Resource Recovery and Reuse (RRR) Project

Baseline Survey Report - Hanoi

2012

Name of city: Hanoi **See terminology in Annex**

A. Official interest in project. Please consult a responsible person in the local waste authorities who can respond to the following questions and/or refer to their policies:

1. **Is Resource Recovery & Reuse (RRR) from waste occurring in the city (waste composting, irrigation with treated wastewater, energy from waste projects)?**

   → Decision 2046/QD-TTg dated 18 December 2011 by Prime Minister approving list of National Target Programmes period 2011-2015, includes (among others):

   i. National Target Programme (NTP) on Rural Water Supply and Sanitation, with three components:

      1. Project 1: Rural water supply and rural environment;
      2. Project 2: Rural sanitation;
      3. Project 3: Capacity building on communication, monitoring and evaluation on the implementation of the programme

   ii. NTP on Recovery and Improvement of Environment, with three components

      1. Project 1: Remedy pollution and environmental improvements in the professional villages with serious pollution;
      2. Project 2: Improve and recover the environment in some areas seriously polluted by chemical residues of plant protection;
      3. Project 3: Collection and treatment of wastewater from the urban type II in three reservoirs of Nhue River, Cau River and Dong Nai river systems.

   iii. Other relevant NTPs on Energy Efficiency and Conservation, Response to Climate Change etc.

   → Decision 1030/QD-TTg dated 20 July 2009 by Prime Minister approving Proposal on "Develop environmental industry until 2015, vision 2025".

   iv. Call for proposal for 2013 Programme "Research on Science, Application and Technology Transfer to develop the Environmental Industry" by Ministry of Industry and Trade according to letter 12183/BCT-KHCN dated 30 December 2011.

2. **Are the authorities in charge of a) solid waste and those in charge of b) wastewater interested in a feasibility study for RRR options and related Sanitation Safety Plans in their city? Please note which authority confirmed interest (name, position, authority; or policy citation).**

   Government authorities in charge of solid waste and wastewater: Ministry of Construction, Ministry of Natural Resoures and Environment, Ministry of Agriculture and Rural Development, Urban Environmental Company.

   Non-government organizations working on solid waste and waste water: Authority in charge of wastewater: Vietnam Association of constructional environment, UNIDO

   Authorities confirmed interest:

   → Ministry of Construction – Department of Technical Infrastructure, Water Supply and Drainage Management Division, Mr. Nguyen Phi Tong – Head of Division

   → Vietnam Association of Civil Engineering and Environment, Mr. Pham Ngoc Dang, Chairman.

3. **Is there private sector interest in innovative resource recovery models? Who? In what? Can this be documented/verified via examples?**

Two governmental projects introduced (3R by JICA and fertilizer from waste by Hanoi Urenco) were not successful, leading to a lower interest from private sector.

Bach Khoa Environmental Friendly Technology (BKEST) (http://inest.hut.edu.vn/bo-mon): pilot model on waste gas and wastewater treatment, management and reuse hazardous waste for professional village.

Epro Consulting Company (Epro) (www.eprovn.com): Cleaner production and Energy Efficiency, livestock waste handling – Ms. Tang Hong Loan, Director.

4. **Are there public complaints (e.g. newspaper reports) about uncontrolled waste reuse or actual or potential health risks (please provide any proof/documentation if yes)?**

   http://www.tin247.com/xu_ly_o_nhiem_moi_truong_ha_noi_da_rat_cap_bach%21-1-21407132.html

   http://hanoimoi.com.vn/newsdetail/Moi-truong/546362/khu-cong-nghiep-noi-bai-xa-thai-gay-o-nhiem-moi-truong.htm

   http://hanoimoi.com.vn/newsdetail/Moi-truong/550064/ha-noi-tap-trung-trien-khai-4-du-an-thoat-nuoc-va-moi-truong.htm

   http://hanoimoi.com.vn/newsdetail/Ban-doc-viet/547337/hai-du-an-thoat-nuoc-bi-dap-chieu.htm

   http://www.vietnamplus.vn/Home/Ha-Noi-Nhieu-khu-vuc-nong-thon-ngap-trong-rac-thai/20124/136483.vnplus

   http://www.baomoi.com/Bao-dong-nuoc-khi-thai-cac-lang-nghe-o-Ha-Noi/45/6010269.epi

   http://moitruongxanh.org.vn/Default.aspx?Module=Site&Function=News&Id=720

   http://www.baotintuc.vn/129N20120307203842100T0/o-nhiem-moi-truong-lang-nghe.htm

5. **What are the major constraints to waste use or waste-resource recovery relating to institutional/legal, cultural or perceptional aspects?**

   Law on water resources was approved and commenced from 01 January 1999. Law on environmental protection was approved on 29 May 2005 and commenced from 01 July 2006. Besides, a large number of related legal documents (circulars, decisions, and instructions) were introduced and national target programmes have been implemented. However, the waste-resource recovery and waste use are not properly managed, laws and regulations are not strictly followed. Main constraints are:

   i. Sanctions are not strict enough
   ii. Lack of inspectors or environmental police in relevant aspects (water resources, wastewater treatment, solid waste)
   iii. Lack of capacity of environmental police and inspectors

B. Project supporting policies (questions should be directed to health and relevant institutions)

6. **Who is concerned about safety issues related to current formal or informal RRR activities? If anyone, which activities are of concern?**

   → Related ministries which make policy related to current formal or informal RRR activities (Ministry of Construction - MoC, Ministry of Natural Resources and Environment - MONRE, Ministry of Agricultural and Rural Development - MARD).

   → Local government (People's Committees) where RRR activities implemented.

   → Residential communities who directly affected by RRR activities.

7. **Are authorities aware of (or practicing) the new WHO (2006) guidelines for safe wastewater irrigation, greywater and excreta use?**

No information found on the awareness or practicing new WHO 2006 guidelines.

8. Do authorities use the WHO promoted Water Safety Plan concept or something comparable (name it) for safeguarding drinking water supply? Give the sources.

→ Ministry of Health (MoH) issued standards for drinking water quality:

- National Technical regulation on drinking water quality: QCVN 01/2009/BYT dated 17 June 2009
- National Technical regulation on domestic water quality: QCVN 02/2009/BYT dated 17 June 2009
- Domestic water standards: Decision 09/2005/QD-BYT dated 11 March 2005

9. Are there policies, plans and/or strategies supporting safe RRR from selected waste streams? Which ones? What is encouraged? What not? Which organizations are involved in the preparation and implementation of regulation?

No	Policy/plan/strategy	Encouraged or not	Involved organization
1	National Strategy on integrated solid waste management until 2025, vision 2050	Yes	Ministry and Departments of Natural Resources and Environment, People's Committees at all levels
2	Decree 59/2007/ND-CP dated 09 April 2007 by Government on Solid Waste Management.	Yes	Ministries of Construction, Natural Resources and Environment, People's Committees at all levels
3	Decision 148/QD-TTg dated 25 January 2011 by Prime Minister on Planning and Treatment of solid waste of Hanoi until 2030, vision 2050	Yes	Ministries of Construction, Health, Finance, Industry and Trade, Natural Resources and Environment, Scientific and Technology, Agricultural and Rural Development, Planning and Investment, Information and Communication, Culture-Sport and Tourist; Hanoi People's Committee

10. Please list key sector policies with RRR section.

→ Law on environmental protection

- → Law on water resources
- → National Target programme on Rural Water Supply Sanitation
- → Also see question 9 above

11. Do any comprehensive investment or feasibility studies exist for RRR from any waste streams which went beyond a small case study?

- → 3R (reduce-recycle-reuse) project funded by JICA within 2006 – 2009
- → 1,019 billion VND (equivalent to 50.95 million USD) funded by Hanoi City Budget for 9 priority programmes and projects to minimize three severe types of pollution in Hanoi (polluted by solid waste, surface water pollution and air pollution) by 2010.

12. Aside for normal incinerators, are there special incentives, policies, or regulations that support the generation of electric or thermal energy from organic wastes (i.e., biogas or combustion/gasification of agro-industrial or domestic waste)?

