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Focus Cities Research Initiative

Strengthening the Economic Dimension of the Focus Cities Research Initiative in Asia and Africa

Cost-Benefit Analysis of Selected Interventions to Address Urban Poverty and Environment in Ariana-Soukra, Colombo, Dakar, Jakarta and Kampala

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Executive Summary

This report has been prepared under **Phase II** of IDRC's Urban Poverty & Environment Program (UPE) known as the *Strengthening the Economic Dimension of the Focus Cities Research Initiative* (henceforth the *Initiative*).

In the course of Phase I, IDRC's UPE supported a research effort with an overall objective to assess the economic cost of environmental burdens in each of the Focus City projects that it supports which included, in the course of Phase I: Colombo (Sri Lanka), Dakar (Senegal), Jakarta (Indonesia), Kampala (Uganda), and Moreno (Argentina). Phase I included the following 3 specific objectives:

Objective 1: Strengthen the knowledge and capacity of the five city research teams: (1) to better understand the nature and methodologies used to undertake an economic analysis of health-related problems associated with inadequate waste management and inadequate water supply and sanitation; (2) to better understand the concept of cost-benefit analysis associated with the interventions proposed by each project as well as the importance of the economic aspects in Focus City projects; and (3) to better appreciate the potential use of economic analysis to achieve policy influence;

Objective 2: Provide an estimate of the damage cost of health-related problems associated with inadequate waste management and inadequate water supply and sanitation in the five Focus City projects. While numerous methodologies may be used to provide such estimates, the selected methodology(ies) shall account for the capacity of the local teams and the existing availability of information and data; and

*Objective 3***:** Set in place a process which will facilitate the conduct of a cost-benefit of the interventions proposed in each Focus City project. The actual cost-benefit analysis will fall under a subsequent terms of reference and contract.

In the case studies developed in the course of **Phase I**, it was shown that the economic costs of environmental burdens range from approximately 1% of household expenditures (Colombo) up to 15.5% of household income (Kampala). The costs included in these studies pertained to the cost of illnesses and the cost of treatment, including in some instances the cost of time lost, but did not include mortality costs, nor did they include the costs of any other impacts associated with polluted water and the lack of sanitation. To this extent, the estimated costs presented in the **Phase I** study were most certainly an under-estimate of the true cost of the environmental burdens experienced by local inhabitants. It is of importance to note that in a number of cases, not all activities designed by the local Focus City teams were in fact implemented by the end of Phase I. Some of the activities were implemented at the outset of Phase II.

As indicated in the description of the third objective above, a follow-up second phase of research (**Phase II**) has been implemented to undertake the actual cost-benefit analysis of the project interventions. The intent was to use the costs of the environmental burdens (estimated in the course of Phase I), as an input into the cost-benefit analysis, with the avoidance of those costs then to be treated as an economic benefit due to the project interventions.

The specific objectives of Phase II are:

Objective 1: Provide continued training and capacity building to each Focus City team on the conduct of cost-benefit analysis;

Objective 2: Undertake a cost-benefit analysis of project interventions implemented by each Focus City project in its experimentation phase; and

Objective 3: Support each Focus City team to use effectively the outcome of the cost-benefit analysis to achieve policy influence.

This report provides the results of economic (cost-benefit) analyses of a number of project interventions undertaken to address issues of urban environmental degradation and poverty in the cities of Ariana-Soukra (Tunisia), Colombo, Dakar, Jakarta and Kampala.[1] These interventions have been undertaken over the period 2008-2010 as part of the Focus Cities Research Initiative in Asia and Africa initiated by IDRC.

As indicated earlier, a key premise of the study design for this Phase II consultancy was the expectation that project interventions would directly address environmental burdens as a key target. However, in all cities, whereas the set of project interventions which were actually implemented may have an indirect impact on environmental health burdens, they did not directly aim at addressing these burdens as it was first envisaged in the course of Phase I. In Ariana-Soukra, the environmental burden addressed by the Focus City team related to the water stress experienced by the local community, and not directly on health related burdens. The water stress was directly addressed by the project interventions through the collection of rain water and the treatment of grey water.

In the case of Colombo, Dakar, Jakarta and Kampala, the important environmental burdens identified in Phase I (and towards which cost estimates were sought) were mostly related to issues of water-borne illnesses and flooding. Although the work of the first consultation showed that some community members in each of the project areas were experiencing a cost of illness due to environmental burdens, in fact, this is likely to continue to be true with or without the set of activities implemented by the project. For instance, households in the study areas of each of these cities are likely to continue to be exposed to sources of contamination through imperfect access to safe drinking water and contact with contaminated water inside and outside their own community.

Furthermore, and perhaps more importantly, for reasons that are relevant to the Focus City teams themselves, a large number of activities implemented by the Focus City teams are aimed at income generation, and do not focus directly at reducing environmental burdens with their associated health benefits. As a result, for reasons not under the control of this consultancy, the intended connection did not fully materialize between the results of the economic analysis presented in Phase I, and the proposed use of these results in Phase II of this consultancy.

Hence, while there is undoubtedly a range of significant benefits to the target communities and the nation from specific project interventions (as indeed is shown in this report), the magnitude of these benefits could not have been adequately estimated if

[1] Moreno (included Phase I) was not included in Phase II; Ariana-Soukra was included in Phase II, but was not included in Phase I.

the scope of the valuation exercise were narrowed to estimating the avoided damage cost of environmental burdens alone.

Each of the interventions is assessed “as if” it were undertaken by the residents of each host country and financed by the country’s own assets and resources. Each cost-benefit analysis study asks whether the monetary and non-monetary gains that accrue from each investment exceed their monetary and non-monetary costs, when compared on a discounted or present value basis. The analysis examines each of the projects “as implemented” and does not propose or consider a set of other alternatives to these projects. As pilot projects, it is likely that the learning and experimentation that are part of these initiatives will suggest improvements that could be incorporated if these interventions were to be replicated elsewhere.

In some cases, the estimated Net Present Value (using a 10 percent, real annual social discount rate) is negative, indicating that project benefits are not as large as project costs when viewed from a social opportunity cost perspective. In other cases, just the opposite is true—the estimated Net Present Value (using a 10 percent, real annual social discount rate) is positive, indicating that project benefits are larger than project costs when viewed from a social opportunity cost perspective. Sensitivity analysis accompanies each estimate and shows the contributions of various cost and benefit components to each outcome. Where some costs or benefits have not been estimated, these ranges indicate how large the omitted or adjusted items would have to be to change the sign or to alter significantly the magnitude of the NPV estimates.

The analyses of these selected interventions is undertaken as part of a larger capacity-building program that has worked with the project teams to explain and to demonstrate the use of social cost-benefit analysis and its role in influencing policy decisions. The analysis has been undertaken near the termination of the Focus City projects using best available estimates as provided by the project teams. Unlike a stand-alone analysis of other investment projects, the analysis is not based on any program of independent collection or field verification of data or of project practices. Although various baseline studies had been compiled for participating communities, none of these exercises fully anticipated that there would be need for all of the specific economic and other data related to cost-benefit analysis. As a result, numerous estimates or values relevant to the analysis are not directly supported by project records or other government or public data. These estimates were provided and updated by the local research teams in the course of focus group discussions and workshop sessions which took place during the project visits undertaken by the consultancy team. In these instances, the estimates are not necessarily supported by written records.

Specific results are as follows.

Colombo

The project intervention that is evaluated in Colombo is the construction and operation of a sewage trunk line through the community. This extension will allow direct sanitary sewer connections by approximately 333 households who formerly discharged most of their waste into storage tanks and pits to be emptied periodically by hired work crews. This project is meant to be a pilot for both a type of sanitation investment, and for a model of building and operating it, that might be replicated in other Under-Served Settlements in the country. When the principal costs and benefits are totaled and

discounted, the Net Present Value is negative with a value of –10,188,185 SLR, as at January 1, 2008. This is approximately equal to USD –$93,800 based on market exchange rates then.

The three largest categories of costs, expressed here as a share of all discounted costs, are the initial construction cost (62%), the annual operating costs (27%) and household connection costs (5%). The two largest categories of benefits are the avoided cost of operating the current septic systems (47%), and the avoided cost of preventing overflows from the current system (45%).

Jakarta

The three project interventions that have been evaluated in Jakarta are the construction and operation of a community water supply system, the development and operation of a program of community-based solid waste management, and a program of urban gutter cleaning and byproducts production. The analysis of each is summarized next.

The urban water supply project is set up to serve piped water to approximately 60 households. Through the formation and operation of a community-based organization, water is purchased in bulk from a private water supply company and stored for subsequent redistribution to participating households. The project includes provision and maintenance of common water pumping and storage works with distribution and metering directly to each household, including billing and accounting functions. Participating households might not have received direct household connections without the project, and now acquire piped water with greater reliability of service and at lower cost than might otherwise have occurred.

For the urban water supply project, when the principal costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of –518,517,207 IDR, as at January 1, 2009. This is approximately equal to USD –$47,540 based on the market exchange rate then. The three largest categories of costs are the initial construction cost (42%), the annual operating costs (44%) and the set up and training costs of the community-based organization (6%). The three largest categories of benefits are the avoided cost of labor used to access and deliver water (47%), the value of project water to the households (once delivered) (41%) and the health benefits (9%).

The solid waste management project in Jakarta has engaged about 120 households to participate in solid waste recycling. Households separate key materials into containers for collection by project staff. The staff also collects a portion of other solid waste materials discarded within the community, and delivers it to the project's processing site. Operating through a community-based organization, some items, such as plastic packaging, are used as raw materials by group members for the creation of handicrafts such as bags and necklaces. Organic materials are shredded and composted, to provide a horticultural product suitable for use as potting soil or as potting soil conditioner. Handicrafts and soil conditioner are sold to retail consumers and, in larger quantities, through wholesalers. Other materials (plastic bottles, metals) are segregated for resale to specialized recyclers, often on a break-even basis. Items that are not recyclable are returned to the community's solid waste stream, where there is a cost savings associated with the reduced volumes of waste that need to be transported for disposal.

For the solid waste management project, when the principal costs and benefits are totaled and discounted, the Net Present Value is negative with a value of –1,550,781,986 IDR, as at January 1, 2009. This is approximately equal to USD –$142,182 based on the market exchange rates then. The three largest categories of costs are the land use (37%), the labour for making handicrafts (24%) and the householders' time for sorting and storing waste (19%). The three largest categories of benefits are the compost and handicraft products (87%), the value of the land at the end of the project's economic life (9%) and the savings in cleanup labour (2%).

