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Multiple sources of water for multifunctional urban agriculture

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Abstract

The main aim of Work package 5.2 is to identify and integrate appropriate productive re-use of urban water for agriculture into the policy, legislative and regulatory, urban planning and decision-making frameworks of cities. The Work package is being implemented in three cities; Accra, Beijing and Lima, and linkages have been developed fwith Hamburg.

Urban agriculture contributes to a wide variety of urban issues; it provides multiple benefits for urban inhabitants and can have many different functions. There are three challenges. The first challenge is to address the diversity and variety of urban farmers and livelihoods. A second challenge is to seek to involve, and undertake appropriate research with, the stakeholders who represent this diversity of functions. The third challenge is to facilitate integration of (water for) urban agriculture into city planning and policy making.

This paper will present an overview of a situation analysis undertaken in WP 5.2 and ongoing action research and demonstrations in these three cities. An update will also be given on the multi-stakeholder processes and action research on productive use or re-use of water in Accra, Beijing, and Lima as part of the Learning Alliances (LA).

Keywords: urban agriculture, water, treatment, livelihoods, multifunctionality, multi stakeholder platforms

1 Introduction

SWITCH promotes innovation in the area of integrated urban water management (IUWM) and seeks to carry out more demand-led, action-orientated research. SWITCH has organised its training, research and demonstration activities in thematic work packages which are embedded in the independent multi-stakeholder platforms or city ‘learning alliances’,

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The most appropriate way of implementing SWITCH; to seek to put research into use and to scale-up its outcomes and impacts, is still being developed and is the subject of debate (Ref. recent SWITCH E-Conference). It is clear that a major challenge lies in the organisation of research; how to involve city stakeholders through joint decision making and knowledge management, through the learning alliances and through joint research in the work packages.

The set up of SWITCH reflects its main aim, which is to facilitate a change in thinking on urban water management and to consolidate research into policy and institutional frameworks. The issues are complex and many actors are involved. This is similar to experiences of working with the issue of urban agriculture. Urban agriculture contributes to a wide variety of urban issues and is a highly integrative concept that needs participation of various disciplines and sectors. A major challenge is its integration into city planning and facilitation of its multiple benefits for the range of urban inhabitants.

Such a situation calls for a number of initiatives, advocacy, multi-stakeholder dialogue and joint action planning. New forms of governance, institutions, and policies are needed which can be constructed through the synergy created by such initiatives. The work package 5.2 focuses on the (re) use of urban water for urban agriculture and is complementary to the work on urban agriculture under the Cities Farming for the Future Programme[1] in Accra, Beijing and Lima. In these three cities the SWITCH partners have organised city working groups which have undertaken institutional and situation analysis in selected areas of the cities and are developing activities through joint action planning, linked to the SWITCH learning alliances. So far the approach of joint situation analysis and action planning has been successfully integrated in the LA.

This paper will give an overview of work in progress. The situation analysis in Accra, Beijing, and Lima addresses leading questions on urban livelihoods-water-agriculture interfaces. In each of these cities, the working groups will guide and participate in selected action research, as part of the city action plans. The paper will also present some thoughts on how the UA working groups complement the LA in the three cities and how to strengthen this.

2 Urban Agriculture

The number of people around the world who live in and around cities is increasing steadily. City authorities around the world face enormous challenges in creating sufficient employment, in providing basic services such as drinking water, sanitation, basic health services and education, in planning and maintaining of green spaces, in managing urban wastes and waste water and in decentralisation and creation of efficient local autonomy. Cities are quickly becoming the principal territories for intervention and planning of strategies that aim to eradicate hunger and poverty and improve livelihoods, requiring innovative ways to stimulate local economic development in combination with enhancing food security and nutrition. Urban agriculture is one such strategy.

Urban agriculture can be defined as the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products. Urban agriculture is located within or on the fringe of a city and comprises a variety of production systems, ranging from subsistence production and processing at household level, to fully commercialised agriculture. It is generally characterised by closeness to markets, high competition for land, limited space, use of urban resources such as organic

[1] Executed by the international network of Resource Centres on Urban Agriculture and Food Security (RUAF: www.ruaf.org).

solid wastes and wastewater, a low degree of farmer organisation, mainly perishable products, and a high degree of specialisation.