- → Biogas is commonly used in rural area of Vietnam generally and in Hanoi particularly. This is not compulsory, but households are encouraged to produce biogas for thermal energy from livestock and domestic waste.
- → National Target Program on Energy Efficiency and Conservation period 2006-2015

C. Local partner capacity

13. Is there a local office of WHO, IWMI SANDEC, or Swiss TPH in the city to facilitate research logistics, visa, conferences etc.? (leave answer blank; this will be answered by these institutions)

- → World Health Organization in Vietnam: 63 Tran Hung Dao Street Ha Noi, Viet Nam. Telephone: (84) 4 3943 3734/5/6 Fax: (84) 4 3943 3740 Email: who.vtn@wpro.who.int, website: http://www2.wpro.who.int/vietnam/home.htm
- → IWMI Representatives: Dr. Dao Trong Tu, 114 yen Lac Street, Hai Ba Trung District Hanoi, Vietnam. Email: tudaotrong49@yahoo.com.vn (http://www.iwmi.cgiar.org/contacts.aspx)
- → SANDEC: There is no local office in Hanoi. But there are a number of projects implemented/supported by SANDEC in Vietnam
- → Swiss TPH: There is no local office in Hanoi. But there are a number of projects implemented/supported by SANDEC (e.g. Institute of Environmental Science and Engineering (IESE); National Institute of Hygiene and Epidemiology (2008-2010); Hanoi School of Public Health (2009-until now – Dr Hung Nguyen-Viet research group…)

14. Give names and contact data of 2-3 key local organisations (NGO, university departments, research institutions, etc.) interested in RRR with likely capacity to coordinate other local institutions (multi-disciplinary teams) and host students also from abroad?

- Institute of Environmental Science and Engineering (IESE), Hanoi University of Civil Engineering – Dr. Nguyen Viet Anh

- Hanoi Urban Environment Company (URENCO), Mr. Dinh MInh Tri

- Hanoi Sewerage and Drainage Company (SADCO, Vietnam). Address: 8 Van ho, Hanoi, Vietnam
Tel: +84 49 762245, Fax: +84 49 762663
Email: urencohn@netnam.or.vn
Contact: Le Minh Chau, Director

15. Which local authority/institutions/university/business schools or research institute could be recommended to work with the project on data generation and knowledge exchange in the areas of:

- Sanitation and sanitation safety plans

Hanoi Urban Environment Company (URENCO)

Sewerage and Drainage Company (SADCO)

Institute of Environmental Science Engineering (IESE), 55 Giai Phong road, Hanoi.

- Public health and risk assessment (epidemiological studies? QMRA?)

Center for public health and ecology research (CENPHER); Hanoi School of Public Health – 138 Giang Vo, Hanoi

National Institute of Hygiene and Epidemiology (NIHE)

National Institute of Environment and Occupational Health (NIOHE) (www.nioeh.org.vn)

Hanoi Medical University (HMU)

- Environmental risk assessment

Center for public health and ecology research (CENPHER); Hanoi School of Public Health – 138 Giang Vo, Hanoi.

National Institute of Environment and Occupational Health (NIEOH) (www.nioeh.org.vn)

Hanoi School of Public Health

- Waste stream analysis and treatment options

IESE, 55 Giai Phong road, Hanoi

Hanoi University of Natural Resources and Environment (www.hunre.edu.vn)

- RRR for energy

Hanoi Urban Environment Company (URENCO)

Vietnam National Energy Efficiency Programme – VNEEP (www.tietkiemnangluong.com.vn)

- Urban agriculture (soil fertility and irrigation)

Institute of Policy and Strategy for Agriculture and Rural Development (www.ipsard.gov.vn)

National Centre for Agricultural Promotion (www.khuyennongvietnam.gov.vn)

Hanoi Agriculture University (www.hau.edu.vn)

Water Resources University (www.wru.edu.vn)

Vietnam National Institute of Soils and Fertilizer

- Institutional analysis

Institute of Policy and Strategy for Agriculture and Rural Development (www.ipsard.gov.vn)

Vietnam National Institute of Soils and Fertilizer

Vietnam Academy of Agricutural Science (www.vaas.org.vn)

Institute of Environmental Science Engineering (IESE), Hanoi University of Civil Engineering.

16. Do any (multi-)stakeholder platforms or learning alliances exist from similar waste (reuse) projects or initiatives which could be linked to for the discussion of RRR business plans and/or SSP development?

DANIDA

UNIDO

UNDP

JICA

World Bank

17. Do any local institutions have or had related RRR projects? Name project content or title and approx. year. Was SANDEC, Swiss TPH or IWMI involved in any of these?

Institute of Environmental Science Engineering (IESE), Hanoi University of Civil Engineering.

Material Flux Analysis (MFA) for Environmental Sanitation Planning - An Introduction Lecture Notes and Exercises. Agnès Montangero, Arunee Ongmongkolkul, Thitiphon Sinsupan, Le Ngoc Cau and Thammarat Koottatep Bangkok, April 2005.

This publication was prepared by the Asian Institute of Technology (AIT, Bangkok/ Thailand) and the Swiss Federal Institute for Environmental Science and Technology (EAWAG, Dübendorf/Switzerland) as lecture notes for an introductory course on material flow analysis (MFA) for environmental sanitation planning. The course was organized within the framework of the National Centre of Competence in Research (NCCR) North-South as part of the project "environmental sanitation and urban agriculture". Course participants were AIT Master Students in environmental engineering.

NIHE: Sanitary Aspects of Drinking water and Wastewater Reuse in Vietnam (Danida-funded project)

IWMI project on Wastewater Reuse in Agriculture in Vietnam: Water Management, Environment, and Human Health Aspects (working NIHE, Vietnam Institute for Water Resources Research, and Vietnam National Institute of Soils and Fertilizer).

Swiss TPH and Sandec project on Productive sanitation: balancing between health risk, livelihood opportunities and environmental impacts (working Hanoi School of Public Health; National Institute of Hygiene and Epidemiology)

18. Can ethical clearance/approval for medical research be easily obtained locally? What is the process? What are the guidelines?

Ethical clearance/approval for medical research can be easily obtained locally. Research proposal needs to be submitted to involved institutions if there is Ethical board at the institution, or to Ministry of Health. Research proposal needs to provide overall goal, objectives, planned activities, sustainability and budget.

The ethical approval process for medical research will be obtained locally (Institute or university), and time process approx. 1-2 months.

The process will follow the guideline of Ministry of Health, including detailed proposal, including detailed budget approved, letter from donors, letter of collaboration from all partners involved in the project (both domestic and international).

The ethical assessment committee at institute or university (5-7 persons) will be assessed and approved.

19. List international and national airlines reaching the city regularly.

International airlines:

China Southern	China Airlines
Austrian Airlines	Thai Airways
Shanghai Airlines	United
Cathay Pacific,	Lao Airlines
Air Canada	Korean Air
Hong Kong Express	Thai AirAsia
Singapore Airlines	Hong Kong Airlines
Tiger Airways	Asiana Airlines
EVA Air	Uni Air
Malaysia Airlines	Air Asia
Vladivostok Air	Japan Airlines
Lufthansa	Hainan Airlines
Aeroflot,	Air France
Dragonair/Hong Kong Dragon Airlines	All Nippon Airways

National airlines: Vietnam Airlines, Vietjet Air, Air Mekong, Jet Star Pacific

D. Demand for RRR i.e. waste resource recovery in industry, farming, construction, etc.

20. Which waste-based products a) have already a demand by whom in and around the city, and b) which could have? Consider waste-derived fuel for cement kilns, irrigation water, nutrients, organo-fertilizer, biogas, etc., and as sectors e.g. urban and peri-urban agriculture, peri-urban agro-industry, parks and gardens, housing sector, aquaculture, forestry, cement industry, other industry.

Hanoi city:

Hanoi is a fast growing and large urban center which has a very high demand in fertilisers, including organic fertiliser types in Hanoi area. Table 1 presents the projection of compost fertiliser demand in Hanoi area.

Table 1. Projection of compost fertilizer demand in Hanoi area

Year	2006	2010	2015
Cereals	15 100	18 875	22 650
Vegetables	8 000	25 069	45 011
Flower gardens	1 980	8 659	9 870
Fruits and other trees	2 100	7 213	15 250
Total, tons	27 180	59 816	92 781

(Source: Institute of Industrial Chemistry, Institute of Natural compounds, Vietnam Academy of Science and technology (VAST) – JICA. 2008 – 2009)

However, due to limited facilities with adequate treatment and high travel expenses, there is only a very small amount of sludge emptied from urban area is reused by the farmers who are informally purchasing sludge from the emptiers. There is no fecal sludge reuse found in urban area in the survey (Figure 1).

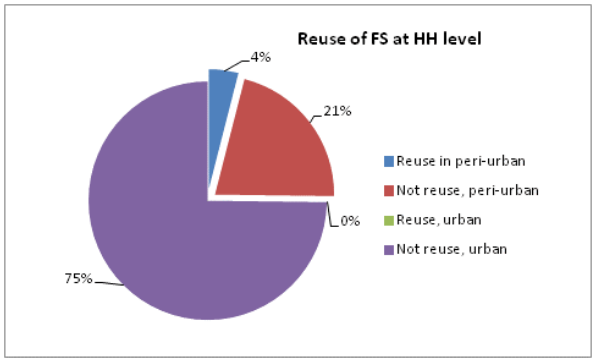

Figure 1. Fecal sludge reuse in Hanoi (not including Cau Dzien co-composting plant)
(Source: Nguyen Viet Anh et al. Fecal sludge management study. BMGF, 2012).