The gutter cleaning project in Jakarta serves a community of about 480 households. With oversight and coordination provided by a community based organization, the project focuses on the network of gutters and micro-drains that are used to move sewage, grey water and accumulated solid waste through and away from the community. These gutters are prone to clogging, poor rates of flow and overflow conditions if not properly maintained. The project hires a crew of workers to clean sludge, waste and debris from the network of gutters with greater frequency and with more extensive coverage than would otherwise occur. Using a processing system that involves bio-activation to remove pathogens, nutrient-rich materials are converted into salable products such as liquid plant fertilizer and a planting medium (potting soil or potting soil conditioner). Some experimentation with the production of bricks and paving blocks has not yet resulted in a product for which there are commercial customers.

When all of these costs and benefits are totaled and discounted, the Net Present Value is negative with a value of –1,534,835,561 IDR, as at January 1, 2009. This is approximately equal to USD –$140,720 based on the market exchange rate then. The three largest categories of costs are the annual operating expenses (85%), land use (7%), and the initial setup costs (5%). The two largest categories of benefits are the value of the increased frequency and extent of gutter cleaning services (49%), and the value of salable products (3%).

Kampala

In Kampala, the two interventions examined are the development and operation of a program to process organic solid waste into feed suitable for poultry and livestock production, and of a program to process organic solid waste into fuel briquettes suitable for cooking use.

The first intervention utilizes the nutritional value of waste plantain peels to manufacture "peel meal" that can be used as a feed or feed supplement in the dietary rations fed to broiler chickens, laying hens and pigs. When the principal costs and benefits are totaled and discounted, the Net Present Value is positive with a value of 53,847,650 UGX, as at January 1, 2010. This is approximately equal to USD $27,614 based on the market exchange rate then. The three largest categories of costs are the fuel, oil and raw materials (46%), the annual operating costs (43%) and the initial investment (10%). The two largest categories of benefits are the value of peel meal as animal feed (58%) and the cost savings from not collecting waste peels (42%).

The second intervention studied in Kampala makes use of more of these plantain or banana peels along with other local ingredients to produce a cooking fuel that can be used in common household cooking stoves. Whereas these stoves would most commonly be fueled with wood charcoal, the manufactured briquettes are a local and

less costly alternative for the project community. In terms of the local environment, this project gathers and uses solid waste that might otherwise be a nuisance in the community, and reduces the impact of wood-fuel consumption on scarce timber resources.

When the principal costs and benefits are totaled and discounted, the Net Present Value is positive with a value of 136,926,688 UGX, as at January 1, 2010. This is approximately equal to USD $70,219 based on market exchange rates then. The two largest categories of costs are the supplies and raw materials (68%) and the annual operating costs (30%). The two largest categories of benefits are the cost savings from not collecting waste peels (63%) and value of briquettes produced (38%).

Dakar

One of the components of the project in Dakar aimed to establish a nursery where various types of plants and trees would be grown, including ornamental plants and fruit trees. This activity aimed to support income generation options for the farmers of Malika by diversifying their sources of income away from traditional vegetable farms. It was indeed deemed by the project team that the proximity of the extensive zone of fruit production of Niayes and Thies would provide an immediate demand for the fruit trees grown by the nursery. Furthermore, the existing national project of renovating the filao stretch which links Dakar to Saint Louis, and which starts at Malika, would offer an additional market for the trees produced by the nursery. Finally, the rapid growth and expansion of the city of Dakar towards Malika is thought of opening new opportunities for household plants.

The nursery would occupy land of approximately 1 hectare and aim to produce approximately 60,000 plants on an annual basis. Of these, 60% are expected to be fruit trees, 25% are expected to be forest seedlings and 15% are expected to be household (ornamental) plants.

Given the information presented by the project team, the Net Present Value of this component of the project was estimated to reach between $75,000 and $265,000 using a discount rate of 10%. If indeed the demand for the products of the nursery is realized as expected, this activity could represent a significant contribution to agricultural income in Dakar.

Ariana-Soukra

In Ariana-Soukra, the environmental burden addressed by the Focus City team related to the water stress experienced by the local community. A key component of the project was the collection and recovery of rain water, and the use of the recovered water to support peri-urban agriculture which has recently experienced a significant decline.

From the very outset of its activities, the team of the Focus City project in Ariana-Soukra was aware of the need to conduct an economic analysis of its interventions, and as such included an economist among the team members. As a result, a preliminary cost-benefit analysis (based on projected costs and benefits) was already included in the project first technical report submitted in May 2008. This analysis was then revised using estimates of actual costs and benefits and presented in the project fourth technical report submitted in February 2010. This has greatly facilitated the conduct of the economic

analysis per terms of this consultancy, and provides an important lesson to which we return below.

The Net Present Value of the pilot rainwater collection and recovery project was estimated to range between $40,000 and $78,000. The Internal Rate of Return was estimated at approximately 26%. In addition to the incremental revenues generated from the production of agricultural products, a key component of the benefits of the project, was a significant reduction in the pumping and treatment costs (avoided costs) of the collected rainwater for the water and wastewater utility of Tunis. The economic analysis clearly demonstrates that in the context of Tunis, the collection and recovery of rainwater to support peri-urban agriculture is an activity which offers a very interesting economic potential to which local and national policy-makers may be responsive.

Concluding remarks

Finally, a number of observations are worth noting.

First, when appropriately perceived as *pilot projects*, it is likely that the learning and experimentation that are part of these important initiatives will suggest improvements that could be incorporated if these interventions were to be replicated elsewhere. To this extent, the economic analysis of various project interventions presented in this report may provide guidance as to those key factors which may determine the economic viability of these interventions if replicated to other areas of the Focus Cities. In other words, a negative Net Present Value may not necessarily imply that similar activities have no chance of offering positive economic results.

Second, while economic efficiency may be perceived as an important criterion used by policy-makers, it may not (and arguably should not) be the only factor guiding policy making. Other factors not captured by means of economic analysis (such as those pertaining to distributional issues and social equity) may also guide policy-making. Hence, it should not be concluded that an initiative has failed or should not be replicated solely and purely on the basis of an economic efficiency criterion.

Finally, although various baseline studies had been compiled for participating communities in the course of Phase I, none of these exercises fully anticipated that there would be need for all of the specific economic and other data related to cost-benefit analysis. As a result, numerous estimates or values relevant to the analysis are not directly supported by project records or other government or public data. An important lesson from this consultancy work was in fact demonstrated in the case of Ariana-Soukra which had an economist as a team member at the outset of the project. This is that making explicit the intent of conducting a project cost-benefit analysis at the outset—not only of project implementation but of project design—may have improved the likelihood that needed data and information would be collected to conduct such analysis.

This study could not have been undertaken without the constructive and informed support of the Focus City project teams, who gave generously of their time and energy to participate in workshop activities and who shared their knowledge of these projects and of the communities that they serve. We are especially grateful for their participation and assistance.

I Background

As specified in the Terms of Reference (Annex 2), the general objective of this consultancy is to strengthen further the economic dimension of the Focus City projects in Asia (Colombo and Jakarta) and Africa (Ariana-Soukra, Dakar and Kampala) with an ultimate purpose of achieving policy influence. Specifically the objectives are to:

Objective 1: Provide continued training and capacity building to each Focus City team on the conduct of cost-benefit analysis.

Objective 2: Undertake a cost-benefit analysis of interventions implemented by each Focus City project in its experimentation phase.

Objective 3: Support each Focus City team to use effectively the outcome of the cost-benefit analysis to achieve policy influence.

In order to facilitate the implementation of these three objectives, one or two visits were made to each of these five Focus Cities over the period from February through September 2010.

II Description of selected interventions to improve the urban environment

The following is a country-by-country description of the project interventions that are the subject of the cost-benefit analysis.

II.1 Sri Lanka

The Colombo Focus City Project operates under the name of *IDRC Focus City – Community Based Assessment and Improvement of Living Environment in Underserved Settlements and the Environs: The Case of Gothami Colombo.*

The Gothamipura district of Colombo, Sri Lanka is a low-lying residential area of Colombo. Historically this area has not been connected to sewage trunk lines to drain household sewage waste from the community. Nonetheless, more than 90% of area residents have private flush toilets that drain into storage tanks and pits, and these are emptied periodically by hired work crews. Unfortunately, the area is low lying topographically, and is adjacent a canal that floods regularly, especially during the monsoons. Recurrent flooding brings with it contaminated wastewater from upstream communities, and flood waters can mix with some of the stored household waste in Gothamipura. This project proposes to provide sewage lines through the community and to the nearest point of connection with existing sanitary sewage collectors. Due to the low elevation, the use of the extended sewer line necessarily involves the installation, operation and maintenance of a pump to elevate waste to the new connection point.

The project to be evaluated here is the construction and operation of a sewage trunk line from the nearby existing (up-gradient) connection point to existing sewage trunk lines through the community of Gothamipura. This extension of one or more sewage lines will allow direct connections by approximately 333 households, including about 46 who are from an adjoining settlement (called “the Neighbourhood”) that is distinct from Gothamipura in a legal and jurisdictional sense.

Due to issues of land tenure, land title and jurisdictional authority, this project cannot be financed and operated under the mandate of the Colombo Municipal Council (CMC), even though the CMC does provide such services for much of Colombo. Gothamipura is one of numerous so-called Under-Served Settlements (USS), built on lands in Colombo that come under national authority through the National Housing Development Authority. Historically, lands in Gothamipura were occupied for housing and community use without the residents acquiring private title (legal ownership) to the lands. With a population of about 350 households, area residents have not been required to pay municipal taxes to the Colombo Municipal Council (CMC), and have not received household sanitation and some other services that are ordinarily provided by the CMC to other residents of Colombo.

This project is meant to be a pilot for both a type of sanitation investment, and a model of building and operating it, that might be replicated in other Under-Served Settlements in the country. Without the direct operational role of the CMC, ongoing operations of the sewage works will be financed, supervised and administered by the local community through their elected Community Development Council. Individual households are expected to subscribe and to pay fees voluntarily if they are to participate in the new sewage collection system. There is an expectation that existing systems of sewage storage, including the current waste collection services by CMC work crews will be discontinued once the new sewer line is operational.

II.2 Indonesia

The Jakarta Focus City Project operates under the name of *HP3 – Lestari*, where *HP3* stands for *Healthy Places, Prosperous People* and *Lestari* is an acronym for a similar phrase in the Bahasa Indonesia language. "*Lestari*" is also a Bahasa word in its own right connoting sustainability.

The methods of cost benefit analysis are employed here to examine three interventions directed at improving the urban environment and addressing issues of urban poverty in Jakarta, Indonesia. All of these interventions are located within the district of Penjaringan in North Jakarta. These interventions include the construction and operation of a community water supply system, the development and operation of a program of community-based solid waste management, and a program of urban gutter cleaning and byproducts production. Each of these three activities is described briefly next.