Although some forms of urban and peri-urban agriculture are based on temporary use of vacant lands, it is still a permanent feature of many cities in developing as well as developed countries. It complements rural agriculture and increases the efficiency of national food systems. Urban agriculture is one of the many different strategies developed by urban citizens to improve their livelihoods and is often combined with other activities. Much urban agricultural production takes place in the informal sector. In West Africa, market oriented irrigated agriculture occupies between 20 and 650 ha in each major city, producing 60-100percent of the locally consumed perishable vegetables (Obuobie, 2006). It is often a response of the urban poor and unemployed to urban poverty and food insecurity/malnutrition. Since poor people generally spend a substantial part of their income on food (60–80percent, Mougeot, 2005), the savings made by substituting home grown vegetables can be substantial. In addition it may contribute to sustainable urban development, by turning urban wastes into a productive resource through compost production, vermiculture, and irrigation with wastewater, and by greening the city. It also functions as an important strategy for poverty alleviation, community building and social integration of disadvantaged groups. However, if not properly managed, it may include risks, especially in the aspect of water reuse.

Indeed, agriculture within cities can have many different functions. Its sustainability is related to this multi-functionality. In order to allow a combination of functions, multi-functional agriculture will have to adopt environmentally friendly production methods, link up with eco-sanitation and decentralised sustainable water and waste management, as well as with parks, nature and recreation planning and management. New forms of governance, institutions, and policies need to be crafted through processes that seek synergies and involve multiple stakeholders (van de Berg and van Veenhuizen, 2005).

2.1 Water for urban agriculture

Farmers use clean water for irrigation when available, but pipe-borne water for irrigation is rare due to the cost involved, unreliability of supply, or lack of access. In many cities farmers tend to use waste water to irrigate their crops. Urban producers/farmers have a variety of motives for using untreated or partly treated wastewater. In semi-arid and arid areas it is often the only source of water available and it is available year-round. It is also an inexpensive source, not just of water but also of nutrients. Irrigated urban agriculture provides livelihoods and has an important niche function (Drechsel et al., 2006).

In the three cities, a lack or rainwater, depletion of groundwater and limited access to piped water and access to waste water provides an opportunity for farmers to reuse urban wastewater for agriculture. Sources of wastewater include surface runoff, city drainage canals, sewage, grey water or black water and drainage channels, as well as hospital and industrial wastewater, and combinations of all of these (each with varying concentrations). However, wastewater use for agriculture is often negatively perceived by the public and by government officials. It has risks for producers and consumers and needs adequate management. Risks need to be assessed according to the type of activities for which the wastewater is being used, the type of irrigation method and the type of user group that has the most direct contact with the water.

A major obstacle to attempts to minimise the risks of wastewater use lies in the non-recognition of urban agriculture as an urban livelihood strategy. The adoption of any measure or policy depends upon whether the authorities and policy-makers take the activity of urban agriculture seriously. In the

SWITCH learning alliances, various stakeholders engage with policy-makers to encourage a well-integrated, supportive policy environment. Better understanding of farmers' perceptions of wastewater quality, economic value and health issues is needed to inform planning initiatives of the policy-makers and the urban authorities. Flexible "response scenarios" need to be developed for specific locations and appropriate risk reducing strategies that are technically, economically, socio-culturally and politically compatible.

2.2 The need for innovation and Multi Stakeholder action planning

Urban agriculture complements, but is different from rural agriculture. In the urban context, the need as well as the opportunities for innovation appear to be higher (DeZeeuw and Prain, 2007). Factors such as closeness to consumers, knowledge of niche markets and products, the confined space for production, use of organic wastes and wastewater, specific health considerations and high land prices, lead urban producers to develop all kinds of new technologies as well as new forms of organisation and cooperation. The proposed action research under WP 5.2 will focus on the role of water and farming in the livelihoods of the urban poor and opportunities and constraints on development, on enhancing innovation through experiential learning - both by urban farmers and other stakeholders, and on institutional innovation.