15.8% of households, who are living in peri-urban areas, or 4% of total surveyed households in Hanoi, are practicing FS reuse by themselves (Figure 1). Co-composting with organic wastes and using as fertilizer is a most common reuse method. Feeding to the fish ponds is another method of FS reuse which is not popular due to potential risk of fish death and low market price of fish fed by FS.

In peri-urban areas, where farming activities are still prevailing, the night soil from pit latrines and fecal sludge from septic tanks is reused at a small scale for making organic fertilizer or for fresh feeding to the fish pond. The farmers reuse night soil or fecal sludge from their own toilet and from neighbors who do not have need in fertilizers. There are some venders who are buying night soil from non-farming families in the area, making compost, and selling compost to the farms. The business is rather small, operated by one person in the family, who might have also some other activities for income.

Manual emptying (some time it is done by the household owners themselves) is applied for night soil from on-site sanitation systems. Both manual and mechanical methods are used for septic tank desludging in peri-urban areas. For mechanical emptying, small trucks equipped with pump are often used. Due to high water content and high ammonia concentration, septic tank sludge is often mixed with agricultural waste for co-composting. Small septic tank size, long desludging interval, long distance for travel to the low-income communities are major factors not attracting desludging enterprise in peri-urban areas.

Most of solid waste is Hanoi, including domestic and industrial, is collected and brought to the Nam Son waste treatment complex, which is located in Soc Son district, 50 km north from the Hanoi center. Nam Son is receiving 2,500 tons of solid waste per day. Sanitary landfill is an only technology applied.

Recently, the system for collection of biogas from landfill cells in Nam Son has been installed. Collected biogas is sent to electricity generator or flared. The system is running under the CDM.

Fecal sludge collected by the Cau Dzien enterprise (or Hanoi URENCO 7) is mostly from public toilets. Solid waste brought into Cau Dzien is mostly from the city markets. The plant has been built in 1992, and upgraded in 2002 by the ODA loan from Spain. The design capacity of Cau Dzien composting plant is 13,600 tons/year. Fecal sludge is an additional material which is co-composted with separated market organic waste for the composting process. Theoretically addition of fecal sludge into the composting pile at appropriate sludge/organic waste ratio provides more favorable environment of C/N ratio and moisture for the composting process and for having a better quality of the compost product. The current capacity of the plant is around 5,000 tons of compost per year.

There is 80 staff of the plant, including 15 engineers, 5 vocational school graduates, 60 workers from different departments dealing with organic waste collection, transportation, separation, compost production, marketing and sale of compost. FSM is only a small business of the plant. Even though the reported amount of sludge collected and brought to Cau Dzien is 50 tons/day, the team has found the actual sludge brought into the plant is only 10 – 20 tons. There is no evidence during the survey that Cau Dzien has a constant number of fecal sludge trucks delivered. Compost product is any way produced from organic waste at Cau Dzien despite of if there is fecal sludge in the composting process line or not.

Current, actual fecal sludge receiving capacity of Cau Dzien is only from 20 to 50 tons/day, due to limitation of treatment and marketing capacities. That amount is still far from estimated city's need or market.

21. How big are the likely interested sectors approx.? e.g. in terms of size of (open-space) farming (number of farmer or area), number/size of industries actually/potentially interested in nutrient/water/energy?

- Production of agriculture accounts for only a small proportion and the lowest ranked in the structure of the entire general economy of the city. Compared with 2000, 2005 to 2010, the proportion of agricultural economy tends to decrease (10.4% in 2000 and 2005 was 6.9%, 5.8% in 2010), this trend reflect the positive transition of economic structure capital as the proportion of industrial and service sectors - construction, rising in GDP across the city, the corresponding proportion of the service, the in 2005 was 52.4% and 40.8% in 2010 was 52.4% and 41.8%.
- In 2010, production value of agriculture, forestry and aquatic products at current prices reached 27,745 billion VND (including planting: 12,422 billion VND 12,889 billion livestock, agricultural services 708 billion, fishery: 1666 billion and forestry: 60 billion).
- Structure of gross agricultural production in recent years there has been a shift toward more positive, consistent with the requirements of development: reducing the proportion of cultivation, increasing the proportion of livestock, fisheries

Planting density tends to decrease; 2000 the proportion was 62.3% in 2010 dropped to 44.8%, livestock density increased continuously up to 2010 is 46.5% (five 2000 reached 32.0%) demonstrated gradually raising the position became a major industry in agriculture structure of fishery production value also increased from 3.4% in 2000 to 6, 0% in 2010. The period 2001 - 2010 agricultural services also tend to increase in density but lack stability.
(Source: Statistical Office in Hanoi in 2010 (by kind of economic VSIC 2007)

22. Amount of rainfall per year (how many dry seasons/number of dry months) (important for wastewater reuse)

Typical climate of Hanoi in North Vietnam, the characteristics of a tropical monsoon climate, hot and humid summer, rainy and cold winters, low rainfall. Due to the sea, Hanoi, humidity and rainfall is quite large, on average 114 rainy days a year. Average air temperature from 23^0 C to annual 23.8^0 C; a clear characteristics

of Hanoi climate is changing and difference of two seasons hot and cold. Hot season lasts from May to September, accompanied by heavy rainfall, average temperature of 29.2^0 C. From November to March next year is the winter climate with average temperature of 15.2^0 C. Along with two transitional period in April and October, the city has all four seasons: spring, summer, autumn and winter.

The average annual rainfall of 1800-2200 mm, the highest monthly rainfall is in July, 8, 9 accounting for 60% of the total annual rainfall; the month so often occurs at the local inundation lower in districts such as Ung Hoa, Phu Xuyen, My Duc ... and floods occur in mountainous communes of Ba Vi. Rainfall is lowest in November, December, January, Febraury is only about 8% of the total rainfall for the whole year so during these months often causes drought, especially the upland villages.

23. Number, size and perennial status of streams crossing city or peri-urban area; b) are they polluted by wastewater, c) are they used for formal or informal irrigation?

Currently, 3 centralized wastewater treatment facilities treat 10% of generated wastewater flow from the Hanoi city. The rest is discharged through several large drainage channels that flow away from the city. Septic tank is an only primary treatment mean for black wastewater from toilet.

Hanoi citadel is divided into two drainage basins, Nhue and To Lich river basins. The Nhue river basin covers peri-urban districts west of the city. All wastewater and storm water flow to those rivers fed by a network of sewers, open channels and ditches. A big challenge for wastewater management now in the city is unclear regulations for responsibility of dischargers to follow effluent standards. It is very difficult for city's authority to reward and punish people. Hence, the wastewater treatment before discharge is not obligatory for most of stakeholders. This situation should be improved by more strict regulations and control measures.

Lack of wastewater treatment makes water contamination a major health threat and aquatic ecosystems are threatened by the high amounts of untreated sewage and industrial wastewater generated in urban centres. The flood regulation ponds are extensively used for aquaculture especially in the larger cities and in peri-urban areas, practices of wastewater reuse are facing big problem of contaminants in wastewaters, causing a high risk for farmers and agro-product users as well as environment. There are number of cases of poisonings due to use of wastewater-fed fishes in Thanh Tri district.

Raschid-Sally et al (2004) found that 75% of domestic wastewater in large cities and 45% in smaller cities are discharged into sewers. Wastewater is used for agriculture or aquaculture in 93% of the cities. On average, wastewater is used in at least 2% of the agricultural land around most cities, predominantly to grow rice. The nation-wide total of such irrigation is conservatively estimated at around 9,000 ha. Wastewater aquaculture is carried out in natural ponds which serve the dual purpose of inundation control and as collection sinks for city wastewater. Wastewater agriculture provides a primary or secondary source of income to 1% of the urban population. The corresponding figure for wastewater aquaculture is 0.1%.

Hanoi's water bodies, surface and groundwater, are being polluted by untreated wastewater discharged from both domestic and industrial sources. Less than half of the household black water is treated by septic tanks and the remainder, as well as the entire volume of grey water, is discharged untreated into the canal waters. A lack of management of sewage and nightsoil/septage causes serious health impacts due to poor construction maintenance and disposal facilities of the toilets. Most sludge, sewage and rubbish is discharged into the pipelines together with the wastewater. Even in the major cities, the storm water drainage is combined with wastewater and at times when the system gets clogged up, waste including human excreta, overflows into streets. Nearly, two thirds of the poor suffer from flooding in the rainy season and half of these stand in floodwaters for long periods of time. Faecal pollution and transmission of waterborne diseases is therefore a particular concern during flood events.