The urban water supply project is set up to serve piped water to approximately 60 households in the sub district known as RW12. Through the formation and operation of a community-based organization, water is purchased in bulk from a private water supply company and stored for subsequent redistribution to participating households. The project includes provision and maintenance of common water pumping and storage works with distribution and metering directly to each household, including billing and accounting functions. Participating households might not have received direct household connections without the project, and now acquire piped water with greater reliability of service and at lower cost than might otherwise have occurred.

The solid waste management project has engaged about 120 households to participate in solid waste recycling in the RW13 sub district. Households separate key materials into containers for collection by project staff. The staff also collects a portion of other

solid waste materials discarded within the community, and delivers it to the project's processing site. Operating through a community-based organization, some items, such as plastic packaging, are used as raw materials by group members for the creation of handicrafts such as bags and necklaces. Organic materials are shredded and composted, to provide a horticultural product suitable for use as potting soil or as potting soil conditioner. Handicrafts and soil conditioner are sold to retail consumers and, in larger quantities, through wholesalers. Other materials (plastic bottles, metals) are segregated for resale to specialized recyclers, often on a break-even basis. Items that are not recyclable are returned to the community's solid waste stream, where there is a cost savings associated with the reduced volumes of waste that need to be transported for disposal.

The gutter cleaning project serves a community of about 480 households in the RW8 sub district. With oversight and coordination provided by a community based organization, the project focuses on the network of gutters and micro-drains that are used to move sewage, grey water and accumulated solid waste through and away from the community. These gutters are prone to clogging, poor rates of flow and overflow conditions if not properly maintained. The project hires a crew of workers to clean sludge, waste and debris from the network of gutters with greater frequency and with more extensive coverage than would otherwise occur. Using a processing system that involves bio-activation to remove pathogens, nutrient-rich materials are converted into salable products such as liquid plant fertilizer and a planting medium (potting soil or potting soil conditioner). Some experimentation with the production of bricks and paving blocks has not yet resulted in a product for which there are commercial customers.

II.3 Uganda

The Kampala Focus City Project, which operates under the name of *Sustainable Neighborhoods in Focus* (SNF), was launched in July 2006.

The methods of cost benefit analysis are employed here to examine two interventions directed at improving the urban environment and addressing issues of urban poverty in Kampala, Uganda. These interventions include the development and operation of a program to process organic solid waste into feed suitable for poultry and livestock production, and of a program to process organic solid waste into fuel briquettes suitable for cooking use. Each of these activities is described briefly next.

A staple of the Ugandan diet is cooked plantains (bananas) prepared as a dish called *matoke*. The wide availability and prominent consumption of this foodstuff generates abundant solid waste, since the peels are not edible. When this waste is not properly managed, it contributes to litter, nuisance and pest problems in the community. This project intervention seeks to utilize the nutritional value of these waste peels, through manufacturing a meal from the dried peels. This "peel meal" can be used as a feed or feed supplement in the dietary rations fed to broiler chickens and laying hens, and can be formulated into feeds for larger animals such as pigs. Important steps in the production process include gathering and drying the peels, screening and grinding them by use of a milling machine, and mixing and bagging the resulting product for local retail sale. The "project" as analyzed here describes the operation of one milling machine to serve a local market.

With a somewhat similar motivation, the second intervention studied here makes use of more of these banana peels along with other local ingredients to produce a cooking fuel that can be used in common household cooking stoves. Whereas these stoves would most commonly be fueled with wood charcoal, the manufactured briquettes are a local and less costly alternative for the project community. In terms of the local environment, this project gathers and uses solid waste that might otherwise be a nuisance in the community, and reduces the impact of wood-fuel consumption on scarce timber resources. Important steps in the production process include gathering and drying the peels, mixing batches of ingredients into composite mixture, then squeezing this mixture into formed molds under considerable pressure using a manually operated briquette press. This is followed by drying the resulting product for local sale. The “project” as analyzed here describes the operation of one briquette press to serve a local market.

II.4 Tunisie

Les ressources en eau de la Tunisie sont d'environ 4.8 milliards de m^3/an pour une population totale de 10.5 millions d’habitants. Elle est classée, parmi les pays pauvres en eau. Parmi les mesures retenues pour affronter cette contrainte, l’utilisation efficiente de l'eau et la valorisation des eaux non conventionnelles occupe une part importante. Cependant, avec la croissance démographique et l'augmentation de la pression sur les ressources naturelles et leur raréfaction, la mobilisation et la valorisation d'autres ressources hydriques notamment les eaux pluviales et grises en milieu urbain sont devenues cruciales.

Dans le Grand Tunis, où vivent environ 2.3 Millions d’habitants (soit plus de 20% de la population tunisienne), l’extension rapide du tissu urbain aux dépens des espaces agricoles et naturels s’est traduite, au cours des trente dernières années, par l’apparition de quartiers périurbains pauvres, l’émergence de difficultés importantes de planification et d’aménagement et la multiplication des contraintes dans la gestion intégrée des ressources en eau et en sol.

Dans ce contexte, le projet de recherche-action s’inscrit intégralement dans les programmes nationaux visant la gestion durable des ressources naturelles et l’amélioration de la qualité de vie des populations vulnérables des cités populaires. Le projet de recherche action proposé centre son action sur la valorisation des ressources en eau, pluviales et grises.

II.5 Sénégal

Senegal has experienced a rapid rate of urbanization in recent years. As a result, urbanization rate increased from an estimated 36.6% in 1982 to 49.6% in 2003. Economic growth has also been significant, increasing at a rate of 2.15% per year between 1996 and 2003. However, despite this economic growth, poverty remains very high. It is estimated that 59% and 88% of the urban and rural population respectively is poor.

With a population of approximately 2.4 million, the region of Dakar is the most urbanized region of Senegal, with an urbanization rate of approximately 97.1%. This region is made of 3 departments (Dakar, Pikine and Rufisque), which are themselves sub-divided into communes and districts (arrondissements). Population density reaches 4,000 inhabitants per km^2.

The Mbeubeuss landfill is located in the district of Malika in the city of Pikine. The city comprises a population of approximately 790,000 inhabitants (33.6% of the population of the Dakar region), and experiences a rapid population growth rate estimated at 5.4% per year. Pikine is also one of the poorest cities of the region with an estimated 30% of its households living in poverty. It is further estimated that 35.8% of its population has limited access to adequate public services. Malika itself comprises a population slightly over 7,000 and represents approximately 10% of the territory of Pikine.

The Mbeubeuss landfill, opened in 1968, receives all solid waste produced by the region of Dakar, an estimated 475,000 tons per year. Approximately 50% of its waste flow is organic waste. As for a large number of other landfill sites in the developing world, the Mbeubeuss landfill is simply an open dump site without any forms of environmental management or controlled access. The Mbeubeuss landfill is a key source of water and soil contamination in the region.

It is generally believed in the local community that this severe contamination has contributed to a large number of documented cases of birth defects in newborns, gastro-intestinal diseases, skin diseases, hepatitis, as well as respiratory diseases (resulting from the heavy traffic in the area). In a 1998 study, researchers carried out a parasitologic survey on 367 inhabitants of Malika, as well as on 433 other residents of Keur Massar, a location 2 km farther, in order to assess parasitic hazards encountered by people neighboring this disposal. As far as intestinal parasitosis is concerned, the prevalence rate was significantly higher in Malika (61.3%) than in Keur Massar (48.5%) thus indicating that proximity to the Mbeubeuss landfill is a key source of contamination.

It has also been noted that domestic animals such as chicken and pork regularly suffer from significant and sudden increases in mortality rate. In 2005, studies done very close to Mbeubeuss by the Pesticide Action Network (PAN) Africa, an information and action network for pesticide control, showed that dioxins, toxic chemicals, were contaminating chicken eggs.

Key components of the project included providing support to the implementation of commercial horticulture activities which has been subjected to a preliminary economic analysis.

Across all five cities, these specific interventions have been developed within the framework of larger programs of community mobilization and development, including action research and capacity building. The cost benefit analyses presented here is focused on the specific interventions, and not on the many other aspects of the larger programs of activities and initiatives.

III. Cost-benefit analysis and net present values

As reported in the separate analyses prepared for projects in each country, the purpose of each cost-benefit analysis (CBA) is to estimate separately the expected costs and benefits from undertaking each type of project intervention. The amount by which the discounted or present value of the benefits exceeds the present value of costs is reported as the Net Present Value (NPV), and if this NPV is positive, this implies that discounted benefits are greater than discounted costs. The following is a country-by-country description of the net present values that are estimated for each project intervention.

III.1 Sri Lanka

For the sewer line extension, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of –10,188,185 SLR, as at January 1, 2008.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD –$90,500 based on exchange rates (112.6 SLR/USD) in September 2010, and approximately equal to USD –$93,800 based on exchange rates in January 2008 (108.6 SLR/USD$).

The interpretation of a negative NPV of this magnitude is that this project, as constituted, would bring members of the reference group (Sri Lankans) more costs than benefits on a discounted basis. Equivalently, Sri Lankans collectively would have been indifferent between losing assets or wealth worth 10,188,185 SLR and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms. The three largest categories of costs are the initial construction cost (62%), the annual operating costs (27%) and household connection costs (5%). If all costs were about 22% lower, with benefits unchanged, the NPV would be positive. The three largest categories of benefits are the avoided cost of operating the current septic systems (47%), the avoided cost of preventing overflows from the current system (45%) and the residual or salvage value of the system at the end of the 25-year economic project life (3%). If all benefits were about 27% higher, with costs unchanged, the NPV would be positive.

The Net Present Value increases for lower values of the discount rate. If the discount rate were lower than 6.45% per year in real terms, the NPV would be positive. In this case, the discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation). Whereas 10% is a widely estimate of the social opportunity cost of capital, some South Asian countries use rates as high as 14% per year. At these rates, the NPV is more negative.

III.2 Indonesia

For the urban water supply project, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of –518,517,207 IDR, as at January 1, 2009.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD –$56,415 based on the market exchange rate (9,191 IDR/USD) in September 2010, and

approximately equal to USD –$47,540 based on the exchange rate in January 2009 (10,907 IDR/USD).

The interpretation of a negative NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Indonesian residents) more costs than benefits on a discounted basis. Equivalently, Indonesians collectively would have been indifferent between losing assets or wealth worth 518,517,207 IDR and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms. The three largest categories of costs are the initial construction cost (42%), the annual operating costs (44%) and the CBO set up and training costs (6%). If all costs were about 40% lower, with benefits unchanged, the NPV would be positive. The three largest categories of benefits are the avoided cost of labour used to access and deliver water (47%), the value of project water to the households (once delivered) (41%) and the health benefits (9%). If all benefits were about 67% higher, with costs unchanged, the NPV would be positive.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach.

