Urban NEXUS – Expert Statements

These statements and articles provided by experts in contribution to the study "Operationalizing the Urban NEXUS: towards resource-efficient and integrated cities and metropolitan regions" by ICLEI and GIZ, illustrate the value of Urban NEXUS thinking and practice.

Operationalizing the Urban NEXUS – Expert Statements **August 2014**

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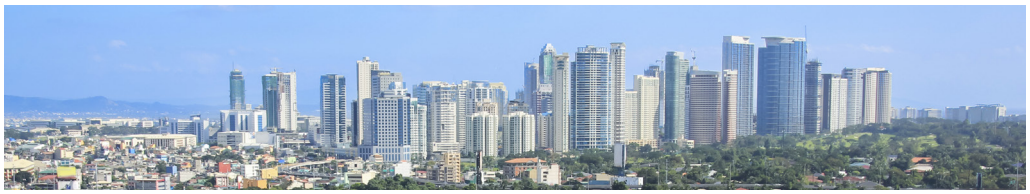
Urban NEXUS Definition

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.

GIZ and ICLEI, 2014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Dr. Uschi Eid

Chair of the United Nations Secretary General's Advisory Board on Water and Sanitation (UNSGAB)

"Against the backdrop of rapid urbanization in most developing countries, especially affecting low-income areas, and by considering the interdependencies between water, energy and food security and related resources for increased efficiency, reduced trade-offs and enhanced synergies, the NEXUS approach provides a useful framework for meeting the needs and demands of a growing urban population.

With increasing population pressure, it has become apparent that 'silo' approaches have reached their limits in dealing with a complex urban environment, characterized by multiple potential resource conflicts between various urban sectors (water, sanitation, wastewater, solid waste, transport, energy, agriculture, amongst others). The NEXUS approach allows containing these potential conflicts or even creating synergies by, for example, promoting increased productivity of resources and resource use efficiency, in line with circular economy principles.

Urban low-income areas present a particular challenge, considering that currently close to 1 billion people live in slum conditions and that by 2030 this figure will have doubled. Slum dwellers often live without safe drinking water, have no decent toilets, leave alone environmentally safe disposal systems. They are rarely connected to modern energy and there is no proper solid waste collection system. In short, slums are public health hotspots and are at the center of the urban crisis in many developing countries.

In order to tackle this challenge, we must start to think and act in a more integrated manner. Good thinking is already underway, especially regarding human waste. In my view, the productive sanitation approach is a good example for the urban NEXUS: Urine is used for liquid fertilizer, human and organic solid waste for compost, grey water for irrigation in urban agriculture and sludge is converted into biogas for cooking in private households and in small cook-shops. At the same time there is no doubt that a lot remains to be done in implementing the urban NEXUS. The right economic incentives need to be set by, e.g. creating workable opportunities across the entire Sanitation Value Chain. Institutional and regulatory frameworks which allow effective cross-sectorial urban development and planning have to be put in place."

"For rapid urban growth to be sustainable, in the context of climate change and food security, there is need for "decoupling". Essentially, this means enhancing the quality of life while simultaneously minimizing resource extraction, energy consumption, and waste generation, and safeguarding ecosystem services. Decoupling will depend on how cities are planned and on how city-based energy, waste, transportation, food, water, and sanitation systems are expanded and/or reconfigured. In this regard, there is a clear role for food systems and urban agriculture. Indeed, well planned and managed urban agriculture can play a key role in decoupling, as part of the overall food systems within a city-region."

Rafael Tuts

Coordinator, Urban Planning and Design Branch, United Nations Human Settlements Programme, UN-Habitat

“It is true that much of the meaningful effort to create sustainable livelihoods for global citizens is taking place - and will take place - in cities. In order to have success in the effort there is need for a "systems" perspective, where one does not only look at the intended effect of an initiative, but also at its effects in all other areas of urban life.

In this broad perspective there is one challenge that is normally neglected, namely how to avoid a huge and destructive inflow of new people to any city that is particularly successful in creating a good life for its citizens. This difficult question needs an answer in order to achieve success in the Urban NEXUS.”

Prof. Dr. Jorgen Randers

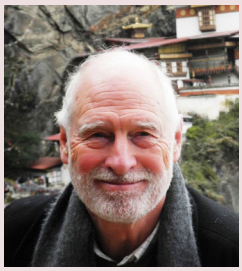
Professor of climate strategy, Norwegian Business School BI; Member of the Club of Rome and Author of "2052, a global forecast of the next forty years"

Dr. Ren Wang

Assistant Director General, Agriculture and Consumer Protection Department, FAO

“Agriculture has been the center of civilization since history began, and food is one of the basic elements of human survival along with clean water and air, that we often take for granted. Food is a common denominator that connects people, environment, and the economy in all situations. In this rapidly urbanizing world, the Urban NEXUS approach that brings together water, energy and food in the urban context, cannot be discussed without the concept of city region food systems. City region food system is defined as “the complex relation of actors, relations and processes related to food production, processing, marketing, and consumption in a given geographical region that includes one main or smaller urban centers and surrounding peri-urban and rural areas that exchange people, goods and services across the urban rural continuum” (City region food system definition from a meeting convened by FAO, December, 2013). In other words, the “urban” cannot stand alone, but it is interdependent with its surroundings, the ecosystem and the people within, and outside the boundaries of the cities.

This requires us to tackle the issues we face today in a holistic manner. With limited natural resources, increase in extreme weather events and volatile global economy, cities must take the NEXUS approach for a more resilient and sustainable development. Producing “more with less” – the Save and Grow approach (FAO 2011) - is one that enables us to deal with this complex issue. Inclusive policy and governance that take into account the various sectors’ interest is key in realizing this approach. For this, all levels of society, from international institutions, national and local governments, and citizens themselves must resume its role in achieving a better future. Knowledge sharing is the first step, and I commend ICLEI for its CITYFOOD program that facilitates this. FAO as a knowledge organization, will also support this important approach.”



Dr. Adrian Atkinson

The current 'Urban NEXUS' problematic and potentials in cities of the south

The failure of conventional institutional interventions in cities of the South

The challenge of sustainable urbanization arises from increasingly serious resource supply bottlenecks and shortfalls in cities of the South, including 'water stress', resulting from expanding cities contending with a fixed resource base; an over-reliance on non-renewable energy resources; and food insecurity manifesting itself in growing undernourishment (quantity) and malnourishment (quality).

Traditionally urban populations have relied on resources to sustain themselves from their immediate hinterland and interior. Today, however, economic growth, general trends of globalisation and corresponding lifestyle changes have led to increasing resource demands, coupled with the availability of cheap energy and greater ease of transport, which has meant looking further afield for resources, as well as wasteful means of managing their flows.

The wasteful, and in most cases poorly functioning, practices of urban resource provision in the South come from attempts to apply methods of provision from the North, which are all too often reinforced by development cooperation and investments formulated and financed by International Financial Institutions (IFI's). This has resulted in 'institutional cultures' that perpetuate inefficiencies in a situation where 'traditional cultural sensitivities' and evolved local practices are both ill-adapted to the attempted methods of provision and may also be resistant to new approaches proposed in the framework of an Urban NEXUS. Finally, all too often local expertise and financial capacity of city authorities are insufficient to implement the conventional systems and methods, with the result that these tend to work very poorly.

Geophysical, cultural and institutional dimensions that international development must take into account

In practice, different cities face different challenges from many viewpoints. Regarding the physical aspect, this means differential stresses and also approaches that might be taken to address these effectively. Regional rainfall and the proximate existence of water bodies are the basis for water provision that will indicate relevant sources but also possible supply improvements, for instance, for rainwater harvesting (not a possibility in low rainfall areas) and the need for the effective recycling of water.

Global trends, however, have also resulted in institutional changes in the management of urban resources. Regarding energy, traditionally cities everywhere obtained energy supply from biofuels from the surrounding countryside and throughout the South, and still do. Expanding urbanization has resulted in biofuel crises which have increasingly triggered programmes to introduce paraffin or Liquid Petroleum Gas (LPG) for cooking. Meanwhile an over-reliance on petroleum also to fuel transport systems and electricity to run industries and households is facing a declining supply and escalating cost crisis. Despite the existence and opportunities of renewable options such as solar and biogas, such technologies are still deemed too expensive to mainstream. In addition, projects at the community level offer limited economic incentives in relation to their complexity, leaving international institutions and NGOs as the likely agents to take the lead in their dissemination. There is at the same time a danger that projects that require community commitment and management organised top-down by IFIs or other international development agencies, will fail to be sustained once the agencies depart.