24. Would treated wastewater have a possible market? Why Yes or No. If Yes, for whom?

Yes, for irrigation and aquaculture, for farmers in downstream districts of cities.

25. Which farming systems (like urban vegetable farming or peri-urban pineapple or firewood plantations) are most likely to use organic waste fertilizer, and on which crops?

Both of them are potential users.

E. Ongoing reuse activities of interest for Sanitation Safety Plans (SSP)

26. Are there any public (or public-private) projects on RRR from any domestic (household or market waste; excreta, wastewater), or agro-industrial waste streams (cassava peelings, food processing waste, cotton husks, etc.) in operation?

- Private enterprises providing septic tank emptying service.
- Private enterprises and individuals making compost for sale.
- Private enterprises buying and selling fertilizers, other agro-chemicals.

For reference readings:

- *In urban areas:* In peri-urban areas of large cities as Hanoi, operation and maintenance costs for secondary and primary sewers are normally taken from the ward PC's budget and by local citizen's contribution in the form of local fund of labour for public in¬te¬rest. In addition, local community leaders play a vital role in mobilizing public participation in ma¬nagement of the facilities and, partially as a consequence of this, communities can be motivated to conduct sewer cleaning, site clearance, etc. In many cases, the drainage network is maintained (cleaned, wastes clearance, dredging etc.) by local people involved as volunteers in the Environment and Health and Sanitation campaigns, which are organised weekly in most urban areas of Vietnam.

  In situations where operation and maintenance requires special skills or equipment, the services are procured through small private entrepreneurs. Those workers are normally either unemployed or staff from SADCO and URENCO who provide the service for extra income. The negotiations with the contractors are made by representatives of community or group of households in the alley.

  All residents, regardless of income level and level of participation, benefit from improved drainage and cleaner alleyways. Due to the improvements in the drainage systems, households have been motivated to upgrade their household latrines and most of the pit latrines have been upgraded and the use of septic tanks has increased. Septic tank construction is now mandatory for house construction or upgrading. The system also contributes to health improvements by reducing, if not eliminating, wastewater puddles and making alley ways more sanitary. The presence of rodents and insects along the public alleyways is reduced and spread of diseases is curtailed. There also are fewer areas that are prone to flooding and flood events are less prolonged during big storms.

  In Hai Ba Trung district, the primary and secondary drainage system was well maintained and functioning reasonably. However, the interconnection of the tertiary system with the central system is observed to cause local problems for operation due to a lack of clarity of where the division between tertiary and secondary system lies.

- *In peri-urban areas like Hoang Mai district:*

  Hoang Mai is a peri-urban district in the south of Hanoi, which is undergoing intensive urbanization. A large part of the city's wastewater flows through the district prior to discharge into the Nhue and Red rivers, but the wastewater that flows from the city is widely used by farmers living on the edge of the city.

The sewerage and drainage system in Hoang Mai was built to receive a mix of domestic wastewater and runoff and the flow is directed to the irrigation network on the fields. With increased urbanization, several canals, formerly used for irrigation, have become sewerage and drainage canals. As the urban-based activities intensify the demands on existing water resources increase and, at the same time, local watercourses become increasingly polluted.

This results in increased use of wastewater for aquaculture and irrigation – either directly or indirectly. In some wards of Hoang Mai district (such as Yen So, Hoang Liet, Thinh Liet, Tran Phu, Linh Nam), wastewater is extracted from drainage channels and reused for irrigation or rice paddy fields and vegetable production, which is a traditional livelihoods activity and a major income source in Yen So Ward, Hoang Mai district. There are 20 ponds with a total area of 185 hectares using wastewater for feeding.

The Commune PC is responsible for management of small communal drainage and irrigation systems. Small repairs, network upgrading and sewers and channels cleaning to address localized flooding are often carried out by local people's labour force. These irrigation canals, including the main canal, should have been transferred to SADCO's responsibility. However, this has not happened yet and therefore local farmers clean up the canals and sewers and provide minor operation and maintenance work by themselves.

After establishment of Hoang Mai district, the sewerage and drainage service in the area was put under the responsibility of Hanoi SADCO. However SADCO is still unable to fully serve this newly urbanized district, especially in the wards formerly belonging to Thanh Tri district. Therefore, SADCO is responsible for main sewers, ditches and channels, while the secondary and tertiary collection and drainage works remain a local authority responsibility.

As in Hai Ba Trung district, SADCO Enterprise No. 3 also maintains all the main sewer lines and channels in Hoang Mai district. The responsibility for tertiary drainage and sewerage network belongs to the local authority, whereas community, through its ward PC, is responsible for smaller collector drains in alleys and household connections. Capital improvements for the tertiary works are funded either entirely from local resources or with some co-financing from the city, and in some cases, central authorities.

The local district authority plays a key role in many areas affecting the environment, organizing and leading environmental awareness campaigns with the active participation of the ward PCs. The weekly "clean-up campaign" is organised with active involvement of Youth's and Women's Unions of the wards in coordination with all private commercial companies located in the district. The collected solid waste or sludge dredged from channels and sewers are brought to the disposal place by the Thang Long Ltd., the private company providing environmental service in the area. The company charges the fee for solid waste collection at the rate US$0.125 per household per month, while the households engaged in commercial activities and generating more wastes pay more, based on agreement.

Demands for water for irrigation and wastewater reuse practices

In Vietnam, it has traditionally been common practice to use untreated human excreta as fertilizer and faecal sludge and septage from septic tanks and bucket latrines are collected and used by private farmers. Nightsoil and faecal sludge from vaults were originally used but the extensive system of wastewater reuse in Hoang Mai was developed over the past 50 years. Wastewater reuse in aquaculture and agriculture is a traditional practice developed by farmers and local communities. Wastewater reuse reduces expenses required for production and vegetables which are traditionally grown in Hoang Mai district and are mostly sold in the city centre. However, much less nightsoil is used on vegetables as most houses now have septic tanks and septage is more likely to be used in fishponds.

From a former single aquaculture business years ago, many farmers in Hoang Mai now use the land for rice growing for 6 months and as fishponds for the other 6 months. Short-term vegetables are also cultivated in between. After harvesting the fish, the land is rich in nutrients for crops. However, there are still areas where specialized ponds are used for aquaculture exclusively. In addition to owner-operated fishponds, some businessmen have leased ponds from the farmers. Lease payments are usually in the form of produce-sharing with landowners.

The responsibility for coordination of wastewater irrigation service and the drainage network rests with the local authority. The commune provides the wastewater pumping service to the farmlands and fishponds. There is an internal agreement that the famer or fishpond owner pays for the pumping expenses provided by the company to bring wastewater to the paddy fields or to individual fishponds.

In Yen So, as well as in another wards, fishpond areas were originally intended as rice fields, but since the shift to a market economy, farmers were given the choice to engage in rice production, or to shift to other economic activities. A number of big ponds are shared by a group of farmers and leased to contractors. The reuse of wastewater makes it possible to feed the fish, which potentially adds to income generated through rice cultivation, often even exceeding the latter.

In Hoang Mai, men are more involved in fish culture, whereas women are more active in farming aquatic vegetables. Men tend to be more involved in transportation and wholesale marketing of fish than women, although women are more involved with transportation of aquatic and terrestrial vegetables on bicycles and motor cycles. Women dominate retail and purchase of produce in retail markets. In Yen So, 10% of workers involved in aquaculture activities are women while this ratio is 85% in rice cultivation. The ratio is even higher in vegetable production where 95% of workers are women.

With increasing demand for cleaner vegetables production due to the increasing awareness of the users about the health risks, reuse of untreated wastewater is not considered to be a suitable water source for many types of vegetables. Looking for alternative water sources for cleaner vegetable production, local authorities and farmers in some wards of Hoang Mai are trying with ground water extraction for installation of the net field for vegetable growth. The ward of Linh Nam is one case where ground water is used for vegetable production, which brings about significant economic benefit for the farmers, as their product can be sold easier and at higher prices than vegetables fed by wastewater. However, as discussed below, this does not provide a sustainable solution as it uses groundwater at a faster rate than replenishment.

27. Is there an informal sector active in RRR from organic waste? (which waste for which purpose)

- Private firms emptying septic tanks for fee.
- Pig farmers collecting food waste from restaurants and recooking before feeding to pigs.
- Some private firms collecting organic solid waste and making compost for sale.