The Net Present Value becomes less negative (i.e., it increases) for lower values of the discount rate. However, even if the discount rate were zero, the estimated NPV would still be negative. The initial construction costs are not much affected by the choice of discount rate, whereas future benefits and future costs are each increased in present value terms for lower values of the discount rate. As used here, the 10% discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation). Whereas 10% is a widely estimate of the social opportunity cost of capital, some South Asian countries use rates as high as 14% per year. At these rates, the NPV is more negative.

For the solid waste management project, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of –1,550,781,986 IDR, as at January 1, 2009.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD –$168,725 based on the market exchange rate (9,191 IDR/USD) in September 2010, and approximately equal to USD –$142,182 based on the exchange rate in January 2009 (10,907 IDR/USD).

The interpretation of a negative NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Indonesian residents) more costs than

benefits on a discounted basis. Equivalently, Indonesians collectively would have been indifferent between losing assets or wealth worth 1,550,781,986 IDR and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms. The three largest categories of costs are the land use (37%), the labour for making handicrafts (24%) and the householders' time for sorting and storing waste (19%). If all costs were about 60% lower, with benefits unchanged, the NPV would be positive. The three largest categories of benefits are the compost and handicraft products (87%), the value of the land at the end of the project's economic life (9%) and the savings in cleanup labour (2%). If all benefits were about 165% higher, with costs unchanged, the NPV would be positive.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach. If there is less odour and pests due to less accumulation of (uncollected) waste in community, or less nuisance or blockage from less waste thrown in canals or burned, including potential health benefits, these are not included.

The Net Present Value becomes more negative (i.e., it decreases) for lower values of the discount rate. With a discount rate of zero, the estimated NPV is smaller (more negative) than for other positive rates. The initial costs are not much affected by the choice of discount rate, whereas the prominent future costs are each increased in present value terms for lower values of the discount rate. As used here, the 10% discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation).

With respect to the gutter cleaning project with byproducts production, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of –1,534,835,561 IDR, as at January 1, 2009.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD –$166,990 based on the market exchange rate (9,191 IDR/USD) in September 2010, and approximately equal to USD –$140,720 based on the exchange rate in January 2009 (10,907 IDR/USD).

The interpretation of a negative NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Indonesian residents) more costs than benefits on a discounted basis. Equivalently, Indonesians collectively would have been indifferent between losing assets or wealth worth 1,534,835,561 IDR and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms. The three largest categories of costs are the annual operating expenses (85%), land use (7%), and the initial setup costs (5%). If all costs were about 60% lower, with benefits unchanged, the NPV would be positive. The three largest categories of benefits are the value of the increased frequency and extent of gutter cleaning services (49%), the value of salable products (3%). If all benefits were about 165% higher, with costs unchanged, the NPV would be positive.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach. If there is less loading of waste to downstream canals and districts since more materials are removed sooner (potential savings of cleaning operations at downstream locations) these benefits have not been estimated.

The Net Present Value becomes more negative (i.e., it decreases) for lower values of the discount rate. With a discount rate of zero, the estimated NPV is smaller (more negative) than for other positive rates. The initial costs are not much affected by the choice of discount rate, whereas the prominent future costs are each increased in present value terms for lower values of the discount rate. As used here, the 10% discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation).

III.3 Uganda

For peel processing for animal feed, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is positive with a value of 53,847,650 UGX, as at January 1, 2010.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD $23,774 based on the market exchange rate (2,265 UGX/USD) in June 2010, and approximately equal to USD $27,614 based on the exchange rate in January 2010 (1,950 UGX/USD).

The interpretation of a positive NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Ugandan residents) more benefits than costs on a discounted basis. Equivalently, Ugandans collectively would have been indifferent between gaining assets or wealth worth 53,847,650 UGX and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms. The three largest categories of costs are the fuel, oil and raw materials (46%), the annual operating costs (43%) and the initial investment (10%). If all

costs were about 70% higher, with benefits unchanged, the NPV would be negative. The two largest categories of benefits are the value of peel meal as animal feed (58%) and the cost savings from not collecting waste peels (42%). If all benefits were about 40% lower, with costs unchanged, the NPV would be negative.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach.

The Net Present Value becomes more positive for lower values of the discount rate. The initial construction costs are not much affected by the choice of discount rate, whereas future benefits and future costs are each increased in present value terms for lower values of the discount rate.

In the case of briquette making for use as a cooking fuel, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is positive with a value of 136,926,688 UGX, as at January 1, 2010.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD $60,453 based on the market exchange rate (2,265 UGX/USD) in June 2010, and approximately equal to USD $70,219 based on the exchange rate in January 2010 (1,950 UGX/USD).

The interpretation of a positive NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Ugandan residents) more benefits than costs on a discounted basis. Equivalently, Ugandans collectively would have been indifferent between gaining assets or wealth worth 136,926,688 UGX and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms. The two largest categories of costs are the supplies and raw materials (68%) and the annual operating costs (30%). If all costs were about 130% higher, with benefits unchanged, the NPV would be negative. The two largest categories of benefits are the cost savings from not collecting waste peels (63%) and value of briquettes produced (38%). If all benefits were about 60% lower, with costs unchanged, the NPV would be negative.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any

demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach.

The Net Present Value becomes more positive for lower values of the discount rate. The initial set-up costs are not much affected by the choice of discount rate, whereas future benefits and future costs are each increased in present value terms for lower values of the discount rate.

III.4 Tunisie

Depuis le tout début de ses activités, l'équipe du projet de valorisation des eaux de pluie et eaux grises de l'Ariana-Soukra a incorporé une expertise économique au sein du projet. Ainsi, le *Premier Rapport Technique* soumis par l'équipe en mai 2008 incorporait déjà une analyse des coûts et bénéfices potentiels des activités pilotes du projet. Cette analyse fut par la suite révisée et incorporée dans le *Quatrième Rapport Technique* soumis en février 2010. La présence de cette expertise au sein de l'équipe a grandement facilité la tâche de cette consultation puisque la majorité des données nécessaires à la conduite de l'analyse économique est présentement disponible.

Ces analyses économiques présentés dans les rapports techniques mentionnés ci-haut ont présenté coûts et bénéfices en termes de mètres cubes ou en termes de marges brutes par types de cultures (tomates, laitue, piment, etc.). Bien qu'estimés de façon adéquate, il a été discuté du fait que ce type de présentation pouvait être d'intérêt aux experts techniques (par exemple les calculs en mètres cubes sont certainement d'intérêt à l'ONAS alors que les calculs de marge brute par types de culture peuvent être d'intérêt aux experts agricoles), mais pouvait ne pas être de grande signification aux décideurs politiques.

Ainsi, l'analyse économique développée au cours de la visite et présentée à l'équipe a pour objectif d'estimer la *valeur présente nette* (VPN) et le *taux de rentabilité interne* (TRI) des activités pilotes du projet. Ces deux notions sont bien comprises et couramment utilisées par les décideurs politiques et experts financiers et économiques.

Tel que présenté au Tableau 1, la VPN de l'activité pilote est positive pour des taux d'actualisation qui varient entre 3% et 8% en termes réels. Le TRI est estimé à 26%. Ces estimés démontrent la rentabilité financière et économique des activités du projet.

Tableau 1
Estimé de la valeur présente nette

Taux d'actualisation	Valeur présente nette (TND)
3%	90,480.60
4%	79,453.77
5%	69,834.95
6%	61,417.14
7%	54,027.00
8%	47,518.97

Cette analyse économique démontre que la valorisation des eaux pluvieuses et eaux grises à l'Ariana-Soukra est une activité rentable du point de vue financier et

économique. Cette analyse ne démontre pas que l'utilisation de terres en friche pour des fins agricoles est la meilleure utilisation qui peut être fait de ces terres. Ce type d'analyse nécessiterait que des utilisations alternatives possibles soient identifiées, et que les coûts et bénéfices de ces utilisations alternatives soient estimés puis comparer à ceux de valorisation des eaux de pluie et eaux grises.

III.5 Sénégal

Le projet se propose de mettre en place une pépinière de plantes forestières, ornementales et fruitières au profit des producteurs maraîchers de Malika. Ce projet pilote s'inscrit dans une perspective d'une amélioration des revenus à travers une diversification agricole (plantes ornementales, plants fruitiers, et plantes forestières). Le but ultime est d'emmener les producteurs agricoles de Malika vers des pratiques agricoles à plus grande valeur ajoutée. La proximité avec la grande zone de production fruitière des Niayes de Dakar et de Thiès offre une large opportunité d'écoulement de plants fruitiers issus de la pépinière. Le projet de rénovation de la bande de filao qui relie Dakar à Saint Louis et qui démarre par Malika fournit une possibilité de reboisement de deux hectares de filaos par an. En outre, l'extension de la ville de Dakar vers Malika et ses environs offre des capacités de développement de la production de plants d'appartement ou d'ornement pour les nouvelles habitations.

La pépinière sera implantée sur un site de 1 hectare et ambitionne une production annuelle de 60 000 plants dont 60% seront réservés aux plants fruitiers, 25% aux plants forestiers et 15% aux plantes d'appartement, d'ornement ou de fleurs coupées. La mise en œuvre de la pépinière nécessitera entre autres la construction d'un mur de protection qui assurera aussi un rôle de brise vent pour les plants, mais également de bâtiments pour le stockage de produits phytosanitaires, pour les vestiaires des producteurs et le local du gardien.

Étant donné les informations présentées (qui ont été utilisées pour les fins de cette analyse sans avoir été validées) démontrent une valeur présente nette variant entre $75,000 et $265,000 à un taux d'actualisation de 10%.

IV. Conclusions

Each of the interventions subjected to economic analysis in this report were assessed "as if" it were undertaken by the residents of each host country and financed by the country's own assets and resources. Each cost-benefit analysis study asked whether the monetary and non-monetary gains that accrue from each investment exceed their monetary and non-monetary costs, when compared on a discounted or present value basis. The analyses examined each of the projects "as implemented" and did not propose or consider a set of other alternatives to these projects.

In some cases, the estimated Net Present Value (using a 10 percent, real annual social discount rate) is negative, indicating that project benefits are not as large as project costs when viewed from a social opportunity cost perspective. In other cases, just the opposite is true—the estimated Net Present Value (using a 10 percent, real annual social discount rate) is positive, indicating that project benefits are larger than project costs when viewed from a social opportunity cost perspective. Sensitivity analysis accompanies each estimate and shows the contributions of various cost and benefit components to each outcome. Where some costs or benefits have not been estimated,

these ranges indicate how large the omitted or adjusted items would have to be to change the sign or the magnitude of the NPV estimates.

