handouts for farmers and in translating them into the local language.

- **Community engagement:** the **NMC** signed the tripartite project agreement (agreement between community, NMC and ICLEI SA) and agreed to monitor the functioning of irrigation pumps for the next five years. Presence of the Mayor during signing of the agreement provided a motivational boost to the community.

The citizens of the ward area of Makhmalabad supported the implementation of performance evaluations of agricultural pump efficiencies by providing us with relevant data information like electricity bills and by allowing auditing in their private farms. The project would not have been successful without their positive response.

Financial incentives for the installation of biogas plants/ the revival of non-functional biogas plants:

The task of setting targets and disbursing funds for the promotion of biogas plants is coordinated by the Ministry of New and Renewable Energy (MNRE). State level targets are further specified at the district and block level.

A package of financial arrangements has been made under the National Biogas and Manure Management Programme (2014-15) by the Government of India.

Some of the means created to extend financial support include subsidies for the beneficiary, a turnkey fee for the biogas entrepreneurs or NGOs and a motivation fee for the motivator. Additionally, loans from several national and regional agriculture and rural development banks and co-operatives are also made available to the beneficiary.

Key Contacts

ICLEI South Asia
Ritu Thakur
Senior Project Officer
Ground Floor, NSIC-STP
Complex, NSIC Bhawan,
Okhla Industrial Estate
New Delhi - 110020, India
Mobile: +91-9871257695
Tel: +91 – 11 – 4106 7220
Fax: +91 - 11 - 4106 7221
Email: ritu.thakur@iclei.org
Web: southasia.iclei.org

ICLEI World Secretariat (WS)
Capacity Center
Kaiser-Friedrich-Str. 7
53113 Bonn, Germany
Tel. +49-228 / 97 62 99-00
Fax +49-228 / 97 62 99-01
Email: urban.research@iclei.org
www.iclei.org/casestudies

Replication

The Urban NEXUS pilot project has also served as a major input to the Sustainable Urban Habitat Action Plan (SUHAP) of Nashik that addresses both the issues of climate change mitigation and adaptation. The revised city development plan of Nashik will include these components of the SUHAP. The SUHAP is being developed by GIZ under its Indo-German Environment Partnership (IGEP) program in consonance with the Government of India's National Mission on Sustainable Habitat.

The pilot project implementation has helped to reinforce the belief that an Urban NEXUS approach is not only essential for meeting future demands of growing population, but also for making well-informed decisions across sectors. The momentum achieved by the pilot project should be harnessed and scaled up to the entire city for larger benefits. The biogas mapping and revival of non-functional plants should be up-scaled for the entire city through the leveraging of funds available under the recent NBMMP program of the Government of India (2014-2015).

Nashik Municipal Corporation, along with other involved stakeholders, has expressed their interest to replicate the project to the entire city with the help of external technical and financial support. Although the NMC is interested to invest in infrastructure improvements, it will still need support in terms of overseas development assistance to bridge institutional and thematic silos.

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The Urban NEXUS project included: a baseline study and report (GIZ and ICLEI, 2014), the identification and preparation of case studies and shorter case stories, and the design and implementation of action-oriented pilot projects supported by the German Development Cooperation.

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Further Reading

- GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS: towards resource efficient and integrated cities and metropolitan regions. Available at: www.iclei.org/urbannexus

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ICLEI Local Governments for Sustainability

This Case Study was elaborated for the Urban NEXUS project 2013-2014.

The ICLEI Case Study series is available at www.iclei.org/casestudies, and focuses on various types of urban sustainability activities of ICLEI Members and local governments that are part of ICLEI projects across the globe.

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