Septic sludge: there are private collectors collect some amount as a source of organic fertilizer for vegetable growing and fish production in the surrounding area of Hanoi.
In Hanoi, the average amount of human waste is about 300 tons/day. URENCO can collect only 30% (100 ton/day). About 80% of households use septic tank and 20% use dry toilet.
(Nguyen Thi Loan Ph.D., Faculty of Environmental Sciences, Vietnam National University, 334 Nguyen Trai, Hanoi Vietnam, Email hanhloan@hn.vnn.vn).

28. Are farmers or others using any domestic or agro-industrial waste products, raw or treated? Do they pay for it? Is the use regulated or informal? If regulated, by which regulation/authority?

Agro-industrial waste products, especially food processing, agricultural wastes, are reused for making compost, making live stock foods, etc. Producers often pay (cheap in most of cases) to waste owner. No regulation for this informal business.

It is estimated that around 2,500 tonnes of household waste are discharged daily in rural areas.

Statistics from the Hanoi city's Natural Resources and Environment Department show that only five out of 18 suburban districts, including Soc Son, Dong Anh, Gia Lam, Me Linh and Thanh Tri, finished transporting all their waste to common waste-treatment plants.

According to the department, stagnant waste along local roads, schools and markets has been blamed for environmental pollution in the suburban districts of Thach That, Quoc Oai and Chuong My.

The department found some communes in suburban districts using ponds or lakes to bury waste, resulting in local water pollution.

Pham Van Khanh, the department's deputy director, said that collecting and transporting waste met difficulties due to tardiness in building landfill sites.

Poor co-operation between managerial agencies and environmental sanitation companies was believed to be adding to the situation, he said.

District-based authorities blamed shortages of land and money on their slowness to build waste treatment sites, he added.

Nguyen Van Doanh, vice chairman of the Chuong My District People's Committee, said that the district had been building temporary landfill sites in the communes of Dong Son, Tan Tien and Tran Phu with the city's support of VND100 million (US$4,800) for each site.

"But that is just a short-term solution. In the long run, we'll face difficulties due to having no money to build waste treatment plants," Doanh said.

According to Khanh, to solve the problem, the city committee should order its units to speed up the progress of building common waste treatment plants in the districts of Son Tay and Soc Son.

As planned, the city targets to build more waste treatment plants with hygienic burying technology by 2015.

The city has called for investment to build these sites; however, no investors were ready to pour money into such projects due to slow payback.

Besides, the cost for treating waste is also a problem, costing $15 per tonne, which the city could not afford.

In the meantime, it was not easy to raise waste collection fees higher than VND1, 500 per person when rural people remained poor, Khanh said.

29. Name private entities actively working on reuse (which waste, which output; how big are these firms; web link). Are there e.g. compost producers in the private sector, community based, or NGO/Research projects?

HMC company: http://thuylucmay.com.vn.

Tam Sinh Nghia Company. http://www.tsn-corp.com.

Urenco No. 7 (Cau Dien Composting Plant – URENCO 7; Address: 60B Nhue Giang, Tay Mo, Tu Liem, Hanoi; Tel: (04) 8373739.
Human wastes and solid wastes
End-products: fertilizer
120 tones/day, 6000 tones/year.
Web link: www.urenco.com.vn

30. Are any reuse-related environmental or health issues known? Are they being addressed?

Yes, some health problems as soil-transmitted helminthes (STHs), diarrhoea, skin problems. It addressed is improving personal hygiene as use of protective measures during work, handwashing after work. Treatment or composting excreta before use as fertilizer (Trang, Tuan Anh, Phuc)

There are 30.1% of households in rural Vietnam are using human excrement in agriculture, fish farming. Most of these households do not compost or compost is not enough time specified. This is one important factor contributing to the pollution of water resources and environment (Ministry of Health, 2007).

By 2010, about 45% of households with livestock pens hygiene of households with livestock pens. The number of housing projects has nearly 17% Biogas only. The collection, waste disposal is also beginning to be concerned, about 32% of communes and towns with the garbage collection (Ministry of Health, 2011).

The waste-related diseases are common diseases in Vietnam. In wastewater, especially from the hospital, containing many germs: bacteria, Viral, Protoza, eggs ... There are over 30 different types of disease transmission from waste, it is a matter of public health important (Dalsgard A, 2009). Some surveys show that the disease is common in cultivation using wastewater as diarrhea, skin, trachoma, gynecological (Trang DT and Lan NTP, 2002).

Reuse of untreated wastewater exacerbated worm infection status for both producers and consumers. Farmers, especially working people to foot ceilings, exposed susceptible wastewater hook worm farmers working than non-contact wastewater. Reuse of treated wastewater is not appropriate that the phenomenon of roundworm infection in humans increases the production and consumer products (Dalsgard A, 2009).

There have been some studies show that many sub-urban areas, farmers use waste vegetable farming and aquaculture to take advantage of irrigation water and organic substances in wastewater. Each 1000m3 of treated waste water contains an average of 52.9 kg of nitrogen, 13.9 kg P2O5 and 28 kg K2O. It is a source of valuable fertilizer for plants and fish is good food (Huong VTT, 2001). However due to urban waste water, including industrial wastewater and hospitals, due to untreated or handle is not effective, so vegetables and aquaculture with wastewater contamination risk for toxic substances like heavy metals, bacteria ... health effects of the growers and consumers, and high risk contaminating water sources (dug wells, deep wells, lakes ...).

In Hanoi, residents to use waste water for aquaculture mainly in districts like Gia Lam, Hoang Mai and Thanh Tri. Residents pump water from four rivers (mainly Kim Nguu and To Lich River) to the system of canals, which distribute in the manufacturing sector, aquaculture (Edwards P, 2005; Phuong NTD, Tuan PA , 2005; Phuong NTD, PA Tuan, NTH Tien, Bau P, Diep HK, Tan NT, 2006). A pump about 1 or 2 times/weeks. One hecta of winter-spring rice crop often use 2563 m^3, accounting for 47.6% of total irrigation water demand for a crop, the corn crop is 1000 m^3 , accounted for 35.7%, 902 m^3/ potatoes crop accounted for 34,2% of total demand. After 5 days of irrigation BOD5 decreased 74.6%, 63.8% COD reduction, 97.2% lower total coliform and E. Coli decreased 98.6% (Huong VTT, 2001).

Vegetables grown in the outskirts of Hanoi is the main vegetable supply for the city. Approximately 62-80% vegetable consumption in Hanoi (184,870 tons /year) is produced in the suburbs, in which vegetable has the most sales: average 77.3 g / person / day (Anh MTP Ali M, Anh HL, TTT Ha, 2004). The vegetables are irrigated with wastewater are: spinach, watercress, water mimosa ... Vegetable growing area of Hoang Mai and Thanh Tri districts, Hanoi is 1669 hectares with a production of 50,145 tons/ year (Lan VT, 2004). A survey has shown that, at Tran Phu and Bang B villages, Hoang Liet commune, Hoang Mai and Thanh Tri districts, Hanoi vegetable growing area of wastewater use per household is 536m^2 and 563m^2 . At 2 sites that use vegetable waste water in rural Bang B, Hoang Liet commune, Thanh Tri district, Hanoi wastewater is 13.400m^3 and 52.000m^3 use / year (Khai NM, Ha PQ, Oborn I, 2007).

Fish production in Hanoi in 2004 about 8972 tons, of which 57% is farmed in Hoang Mai and Thanh Tri district (NTD Phuong, Tuan PA, 2005). In 1019 ha of fish in two districts in 2002 with 417 ha of wastewater use. The time from breeding to harvesting about 10 months. The fish are usually fed with wastewater: common carp, grass carp, the silver copy Chinese, Indian carp, the first copy to, tilapia tissue Bich Zambia, Nile tilapia ... The study monitoring of fish consumption is very limited. A survey 500 households in Hanoi on consumption of fish (freshwater, saltwater ...) shows the average consumption in the city is 50.5 g / person / day in the suburbs is 36 ,9g/nguoi/ngay (Ali M, Quan NT, Nam NV, 2006). Another study in northern Vietnam (Dey MM, MA Rab, Paraguas FJ, Piumsombun S, Bhatta R, Alam MF, Ahmed M, 2005) showed that fish consumption is 6.86 to 19.32 kg/person/year depending on income level. As announced by FAO in 2003, the average fish consumption in Vietnam is 14.7 kg/year, of which 6.9 kg of fresh fish (FAO, 2003).