Many southern countries are concerned with food security and even have ministries and/or national and local agencies to address the problem. However, these generally involve 'top down' approaches, attempting to address the issue through general improvement in agricultural production seen from the national level and influencing import and export policies, with local food production still too often being left out of the 'food security discourse'.

A key challenge, and crucial step, for Urban NEXUS resource management in the South, includes the re-

integration of municipalities and local stakeholders into the oversight and management process of local resource flows. This problem is occurring at the sector level, which makes linking multiple sectors to accomplish Urban NEXUS initiatives through single projects and investments for water, energy and food, problematic.

For example, whilst water supply earlier in the 20th century was a municipal function, today the management has usually been transferred to sub-regional water 'utilities' and more recently private corporations whose scope is determined by the area of the watershed rather than municipal boundaries, leaving municipalities with little to no responsibility and a loss of knowledge and expertise.

Thus, the potential and challenge of the Urban NEXUS in the South, as both a policy and resource management design, is how to re-integrate local resource management into local authority responsibilities, in sustainable and integrated means to promote efficient cross-sectoral resource and delivery service management.

Implications for re-localisation and integrated management of resource supply – some tentative starts

A crucial dimension of re-localisation involves ensuring the return of resources to urban sub-regions, where in recent years city administrations have had decreasing responsibility managing their supply. A good example can be seen in China where, in the 1950s, the government expanded urban boundaries substantially to improve food security for the cities. For example Beijing municipal boundaries were extended from 4,822 km^2 to 16,808 km2 which has stood the city in good stead in terms of food quantity and quality.

Although it holds great potential in the context of a rapidly growing social movement, as of yet, there is little – but nevertheless growing – official attention being paid to urban and peri-urban agriculture (UPA) for food-security - but also for improved food quality and increasing community responsibility for food production and distribution.

This raises the issue of urban and peri-urban agricultural land as a resource, which in very many cities in the South, land is subject to land speculation but left unused often over long periods or even spoiled for agricultural use. This needs to become the subject of regulation and enforcement to encourage the owners to bringthe land back into production (even if temporarily, while waiting for urban development). This would also lend itself well to improvement with locally-produced compost from urban organic wastes.

Right across the globe, small moves involving urban populations through ecological sanitation projects for recycling and reuse of solid waste and the recovery of wastewater and nutrients from human waste are progressing in the direction of significant institutional – and cultural – changes necessary to implement NEXUS initiatives effectively. In increasing numbers of cities in Asia such as Korat, Thailand, and Cebu City, Philippines, municipalities have begun to implement pilot projects experimenting with organic waste separation at the source for energy production with biodigesters (as discussed in the box Urban 'Waste' as Resource, in Annex B of the Study). These serve as a trial to support the idea of resource efficiency and the reduction of trade-offs, although truly community-organised systems have yet to be effectively tried.

Facilitating successful re-integration

Many Urban Nexus initiatives are both culturally sensitive in practice, cheaper and technically less demanding than 'conventional' urban resource management systems. However, making better use of the resources present in cities and their sub-regions requires a complex reworking of municipal departmental responsibilities and the involvement of other local institutions including community groups. This often calls crucially for changes in cultural attitudes and prejudices at the local, national and international levels. This is the context in which current pilot projects might be expected to be scaled up to become significant dimensions of efficient and effective urban resource management. Therefore, steps for IFI's and the international development community to take into consideration in order to ensure robust, sustainable Urban NEXUS projects, include taking the institutional, cultural and geographic settings into careful consideration, rather than employing blanket conventional solutions, and ensuring that local authorities have the capacity, knowledge and managerial structures to continue projects upon the completion of international interventions.

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Urban 'waste' as resource: Recycling as a key NEXUS Opportunity

Recycling resources within cities

Human populations produce inordinate amounts of water, food and energy 'waste', along with complex systems built to dispose of these. However, most of what we perceive to be 'waste' or in need for 'disposal' - from the rain discharged into our drainage systems through toilet wastes and washing water, to market, kitchen and garden organic wastes - are in fact resources that should be used to significantly substitute present-day urban resource imports. However, it requires a shift in thinking, attitudes and practices to fundamentally change our way of processing waste.

Conventional sanitation as a lost opportunity

In the past, organic 'waste' was the only source to sustain the fertility of the soil and until the 20th century almost all towns and cities sent their waste to farmers on the periphery of towns and cities as fertiliser to improve their output (see also Lüthi and Schütze, 2011). Modern 'waste disposal' and sewerage was invented because cities grew too large and dense for the removal of waste to the urban edge and the sudden appearance of pandemics of cholera and other diseases, traced to human waste, triggered the invention of modern waste disposal systems.

Today, conventional 'waste disposal' systems demand substantial energy resources from trucking, pumping and general operation, whilst throwing away substantial amounts of embodied energy. And whilst substantial amounts of energy are used to pump water to the city's taps, more is used to dispose of rainwater and the water used by households. Rather than reusing these valuable urban 'waste' outputs, we maintain the fertility of food production by application of non-renewable agrochemicals.

1.What is involved in recycling these 'wastes'?

In practice, 'conventional' waste management systems that we find in northern cities have almost entirely failed in the South. The recent realization of this failure has led to many 'pilot projects' in Asian and African cities motivated by the low cost and other benefits of 'alternative' resource recovery procedures. So far, we find many small pilot projects that demonstrate the workability of elements of the alternative system, but these have yet to be interconnected to form integrated, Urban NEXUS, resource management systems. The table below describes what is happening so far, contrasted with the alternatives, so that it becomes evident what still has to be done to realise such systems in practice.

Resource	"Conventional Solutions"	"Alternative" System Components
Rainwater	Falls upon sealed surfaces, flowing into drains and ultimately to urban waterways or the sea; or into 'combined sewers' that often stress treatment plants; small amounts of incidental groundwater recharge in open spaces and mild to severe urban flooding.	Rainwater harvesting cisterns should be installed on, or adjacent to buildings of all sizes. This water can be captured and used for flushing, washing and, if well-collected, for cooking and drinking. Ensure/enforce permeable open spaces, road verges, car parking areas etc. facilities to improve groundwater recharge.
Household washing water waste ('grey water')	'Grey' water is discharged into septic tanks/cesspits or into the sewer/drainage system or discharged directly into open drains.	Can be collected separately to reuse on onsite plants or sent to neighbourhood 'constructed wetlands' for treatment prior to use in urban agriculture.

Resource	"Conventional Solutions"	"Alternative" System Components
Household toilet waste (‘black water’)	These wastes are at worst ejected into plastic bags and thrown into the environment (‘flying toilets’) and otherwise discharged into groundwater-polluting septic tanks/ cesspits or the sewer system, often along with rain and grey water, provided there is a sewerage system and if not water combined with human waste is discharged direct into urban waterways, untreated.	Install ‘eco-san’ toilets to separate urine from faeces, the former diluted and treated to use directly as fertiliser on urban farms, the latter sent to biogas digesters to produce gas for sale to householders for cooking or to generate electricity, with the sludge dried and used directly as soil conditioner or added to other composted materials before use by urban farmers.
Household solid waste	Usually collected un-segregated and taken to a landfill or dump with informal recycling along the way by ‘waste pickers’ Often informally dumped in waterways and on vacant land.	Source separated in households, the ‘dry’ waste (metal, plastic, glass, paper) sold to/by small enterprises, the organic component fed to livestock and their waste sent to bio-digesters, or the organic waste sent direct to bio-digesters or composted for use in urban agriculture. The small remaining residual household solid waste sent to landfill or used as construction backfill.
Market and slaughter-house waste	Organic market and slaughterhouse wastes are currently sent to landfill (usually waste dumps or informally disposed of).	Market wastes fed to livestock, the waste of which is bio-digested; or, together with slaughterhouse waste, fed directly to bio-digesters, the gas and sludge sold/used as outlined above.
Park and agriculture waste	Park, urban agriculture, and road verge biological wastes are left uncollected, or are collected and landfilled.	These wastes can be collected for compost or fed into biogas digesters to be used for energy provision and compost.