The analyses of these selected interventions is undertaken as part of a larger capacity-building program that has worked with the project teams to explain and to demonstrate the use of social cost benefit analysis and its role in influencing policy decisions. The analysis has been undertaken near the termination of the city projects using best available estimates as provided by the project teams. Unlike a stand-alone analysis of other investment projects, the analysis is not based on any program of independent collection or field verification of data or of project practices.

Finally, a number of observations are worth noting.

First, when appropriately perceived as *pilot projects*, it is likely that the learning and experimentation that are part of these important initiatives will suggest improvements that could be incorporated if these interventions were to be replicated elsewhere. To this extent, the economic analysis of various project interventions presented in this report may provide guidance as to those key factors which may determine the economic viability of these interventions if replicated to other areas of the Focus Cities. In other words, a negative Net Present Value may not necessarily imply that similar activities have no chance of offering positive economic results.

Second, while economic efficiency may be perceived as an important criterion used by policy-makers, it may not (and arguably should not) be the only factor guiding policy making. Other factors not captured by means of economic analysis (such as those pertaining to distributional issues and social equity) may also guide policy-making. Hence, it should not be concluded that an initiative has failed or should not be replicated solely and purely on the basis of an economic efficiency criterion.

Finally, although various baseline studies had been compiled for participating communities in the course of Phase I, none of these exercises fully anticipated that there would be need for specific economic and other data related to cost-benefit analysis. As a result, numerous estimates or values relevant to the analysis are not directly supported by project records or other government or public data. An important lesson from this consultancy work was in fact demonstrated in the case of Ariana-Soukra which had an economist as a team member at the outset of the project. This is that making explicit the intent of conducting a project cost-benefit analysis at the outset—not only of project implementation but of project design—may have improved the likelihood that needed data and information would be collected to conduct such analysis.

This study could not have been undertaken without the constructive and informed support of the Focus City project teams, who gave generously of their time and energy to participate in workshop activities and who shared their knowledge of these projects and of the communities that they serve. We are especially grateful for their participation and assistance.

Annex 1
Abbreviations and acronyms used in this report

CBA	Cost Benefit Analysis
CBO	Community-Based Organization
FC	Focus Cities program of the Urban Poverty and Environment Program Initiative of the International Development Research Centre
IDR	Indonesian Rupiah, market exchange rates 9,191 IDR/USD in September 2010 and 10,907 IDR/USD in January 2009
IDRC	International Development Research Centre
NPV	Net Present Value
PALYJA	PT.PAM Lyonnaise des Eaux (private sector water supply company serving the western portions of Jakarta)
RW	*Rukun Warga* – Indonesia word for neighbourhood, an organizational sub-unit in Indonesian cities. Each is designated numerically. For example, RW8, RW12 and RW13 are sites of project activities.
SLR	Sri Lankan Rupee, market exchange rates 112.6 SLR/USD in September 2010 and 108.6 SLR/USD in January 2008
TND	Tunisian Dinars
TRI	Taux de rendement interne
UGX	Ugandan Shillings, with approximate market exchange rates of 1,950 UGX per USD in January 2010 and 2,265 UGX per USD in June 2010.
UPE	Urban Poverty and Environment Program Initiative of IDRC
VPN	Valeur présente nette

Annex 2
Terms of Reference

Strengthening the Economic Dimension of Focus Cities Research Initiative In Asia and Africa

A. Background information:

IDRC's Urban Poverty & Environment Program Initiative (UPE) supports integrated and participatory research to reduce environmental burdens on the urban poor, and enhance the use of natural resources for food, water, and income security. UPE takes an integrated approach to environment and natural resources issues in cities, working within the themes of urban agriculture, urban water and sanitation, waste management, and vulnerability to natural disasters, with land tenure as a cross-cutting issue. A key component of UPE, the Focus Cities Research Initiative is supporting multi-stakeholder research teams in eight cities around the world to promote awareness, policy options and best practices for reducing environmental impacts in poor urban and peri-urban areas. Focus City (FC) projects under implementation in Asia, Africa and Latin America are: Jakarta (Sri Lanka), Jakarta (Indonesia), Kampala (Uganda), Dakar (Senegal), Ariana-Soukra (Tunisia), Lima (Peru), Cochabamba (Bolivia), and Moreno (Argentina).

UPE has three primary objectives:

1. To understand the nature and context of environmental burdens and constrained use of natural resources, their impact on food, water and income security, and identify potential solutions.

2. To test interventions and assess policies in low-income urban neighborhoods that ease environmental burdens, and enhance the use of natural resources for food, water and income security.

3. To contribute to the integrated planning, development, and implementation of sustainable and equitable urban environmental and natural resource policies.

Each of UPE's objectives outlined above represents one phase of a Focus City project's research cycle: diagnosis, experimentation and policy influence.

Strengthening the economic dimension of the Focus Cities Research Initiative will help Focus City projects: 1) assessing during their diagnosis phase the damage cost associated with poor environmental services, 2) undertaking during their experimentation phase a cost-benefit analysis of proposed interventions, and 3) using the economic findings to influence policy. The economic dimension of the Focus Cities in Asia (Jakarta and Jakarta) and Africa (Dakar and Jakarta) as well as of the city of Moreno (Argentina) was strengthened through a consultation that was commissioned by UPE in January 2007. A second consultation is currently taking place to strengthen the economic dimension of Focus Cities in Latin America (Cochabamba, Lima and Moreno). Each Focus City is facing an environmental burden (diagnosis phase) and the overall objective of FC Research Initiative is to reduce these environmental burdens through experimentation with interventions (experimentation phase). Once tested and validated, it is hoped that these interventions, through policy influence, are adopted and scaled up (policy influence phase).

The first consultation aimed at assessing in monetary terms the current environmental burden in Focus Cities. This burden was mostly associated with damage to health (e.g. waterborne diseases associated with poor water, sanitation and solid waste management systems).

The proposed interventions in FC projects are expected to reduce environmental burdens through an improvement of these systems. The proposed consultation will undertake a cost-benefit analysis of these interventions. Generally speaking, the costs present the actual costs of the interventions themselves. The benefits are the avoided damage cost of environmental burdens; a cost that was assessed in the first consultation.

In order to enhance policy influence, the adoption and the scaling up of proposed interventions, FC projects should aim to show that the benefits that will be yielded from the implementation of these interventions (e.g. avoided damage cost to health) exceed their implementation and operational costs.

B. Objectives:

The general objective is to further strengthen the economic dimension of Focus City projects in Asia (Jakarta and Jakarta) and Africa (Ariana-Soukra, Dakar, and Jakarta) with an ultimate purpose of achieving policy influence.

Specific objectives are:

Objective 1: Provide continued training and capacity building to each Focus City team on the conduct of cost-benefit analysis[2].

Objective 2: Undertake a cost-benefit analysis of interventions implemented by each Focus City project in its experimentation phase.

Objective 3: Support each Focus City team to use effectively the outcome of the cost-benefit analysis to achieve policy influence.

C. Overall methodology:

In order to effectively achieve the above three objectives, extensive communication between the resource person and each Focus City team will be necessary. This communication will partly take place by electronic means. In addition to electronic communication, there is need for on-site discussion, consultation, and training. Two trips are proposed in the framework of this consultation. The first will provide training and capacity building to each Focus City team on the conduct of cost-benefit analysis and will identify the data to be collected. The second trip will aim at discussing a draft of the cost-benefit analysis, finalizing the analysis, and providing training on the effective use of the results for policy influence.

[2] A first round of training and capacity building was conducted in the framework of the first consultation (over the period June – August 2007). This first round focused mostly on methodologies for the economic valuation of health damages. This proposed second round of training and capacity building will focus on the conduct of cost-benefit analysis.

All Focus City teams are expected to actively participate in data collection necessary to the preparation of the reports described below.

D. Activities and reports:

Activity 1: Preparation and delivery of a two-day workshop on cost-benefit analysis, in the specific context of Focus City projects' interventions.

Activity 2: In collaboration with each Focus City team, identification of needed data and data collection process to conduct the cost-benefit analysis. The resource person is expected, through distance communication, to monitor and mentor the data collection process that will be led by the Focus City teams.

Activities 1 and 2 will be completed in the course of the first visit to each Focus City project.

First Report: This report (or set of reports – one for each Focus City) will be on the outcome, observations, and recommendations made following the first visit.

Activity 3: In consultation with each Focus City team, preparation of a draft on the cost-benefit analysis of interventions in Focus City projects.

*Second report***:** Draft of the cost-benefit analysis.

Activity 4: Preparation and delivery of a two-day workshop on the results of the cost-benefit analysis, and capacity building on the use of these results for purpose of achieving policy influence.

Third report: This report (or set of reports – one for each Focus City) will be on the outcome, observations, and recommendations made following the second visit.

Fourth report: Final report of the cost-benefit analysis.

E. Duration and level of efforts:

The time frame of this proposed consultation is up to 12 months. The estimated level of efforts is up to 80 days to be allocated as follows:

- Up to 4 days/visit to each focus city totalling to 40 days.
- Up to 8 days / Focus City Project to prepare for activities 1&4, undertake activities 2&3 and write the final report, totalling to 40 days.

ACCOMPANYING DOCUMENTS

Cost-Benefit Analysis of the Sewer Line Extension in Colombo, Sri Lanka

Cost-Benefit Analysis of Selected Interventions to Improve the Urban Environment in Jakarta, Indonesia

Cost-Benefit Analysis of Selected Interventions to Improve the Urban Environment in Kampala, Uganda

Cost-Benefit Analysis of Selected Interventions to Improve the Urban Environment in Ariana-Soukra, Tunisia

Cost-Benefit Analysis of Selected Interventions to Improve the Urban Environment in Dakar, Senegal

SRI LANKA

I) Description of the sewer line extension project

The Gothamipura district of Colombo, Sri Lanka is a low-lying residential area of Colombo. Historically this area has not been connected to sewage trunk lines to drain household sewage waste from the community. Nonetheless, more than 90% of area residents have private flush toilets that drain into storage tanks and pits, and these are emptied periodically by hired work crews. Unfortunately, the area is low lying topographically, and is adjacent a canal that floods regularly, especially during the monsoons. Recurrent flooding brings with it contaminated wastewater from upstream communities, and flood waters can mix with some of the stored household waste in Gothamipura. This project proposes to provide sewage lines through the community and to the nearest point of connection with existing sanitary sewage collectors. Due to the low elevation, the use of the extended sewer line necessarily involves the installation, operation and maintenance of a pump to elevate waste to the new connection point.