A study in Yen commune, Thanh Tri district, Hanoi showed that the Kim Nguu river flows through the Yen So is the most polluted rivers because every day there are about 100.000m^3 wastewater contains many kinds of chemicals industry, fertilizers, plant protection chemicals and excreta discharged into the river. Concentration

of BOD5, COD 3-7 times higher than permitted standards, higher amounts of total coliform permitted standard for up to hundreds, even thousands of times (DT Trang and Lan NTP, 2002). In this community more than 50% of agricultural land (approximately 185 ha) is used to make fish ponds, most of which use water from Kim Nguu river. Every 7 to 10 days pumping water from the river into the pond one time, each pumping about 10% capacity of the pond. About 25 hectares of vegetable fields, mostly vegetable, are irrigated with water from Kim Nguu. But do not pump water directly from rivers where Kim Nguu river water is pumped into the fish pond, then through rice paddies, fields of vegetables or over rice fields and then the adjacent vegetable fields.

Elements such as Cr, Cu, Fe, Mo, Mn, Ni, Zn is a trace element essential for activity and physical development. However, the absorption of many other elements can also be toxic. There are some in which the distance between beneficial doses and toxic doses very close together, others such as Be, Cd, Pb, almost no function in the body and can cause toxic dose is very low. According to research by Marcussen H. , 2007 on the reuse of waste water to grow vegetables and fish in Hoang Mai and Thanh Tri district, Hanoi showed the greatest concentration of elements potentially toxic (PTEs: potentially toxic elements) in spinach as follows: As: 0.190 mg/kg, Cd: 0.032, Cu: 2.950, Ni: 412, Pb: 0.206, Zn: 9.080. (Source: Marcussen H, Holm PE, Dalsgaard A, 2007)

Concentrations of PTEs in spinach was irrigated with waste water tends to be higher but not significantly higher than their contents in spinach irrigated with clean water. According to calculations, the amount of daily consumption of spinach today, users of spinach irrigated with waste water into the body of daily PTEs only about 11% of the maximum tolerance allowed (PTI: toleranable permit intake). Thus can be seen spinach irrigated with wastewater was here only a low risk for users.

Concentrations of As, Cd and Pb in meat, liver and skin fed by waste water is low, mostly undetectable. However, Cd and Pb average amount in the liver of tilapia is o, 336 and 0.31 mg / kg wet weight, the amount of As in tilapia skin is 0.15 mg / kg wet weight. According to calculations, the amount of As, Pb and Cd into the body by eating fish daily fed with waste water in only 9% PTI. Therefore also said the risk of toxic heavy metals by eating fish with waste water here is not high (Marcussen H, Holm PE, Dalsgaard A, 2007).

According to the results of this study, river sediment in Lich, river water is used in this culture, heavily contaminated by As, Ba, Cd, Cu, Ni, Pb and Sb. Highest concentration of Cd in sludge To Lich is river 427mg/kg dry weight. According to the authors, the retention of PTEs in river sediment in the waste in Hanoi is a mechanism to prevent the transport of PTEs through wastewater reuse in aquaculture systems (Marcussen H, Dalsgaard A, Holm PE , 2007, IV).

Currently, no studies in Vietnam evaluated the amount of toxic substances, heavy metals in food crops, fruit trees are irrigated with recycled wastewater.

According to a survey of rural environmental sanitation of the Ministry of Health in 2007 showed that 25% of rural households have no latrines Vietnam, so the members of the family must go to the bathroom or toilet the field or wherever possible. Among households with latrines 82% is not meet hygiene standards of construction or the use of the Decision No. 08/2005/QD-BYT. 30% of households using human excreta in agriculture, of which only 20.6% composting prescribed 6 months. The reason this is an important contributor to pollution of water resources and environment.

In general, the problem re-use of wastewater, excreta and domestic animals in agriculture, aquaculture also contains many problems and inadequacies, has not been studied as a whole. It is important that all the research programs, providing scientific basis for the issuance of the appropriate policies. These policies are necessary to be built soon in order to strengthen pollution control, disease control, health protection of people, besides, still gathering all the resources is that waste water, nutrients, ... for agriculture. The problem re-use distribution, wastewater in suburban areas, agricultural areas downstream should be considered carefully when planning urban drainage. Community awareness of waste reuse in agriculture, fisheries should be enhanced.

31. List all major RRR related projects (wastewater irrigation/aquaculture; organic fertilizer/composting, energy/biogas/fuel; ecosan) operating in the city over the last 5 years as

well as (all) ongoing ones with their main external and local partners and if possible donor or provide web sites of those projects.

- 3R project for Hanoi city. Pilot phase. JICA support. Hanoi URENCO implementing organization.
- FSM landscaping model study. BMGF support. IESE implementing.
- NTP3 for rural communities (2011 – 2015). MARD.

Urban Fecal Sludge Management – Problems and Solutions. IESE, HUCE. 55 Giai Phong Rd., HBT. Dist., Hanoi, supported by Bill Melina Gates foundation.

Wastewater for irrigation in developing countries Vietnam Case Study on Health Impact and Adaptation Graduate Program in Sustainability Science (2011), NGUYEN Huong Lan, University of Tokyo, Supervisor: Prof. YAMAJI Eiji. The case study will be conducted in Hanoi - Vietnam where wastewater is used widely to irrigate urban agriculture products, about 80% vegetable production from urban and peri-urban area of Hanoi is irrigated with diluted wastewater (Lai, 2002).

32. Is there any <white elephant> project of significant RRR failure? Which, reasons?

- 3R project, JICA support for 4 communes in Hanoi.
- Number of composting projects.

33. Is there irrigation with (i) polluted water/wastewater or (ii) treated or (iii) partially treated wastewater? (Any info on locations, approx. number of farmers or ha). Is the use regulated? If yes, by which regulation/ authority?

Yes (see answer for question No. 30). No regulation.

In Hanoi, total area irrigated with wastewater is 43,778 ha and involved 58.300 farmers (L Raschid-Sally & Jayakody, 2008). Depite the amount of wastewater generated from urban population, and the contribution of urban farmers to generate vast quantity of urban waste including solid and wastewater through agriculture practices, these activities are very little recognized by municipal's management authorities (Do et al, 2006) nor looked down by the community.

34. Is there agricultural use of (i) fecal sludge or only (ii) feces or (iii) urine (fresh or treated) ongoing? (any info on locations, approx. number of farmers or ha) Is the use regulated? If yes, by which regulation/authority?

Yes (see answer for question No. 30). No regulation.

35. Is there use of other organic waste (fresh or composted) ongoing? (any info on locations, approx.. number of farmers or ha) Is the use regulated? If yes, by which regulation/authority?

Yes (see answer for question No. 30). No regulation.

36. Are waste products already used for energy recovery? If yes, which waste for which purpose and which approx. scale?

Biogas for energy recovery for families growing pigs, for farms with pigs, cows, chicken.

~500,000 biogas plants built in Vietnam.

Disposal of animal wastes by using biogas to generate energy at household level for cooking.

In Ha Noi, Vietnam, the Ministry of Agriculture and Rural Development are to invest $100 million (€73.6 million) over an eight-year period to expand its Biogas Programme.

The expansion project will see a further 100,000 biogas generators installed on farms across 35 provinces. According to the deputy director of the ministry's Animal Husbandry Department Nguyen Thanh Son, 'Accomplishing this target would help increase the efficiency of the restructuring animal husbandry process which is underway and enable farmers to take the initiative in coping with climate change.'

It is not just owners of the small-scale farms who would benefit from the project. Larger centralized farm owners are also set to receive beneficiaries, as the amount of financial aid they are entitled to will increase to a minimum of $154 million, up from between $51 and $61.

Ministry statistics demonstrate that 100,000 biogas generators have already been installed throughout the nation, generating renewable energy for use in cooking and farming, as well as for lighting. It is estimated that every one operational generator in Vietnam eliminates two tonnes of carbon dioxide from the atmosphere each year.

However there are some drawbacks associated with the Biogas Programme. Poor design, high building costs and a limited number of technical officials and builders have all been reported in the first phase of the project. In addition, according to the deputy minister Dien Kinh Tan, of the estimated 8.5 million farming households in Vietnam, only one-fifth of them have biogas generators. 'Animal farming is thriving but of the 18,000 livestock farms, only 60% treat waste with the help of the generators,' he said. Ha Noi is the leading user of biogas generators, accounting for one-tenth of the country's total.

37. Are there competing uses for the waste e.g. as fuel, livestock or aquaculture feed, which compete with RRR e.g. for nutrients or energy? If yes, which waste for which purposes and at which scale (small/medium/large)?

Yes. For all small, medium and large scales.

38. Are there major sources of alternative fertilizers that are likely to be cheaper than waste based products, e.g. like nearly free farm yard manure? chicken manure?

Yes, but not much.