Implementation of Urban NEXUS Approaches

There are two primary challenges associated with Urban NEXUS implementation, regarding the deployment of infrastructure and the institutionalization needed to support and maintain Urban NEXUS projects. In dense urban areas it can be difficult to find open spaces to implement more than one or two components. While, one-off components, such as single bio-digesters and eco-san toilets in informal settlements have been widely attempted, few have survived in the long term due to weak institutional commitment, cultural resistances and non-interconnection of profitable components. Thus, more integrated systems - such as rainwater harvesting, eco-san toilets with bio-digesters, the use of biogas for cooking, water heating, electricity and the use of sludge for growing vegetables – have been pioneered through the assistance of institutions that are prepared to manage such systems. The German NGO BORDA, has built and successfully implemented many integrated systems, particularly in hospitals in Asian and African cities.

The construction of these integrated solutions is a small challenge, compared to the greater hurdle of their long-term operation, which is heavily dependent upon public awareness, community participation and organization at the neighborhood level. In principle, these systems may be expected to develop where there is enough vacant land that may be close to city centres but clearly becomes more viable in suburban and peri-urban areas. Eco-san toilets have proved to be both technically workable and profitable - they collect urine and faeces and can be combined with local bio-digesters from which the gas and sludge can be sold for income/profit, which

provides an incentive for communities or small enterprises to operate them over the long term. Such systems, as integrated systems, have however, yet to be proven as viable within the overall urban institutional framework.

Many municipalities in Asia and some in Africa are showing interest and even skills necessary to support such projects. This is essential for success, with water, wastewater and solid waste management authorities, environment and health departments and perhaps others collaborating, perhaps through cross-sectoral 'NEXUS Task Force' engagement, to formulate coherent policies and thence plans to develop such initiatives.

Successful examples in GIZ project cities include, in the city of Korat in Thailand, municipally organised household source separation of organic waste, centrally bio-digested to generate electricity and applying the sludge to extensive peri-urban agriculture; and an 'Energy from Waste' project in Nashik, India, using market wastes and waste from community toilets to produce biogas used to generated electricity. Another example is where the city of Cebu in the Philippines is using market and household organic waste to produce biogas used in free community kitchens, the sludge being used by a neighbouring Municipal, tree nursery.

What Gains?

The small pilot projects experimented with in so many southern cities in recent years show clear NEXUS gains, in the production and use of gas combined with the application of the sludge to assist in growing vegetables. Given the elimination of conventional sanitation energy costs, this may be deemed a definite economic as well as resource gain. No calculations have been carried out to assess the overall resource balance of such systems. Providing measurable and quantifiable analysis should be a component of all urban NEXUS projects, in order to identify the priorities and 'line of least resistance' in developing initiatives. Future projects should employ an overall calculation and evaluation of short and long-term financial and social benefits in terms of urban resource accounting. However, when it comes to placing a cost on our future and assessing the true value of 'waste', this requires a revolution in thinking, attitudes and practices.

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Robert Crauderueff

Lessons from New York City's Green Roof Incentive Program

When the Stormwater Infrastructure Matters (S.W.I.M.) coalition was founded in 2007, the City of New York was resistant to the use of green infrastructure, including green roofs, to manage stormwater. At the time, more than 30 billion gallons of combined storm and sewage water overflow were being released into the New York Harbor per annum due to the antiquated sewage system, designed to drain the combined effluent into surrounding waterways. City engineers thought 'hard infrastructure' such as concrete pipes and tanks were legitimate interventions whereas 'green infrastructure' approaches such as green roofs and parkland were only useful for beautification and recreation. In response, community and environmental leaders founded S.W.I.M. to advance fishable and swimmable waterways – a Federal Clean Water Act goal – in New York City communities through the use of green infrastructure.

S.W.I.M. has embraced an 'Urban NEXUS' approach, understanding that green roofs can cost-effectively address stormwater management compared to hard infrastructure interventions while also reducing energy demand, adapting to climate change, and enhancing community health.

Though challenges emerged during our activities, the following four lessons are gradually informing successful policy development in New York City: (1) utilize a collaborative approach; (2) advance an agency agenda; (3) get the price 'right'; and (4) make participation easy and flexible.

The S.W.I.M. Green Roof Initiative

S.W.I.M. built a citywide, cross-sector coalition of more than 70 organizations, successfully advancing a $1 billion, legally binding commitment by the NYC Department of Environmental Protection to use green infrastructure as a stormwater management strategy over the next several decades, in addition to two five-year green roof property tax incentive programs.

In 2008, S.W.I.M. developed a specialized working group among contractors, environmental organizations, business owners, economic development corporations, and community organizations to advocate for a green roof incentive program based on the scientific and economic benefits of green roofs. Research had concluded that a green roof cost sharing program would cost less than hard infrastructure solutions to manage stormwater while creating additional benefits.

Lesson #1: Utilize a collaborative approach

A collaborative, inter-sector and inter-agency approach can lead to successful policy development and implementation. During the development of the first round of the green roof incentive program, the Mayor's Office of Long Term Planning and Sustainability (OLTPS) introduced legislation without seeking the input of S.W.I.M., despite recommendations provided by the coalition. As a consequence, the legislation was not written in a way that could be easily implemented and was infrequently utilized, with less than a half dozen projects supported by the program over five years. During the development of the incentive's second round, the NYC Department of Environmental Protection (DEP) has worked closely with the S.W.I.M. green roof working group and key city agencies, such as the Department of Buildings, which provides permits for projects, to identify policy barriers and develop strategies to overcome them.

Lesson #2: Advance an agency agenda

Whereas the green roof tax abatement languished under the OLTPS, it is improving under the DEP because the latter has an incentive to make the program work. The green roof tax abatement was but one of 127 initiatives the OLTPS was responsible to advance in a three-year timeframe. The DEP, on the other hand, has a strong incentive to see the program succeed because green roofs provide the agency with credit under its regulated

stormwater management plans.

Lesson #3: Get the price right

To begin transforming a marketplace, the economic value of a green roof incentive should be large enough to stimulate significant demand from private building owners, encourage competition among contractors, and foster economies of scale. The costs of green roofs will come down in time and incentives can gradually be reduced or eliminated in favor of regulations, as has taken place in cities throughout Germany and Switzerland. The value of NYC's initial tax abatement, $4.25/square foot, was not nearly great enough to encourage participation (green roofs cost around $20/square foot). The S.W.I.M. evaluation concluded the green roof tax abatement should be in the range of $9 to $14/square foot, depending on the administrative costs imposed by the program. In 2013, the incentive value was increased to $5.23/ square foot; the total per-project value was doubled to $200,000 per project, benefitting larger projects – a step in the right direction.

Lesson #4: Make participation easy and flexible

A successful program that encourages participation and innovation needs to be easy and flexible for applicants. The few successful applicants of the NYC tax abatement spent dozens of hours (up to 100 hours!) negotiating the complex bureaucracy of NYC because the law had overly stringent requirements, even for basic 'extensive' green roof projects. Whereas the original legislation required 'drought-tolerant plants, such as sedum', native plantings and urban agriculture emerged as popular practices a few years into the 5-year pilot period. The City could not outright change its policies due to the way the law was written, so there was uncertainty among applicants for applications of these project types for several years. Through the aid of multiple stakeholders, legislation enabling the second pilot period, which begins in 2014, ensured that the language of the law encourages the use of both native plants and urban agriculture.

Conclusion

Lessons from New York City, adapted to local context, could help inform green roof policymaking in other cities around the world. Cost-sharing programs that require a private investment can encourage the broad dissemination of green roofs, while minimizing the use of scarce public resources. Agency support is necessary for a program to develop and grow. Partnerships and collaboration are critical, not just among agencies but also with outside groups such as S.W.I.M. On the other hand, at times, S.W.I.M. was willing to openly disagree with city agencies, helping to foster the political will to encourage the green roof tax abatement to be implemented (if imperfectly) the first time around, and that it be renewed and improved under a preferable city agency a second time. Though green roofs are no panacea, with the support of public policy, they can provide multiple benefits to cities and communities.