Policy development and action planning on urban agriculture should involve various sectors and disciplines: agriculture, health, waste management, water managers, community development, parks and nature management, among others. Urban farmers and the CBOs and NGOs supporting them, have to be involved in the planning process. This multi stakeholder platform or learning alliance, assisted by one or more working groups should function as a platform for dialogue, joint research and consensus building. In Accra, Lima and Beijing, the working groups consist of members, some of which are also involved in RUAF Multi-stakeholder Policy formulation and Action Planning (MPAP) for urban agriculture[2]. A related approach has been initiated under SWITCH, with linkages being developed between the working groups and learning alliances.

3 Situation analysis and proposed action research

A situation analysis has been undertaken under Work package 5.2 in Accra, Beijing and Lima guided by the SWITCH partners with the city working groups. Baseline data have been gathered on water sources, urban water dependent livelihood opportunities options: for on-farm treatment of poor quality water for agriculture (in Accra); co-operative horticulture and agro-tourism using rainwater harvesting (in Beijing); and neighbourhood and household treatment of grey water for urban farming (Lima).

3.1 Accra

Accra has a population of 1.6 million and an annual growth of 3.4% (GSS, 2000). Rainfall in Accra is relatively low (730 mm/year). Identified sources of water are streams, drains, pipe-borne water, shallow groundwater and rainfall. It is estimated that 81% of water supplied by Ghana Water Company Limited is consumed by domestic users, 17.5% by industry and 1.5% by public institutions. It is evident from this that piped water supply is the source of water most commonly used, with

[2] Under the MPAP the development of a City Strategic Agenda on urban agriculture is facilitated towards the development of a municipal, inter-institutional policy as well as the design and planning of various projects, as prioritized in the strategic agenda, and implemented by the different stakeholders involved.

households consuming the highest amount of water (average of 50 million m^3) per year. Water is used for a number of activities and enterprises, the livelihood importance of which has been expressed in income and relative water costs. Water supply coverage to the city is said to be 80%, but this does not necessarily imply a house connection. In reality only 45% of the population has a household or at best a yard connection, and this category includes the urban rich. The majority who live in the low income settlements depend on water vendors for their daily needs.

Both domestic water and wastewater (including storm water runoff and all polluted surface water sources such as city waterways), are used for multiple purposes. Some of the livelihood opportunities of urban poor (most of which depended on domestic water supply) were sale of food and drinks, hairdressing, car washing and irrigated vegetable farming. There is insufficient information on the amount of water used in Accra by certain livelihood activities (restaurants, hairdressers, golf courses etc).

There are various forms of urban agriculture with irrigated crop cultivation occurring on some 7 major sites in Accra (Abraham et. al.). Wastewater from the city is a potential "water resource" providing water (and nutrients) for irrigated urban agriculture. It is estimated that about 100,000 m^3 per day of wastewater is generated, though this is based on an average per capita daily consumption of 76 liters, and a wastewater return flow of 80%. A portion of this reaches the stream and drainage network of the city which serves as the main source of water for irrigated urban agriculture. In Accra practically any open space is used for farming vegetables and other crops because of the high demand from the city. Land is continuously lost to estate developers hence the shrinking size of farmlands. (Obuobie et al., 2006). In total there are about 100ha under vegetable irrigation in the dry season. There are about 800-1000 vegetable farmers in Accra. The practice is predominantly a male activity. On average less than 10% of all open space farmers were women. However, women dominate vegetable marketing. Open space crop cultivation brings in very good earnings in spite of the challenge of crop loss. Monthly net income from irrigated mixed vegetable farming in Accra (US$ per actual farm size) is estimated at 40-57.