Animal manure as pig, chicken, cow, buffalo. This wastes most in rural area of Hanoi, farmers used it for rice crop and vegetables.

39. Are industrial fertilizer subsidized? Which ones, how much? Or what is the price e.g. for 50kg Urea or 50 kg NPK 15-15-15)?

Agricultural production facing to a problem is intensive in order to get high quantity. Amount of fertilizers has been used quite high. Average amount of inorganic fertilizers using in agricultural land is 190 kg (N+ P2O5 + K2O) in 2000 and it tend to increase year by year. Organic fertilizers using per ha of agricultural land is of 190 kg (all manures equivalent in to nitrogen, phosphorus and potassium).
Yes, NPK Dau Trau (15-15-15): 12.800 VND/Kg. Binh Dien Fertiliser J.S.C.
DAP 14.800 VND/kg, it is Chinese product.

F. Waste supply and management in the city

40. Population size of the city (with year of reference) and official city area.

According to the General Statistics Office, the population of Hanoi city is 6,561,900 people (as of 2010), and the official city area is 3344.6 km^2.

41. Solid waste collection coverage (percent of population serviced; year of reference)?

Approximately, 3,500 tons of solid waste is collected daily, including 90-95 % of total solid waste generated in the urban area and 50-70% of that generated in the rural areas of Hanoi (as of 2011). The remaining waste is either improperly disposed of into open landfills or illegally thrown to the city's rivers and lakes. In addition, the Lam Du and Van Noi landfills are currently receiving and treating about 1,000 tons of construction wastes every day. Composition of the city solid waste is 60% municipal waste, 25% construction waste, 10% industrial and hospital waste, and 5% fecal sludge. The solid waste is not on-site classified, and only a small portion of the organic solid waste is classified and used for compost production in a composting plant placed under management of Hanoi URENCO.

42. Solid waste collection carried out by municipality or private sector or both? Is there any source separation going on? (how many households) Or any segregation after collection?

Solid waste collection in the urban areas of Hanoi city is carried out by Hanoi Urban Environment Company (URENCO) – a public non-profit utility belonged to Hanoi People's Committee. The Company's operation is under the form of Mother Company and 15 subsidiary companies and affiliates (as of 2011), including several environmental technologies enterprises, a waste composting enterprise, and a landfill/solid waste treatment complex. Every day, the company collects approx. 3,500 tons of municipal wastes from the inner city districts. The collection and management of solid waste generated in peri-urban and rural districts is the responsibility of local authorities, the people's committee at district and ward levels (such URENCO subsidiaries in Dong Anh and Gia Lam districts). In the expanded Hanoi area (former Ha Tay province), there are 4 companies responsible for the collection and transportation of solid waste, including Ha Dong Urban Environment Company, Son Tay Environment and Public Works, and 2 private enterprises in Chuong My district). Privatization of solid waste management has been implemented since 1999, with private companies doing solid waste collection and transportation in the peri-urban districts.

Source separation has been done in pilot scale in a number of wards/communes in Hoan Kiem district and Ba Dinh district since 2003 within the framework of a collaboration project between Hanoi URENCO and JICA (no specific number of households). Segregation is also performed after collection by URENCO and scavengers (waste pickers) for recyclable materials. The scavengers often concentrate in the waste collection points or the city landfill (e.g. Nam Son landfill).

43. Approximation of how much of the city is sewered (percentage of households connected to sewerage)? Approximation of how much of the wastewater entering sewers is eventually treated and to which level (i.e. primary, secondary, tertiary)? Estimated percentage of treatment plants that work as designed?

The Hanoi sewerage and drainage company (SADCO) is responsible for the operation and maintenance of sewerage and drainage at the city and district levels. Like URENCO, SADCO is also under the management of Hanoi People's Committee. The drainage system at ward/commune level is operate and maintained by local authorities. According to SADCO, the city drainage system is a common system for industrial and domestic wastewater as well as storm water. In the old French-style quarter of the Hanoi city, there are 74 km of drain in an area of 1,000 ha, while the total length of Hanoi drain lines is about 634 km (with an area of 92,000 ha). It is estimated that only 70% of the total length of the city roads/streets have drains, while the remaining is tertiary drains for small streets and communities which are under the management of local authorities. Approximately 60-70% households are connected to sewerage, and the current capacity of the drainage system only meets about 60% demand of the city. It has been planned that the service area of the city drainage will be expanded to cover 80% of the city households.

About 5-10% of the total domestic generated wastewater is treated before being discharged. Most of wastewater is discharged untreated into water receiving bodies. At present, Hanoi has established several centralized wastewater treatment stations and plants, piloting in Kim Lien area with the capacity of 3,700 m^3/day with 9,500 beneficiary inhabitants, Truc Bach area with the capacity of 2,300 m^3/day with 15,700 beneficiary inhabitants, and North Thang Long – Van Tri area with the total capacity of 42,000 m^3/day. The current demand of wastewater treatment of the city is 450,000-500,000 m^3/day. Currently, Hanoi has approx. 369 factories and plants, 15,880 private manufacturing facilities, more than 1,000 offices of the central government, 29 hospitals, and 10 industrial zones. Of these institutions, only 40 industrial facilities, 25 large service facilities, and 10 big hospitals in the city (such as Bach Mai hospital, Military Hospital 108, National Pediatric Hospital, etc) have an internal wastewater treatment system.

44. How many households or estimated percentage of the city depend on on-site sanitation systems for fecal sludge storage? What kind of onsite FS systems are there in percent (pit latrines, public toilets, household septic tanks, Urine diverting dry toilets, etc.)?

No data

45. Who is cleaning septic tanks and latrines? Are there trucks with vacuum pump (maybe called cesspit tank operators, honey suckers, etc.)? Are they operated by the public or private sector or both? Any number of trucks available?

URENCO and its subsidiaries (specialized in sanitation service enterprises) as well as a number of private companies provide services to clean septic tanks and latrines. It is estimated that approximately 50 enterprises are doing septic tank/latrine cleaning services. They do possess trucks (of different sizes) with vacuum pumps. No available number of these trucks.

46. Is the municipality or private sector or both in charge of fecal sludge collection in the city? How many septic trucks are approximately operating across the city? Share of vacuum trucks vs. manual collection?

Both the municipality (URENCO) and private sector are in charge of sludge collection in the city. Manual collection is not very common, only in the rural areas of Hanoi or in the streets where trucks are inaccessible.

47. Where are most on-site systems in the city? Only in slums/low-income class areas? Or also in high-class areas etc.?

On-site systems in Hanoi are not common nowadays, often in the old quarters of Hanoi (central city, high-class area but with old infrastructure and limited renovation) and rural areas of Hanoi. In the slums or low-income class areas, human excreta is either discharged directly to the environment (ponds, lakes, rivers, agricultural fields, drainage system), or treated in non septic tank latrines (e.g. single/double vault latrines, pit latrines, compost latrine, etc.)In Hanoi city, most popular sanitation facility is flushing toilets with septic tanks. Other sanitation types: dry sanitation (pit latrines, ventilated improved pit latrines (VIP), double vault with urine-diverting toilets, single vault with urine diverting latrines); wet sanitation: pour-flush toilets with filtration pit; biogas digesters are also found in rural areas. Around 70 % of total population is served with flushing toilet with septic tank (Hanoi URENCO) (Le Ngoc Cau).

In Hanoi, at present, single drainage system is used to collect both wastewater and storm water. This drainage system consists of rivers, canals, regulating ponds, ditches and pipes. Wastewater from domestic and other uses is discharged directly into open lakes or canals by ditches and pipes. The coverage of sewerage and drainage system in only about 40% of the city area and most part of the system is more than 100 years old. However, some parts of the system have been reconstructed or newly built by Hanoi Master Plan for sewerage and drainage project (Hanoi Sewerage and drainage company – SADCO).

Hanoi has four main rivers To lich, Set, Lu and Kim Nguu that are used to drain the wastewater from the city to the reservoir called Yen so. In recent years, many new drains and components have been built, especially a large system of regulating reservoirs and a pumping station to pump the wastewater directly to the Red river (Nguyen Hoai Nam).

48. Where is the collected fecal sludge (FS) from on-site septic tanks deposited/dumped? Percentage estimates: In septage ponds, other treatment plants, in water bodies/ocean, in land depressions/environment, in farms for crop production, elsewhere (please specify)?