Robert Crauderueff is president of Crauderueff & Associates, a NYC-based green development planning firm, and co-chairs S.W.I.M.'s green roof working group.

Marielle Dubbeling

Local food production contributing to climate change adaptation, resource efficiency and poverty alleviation

There are interactions between food, energy, water, waste and transport systems that can be exploited for more resilient city growth. Water and waste flows can be taken up in local food (and energy) production. Localized food production may reduce food transports, storage and processing, and related energy use and emissions. Productive and green use of open spaces and flood zones may also contribute to reducing climate risks (flood risks; dust storms; increased temperatures) while at the same time contributing to increased diversity of food and income sources of vulnerable poor residents, thus reducing their vulnerability to shocks in the food supply system. Cities need to start thinking beyond their immediate interests to consider their role as nodes of human consumption and waste production and they must embrace the challenge of providing uninterrupted access to water, food, and energy, and improve quality of life of all of their citizens.

In order to realize integrated policy and action in the food-climate-water nexus, closer cooperation and "clustering" between different sectors of the city (agriculture, environment, urban planning, sanitation) is required as well as planning beyond city boundaries and linking of local, sub-national and national policies.

It is important to consider planning at the city-region level – beyond the boundaries of the urban center itself, including towns, semi-urban areas, and outlying rural lands. At this level, there are key opportunities to plan for landscape mosaic patterns that: protect valuable ecosystems and biodiversity hotspots; preserve natural corridors that prevent flooding and landslides; optimize and expand existing transportation network infrastructure; construct a built environment that uses water and energy efficiently; and promote compact cities and planned extensions (e.g. designating low lying areas and flood plains for agriculture to prevent construction and reduce impact of floods). In this regard, agriculture must be considered as a key land use feature in the city-region where you have such challenges.

Integration of food systems in city-region planning – including regulated urban agriculture in flood plains, incorporation of rooftop gardening into building codes, or inclusion of home gardens in social housing schemes or in slum upgrading – requires support from a full suite of urban management and governance measures. In terms of urban management, special attention needs to be paid to health standards, storage and processing, land zoning, land tenure systems, use of vacant land, and access to water. It also requires articulating different levels of policy: from local to sub-national and national level (Tuts, 2013).

Integrated approaches to food production and climate adaptation in Sri Lanka

The Western Province in Sri Lanka is the most urbanized province in the country. Food (transport) and construction are two major sources of greenhouse gas (GHG) emissions. Food production in the province is not sufficient, and importing food from other areas of the country is threatened by negative climate impacts on both agricultural production and transport. Cultivable land, often located in low-lying areas, is being converted to residential and commercial uses, at the same time significantly altering natural water flows and drainage. Flood-related disasters are projected to increase, as will economic and social vulnerability to other effects of climate change.

Since 2005, the Western Province has promoted home gardening and urban agriculture as part of the country's policy aimed at achieving food sovereignty and promoting domestic food production. However, this was not done from a climate change perspective. In partnership with the international network of Resource Centres on Urban Agriculture and Food Security (RUAF Foundation), the International Water Management Institute (IWMI), UN-Habitat, the Western Province and the local non-governmental organization (NGO) Janathakshan promoted the productive rehabilitation of abandoned paddy lands in Kesbewa Urban Council, one of the fast growing cities in the Province.

Two clusters of abandoned paddy lands were selected, located in medium- to high-risk flood zones. Their sustainable rehabilitation included the promotion of more salt-resistant and local varieties of paddy (which are high in demand and fetch good market prices), alongside the cultivation of vegetables in raised bunds to generate additional income.

Impact monitoring by the University of Moratuwa and the University of Colombo shows that households involved in the production and sale of urban food can increase their income and reduce their food expenditures, improving both food security and dietary diversification. Flooding incidences and impacts are estimated to be lower when paddy lands are preserved and well-managed. And when computing the difference between the amount of GHG released during the production and transportation of a ton of each of the selected vegetables to Kesbewa and the amount of GHG emitted when this amount of vegetables is produced locally, GHG emissions can be lowered by 74,89 tons per year.

In parallel to project implementation and monitoring, researchers conducted a policy review to determine where intervention would be needed to scale up these models, at three levels:

- **Local level** – promoting the integration of urban agriculture into urban development plans and in municipal programmes and budgets.
- **Provincial level** – developing – with the contribution of all stakeholders – a provincial climate change adaptation action plan that will help the Western Province better cope with climate change impacts. The plan will seek to integrate urban agriculture in each of the five sectors to be covered: food security, biodiversity, health, water and human settlements.
- **National level** – revising the Paddy Act, which previously allowed for paddy cultivation only in assigned areas. The Act should promote and support new production models for mixed cultivation of rice and vegetables that can increase income, promote and revalorise agro-ecological forms of production and traditional salt-water resistant rice varieties, and maintain the natural drainage functions of paddies.

Experiences in Sri Lanka have shown that urban agriculture can help reduce the vulnerability of the urban poor and enhance their coping capacity by: i) diversifying food and income sources; ii) keeping low-lying zones free from construction so that floods have less impact; iii) reducing storm water runoff; and iv) establishing green open spaces that can store and absorb excess water. At the same time, local production may help reduce urban energy use and lower GHG emissions by requiring less energy for transport, cooling, storage and packaging. Therefore, urban agriculture can be a low-cost adaptation strategy, bringing with it potentially significant co-benefits in the form of food security and job creation.

Conclusion

Cities should allow sufficient space for natural systems to continue providing crucial goods and services like fresh water, food, fuel and waste conversion. However, much more work is needed to build up a credible dataset that allows decision makers to integrate these issues in various spheres of policy development. More information is also needed on which production systems (e.g. home gardens, community gardens, or agroforestry) are working where (e.g. on rooftops, in backyards, in peri-urban fringes), and what are the related barriers and enablers (e.g. regulations, incentives and zoning)?

At the same time urban design concepts need to be reviewed in order to integrate green mosaic planning. Until recently, climate change literature has almost exclusively called for increasing the density of cities to make transport and services systems more efficient. Urban plans should include ecosystems design principles and low-cost climate change adaptation strategies, such as rehabilitating and re-connecting productive green spaces throughout the city.

Finding a common language and interest among researchers and policy-makers is also crucial for the uptake of results. For example, presenting research data on reductions in GHG emissions in tons CO2 may have no meaning to policy-makers unless it is compared to impacts of other interventions or presented in other forms like “the emission or energy equivalent of X urban households”. Individual householders simply want to

know how much money they can to save by reducing emission or energy costs. Similarly, data on local food production should be presented in percentage of urban consumption (for specific crops) and linked to land availability and land-use potential (i.e. how much food can realistically be locally produced and how much land would it require).

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Michael Kuhndt

The role of sustainable consumption and production (SCP) for the Water-Energy-Food NEXUS

Considering the Water-Energy-Food NEXUS from the perspective of sustainable consumption and production (SCP) makes for a natural fit, because one could consider SCP as a nexus as well. SCP takes into account very different resources in a broad way and in connection with each other, just like the Nexus approach does with water, energy and food. SCP considers each resource component, such as water, energy, minerals and agricultural products, together with overarching considerations such as environmental factors like resource efficiency, climate change and biodiversity, and social aspects such as child labor and consumer well-being.

If we were to consider a given product such as a packaged food item, this overlap in the NEXUS and SCP-approaches becomes evident. For example, in its production, a more sustainable product would likely be more water and energy-efficient than an alternative, less sustainability-minded product. If we consume products more sustainably, we would typically use less water, energy, food or a combination of the above. Think of making coffee: if you buy certified fair-trade coffee and brew only the amount you really need using an energy-efficient coffee machine, you are saving water, energy and food (or to be precise coffee beans), and you are consuming sustainably.

It is important that within the sustainability realm we do not become entrenched in our own little bubbles or silos, whether these be climate change, biodiversity, SCP or the comparatively newer NEXUS approach. All of these are interconnected and share the joint objective of increased sustainability. At times new buzzwords create a new group with its own conferences and institutions. Since one key idea and aim of the Nexus approach is to create linkages, it should avoid becoming a new silo in and of itself, separated from other approaches, projects and policy discussions in the sustainability sphere.