The project to be evaluated here is the construction and operation of a sewage trunk line from the nearby existing (up-gradient) connection point to existing sewage trunk lines through the community of Gothamipura. This extension of one or more sewage lines will allow direct connections by approximately 333 households, including about 46 who are from an adjoining settlement (called “the Neighbourhood”) that is distinct from Gothamipura in a legal and jurisdictional sense.

Due to issues of land tenure, land title and jurisdictional authority, this project cannot be financed and operated under the mandate of the Colombo Municipal Council (CMC), even though the CMC does provide such services for much of Colombo. Gothamipura is one of numerous so-called Under-Served Settlements (USS), built on lands in Colombo that come under national authority through the National Housing Development Authority. Historically, lands in Gothamipura were occupied for housing and community use without the residents acquiring private title (legal ownership) to the lands. With a population of about 350 households, area residents have not been required to pay municipal taxes to the Colombo Municipal Council (CMC), and have not received household sanitation and some other services that are ordinarily provided by the CMC to other residents of Colombo.

This project is meant to be a pilot for both a type of sanitation investment, and a model of building and operating it, that might be replicated in other Under-Served Settlements in the country. Without the direct operational role of the CMC, ongoing operations of the sewage works will be financed, supervised and administered by the local community through their elected Community Development Council. Individual households are expected to subscribe and to pay fees voluntarily if they are to participate in the new sewage collection system. There is an expectation that existing systems of sewage storage, including the current waste collection services by CMC work crews will be discontinued once the new sewer line is operational.

The sewer line extension project is one component part of a much larger multiyear program of activities addressing issues of environmental degradation and urban poverty in Colombo. Other components include community mobilization, solid waste

management and provision of greater security of tenure in the form of private land titles. Some of these interventions, including the sewage line extension, are the subject of a recent educational video.[3]

II) Key assumptions and methodology

The purpose of this cost-benefit analysis (CBA) is to estimate the expected costs and benefits from undertaking the extension of this sewer line in the Gothamipura area of Colombo, Sri Lanka. The amount by which the discounted or present value of the benefits exceeds the present value of costs is reported as the Net Present Value (NPV), and if this NPV is negative, this implies that discounted benefits are less than discounted costs.

Some of the key assumptions that influence the outcome of any cost-benefit study are the analyst's choice of:

- Reference group
- Formative versus summative analysis
- Project economic life
- Social discount rate, and
- Method for addressing foreign exchange and trade effects.

Each of these will be presented briefly in turn. Brief comments on other selected methodological issues follow that.

Reference group

A key step in any CBA is identification of the reference group. This is the set of persons whose benefits and costs will be included in the calculations. Once the reference group is chosen, any benefits or costs that accrue to other people outside of the reference group are not to be reflected in this NPV. As examples, in the case of a project in Gothamipura, it might have been informative to ask for an estimation of expected Net Present Value from the perspective of:

- All of the residents of Gothamipura (only)
- The Community Development Council (only) in Gothamipura who will oversee the project's future operations
- The residents of Colombo
- The residents of Sri Lanka
- Global residents

Each potential choice of reference group would necessitate its own set of calculations, leading to an estimate of its own NPV.

[3] Ghose, Rana. 2010. "*Making It Work: Bringing People Together To Find Sustainable Solutions To Urban Waste Water Management*," Ottawa: International Development Research Centre. Video presentation accessed at: http://www.youtube.com/watch?v=kQMXuhpl6Rw and http://www.youtube.com/watch?v=KioE_m0WsW8&NR=1

In the current context, one motivation for preparing such a cost-benefit analysis is to provide information about the potential for replicating this type of intervention in other underserved settlements of Sri Lanka, and to influence policies for doing so. These are potentially issues that would be of interest to the Colombo Municipal Council when acting on behalf of the residents of Colombo, or to the national government of Sri Lanka when acting on behalf of the residents of Sri Lanka.

With a view to providing (only) one cost-benefit analysis with one estimated Net Present Value that can serve this purpose, the present analysis will be undertaken from the national perspective. This study's reference group is the residents of Sri Lanka, with one modifying assumption. The current project has benefited from some inflows of funds from the International Development Research Centre, an international agency that is external to the reference group. The cost of IDRC funding and resources provided to Sri Lanka might ordinarily be treated as zero, if one were strictly following the application of this national reference group. In order that the results can be interpreted for national policy making purposes; by assumption, all of these IDRC resource costs will be included as if they had been generated from sources inside Sri Lanka. In this way, the results of the analysis can be interpreted "as if" the project were undertaken with Sri Lankan resources for Sri Lankans. These results can help indicate whether investment of domestic resources for this project would have been beneficial if it had been fully financed domestically.

The implication of this choice of reference group is that this analysis will follow the methods of *social cost benefit analysis*, as opposed to private or financial analysis. In principle, all costs and benefits that accrue to members of the reference group because of the project should be included in this analysis. Some of these costs and benefits might not be monetized, such as the use of community members' time or changes in community members' health status.

Formative versus summative analysis

This is a *summative* analysis, which implies that this analysis is examining only one, pre-specified project alternative for the sewer line extension. As a result, the analysis can be interpreted to indicate whether the reference group is better off with or without this specific project. It is beyond the scope of a summative analysis to explore alternative project designs or alternative projects, such as other technologies and programs for community sanitation in Gothamipura.

Thus, as a cautionary note, the results should <u>not</u> be interpreted to mean that this project is the best one or the worst one available, only to show how it compares to the "without project" case. By contrast, a *formative* analysis would take improved project design within its terms of reference, and might examine a range of alternatives with respect to technologies, routes, timing, funding, pricing and so on, to arrive at the most preferred community sanitation option.

Choice of project economic life

It is expected that the extended sewer line will serve the residents of Gothamipura indefinitely into the future. From time to time, various connections, sections of the line, or pump components may need replacement, but, by assumption, this project will continue to provide the primary method of household sewage waste collection for the

participating households. Even so, the project will be analyzed with an assumed economic project life of 25 years, from the start of construction in 2007 until the end of 2032. Details of estimated annual costs and benefits will be tracked only for this time period.

It is common in cost-benefit analysis to include some residual credit for future expected benefits after the end of the project's economic life. One approach is to treat the project "as if" it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, such as the land and equipment. An alternative approach is to assume that the project will continue indefinitely with annual flows of costs and benefits very much like those in the earlier periods. Future benefits flows, net of future costs (after the end of the project's economic life) would be treated much the same as a perpetual income stream. Instead of itemizing all of these annual transactions, the present value of this series of annual future benefits would be treated as a lump-sum benefit in the project's last year. The former of these two approaches is used in this study.

Social discount rate

The social discount rate is the rate that is used to compare social costs or benefits that accrue at different points in time, such as when adding them up to estimate the Net Present Value. Among economic practitioners, one methodological approach is to choose a rate that is the Social Rate of Time Preference and that indicates how consumers compare consumption at different points in time. An alternative approach chooses a rate that is the Social Opportunity Cost of Capital and that reflects the opportunity cost of funds used by a project. This choice necessitates other adjustments in the methodology, such as whether or not it will also be necessary to itemize financing costs for a project.

When the second approach is chosen, as in this study, there is no need to track the specific sourcing of project funds and cash flows over the project life, nor is there a need to include additional cost entries that reflect what the shadow price of those funds might be in the context of this project. Accordingly, the social discount rate employed here is 10% per year, in real terms, reflecting the Social Opportunity Cost of Capital. As further explained by Zhuang *et al.* (2007), this choice is in line with the conventions followed by numerous international financial institutions, development banks, and others, although some South Asian countries use higher rates.[4]

Method for addressing foreign exchange and trade effects

Economists are often concerned that various distortions (including tariffs, taxes, import quotas and other features of each country's commercial policy and international financial practice) cause the observed market exchange rates for a country's currency not to reflect accurately its opportunity cost to citizens of the country. To address this, some practitioners attempt to estimate the value of all costs and benefits in an international currency (US dollars, Euros) as measured at world market prices. This allows the resulting NPV to be interpreted as representing an amount of purchasing power on world

[4] Zhuang, Juzhong; Zhihong Liang, Tun Lin and Franklin De Guzman, May 2007. *Theory and Practice in the Choice of Social Discount Rate for Cost-benefit Analysis: A Survey*. ERD Working Paper No. 94, Manila, Philippines: Asian Development Bank, Economics and Research Department. http://www.adb.org/Documents/ERD/Working_Papers/WP094.pdf

markets. A second approach, the one used here, is to track all benefits and costs in the domestic currency of the country of study. Since the market exchange rate may not reflect opportunity cost accurately, this approach recommends the adoption of an alternative "shadow exchange rate" that would be used to adjust the value of all tradable goods or services employed in the project. As will be seen, the tradable components of the current project are not significant in size. Although costs and benefits are tracked in Sri Lankan rupees (SLR), no "shadow exchange rate" adjustments are employed here.

Description of the "without project" case

The Net Present Value of a project is an estimate of the value that accrues to the reference group over the life of the project if they undertake the project compared to the value that accrues to them if they do not. Almost always, maintaining the "before project" status quo will not be an option, even without the project. Thus, it is important to identify or explain the key features of this presumed, counterfactual "without project" environment that forms the reference point for estimating a Net Present Value.

For the sewer line extension in Gothamipura, the assumption used here is that the community would continue to grow in total population and in number of households, and that the current waste disposal technologies and practices would continue unabated without the project. It is expected that without the project there will be some decrease in the frequency of seasonal flooding of the district, such as through investments that the Colombo Municipal Council and other agencies will make in regional drainage and flood control. All the same, with or without the project, one expects that there will continue to be occasions when low lying parts of the project area are flooded and household members will face potential contact and exposure to wastewater and other contaminants.

Other methodological issues

This analysis is undertaken after the proponents had decided to undertake the project. So, even though all facets of the project were not yet operational at the time of this analysis, this is considered an *ex post* analysis. The analysis is *deterministic* in nature, as opposed to reflecting a stochastic analysis, and it uses the methods of partial equilibrium analysis (as opposed to general equilibrium) in establishing the value of various costs and benefits.

Most of the costs and benefits in this study are estimated at market prices, or expected market prices, even though there may be some market distortions that suggest alternative opportunity costs for the reference group. This practice is dictated in part by data limitations, such as an absence of information about specific labour market conditions for various types of project labour. As explained further below, for some unpriced effects, such as the community members' use of their own time to attend (unpaid) project meetings or to provide project labour, an estimated day rate for unskilled labour is used for members of the general community. An opportunity cost that is 50% higher is applied for those persons elected to the executive committee of the CDC who will attend operational meetings in future.