As the rainfall is relatively low, vegetable farming which has high water requirements, is mainly dependent on irrigation. It is therefore mainly practiced on valley bottoms along streams, which are now practically wastewater conduits. Farmers do not pay for this water and they perceive the nutrients in the wastewater and its year round availability as advantages. These users are estimated to provide up to 90 % of the most perishable vegetable needs of the city.

The risks and the challenges of urban agriculture include post production contamination (especially vegetables) from handling and water that is used to wash the vegetables. Urban agriculture in Accra is equally constrained by a number of factors including competition for land use, lack of access to good quality water for production, use of polluted water, and contamination of vegetables. The opportunities identified included increasing the contribution to livelihoods of the poor, growth in response to high demand for vegetables and the contribution to urban greening, flood control, land reclamation and protection. (Abraham et al, 2007). A number of studies have been undertaken by IWMI which will be part of the knowledge base.

The Accra working group identified the need for research and demonstration of multiple water uses in an urban watershed, and for development of guidelines for institutional support and minimisation of health risks based on the specific role of urban agriculture in livelihoods. The hidden contribution of urban water and wastewater to livelihoods will be quantified on a watershed basis and the role of informal enterprises will be quantified and analysed.

The emerging issues from the study on urban water for agriculture and other livelihood purposes are characterized under the following thematic areas/interfaces (and as such discussed in the SWITCH working group for WP 5.2): *Water for livelihood:* The main issues considered here are: institutional arrangement, price regulation and research for optimizing urban wastewater re-use in household context. *Water for urban agriculture:* Drain and stream water treatment are seen as main issues here, with the main objective of minimizing the health and environmental risks associated with the use of wastewater for urban agriculture. *Livelihood from Urban Agriculture:* The main issue here is seen as awareness creation and public education.

3.2 Beijing

Covering an area of 16,808 sq. km, the municipality of Beijing is divided into 16 districts and 2 counties. In 2004, the registered population numbered over 14.5 million, of which 3.2 million were living in the peri-urban areas. Beijing is a city faced by a shortage of water. Rainfall is unpredictable and highly variable, even across the city, and on average less than 600mm per year. The average water availability per person is less than 300 cubic meters, which is one eighth of the country average and one thirtieth of the world average. In recent years, the rainfall has been decreasing, resulting in reduced availability of surface water and underground water.

Millions of people have migrated to Beijing in search of jobs and economic security. At present there are more than 4 million migrants in the city (who lack the status of a registered citizen of Beijing). Quite a number of these migrants stay in the peri-urban areas and turn to urban agriculture for their livelihoods. In the context of China's fast growing economy, Beijing like other cities, supports the upgrading of peri-urban areas. One element in the city's efforts to develop peri-urban agriculture is the "2-2-1 Action Programme on Urban Agriculture". The productivity of agricultural land in peri-urban Beijing has increased and traditional farming (mainly grains) has gradually given way to more intensive production systems often linked with agro-enterprises that undertake the processing and marketing (herbs, vegetables, animal products, flowers, tree seedlings, pot plants, etc.). Agricultural cooperatives are being created that facilitate capacity building and joint marketing. These are often closely linked to (party-led) village-level management. There are currently about 150,000 farmer cooperatives in the country, 1000 of which are located in peri-urban Beijing. Privately owned land does not exist in China; all land is owned by the state (in urban areas) or by village collectives (in rural areas). This fact determines the way cooperatives are organised.

Apart from the traditional food production function, agricultural land use has been fulfilling other functions in Beijing. Agrotourism in Beijing has made great progress in the last two decades, and is generating more and more income for farmers due to the high demand from rich urban residents. By 2002, there were 2,246 agrotourism sites in Beijing that attracted 36.2 million tourists and grossed an annual income of nearly 2.3 billion Yuan (equivalent to about US$285 million). The government has played an important role in the rapid development of this sector.

Agriculture is a big consumer of water. Groundwater levels are decreasing rapidly. New regulations prohibit the use of groundwater for agricultural production in rural areas of Beijing. This will affect the livelihoods of many farmers, especially the poor migrant farmers. Re use of wastewater and rainwater harvesting are identified as proper alternatives, and the latter is stimulated by government. Water saving and re-use of waste water for agriculture has become an urgent need and is part of a common understanding.