Similarly, the Urban NEXUS should not proceed in isolation from non-urban NEXUS deliberations. The Collaborating Centre on Sustainable Consumption and Production (CSCP), which I head, has worked on several urban projects. Key among these are the Low Carbon Future Cities project linking Wuxi in China and Düsseldorf-region in Germany, as well as a project focusing on sustainable public procurement in urban administrations in China. At the CSCP we consider cities to be important actors and spaces for sustainable consumption and production, both by direct actions from local governments and by setting the framework conditions for individuals and companies to enable and foster sustainable lifestyles, infrastructures, products and services and related business models.

Since the CSCP works with cities and other public authorities, as well as with a range of actors from the private sector, we are able to identify cross-cutting themes and solutions. One such idea relevant for both the private sector and for public authorities, such as local governments, is the “Handprint”. The Ecological Footprint is widely known in certain circles as a measure of the impact a nation, city, business or individual leaves on the planet. The Handprint is a newer idea to also indicate the positive effects actors can have on the planet by deliberately acting sustainably. Contrary to the Ecological Footprint, the Handprint includes both environmental and social aspects, and in order to obtain a holistic picture, it builds and on and includes negative Footprint aspects, as well as the positive Handprint aspects.

One significant strength of the Handprint is its systematic methodology to consider positive and negative social and environmental aspects. Moreover, the Handprint allows for positive storytelling and narratives, thereby motivating actors and rewarding positive behaviour rather than ‘naming and shaming’ by focusing on Footprints. Once the Handprint graduates from its current early stages of development, it would be worthwhile to explore an application of the Handprint methodology to a whole city in order to assess its sustainability. When doing so, positive implications for the Water-Energy-Food NEXUS could be expected.

Another concept at the heart of SCP is the systemic lifecycle approach, which considers products, services and infrastructures (such as buildings) from the design stage, through production, transport and use, all the way to the end of its life. While this approach is well known for products and comes with an established methodology, it is not yet widely known in urban circles. This systemic lifecycle approach ties in with the Circular Economy in which materials are reused as much as possible, thus increasing resource efficiency and sustainability. It would be beneficial for the thinking behind the life cycle approach and the Circular Economy to become more known among city officials and urban experts and to be adapted to urban applications.

Bringing the lifecycle and Circular Economy thinking to an urban context, the key question to be addressed is how city decisions and local government purchases and facilities can be optimised in this regard. One existing area where such an approach is taken is sustainable public procurement, where the lifecycle of products is one decision-making factor. Yet there is potential to take the lifecycle approach much further and deeper in an urban context. It should be considered not only in external purchasing decisions, but also in internal structures, decisions and planning.

To mention but one of numerous potential examples, when planning and building a new facility such as a school, city authorities could consider the short and long-term use ranging form energy-efficiency measures to a modular building style allowing for change in the building function when demography necessitates it (say, from a school to a retirement home). By systematically applying lifecycle-thinking, linkages among different issues would become apparent and thus cooperation among different local governments departments and NEXUS thinking would be encouraged.

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Dr. Dinesh Kumar

Addressing rural-urban resource conflicts: Co-Management of water, energy and wastewater flows for water and food security

In India, one of the immediate implications of urbanization is on the ability to manage water for municipal and industrial water needs. In megacities, the dependence on imported water is as high as 90% (Mukherjee et al., 2010; Arghyam/IRAP, 2010). In regions, with limited surface water, the dependence on groundwater and the associated energy needed for its use in irrigation is very high. As a result, India's urban-rural resource cycles for water, energy and food security, form a complex NEXUS of production and consumption, highly reliant on the management of their respective sectors to sustain and enhance their provision.

The great water management challenges Indian cities face stem from the rising cost of supply infrastructure; ageing distribution systems and overall institutional weaknesses and lacking political support, which incur heavy water losses. Another significant problem affecting the NEXUS is the high pilferage of water from the system, owing to insufficient staff maintenance and equipment to detect illegal connections. The extent of unaccounted for water (UFW) is an average of 40.8% in cities, owing to long distribution pipes (Arghyam/IRAP, 2010). The absence of effective demand management forces utilities to invest more in supply augmentation (Mukherjee et al., 2010). Meanwhile utilities have exhibited a lack of willingness to invest in wastewater collection and treatment systems, resulting in untreated urban sewage, which contaminates groundwater for the irrigation of fruits and vegetables (Arghyam/IRAP, 2010).

Water management is not the only problematic factor in the rural-urban Nexus – in most Indian states, electricity is heavily subsidized for agricultural groundwater pumping with almost zero marginal cost. This, combined with the lack of well-defined groundwater rights, results in its un-sustainable use (Kumar et al., 2011). With limited access to surface water, groundwater mining for irrigation leads to widespread well failures, which impacts agricultural production and food security.

In response, integrated urban water management (IWM) is gaining acceptance in developing as well as developed economies. The solution for many lies in looking at the urban water system as a whole with the following approaches: integrated development of groundwater and surface water resources; treating urban storm water, treated wastewater, rainwater from artificial catchments, and freshwater from reservoirs and aquifers as part of the urban water cycle; and water demand management along with supply augmentation (Mitchell, 2004; Arghyam/IRAP, 2010; Kumar, 2012). In order to address the growing urban water management challenges, several interventions on the technical, economic and policy front would be required.

Research shows that rainwater harvesting tanks to manage stormwater while storing water for multiple uses, including drinking and domestic uses like gardening, would be viable in both physical and economic terms in towns and cities in mountainous areas with annual rainfall exceeding 2500mm. Stormwater management systems such as rain gardens and surface detention ponds can augment water resources in cities having large built up area, falling in moderate to high rainfall regions with high urban runoffs (Arghyam/IRAP, 2010). In regards to water demand management measures for urban areas, leakage reduction would require engineering interventions; but theft prevention and efficient use would require metering and volumetric pricing.

The key challenges in implementing various components of integrated urban water management in Indian cities and towns, are: a) introducing physical and environmental sustainability considerations in urban water supply planning; b) integrated development of groundwater, surface water and catchments, which are managed by different line agencies; c) treating storm water as a useful source of water on a sustainable basis; d) making wastewater treatment financial or economically viable; and e) efficient pricing and metering of urban water supplies (Kumar, 2012).

To overcome these challenges, the agencies concerned with development and allocation of water for municipal uses should be confronted with the opportunity cost of using it. Secondly, the actions of the line agencies such as the municipal water supply and sewerage departments, irrigation agencies (surface and groundwater) and rural water supply department need to be coordinated at the level of river basins. Determining the optimal level of wastewater treatment where the real costs do not exceed the net social welfare; evaluating the real marginal opportunity cost of water supply and ascertaining the economic viability of metering; and increasing the willingness of communities to pay for water are the other key interventions. These interventions can affect reduction in demand for water in urban areas, while ensuring increased supply of treated wastewater for irrigation.

In rural areas, co-management of water and electricity in irrigated agriculture could be achieved through pro rata pricing of electricity in the farm sector. With improved efficiency in water use, the same amount of groundwater could be used to irrigate larger amount of land. With efficient use of electricity in irrigation through the adoption of energy-efficient pump sets, electricity consumption in agriculture could drop significantly. Energy rationing could be the next step to achieve sustainable groundwater and energy use. Electricity pricing will ultimately improve the viability of power sector as well as enhancing agricultural productivity (Kumar, 2005; Kumar et al., 2011). These steps can free more electricity and surface water from agriculture sector for energy security and water security in urban areas.

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Muna Lakhani

A Zero Waste systems approach to organic waste management and sanitation

A key issue in all urban conurbations is one of waste. While lip service is paid to "waste as a resource", little has been achieved in over 30 years, as evidenced by the growing mountains of waste in cities, overflowing landfills, improperly running sewage works, and creaking infrastructure. Although significant strides have been made in diagnosing urban environmental problems, the gap in implementing tested simple solutions points to a clear disconnect at the level of institutionalized decision making, planning and implementation as systems thinking is not part of any mainstream education system, and remains limited within policy and academia.

If a systems approach were taken it would become clear that continuing with "end of pipe" interventions – such as landfills, incineration, "waste to energy" and recycling (South African National Waste Management Strategy 2011) – will always fail, evidenced by the fact that the problem has grown exponentially.