Limitations of this analysis

The analysis of this project is undertaken as part of a capacity-building program that has worked with the project team to explain and to demonstrate the use of social cost benefit analysis and its role in influencing policy decisions. The analysis is undertaken near the termination of this project using best available estimates as provided by the project team. Unlike a stand-alone analysis of other investment projects, this analysis is not based on a program of independent collection or field verification of data or of project practices. Although various baseline studies had been compiled for the participating community, those exercises did not fully anticipated that there would be need for specific economic and other data related to cost benefit analysis. As a result, numerous estimates or values relevant to the analysis are not directly supported by project records or other government or public data.

III) Evaluation of project benefits and costs

Description of the principal types of benefits

In general, when a public project of this nature provides services to a community, the benefits can take either or both of two principal forms. The first is that there is usually an increase in the total level of services used, and this additional level of service is to be valued according to the community's willingness to pay for it. The second is that there may be a decrease in the former or alternative service that would be in use without the project. This reduction gives rise to some forms of cost savings, which also count as project benefits. Other benefits, above and beyond these sewage disposal effects can come in the form of health and/or environmental improvements.

Applying this reasoning to the sewer line extension suggests the following general categories of benefits:

- Benefit of being able to install a private toilet and to connect for some of the households that currently do not have any private toilet with connection. This is the value of an increase in the access to sanitation services above what would have happened without the project. In general, there will be some value to these households that exceeds the costs they incur for toilet fixtures, pipes and connections.
- Cost saving for currently serviced households from not operating the former, existing systems of sewage collection such as community septic and private septic and pit systems. These cost savings arise from eliminating the need for pumping and hauling the waste at regular intervals, and avoiding other periodic maintenance and service needs, such as service calls to clear regular blockages in these systems.
- Value of environmental improvement and health effects from having less sewage deposited into the adjoining canal (by those households that currently dispose there) and from reducing or eliminating the periodic overflow of the larger community sewage septic holding tank.

Potential health benefits to Gothamipura from the sewer line extension

A premise of the study design for this consultancy was the expectation that project interventions will address environmental burdens as a key target. In the case of the Colombo Focus City project, the important environmental burdens identified in the first consultation (undertaken in 2007 and 2008), and towards which cost estimates were sought, were related to issues of water-borne illness and flooding. However, the current set of project interventions is not directed at flood reduction. There may be a range of significant benefits to the target communities and the nation from specific project interventions. However, the magnitude of these benefits could not be adequately estimated if the scope of the valuation exercise were to be narrowed to estimating the avoided damage cost of environmental burdens alone.

Although the work of the first consultation showed that some community members were experiencing a cost of illness due to environmental burdens, this is likely to continue to be true with or without the set of project activities now underway. For instance, households in the study area are likely to continue to be exposed to sources of contamination through imperfect access to safe drinking water and contact with contaminated water inside and outside their own community. Exposure to sources of contamination may well be seasonal or episodic, such as with increases during the wetter months or during specific high-rainfall events.

Consider specifically the extension of the sewer line and the construction of a pumping station to operationalize it. In this settlement, somewhat more than 90% of the households already have private flush toilets, and so the principal effect of the new sewer line, once activated, will be to change the routes, processes and technology by which the household waste is transported from existing toilets located in residences. There may be incentive for some of the remaining homes to establish private toilets and to connect to the sewer line, and this effect will be included. However, in a number of cases, such as squatter households built with temporary materials and designs, it is expected to be quite some time—if ever, for those with a space constraint—before these structures might be upgraded so as to be eligible or capable to secure a water service or a flush toilet.

Sanitation studies highlight the gains to providing sewerage access to households. The largest health and environment gains appear to come from the transition from unimproved or non-existent household sanitation facilities to improved sanitation facilities, not from replacing holding or septic tanks with sewers where private toilets are already operational. The historical practice in Gothamipura has been to store household toilet waste in local septic tanks, at the household level or, for some households, in a communal tank. These tanks are evacuated periodically and the waste is transported by truck for disposal. The final disposal site for pumped waste has apparently been the main sewer system of Colombo Municipal Council and this will continue to be the destination of this community's sewage waste with or without the project. Since the Colombo Municipal Council does not process its sewer system waste, but instead pipes it into the ocean, there will be no additional treatment cost "burden" associated with increased sewer use in Gothamipura. The ultimate environmental loading of this sewage on the ocean, and potentially on coastal communities, will presumably be the same with as without the project.

One environmental effect that is expected to follow from the new sewer line is a reduction in sewage loading to the bordering canal, which flows through Gothamipura across Colombo to the ocean. It seems that the canal will continue to receive significant loading of contaminants both upstream and downstream of Gothamipura even if these loadings from Gothamipura are reduced or discontinued. The inundation of sections of Gothamipura with canal water during the rainy seasons is expected to continue, even once the sewer line is activated, and so households will continue to face considerable exposure to sewage contaminated water and to water-borne disease. There will be some environmental benefit from reduced canal loadings, but these might be small and might be felt further downstream from Gothamipura.

Another environmental effect that is expected to follow from the new sewer line is a reduction in sewage periodically overflowing from the community septic tank. In the past, the overflow problem has been tackled by asking for additional pumping to clear that tank once it is full, but the occurrences of overflow have not been completely eliminated. With the activation of the new sewer line, it is expected that all households will discontinue their use of this community septic facility, avoiding the possibility of future overflow. Subject to this discontinuance of the septic tank's use, this environmental problem will be solved, and any associated health effects removed too.

In considering the aggregate effects of the sewer line extension, there may, on balance, be some environmental and health benefits, but the avoided environmental harm is not likely to be a large or significant benefit relative to other types of benefits expected.

Specific estimates of project benefits

The project plans called for the new sewage line and pump to be operational during 2010. This was to be a year of considerable project activity, such as when numerous individual households connect to the (already constructed) sewage line and disconnect from their former tank or storage systems. Not all households are expected to connect to the new system at the very first available opportunity and a schedule is provided for a transition to the system over five years, after which none of the former systems would be operated any longer. As of the September 2010 workshop, the line and pumps were not operational and no households were yet able to connect. The cost and benefit details here are based upon the proposed project schedule, and proposed numbers of connections for 2010 and subsequent years, "as if" this schedule had been met.

For each year of the project life, various categories of costs are listed (numbered 1 – 6) and are aggregated to give a total cost per year. Similarly, various categories of benefits are listed (designated a - h) and are aggregated to give a total benefit per year. Benefits minus costs for each year are shown next. These annual amounts are then discounted to reflect their present value at the start of 2008. Summing these across years gives the project's Net Present Value.

There are eight principal categories of project benefits that are itemized:

a. Cost savings - Value of reduction in blockages
b. Cost savings from not operating septic/pit systems
c. Avoided cost of discharges to canal
d. Avoided cost of preventing community overflows

e. Value of new private toilets

f. Salvage value of infrastructure in year 25

g. Value of land in year 25 if project ends

h. Regain use of land occupied by former community septic tank

Each of these estimates will be described in turn.

a. Cost savings - Value of reduction in blockages

As estimated by baseline surveys conducted for the project, a considerable number of households regularly experience various blockages and service disruptions with their current septic and pit storage systems. Survey responses indicate the frequency of these blockages, and the costs and methods used to resolve them, including in some cases the householders' own time, hired workers or efforts of staff of the Colombo Municipal Council. All of these blockages are expected to be eliminated once there are direct household connections to the new sewer line, and so there will be an associated cost savings. As shown in the table below, the estimated cost savings per occurrence is 56.25 SLR[5] for households in the Under Served Settlement (USS) with 1.51 blockages per household per year on average. For households in the Neighbourhood (NBH), the estimated cost saving is 43.83 SLR per occurrence with 1.07 blockages per household per year.

Table 1 - Cost savings from reducing household blockages

Year	Area	Number of household connections[a]	Number of blockages per household	Cost savings per household per blockage (SLR)	New savings each year from reduced blockages (SLR)	Accumulated savings each year from reduced blockages (SLR)
2010	USS	165	1.51	56.25	14,014	
	NBH	35	1.07	43.82	1,641	**15,655**
2011	USS	50	1.51	56.25	4,247	
	NBH	0				**19,902**
2012	USS	30	1.51	56.25	2,548	
	NBH	0				**22,450**
2013	USS	28	1.51	56.25	2,378	
	NBH	0				**24,828**
2014	USS	25	1.51	56.25	2,123	
	Total	333				**26,951**

[a] number of (connected) households grows by 1.5% /year starting in 2015 only for USS

The number of connections for each year of the five-year transition to the new sewage line is also shown in the table, with an included assumption that population, number of connections and numbers of blockages avoided will continue to grow at an annual rate of 1.5% per year through the project life. Savings in the table accumulate each year as

[5] All currency figures are in constant Sri Lankan Rupees, with a market exchange rate of approximately 112.6 SLR per USD in September 2010.

the base of connected households grows. Each year the project saves the cost of clearing blockages in those households that are newly connected, in addition to the annual cost savings of all those households who connected before them.

b. Cost savings from not operating septic/pit systems

The principal operating cost of the current storage based systems is incurred when a crew attends each household an average of four times per year to evacuate the storage tank and deliver the waste from the community. There is a large tank truck (referred to as a Gully Bowser) operated by a driver and two workers. The annual cost savings per household is estimated based upon an hourly cost for the workers, and hourly cost for the vehicle, and an estimate of the number of hours per household per year, as shown below.

Wages of 3 person Bowser crew (45,000+20,000+20,000 SLR/month =) 85,000/month
85,000 SLR/mo / (25 days/mo.) / (8 hours/day) = **425 SLR/hr**

Expense of Bowser vehicle	SLR/year
Capital cost: 9 million SLR every 15 years =	600,000
Maintenance: 20,000 SLR/month × 12 months/year =	240,000
Insurance (3rd party): 6,250 SLR/month × 12 months/year =	75,000
Fuel: 20 l/day × 70 SLR/l × 30 days/month × 12 months/year =	504,000
Bowser cost per year	1,419,000
Bowser Cost per hour (with 30 days/month, 8 hours/day) **493 SLR/hr**	

Average expense per household per year

2 hours per collection/household and 4 collections / hh / year gives:	SLR/year
8 hours/hh/year × (425+493 SLR/hour) = annual cost per household	7,344

Table 2 - Cost savings from not operating septic/pit systems

Year	Area	Number of household connections[a]	Operating cost savings per household (SLR)	New savings each year from reduced operating costs (SLR)	Accumulated savings each year from reduced operating costs (SLR)
2010	USS	165	7,344	1,211,760	
	NBH	35	7,344	257,040	**1,468,800**
2011	USS	50	7,344	367,200	
	NBH	0			**1,836,000**
2012	USS	30	7,344	220,320	
	NBH	0			**2,056,320**
2013	USS	28	7,344	205,632	
	NBH	0			**2,261,952**
2014	USS	25	7,344	183,600	
	Total	333			**2,445,552**

[a] number of (connected) households grows by 1.5% /year starting in 2015 only for USS

c. Avoided cost of discharges to canal

Without the project, it is assumed that there would continue to be some discharges of sewage originating in the community into the canal that adjoins the community and that flows through the city. Any benefit from reduction of these discharges with the project would accrue downstream, likely in the form of aesthetic and possibly health gains to other residents. Although there is some information about the nature and magnitude of possible discharges of wastewater into the canal, there are no estimates of what the value might be of these aesthetic and health gains downstream.