The Beijing working group has identified a research and demonstration project under SWITCH in Huairou on water harvesting and re-use of grey-water for horticultural crops, linked to /within a agro-

tourism cooperative in peri-urban Beijing. A further link will be made to the replenishment of groundwater. This technology system comprises the surface of greenhouse where rainwater is collected, a rainwater collection flume, a deposit pool, and use of this water by using micro (drip) irrigation (*see Beijing paper*). Under SWITCH the Huairou working group will seek to support the cooperative in developing a combination of vegetable production for the Beijing market with the development of other functions like agro tourism and groundwater replenishment. SWITCH research is currently on water flows and quantities, the combination with a biogas installation, and it will facilitate the multi stakeholder platform at district (working group) and city (learning alliance) level. The demonstration project is to assist the cooperative to establish this multi-functional rainwater harvesting system (more intensive producer-consumer linkages, reed, duckweed, fishing, recreation) and to facilitate dissemination.

3.3 Lima

In Perú, urbanization is intense, especially in metropolitan Lima. Massive migration resulted in urbanization of poverty, which in Lima is concentrated in the expanding outer zones of the city. Lima has a population of 7,765,151 inhabitants (which increase by 2.1 % per year) on an area of 2,794 km2, covering 49 districts (which includes Callao).

In Lima water is scarce. Rainfall is less than 25 mm. The principal sources for water are therefore surface water (through the rivers Rimac, Chillón and Lurín) and subsurface water. The latter is mainly for industrial and domestic purposes). Seventy five percent of available water is for human consumption. This clean water is used for urban greening, while poor citizen do not have access to drinking water. People in informal settlements pay 10 times as much to informal vendors. Groundwater is for domestic and industrial purposes.

The majority of wastewater will end up in one of three rivers and flow to the Pacific. Water pollution is a major problem in Lima metropolitan area. Due to the inadequate sanitary and solid waste disposal facilities, people discharge the waste to the waterways. Some raw sewage is used for irrigation of food crops, mainly vegetables, and some is used in parks. The rest is discharged to the ocean without treatment. In a survey, some 37 examples of treatment and reuse of waste water have been identified, which together count for only 9.2 % of total waste water.

In Lima, municipalities provide water free of charge for some community gardeners. In addition large quantities of water are used for irrigation of gardens and parks. There are several initiatives which are using wastewater (grey and black) for greening and agriculture. The challenge is how to upscale these experiences, and identify best practices.

Urban agriculture provides promising alternatives for developing livelihoods for the urban poor. Urban agriculture is an important strategy in community upgrading, both in terms of social inclusion and improvement of income. A number of urban agricultural systems have been analysed. There are two major types, intra-urban and peri-urban agriculture. Urban agriculture is more of a subsistence activity undertaken on community gardens. The area under cultivation is smaller (less than 1000 m2 on average). This type of agriculture often uses clean water. While periurban farmers have often been farming long term, intra-urban farmers are most often urban citizens who took up farming recently and have limited experience in farming.

From the (37) systems of water re-use, 3 are used for irrigation of vegetables without treatment, while the other 34 have one way or another of treatment. Smaller cycles and treatment and re-use of waste water for activities that do not need clean water, like greening and community gardens would reduce

the demand for water. In addition, productive use of treated waste water could enhance poor sections of the city.

In 2007 SWITCH in Lima has undertaken research. Initially a broad review of experiences was undertaken, out of which 12 cases have been selected, 6 waste water treatment and re-use and 6 types of urban agriculture, which illustrate the wide diversity of practices in Lima. In depth case studies will be undertaken (institutional, social, technical, economic and environmental). This research will feed the development of guidelines and suggestions for policy change. One of the case studies will focus on decentralised treatment ponds and use for community gardens, which will function as a demonstration pilot.