Let us take sanitation, which currently involves infrastructure that is expensive to build, maintain and run, and wastes large amounts of water that is often potable. In more rural areas of South Africa, the misnamed VIP (Ventilated Improved Pit Latrine) toilet is the norm, however, this is an undignified short-term solution, requiring replacement every 5 years or less, while impacting negatively on groundwater supplies, and has proven hazardous to small children. On the other hand, the water-sanitation-energy-nutrition NEXUS approach (which incidentally also promotes gender equality), illustrated below, depicts simple, creative measures to avoid wasting and competing uses for water, and closes resource loops while removing key challenges.

Case Study: Chris Hani Municipality – Integrated Biogas Project
Integrated design solution with bio-digester at a school achieves multiple benefits

An example of a creative design and implementation is the Chris Hani Integrated Biogas Project, carried out by People's Power Africa (IZWA member) as part of the Development Bank of South Africa (DBSA) funded "Chris Hani District Municipality Environmental Support Programme".

In a rural school previously utilizing VIP's, a flush toilet Biodigester based sanitation solution was implemented (based on flush toilets to provide decent and safe sanitation) to treat sewage (the outputs being nutrient rich clean water, algae for animal feed, composting and gas) and the following benefits were achieved:

1. Decent, dignified and safe sanitation,
2. Increase in quality nutrition, food security and associated positive health and learning impacts – it is impossible to place a cost / saving on this,
3. Generation of a local energy supply for cooking of school meals saving ~ US$1200 (February2014 exchange rate) on imported Liquid Petroleum Gas (LPG) per annum,
4. Bio-fertilizer production ~ US$650 per annum,
5. Savings in school feeding scheme costs ~ US$370 per annum,
6. Water recycling ~ US$65 per annum,
7. Greatly reduced stress on sewage works and associated infrastructure,
8. Reduced exposure to pathogens,
9. Return on investment ~ 10 to 15 years; life of 30 years plus.

This project proved that locally adapted NEXUS solutions work well, ultimately increasing nutrition through the integration of use of the nutrient rich water and onsite compost to a school garden, significantly saving on school feeding costs, reducing infrastructural stress and supporting an overall improvement on health.

An additional unforeseen (but welcome) positive consequence was the higher attendance of female learners, as they now had a safe, clean and dignified space to take care of their monthly menstrual needs.

The Urban Scale – possible solutions

In an urban context, a local bio-digester system should be constructed at the time housing is built, utilizing low flush toilets (a safe, decent and dignified solution), would consequentially reduce piping and treatment volumes by handling sanitation at the local level. Additionally, green garden waste and household kitchen waste fed to the digester would boost methane gas production for local economic development, while reducing "waste management" costs and disposal. This is a major step in the right direction, as organic waste comprises an average of 50% of all landfill content globally, higher in non-urban areas. The nutrient rich water should be used for local food security. Local and localized systems such as the one described, are wholly scalable – from single homes to clusters of many thousands of people and can be incrementally implemented, beginning with the urban periphery. This can then be cascaded to larger sewage piping nodes, and ending in a complete redesign of the urban organic waste stream to include greywater systems and localized digesters.

The benefits (reduced load on sewage works and associated infrastructure; reduced energy needs for pumping and treatment; fewer breeding environments for vermin and insects; reduced smells; reducing transport of waste; reducing landfill need by 50% or more; climate positive impacts) far outweigh the need to begin to redesign urban environments.

This approach turns major problems like sewage, sanitation, organic waste, water use, food insecurity, energy poverty into unified solutions, while making communities and cities more "climate resilient", simultaneously boosting local, genuinely sustainable, economic development.

Replication and scaling up requires enabling framework from municipalities.

This is a rapidly deployable long-term solution that is organic, requires minimal maintenance, and is people and planet-friendly. It would accelerate this approach if national housing, water and sanitation policy was rewritten to enable such solutions. These steps would include: immediate implementation for new construction; gradual implementation of low flush toilets in existing cisterns, leading to a ban on current cisterns; funding, especially at the Municipal/local government level diverted to such solutions, in place of extending current infrastructure; and the re-training of water engineers. The financial justification is clear – however, our current systems, policy and local government processes are locked into centralized systems, and will require political will for such a roll-out.

All it takes for success is for the mind-set of politicians, urban designers and engineers, and citizens as the end-users, to embrace proven, if slightly non-traditional, technologies.

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Hans Mönninghoff

Hannover's institutional NEXUS: merging municipal departments for synergies between economic and environmental affairs

Nearly a decade ago, the City of Hannover was faced with a growing population of 520,000, increasing industrialization, increasing impacts of climate change, and a choice to either recognize the realities of our interconnected and horizontal problems, or to continue down a "business as usual" course of departmental planning and action.

In 2005, realizing that sustainable development relies on the harmonization of economic, ecological and social issues, the City underwent the bold decision to become one of the first European metropolitan cities to combine the Department for Environment with the Department of Economic Affairs. The choice to merge the valuable interfaces between ecology and economy initially received a healthy dose of criticism; however, the result of our interconnected action has quickly become a celebrated success in five primary areas.

Building for Economy and Ecology: municipal land and construction policies

Hannover is the greenest city in Germany, with roughly 50% of the city area dedicated to green space and open areas. Simultaneously, however, Hannover's urbanization continues to increase, along with the area required for development, currently an annual 11 hectares of open space.

The merging of the Department for Environment and Economic affairs has had a strong and positive influence on the city's built urban environment through ecologically oriented urban planning and design stipulations and the prioritization of open space. Our newfound integrated planning approach enabled the Economic Administration to purchase areas of land, to be allocated and sold based on the highest ecological standard of the bidder's planned use, determined by the Environmental department, rather than the price. To date, our joint commitment may be observed at both the neighbourhood level through the promotion of passive houses, e.g. in Kronsberg, the award-winning sustainable district, as well as at the city-wide scale, via larger adaptation schemes, such as compulsory green roof policies for new buildings, which avoided 400,000 m^3 of stormwater runoff along with the costly infrastructure to alleviate it, within the last decade.

Promotion of Eco-economic Development

Environment and economy complement each other and today this can be seen more than ever in arena of Hannover's Green Economy. At present, Hannover provides approximately 10,000 more employment opportunities within in the region than in 2006, 3,000 of which directly relate to climate protection.

In recent years more than 120 enterprises participated in the Eco-profit (Ökoprofit Hannover) project to promote cross-sectoral ecological and integrated environmental technology. Moreover, through our combined efforts over, 12,000 tons of CO2, 35 million liters of water and an estimated 8.5 million euro in operational costs were avoided (Landeshauptstadt Hannover, 2011; Hannover Aktuell und Wirtschaft, 2010).

Management of Publicly Owned Buildings

The City of Hannover has ambitious goals and we intend to reach them. This includes having a carbon free Hannover region by 2050. At the moment, Hannover's inhabitants, commerce and industry spend approximately 1.5 billion euro per annum on electricity, heating and fuel. In order to attain our target, the City is doing everything in our power to enhance the living standards and comfort of our citizens. The City manages roughly 600 buildings ranging from schools and kindergartens, to hospitals and administrations. Rather than waiting for a national standard to raise the bar, Hannover has begun the process of retrofitting municipal buildings exceeding energy saving targets by 30% as compared to the national norm.

Energy Sector: greening our power through strategic alliances and action

The energy sector offers the best opportunities to synergize the environment and economy on the local level. In spite of economic and urban growth, including heavy vehicle and air traffic, due to Hannover's consistent efforts in implementing renewable energy and energy efficiency measures, energy consumption in Hannover has decreased by 10% (2010) as compared to our 1990 base levels, while in many other cities this figure has increased.

Recognizing that the challenges we face demand multi-sectoral solutions, the City created the "Climate Alliance 2020" campaign to offer a range of opportunities for multiple stakeholders including companies, housing associations and interest groups to aid in the development of the City's climate protection program. A component of this includes the commitment of all stakeholders to reduce CO2 emissions by 40% by 2020 compared to 1990 levels. Hannover's active engagement in a local energy transformation also includes offering our citizens an online Solar Atlas platform to allow them to compare their roof suitability for energy production, free energy consulting offered by the Hannover Climate Protection Agency and a robust climate campaign to boost renewable energies to satiate the demand of 70,000 citizens and mitigate 77,000 tons of CO2.