About 67% of the FS generated in Hanoi is currently collected By protocol, FS collected from septic tanks is deposited and dumped in the only official waste processing enterprise in Hanoi, which is the Cau Dien waste processing and treatment enterprise (URENCO 7), and then strictly follow a treatment process to produce organic fertilizers. However, most of FS collected by private enterprises is collected and processed in an inappropriate manner, and usually dumped illegally into lakes, rivers, sewers, and agricultural fields. It is estimated that every year URENCO 7 loses about 1.9 billion VND (~93,000 USD) due to high investment and limited FS collection from the city households, while the Cau Dien composting plant does not operate with its full capacity and result in a low productivity of organic fertilizer products.

49. What is the approximate FS quantity disposed of in official places per year vs. unofficial sites?

Not sure, probably 30% of FS disposal in official places vs. 70% in unofficial places.

50. Please provide a brief description of the major commercial activities in animal husbandry, food industry and other agro-industrial (e.g. cotton) processing sub-sectors in the city? Who are the big players providing significant processing or agro waste?

No data

51. Are there any data how much organic waste the major 5 to10 companies operating in these sub-sectors generate e.g. per year?

No data

G. Pollution and sanitation

52. What are the major environmental challenges in the city area? (waste, air/water pollution, flooding, diseases, water shortage, energy shortage, unsafe food production,……)

Three major environmental challenges in Hanoi is waste, polluted wastewater and air pollution

53. What kind of industries (e.g. beverage, chemical, textile, food,(sugar ……) are there in the city and discharging waste? Is the industrial waste treated in each case? Which one not?

There are 8 industrial zones and 1,270 trade villages including 244 traditional trade villages. 8 industrial zones are divided into main sectors: electronics, chemicals, mechanics and construction

All these industrial zones discharge waste and wastewater but not all the industrial zones treated wastewater or waste prior to discharge to common city channels. No documents are available to know which kind of industrial waste is treated in each case. No waste or wastewater treatment plants exist in trade villages in Hanoi.

54. Are there any reports on the probability of chemical contamination (heavy metals) of organic and/or liquid waste streams? Could you cite related reports/papers?

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55. Have any food safety/health issues been reported due to wastewater irrigation? By whom? Citation/reference?

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H. Energy situation (per country if not per city) – needs sector expert assistance

56. Percent of rural/urban population with access to electricity from the grid?

In rural area, 96.68% of households (4.69 mil households) access to electricity from the grid (update to 31 march 2012)

In urban area, 100% of households access to electricity from the grid

57. Please list the institutions/companies responsible for generation, transmission, and distribution of electricity in the country and elaborate briefly on their respective roles and responsibilities, including ownership.

Vietnam Electricity (EVN) is a unique corporate to be responsible for generation, transmission and distribution of electricity in Vietnam. Price of electricity is decided by EVN. Lack of investment capital is the most challenge for EVN. EVN established a company to sell electricity to consumers. EVN owns 65% ownership of this company.

58. What entities *regulate* the energy sector? Please briefly describe their roles and responsibilities?

The energy sector is regulated by the ELECTRICITY LAW (No. 28/2004/QH11) issued in 2004. Electronic copy is attached.

59. Total installed electric capacity (MW) and annual electric generation (e.g. in Megawatt, MW) by fuel source? *Please include a breakdown of renewable energy generation by source.*

Total annual production in 2012: 120,795 bil. kWh

a. thermo-electricity (charcoal) is 24.78 bil kWh,
b. hydro-electricity is 45,029 bil. kWh,
c. thermo-electricity (by gas turbine) is 45,744 bil. kWh,
d. thermo-electricity (by oil) is 0.5 bil kWh.

60. Total electricity exported/imported?

Total electricity imported from China in 2012 is estimated by 4.65 bil. kWh

61. Are there gaps between supply and demand? If yes, how frequent, and how are the shortfalls met?

Yes, there are gaps between supply and demand.

62. Average price per kWh for electricity at the wholesale level (by major generator) and then at the retail level by client type (industrial, commercial, domestic)?

a. Average price per kWh for electricity at the wholesale level (by major generator) is 891.4 VND
b. Average price per kWh for electricity at the retail level by client type

1) Industry

No	Voltage supplied	Price (VND/kWh)
1	110 kV and higher	
	a) Normal hours	1.043
	b) Low hours	646
	c) High hours	1.862
2	22 kV -110 kV	
	a) Normal	1.068
	b) Low	670
	c) High	1.937
3	6 kV - 22 kV	
	a) Normal	1.093
	b) Low	683
	c) High	1.999
4	< 6 kV	
	a) normal	1.139
	b) low	708
	c) high	2.061

2) Commercial

No	Voltage supplied	Price (VND/kWh)
1	≥ 22 kV	
	a) Normal	1.713
	b) Low	968
	c) High	2.955
2	6 kV - < 22 kV	
	a) Normal	1.838
	b) Low	1.093
	c) High	3.067
3	< 6 kV	
	a) Normal	1.862
	b) Low	1.142
	c) High	3.193

3) Domestic

No	Quantity used for a household per month (kWh)	Price (VND/kWh)
1	50 kWh (poor household/low-income household)	993
2	0 - 100 (not poor household)	1.242
3	101 - 150	1.304
4	151 - 200	1.651
5	201 - 300	1.788
6	301 - 400	1.912
7	≥401	1.962

63. Are private companies allowed to generate, bank, transmit, and/or distribute energy? If yes, in both urban and rural contexts? Please elaborate on the structure of such if possible.

Private companies are allowed to generate, bank and transmit but not distribute energy

64. Are there any organic waste-to-energy plants?

If yes, what is the installed capacity (agro-industrial or domestic) thermal and electric, in MW? Please list ownership, kind of waste/source of fuel, capacity, annual energy generation for each.

No organic waste-to-energy plants are available in Vietnam

65. Please add information how the major organic waste-to-energy projects have been financed?

Not applicable

Annex: Terminology

- **Biosolids** are stabilized (treated) excreta or the treated byproducts of domestic and commercial sewage, wastewater and faecal sludge treatment, which can be beneficially utilized as soil amendment and fertilizer after drying.
- **Business Model (in this context):** a model that contributes to cost recovery or profit from reuse, ideally supporting in this way the sanitation service
- **Co-composting**: Is the simultaneous composting of excreta with other organic waste. Alternatively, both components can also be composted separately and mixed later.
- **Domestic effluent**: **blackwater** (excreta, urine and faecal sludge, i.e. toilet wastewater) and **greywater** (kitchen and bathing wastewater)
- **Dried Sludge** is found on drying beds where biosolids from WWTPs are exposed to sun.
- **Excreta:** human faeces and urine (sometimes also called night soil)
- **Faecal Sludge**: Sludge of variable consistencies **collected from on-site sanitation systems**, such as latrines, non-sewered public toilets, septic tanks and aqua privies which store blackwater. The faecal sludge comprises of varying concentrations of settleable solids as well as of other, non-faecal matter. Faecal sludge consists of human faeces and urine (and flushing water) and has a high concentration of organic matter and nutrients. The term usually refers to fresh (watery) sludge.
- **Organic waste** - kitchen waste, plant material, human and animal excreta, agro-industrial, wood and food pressing waste
- **Peri-urban agriculture** (PUA): agriculture within approx. 30 Km around the build-up city area.
- **Reclaimed water or recycled water** is treated wastewater that can officially be used under controlled conditions for beneficial purposes (potable, non-potable)
- **Sanitation Safety Plan:** A manual to operationalize e.g. safe wastewater reuse like the Water Safety Plans operationalize the WHO Drinking Water Guidelines.
- **Septage**: A term used for the combination of sludge, scum and liquid pumped from a **septic tank** where household black water ends (on-site sanitation) if not flushed away in a sewer; Septage is largely similar to faecal sludge.
- **Sewage sludge**: **Sludge produced in wastewater treatment plants** as a result of the treatment process. It includes faeces, other waste products and the excess bacteria used in activated sludge treatment processes. The quantity of sludge produced depends on the treatment technique.
- **Sewage:** The spent and used water from a community that contains dissolved or suspended matter, including faeces and urine, and usually moves in pipes or sewers.
- **Sewerage:** a domestic drainage system involving sewers or pipes
- **Treated wastewater**: is wastewater that has been processed through a wastewater treatment plant up to certain standards in order to reduce its pollution or health hazard. If this is not fulfilled the wastewater is considered to be partially treated. What is called treated ww in low-income countries might still classify as untreated ww in high-income countries.
- **Urban agriculture** (UA): agriculture incl. aquaculture and livestock keeping within the build-up area, usually on open-spaces (backyards are not target of the study);
- **Wastewater:** All types of domestic, commercial and/or industrial effluent as well as storm water runoff, usually mixed and of different qualities, ranging from raw to diluted. The term does not imply any form of transport or treatment. It should be differentiated between raw wastewater and wastewater which entered natural water bodies (diluted wastewater, polluted stream water)