City	Accra	Beijing	Lima
Population (growth rate)	1.7M (3,4%)	15M ()	8M (1.9%)
Rainfall	730mm	590mm (500-800mm)	25mm
Main water related problems	Pollution, erosion of drains, Leakage Flooding Water shortage	Water shortage Low surface supply erratic rainfall decreasing sub-surface	Drought Polluted surface (rivers)
Main UA system	Various (backyard and open space farming) Focus on open space irrigated vegetable farming	Small scale horticulture (migrants) and Entrepreneurial AgroTourism (govt. supported, different scales)	Fruits and Vegetable farming in periurban areas, Community gardening organic agriculture and small livestock inner urban
Opportunities for intervention	Improved Management (treatment of waste water and irrigation practices), Awareness raising (producers, consumers and policy makers), New Institutions	Rainwater harvesting and Re-use of waste water as alternatives to groundwater. Water pricing New Institutions	Re use of waste water for greening (parks and community gardens), to improve availability of drinking water elsewhere New Institutions

4 Research and action planning in a multi actor setting

A learning alliance consists of a group of institutions which seek to take a relevant innovation to scale (Morris, 2007). SWITCH aims to foster alliances of institutions in order to facilitate scaling up of innovations in urban water management. Individual researchers or (working) groups of researchers operate under these learning alliances. Under the WP 5.2, *Multi Stakeholder Working Groups* on productive use of urban water for agriculture are established in three cities, Accra, Beijing and Lima. These working groups involve several relevant stakeholders, like farmers, civil society, research institutes and universities, and municipal agencies.

The working groups members have been involved from the onset in the development of research and demonstration and meet on a regular basis to discuss main findings, facilitated by the SWITCH

partners IPES, IWMI, IGSNRR and the city coordinators. Institutes that are part of the working group also participate in the learning alliance, and as such are exposed and involved in activities of other work packages.

The working groups also are platforms for dialogue, but its members are to different degrees involved in (action) research: problem definition, agenda setting and identification of priorities, joint action planning and budgeting (including the opportunity to provide grants to non-SWITCH partners), and drawing lessons and adjustment of strategies.

The working group regularly reports back to the learning alliance. In the three cities, WP 5.2 is the main work package involving field research. As such the working groups function as a learning alliance (in Beijing) or assure the involvement of all (Lima) or a large part (Accra) of the learning alliance members in SWITCH research, thus assuring involvement in decision making on research, in sharing of knowledge and decision making.

Beijing
In China the Learning Alliance consists of stakeholders from Beijing and Chongqing. A first LA meeting was held in May, where ongoing lines of research, proposed research activities and SWITCH demonstration projects in Beijing and Chongqing were discussed. The major actors in both cities met, and it was agreed that under the LA, relatively independent working groups will operate in both cities. In that sense the WP in Beijing will act like a city learning alliance. Also in this first meeting an overview was made and discussed of ongoing research related to SWITCH by others (notably on stormwater harvesting for parks and gardens), the research under SWITCH, and suggestions of the Beijing LA members for linkages to SWITCH research elsewhere. In fact, this was a first form of joint action planning. Next to the research lines as described above in Huairou, further collaboration will be sought with Xiedao Resort on sustainable sanitation, and with the Ministry of Housing and Construction and the Ministry of Water Resources, the Beijing Water Authority, both on ongoing research on rain water harvesting.

Lima
Although Lima is not yet acknowledged as a SWITCH demonstration city, the main SWITCH partner, IPES, has facilitated a first meeting of a wider group of institutions (including the WP 5.2 working group), which was initiated as the Lima LA in August 2007. At the end of the first meeting of the LA, representatives of 26 institutions declared their willingness to participate. This group has taken the responsibility to further integrate other partners under this umbrella, and the Environmental Department of the Ministry of Housing and Sanitation has taken the lead in organizing a follow-up meeting.

Under this LA a working group has been working on the review and has been trained in action research. Next to the abovementioned research a stakeholder analysis cum needs analysis (of information and training) has been undertaken and an analysis of the legal and policy framework. Relevant institutions are involved in (or will be informed on) ongoing, research into the selected systems and will be involved in the development of new policies. The working group is also involved in collaborative monitoring of a project on greywater treatment and use at neighbourhood level (which could be seen as the city demonstration project), which will lead to a set of technical and policy guidelines.