Eco-logical Marketing

The success of our future initiatives is largely dependent on securing a strong base of public awareness. A key aspect of the merge of the Department of Economics and Environment included the mutual oversight of our Public Relations department. Together the departments ensure the communication of our endeavors and achievements amongst citizens and visitors.

In 2011, as a result of multi-sectoral efforts to maintain Hannover's green areas, the city was proclaimed the "German Capital of Biodiversity" amongst 129 competitors. We make a concerted effort to advertise Hannover's high quality of life though our abundant parks and recreational areas to visitors, citizens and all sectors of society. As a result of the City's tourism marketing efforts, we have experienced an increase of 70% (2001-2011).

Forward-thinking Finance

Of course, setting Hannover's initiatives into motion depends on investing in our future in forward-thinking ways. The City of Hannover's departmental merge has elicited numerous funding opportunities and mechanisms to guarantee we reach our goals and provide a sustainable and economic future. For the last decade the City has invested an annual five million euros to sustainable projects through an additional charge on the gas sold within the city, combined with municipal energy utility profits. This has provided financial support for an average of roughly 1,000 flagship initiatives each year. In addition, the City offers a variety of subsidies to home owners to improve insulation and energy efficiency measures along with training for craftsmen and architects.

Long-term thinking by doing

Growth and sustainable development arenot contradictions.In other cities, development projects have often caused hard controversies between politics and nature conservation, whereas Hannover has experienced very few. The driving forces behind our success include a strong political will, social acceptance and an integrated approach to economic and environmental protection. Merging the Department for Environment with the Department of Economic Affairs has enabled us to realize the highest ecological standards while proving that urban economy and ecology enhance each other's potential.These actions enabled us to save on significant public expenditures through sustainable improvement measures across numerous sectors, including water, energy and waste. Without combining the departments, Hannover would have undergone greater economic and ecological loss.

Hans Mönninghoff is the former Deputy Chief Executive of the Lord Mayor of Hannover and Head of the combined Directorate of Economic and Environmental Affairs of the City of Hannover

Prof. Dr. Peter Newman

Solving the Urban NEXUS through local scale

What is the Best Scale for the Urban NEXUS?

There are many reasons why integrated approaches in urban planning and management are not easy: the modernist disciplines remain isolated in their training and professional development, the tools for making decisions are not easily integrated across sectors, technologies to enable integrated urban infrastructure are still under development, and the governance within cities remains stuck in the past. However, I would like to posit that the scale we use to approach the integration is also a major issue.

Most cities with reasonable infrastructure for managing energy, water, waste, food and transport were built in the 19th century when the technology was based around centralized large-scale systems to maximize resource flows: big pipes of water flow in from big dams or rivers; big pipes take out sewage to a big treatment plant; big power plants with long distribution grids pump electricity across the whole city; big agricultural systems in the region or from across the globe supply the food; and, big transport systems on road and rail take people across the whole city.

The kind of technologies we are hoping will enable integrated and efficient solutions for the future, however, are much smaller in scale. They work best within a Precinct, a Neighborhood, a Sub-Division, a Kampong etc. These technologies consist of renewable energy (especially PV), co and tri-generation, automated waste systems, storm water collection and recycled greywater, small-scale intensive food systems, and pedestrian and cycle systems with intensive local transit (Newman, Beatley and Boyer, 2009). These systems are beginning to be used as the basis of new eco-urban developments.

Eco-Precinct Demonstrations

The results from a global survey of 90 precinct-scale demonstration projects (Thomson and Newman, 2014) can be summarized to show:

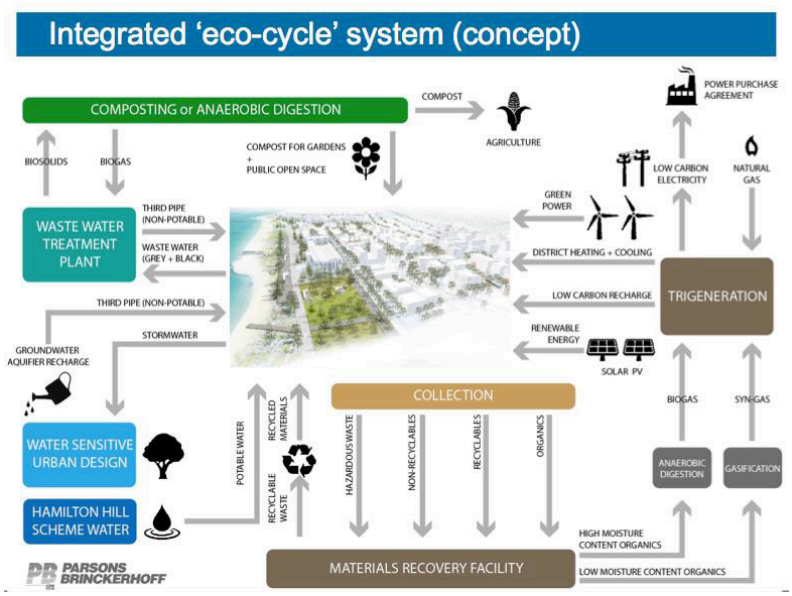
- Significant integration of technologies for urban infrastructure is now possible with substantially reduced resource footprints;
- Smart systems enable the new green technologies to function effectively;
- The process of integration must occur at the earliest stage of design rather than being attached at the end;
- The technology is still developing and there are only a few that can be seen as mainstream though prices are rapidly dropping;
- Governance at the precinct scale is much more likely to lead to good outcomes;
- Community-oriented behavior change can make a large difference to the success of any eco-precinct.

In other words, an integrated "Urban NEXUS" approach has great potential and must be employed from the very first stage of project or policy design, and at the most appropriate scale. However, in order to enable such projects to happen urban planners need tools that can facilitate integrated scenarios and integrated assessment of the options against desired outcomes. Such tools are rare.

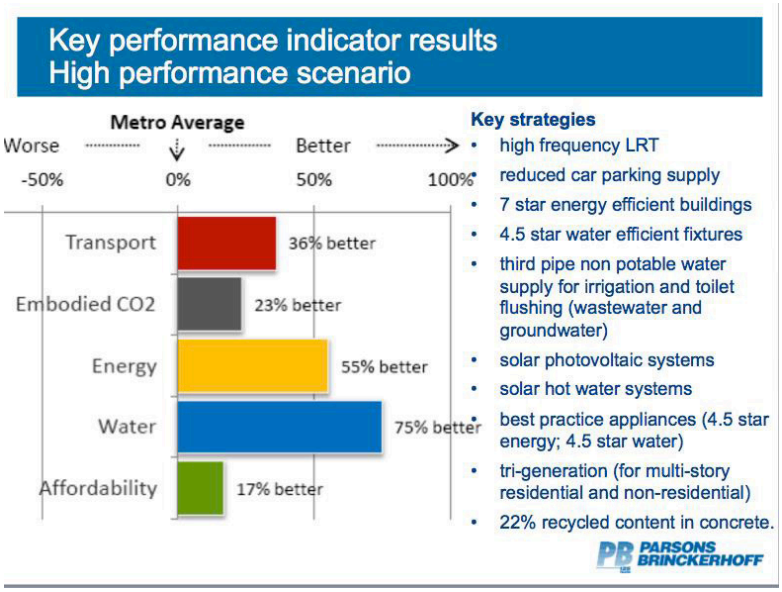
Integrated Sustainable Design and Assessment Tools

After assessing some 50 design and assessment tools we were able to find one that used an integrated approach to calculating the major assessment parameters for any urban eco-precinct (Beattie et al, 2012). The key design and assessment parameters were: power, embodied energy, water, waste, greenhouse gas emissions, vehicle kilometers travelled (VKT), affordable housing, and cost. This could be compared to average conventional urban development.

The model, CCapCity was developed by the New South Wales Government as a digital assessment tool. Although it is a propriety tool used as a business by the people who developed it, we were granted access to use it on a number of demonstration projects, and found that it could enable developers and local governments to take risks with the eco-options selected due to the sheer cost savings from an integrated approach (Rauland, et al, 2011; Newman et al, 2011; Bunning et al, 2013). The Urban NEXUS can best be demonstrated in numbers, e.g. through the example of a new urban village in Perth called Cockburn Coast, where the CCaP tool was used in the project modelling and assessment.



The numerous components of water, energy, food, and waste systems feed into each other in the integrated Cockburn Coast 'eco-cycle' system



Outcomes of Urban Nexus modelling on Cockburn Coast

Applying the CCaP Precinct tool – a case study of Cockburn Coast

Cockburn Coast is a large redevelopment site proposed by Landcorp, the West Australian land redevelopment agency, in the Perth Metropolitan Region, covering just over 200ha. The development aims to provide 4850 new dwellings with 10,000 residents and 6,800 jobs. A range of sustainability targets was set out in the District Structure Plan (DSP) that was created for the development. This included a 40% reduction in stationary greenhouse gas emissions. The project was modelled using the CCaP tool and a number of sustainable interventions were included in a high performance, best-case scenario for comparison with the original Districted Structure Plan (DSP) scenario.

What is next?

The stage we are in is moving from demonstrations to mainstream. Design tools need to be mainstreamed to enable the Urban NEXUS outcomes to be assessed and communities to be engaged. Governance needs to be established around the Precinct as already exists in many emerging cities. And the world of finance needs to be shown that this is the model of the future. CUSP is planning for research in each of these areas.

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Prof. Dr. Mark Roseland

Networking the NEXUS: Mobilising research and collaboration to support the Urban NEXUS

Local authorities have limited capacity, expertise, and resources to successfully implement their sustainability goals. At the same time, researchers find it challenging to partner with local authorities to conduct and share case studies, pilot projects, best practices, and other forms of research that could accelerate the development of sustainable communities.

In recent years there has been a notable increase in the number of networks that aim to facilitate cooperation and enable the sharing of sustainability knowledge, policy ideas, and strategies across local jurisdictions and borders.

Networking provides a means through which local authorities can enhance their institutional capacity to plan for sustainability. Sustainability is an evolving process that requires long-term planning and goal-setting, as well as learning: because government staff personnel is bound to change before many long-term goals can be met, it is crucial that sustainable development be understood intimately throughout local authorities and that cross-departmental cooperation occurs (Evans et al., 2006; Polk 2011). Therefore successful planning for sustainable development requires strong institutional capacity within local authorities.

Recent research shows that networks and networking can have a positive impact on policy learning in cities (Polk 2011; Seymoar 2009; Benz, &Fürst 2002). Seymoar et al. (2009) found that there are five ways through which networks can enable local authority learning around sustainability: (1) by lowering the costs associated with knowledge acquisition;(2) by enhancing organizational memory; (3) by nurturing organizational flexibility; (4) by building bridges between departmental silos; and (5) by making knowledge communal (p. 9). Networks are able to lower the costs involved with finding new solutions to problems while at the same time providing access to a wealth of technical information and expertise (Benz &Fürst 2002; Seymoar 2009).

However, networking as a method of trying to build urban sustainability is not without its difficulties. These range from the questionable caliber of information flowing through the networks; the reliance on 'best practices' as a one-size-fits-all solution to sustainability challenges; and the effect that sharing policy solutions across jurisdictions may erase geographic particularities. Despite these drawbacks, networking has enormous potential to be a catalyst for policy innovation around sustainability at the local level by encouraging cross-disciplinary dialogue and connecting various areas of expertise. Connecting local policy-makers and sustainability researchers via networks can produce effective and innovative sustainability policy solutions for local communities (Kristensen and Roseland 2012).

Pando | Sustainable Communities was created in response to a need and desire articulated by local governments at the ICLEI 2009 World Congress Researchers Symposium in Edmonton, Canada to develop an international network of local sustainability researchers and interested local authorities staffto address core needs of local authorities and researchers interested in sustainable communities: how to get local authorities access to good, relevant research and researchers; and how to get researchers access to local authority officials in order to make their research more useful and relevant.

Pando is the international network where sustainable communities' researchers and practitioners meet, share and collaborate. Pando is an online community with a professional focus, where researchers, academics, and public and private-sector practitioners share knowledge, network, and collaborate on sustainability solutions that can be enacted at the community level – including the "Urban NEXUS" of water, energy and food security.

pando | sustainable communities
research. practice. network.

The Pando "tree" is a single living organism with a massive underground root structure and 47,000 connected trunks. In Latin the word "Pando" means "I spread."

Pando connects sustainability-focused academics and other researchers with local authority officials who are working at the Urban NEXUS. Specifically, Pando's target audience is local authority staff, elected officials, academic researchers, non-governmental researchers, and senior-level government researchers, consultants/developers, and graduate/doctoral students who work within the field of sustainable communities (Roseland 2012).

The capacity of local authorities to build environmentally, economically, and socially sustainable communities must be enhanced. Strengthening that capacity by networking and collaborating between local authority staff and sustainability researchers seems an obvious way to tap previously untapped intellectual resources and propel local authorities forward.

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Prof. Dr. Christopher A. Scott

From black to green to gold: Farming with wastewater need not be an urban fringe activity

Introduction

The rapid growth of cities, which are now home to over half the planet's 7 billion people, marks a dramatic shift in the use of land, water, energy, and other key resources. Compared to rural areas and small towns, cities consume resources more efficiently on a per-capita basis. However, the sheer concentration of human activity in cities, their economic dynamism that heightens resource consumption and reliance on urban infrastructure that separates resource use from environmental processes, all translate into unprecedented pollution and waste management challenges. Conventionally, waste has been treated as a problem of disposal, leading to a vicious cycle of solid-waste dumping and sewage discharges in the peri-urban margins that are vital to cities' own functioning. Increasingly, a resource-from-waste recovery paradigm (Scott et al. 2004) is recognized to offer virtuous-cycle opportunities for policy-making and public engagement to address these challenges.

Responding to challenges: Land, water, livelihoods, and public health

Because cities are the center of political power, we have within reach governance responses to the Urban NEXUS as an approach to cross-sectoral policy design. Wastewater is a particular Urban Nexus challenge. Beneficial recovery of water and nutrients, enhanced productivity of urban agriculture, and amenity value provided by wastewater use in landscaping and greenbelts can be outweighed by serious public-health risks. Fortunately, policy and management solutions exist for making effective and safe use of wastewater (Drechsel et al. 2010). For instance, cross-sectoral planning by public health, irrigation, and agriculture agencies together with farmers and civil society organizations, where applicable, has identified and disseminated safe practices such as restrictions on produce eaten raw, farmer-to-farmer enforcement, and making safe wash water available at urban markets.

Ongoing experience in Hyderabad, India and Hermosillo, Mexico – to name just two examples – offers several lessons learned. These include decentralized options for partial primary treatment of wastewater, e.g., settling and aeration lagoons, or initial diversion and partial remediation of wastewater through fields used to cultivate animal fodder – alfalfa, perennial cut-and-carry grass, etc. – followed sequentially by irrigation of crops for human consumption. Communication with and training of urban farmers identified via markets and site visits to urban/peri-urban farms and gardens have been shown to strengthen the adoption of safe management practices. Additionally, the planning and monitoring of resource recovery and beneficial use, e.g., making urban agriculture a more formal activity with extension and credit support coupled with in-field monitoring of farmers' activities, nutrient and water balances, and contaminant risk evaluation, are crucial processes that university or research partners can bring to the table.

Urban farming with wastewater is emerging from the shadows to increasingly become an urban core activity. In doing so, it provides waste remediation and economic benefits for producers and consumers of urban agriculture as well as offering urban residents more generally increased amenity in gardens, parks, and greenbelts.

The Way Forward

The wastewater irrigation dimension of the Urban NEXUS provides real mechanisms to integrate resource flows, people, and policies. Seizing these opportunities becomes all the more important in the 2015 transition from the Millennium Development Goals to the Sustainable Development Goals, a process in which water and sanitation services must be central to urban sustainability. In this transition, cities and allied organizations will play a central role in identifying and disseminating opportunities for mainstreaming resource-from-waste practices and policies.

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To learn more about the Urban NEXUS, read the full study:

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

ICLEI – Local Governments for Sustainability is an international association of local governments implementing sustainable development. ICLEI's mission is to build and serve a worldwide movement of local governments to achieve tangible improvements in global sustainability with special focus on environmental conditions through cumulative local actions.

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