Accra
The Accra learning alliance has had three meetings and is quite well established. The working group related to WP 5.2 consists of some members of the LA and several members of the Accra Working Group on Urban Agriculture. This working group will actively be involved in the research and demonstration activities. A first start up workshop was organised to assure the participants involvement in the multi-stakeholder process, to discuss the current use of water, identify constraints and opportunities; prioritize issues for water intervention; and formulate action plans for implementation, based on the situation analysis on urban water use for agriculture in Accra, and related to three thematic areas: water for livelihood; water for urban agriculture; and urban agriculture for livelihood. Discussion on the presentations emphasized the need to consider the option of ground water as an alternative water source for agriculture, to harness rainwater for productive uses and to encourage the Municipality (Accra Municipal Authority) to assure access to land for participating farmers in the demo. In a second meeting held recently in Accra, the working group members were trained in action research and developed a research framework, using the micro scenario's, focusing on improved management (local practices and improved options for treatment) and awareness raising.

The PhD research aims at developing a stakeholder oriented integrated urban planning framework, which relates the impacts on the biophysical environment to stakeholder interventions and institutional responses. It will build on investigation of users' access to water resources and benefits from water dependent productive activities, and their organization to negotiate for rights to water resources in relation to different livelihood circumstances. It will identify community actions and institutional responses to address unsustainable utilization of the water resources and hot spots of pollution.

Based on these initial reviews, research in WP 5.2 has started, which is closely linked to the identified demonstration projects. The situation analysis has been discussed with the working groups in the three cities, and a joint action plan on livelihoods-water-agriculture in the city has been developed, which includes ongoing research activities (which are already funded and undertaken by the stakeholders) and those (research) activities for which funding is sought, of which the (research) activities under SWITCH are part (see further in section 4). For each city the linkages between livelihoods-water-agriculture, innovation and institutional support has been looked at.

5 Discussion and way forward

The role and importance of water for urban agriculture and livelihoods varies considerably across the cities, both currently and in terms of their visions for the future. However, there are similarities in terms of water management, water scarcity and the need for new and innovative systems to allow for the use of different sources of water (rainwater and waste water). Based on the analysis of the specifics of farming under urban conditions and the actual role of farming in the livelihoods of the urban poor and the opportunities/constraints for its development, lines of research and demonstration have been suggested and a joint action plan developed. The action research in these areas under SWITCH will be important to inform decision making processes, whether these relate to agro tourism initiatives in Beijing, community gardens in Lima, or safer use of waste-water for sustainable urban agriculture in Accra.

There are common challenges across the three cities as well as specific ones. It is clear overall that the process of developing joint action within a multi-stakeholder context requires time and has to be adapted to the particular institutional arrangements and research and planning cultures of the different countries.

The process needs inputs from researchers, under appropriate learning settings. The search for technical and organizational innovation will be linked to institutional innovation. The working groups linked to the Learning Alliances and with the active participation of urban producers and water users are important sources of innovation, drawing on local technical, institutional and social knowledge. The role of working groups that function as learning alliance (in Beijing) or assure the involvement of all the learning alliance members (Lima) or a large part of them (Accra) in the research, and as such assuring involvement in decision making on research, in sharing of knowledge and decision making. Assessment of water related technologies is conducted within a livelihoods, cross-sectoral, urban and agro eco system and policy sensitive focus involving joint learning and problem solving.

A further issue is the degree to which sustainable and profitable use of water in urban agriculture and livelihoods can be combined with socially inclusive and poverty focused approaches, in particular recognizing needs for support for capacity strengthening for group development, networking, marketing, financial management and other skills.

To meet the challenge of learning from the process and using this knowledge to scale up and scale out the experiences, effective process documentation and systematisation, M&E (outcome mapping and the use of micro-scenario's), and knowledge management is required, facilitated by the SWITCH learning alliances.

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