Apparently, two households discharge household waste directly to the canal and some other households near the canal allow periodic overflow from their storage systems to drain to the canal. We estimate that there are 10 households that are the source of these discharges and that this number of households would not increase with or without the sewer line extension. In the absence of specific estimates of the damage caused by these discharges, we can arrive at a measure of benefits based on the concept of avoided costs. That is, if these discharges were seen as harmful or a practice to be discontinued, there is the option to take steps other than the sewer line extension to eliminate these discharges. If the cost of those preventative actions is known, and if incurring those costs is a reasonable strategy for addressing the problem, then a benefit of the sewer line extension to avoid the need to incur such preventative expenses.

The specific preventative action that are considered here as a means to control the discharges without the sewer line is a selective or targeted increase in the frequency of emptying the existing storages so that they do not overflow. This strategy seems practical for those with overflow issues. For the two households with direct discharges to the canal, such a strategy could also require some other improvements to the storage system, but the state of their storages, if any, has not been assessed for the purpose of the current study, and no such structural improvements have been estimated.

It is expected that tripling the frequency of pumping for the ten targeted households would be an alternative preventative strategy capable of eliminating or reducing discharges to the canal. The avoided cost of such additional pumping is a benefit of extending the sewer line, and the estimated benefit will stand as a proxy for the value of reducing discharges to the canal.

The magnitude of the estimated annual benefit is the cost of additional pumping for ten households, twice as often. That is, the estimated benefit is 10 households times two times 7,344 SLR/year = **146,880 SLR/year**. This is equivalent to increasing the frequency from quarterly to monthly, where the avoided cost of the quarterly pumping is already included in item (b) above.

d. Avoided cost of preventing community overflows

Without the project, there would continue to be periodic overflows from diverse storages within the community, where these overflows constitute an aesthetic and health risk to residents. These storages mainly result from insufficient storage capacity or insufficient frequency of collection of water, or from (seasonal) overland flooding events that cause flood waters to mix with septic storages.

In the absence of specific estimates of the damage caused by these overflows, as above, one can estimate what the preventative cost would be to control these overflows without the sewer line extension. The discharges could be largely controlled—perhaps not eliminated completely—by doubling the frequency of pumping for the entire community. These avoided costs are benefits. The regular collections are already included above. The additional pumping costs would be 7,344 SLR per household per year. This is an avoided cost, or benefit, equal in magnitude to the operating costs estimated (as item (b) above), reduced by the cost for the 10 households near the canal whose extra pumping is already included in item (c).

e. Value of new private toilets

A baseline survey that contacted slightly more than half of the households in the project area found that 13 lacked private toilets. Extrapolating this number to the entire community suggests that 25 households may lack private toilets without the project. In some cases, this situation might be due to a lack of resources to afford a toilet, or to afford the materials and space for a septic pit or storage tank. The baseline survey collected views about willingness to pay to have a connection to a sewer line, and about the likelihood that these households would or would not connect immediately once it became available. The willingness to pay responses are for the new connection alone, and reflect a gain to households above and beyond the costs they will incur for the toilet and other connections and fittings.

The expected schedule of connection for these 25 households to acquire private toilets is 2010: 15; 2011: 3; 2012: 3; 2013: 3; and 2014: 1. The average willingness to pay for a new connection (one-time payment) is 2,867 SLR per household.

f. Salvage value of infrastructure in year 25

To compensate for the truncation of project benefits and costs at the end of the 25 year economic project life, the approach followed here is to treat the project “as if” it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, such as the land and equipment.

The remaining infrastructure will mainly consist of the buried sewer line complete with connections, the pump and pump house. Working from the assumption that these assets have a physical life of about 40 years on average, about 40% of the assets’ useful service life will remain at the end of year 25. A one-time entry is included as a benefit at the end of year 25, reflecting 25% of the initial capital costs.

g. Value of land in year 25 if project ends

As above, if the project were to end, the land that is occupied by the pump house would no longer be so occupied. This land could return to its next highest and best use, perhaps after incurring some expense to remove the pump house and pump for example. A one-time entry is included as a benefit at the end of year 25, reflecting 100% of the initial opportunity cost of land used for the project.

h. Regain use of land occupied by former community septic tank

With the project, there will be no need for the community septic tank, and this site can be used once the former tank is no longer in use. This land could be used by the community for something else, and its capital value appears as a one-time benefit in Year 4.

Description of the principal types of costs

The main types of costs to be incurred with the project are:

- Cost of construction of new sewer lines and pump house, including all labour, equipment use, machinery, pipes, manholes, supplies, required financing, and land used by new pump house
- Cost of households connecting to new system, including own labour, equipment, supplies, T-intersections, and
- Cost of maintaining and operating the new sewage system and pump house, including labour and electricity charges.

Specific estimates of project costs

There are six principal categories of project costs that are itemized:

1. Initial construction cost
2. Value of land for pump site
3. Connection costs for connections by households to T connectors
4. Organizational meetings and training costs
5. Annual operating costs
6. Annual organization / administration

Each of these estimates will be described in turn.

1. Initial construction cost

The estimated cost (**34,000,000 SLR**) of construction is allocated evenly over the 4-year construction period.

2. Value of land for pump site

The value of approximately one “purchase” (25 square meters) of land reflects the opportunity cost of the pump house site. It is shown as a one-time capital value, not an annual equivalent.

3. Connection costs for connections by households to T connectors

With the sewer line extension in place, each household incurs some expense to connect their own household sewer works to the common line, and to disconnect existing storage systems. These costs can be disaggregated into those incurred by the project and those incurred by the households themselves. The cost to the project for installing the T

junctions, including parts and labour has been estimated at 343,250 SLR as shown in Table 3.

Table 3 – Costs incurred by the project for connections to the new sewer line

Connection Type	Number of connections	Labour cost per connection (SLR)	Materials cost per connection (SLR)	Total cost per connection (SLR)	Total cost for all connections (SLR)
160x110	8	350	1,200	1,550	12,400
110x110	47	350	1,200	1,550	72,850
225x225	20	550	5,900	6,450	129,000
225x225	17	550	5,900	6,450	109,650
225x225	3	550	5,900	6,450	19,350
					343,250

The cost to each household to make each of their connections to the T connector, including an imputed value of own labour and materials is 10,000 SLR. Some households will provide their own labour and others are expected to hire labour for this task. The 48 households in the Neighbourhood flats count as one common connection lowering the total number of connections required from 333 households to 286 connections. The schedule of connections is shown in Table 4.

Table 4 – Overall costs and schedule for connections to the new sewer line

Year	Number of connections[a]	Household connection costs at 10,000/ household (SLR)	Project connection costs (see Table 3) (SLR)	Total connection costs (SLR)
2010	153	1,530,000	183,627	**1,713,627**
2011	50	500,000	60,009	**560,009**
2012	30	300,000	36,005	**336,005**
2013	28	280,000	33,605	**313,605**
2014	25	250,000	30,004	**280,004**
Total	286	2,860,000	343,250	**3,203,250**
[a] Since the number of (connected) households grows by 1.5% /year starting in 2015, but only for USS (with no growth in the number of households in the Neighbourhood or flats), there will be additional connection costs throughout the project life.				

4. Organizational meetings and training costs

To initiate a project like this that requires community understanding and voluntary subscription. It is necessary to hold one or more information and organizational meetings in the start-up phases. The opportunity cost of the participants' time is

included at: 100 SLR/hour for one, two-hour meeting, with 80 participants (100 SLR/participant per hour × 2 hours/meeting × 1 meeting × 80 participants =) 16,000 SLR.

In addition, a training program has been proposed for various targets groups, such as: 4 pump operator(s): 2 days; 12 members of the Operations and Maintenance Committee: ½ day; 80 community members: ½ day. Training program preparation and delivery costs are estimated at 370,000 SLR. The value of participants' time is estimated at 432 hours × 100 SLR/hour = 43,200 SLR. Combining these three types of set-up costs gives 16,000 + 43,200 + 370,000 = **429,200 SLR**.

5. Annual operating costs

Estimates of monthly operating costs are lower for the first three years, then are increased for the remaining years of the project life. The following cost items are expected.

Operating Costs for 2010-2012	Cost per month (SLR)
Electricity to operate sewage pump	25,000
Electricity for lighting	1,000
Building maintenance	3,000
Sump cleaning (two labourers)	22,000
Vehicle usage to transport silt	20,000
Security labour (one person – 24 hours)	11,000
Premises maintenance (labour)	11,000
Total	**93,000/month = 1,116,000/year**

Additional Operating Costs for 2013-2032	Cost per month (SLR)	
Break down repair & maintenance –incl. 2 pumps	10,000	
System maintenance - 5 days/month		
5 men	25,000	
Overseer	20,000	
Gully Bowser	20,000	
Sub-total	75,000/month	**= 900,000 /year**
Total (including same costs as 2010-2012)	**168,000/month = 2,016,000/year**	

6. Annual organization / administration

To operate a project like this requires community members to assume roles with responsibility for financing and oversight. It is necessary to hold a number of meetings throughout the project life, including meetings of the Steering Committee and of other community participants. The cost of the Steering Committee participants' time is included at: 150 SLR/hour for 12 meetings per year (3 hours each) with 12 participants, plus one extra day per month of miscellaneous administrative time(such as book-keeping and record keeping) plus approximately 10,000 SLR per month for related materials and supplies.

This yields:

(12 meetings × 3 hours × 12 people × 150 SLR/hour =	64,800 SLR /year
(8 hours per month × 150 SLR/hour × 12 months =	14,400 SLR /year
Materials and supplies	120,000 SLR/year
Overall organization and administrative cost:	**199,200 SLR /year**

IV) Net Present Value and sensitivity analysis

As shown in Annex 2, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of **–10,188,185 SLR**, as at January 1, 2008.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD –$90,500 based on exchange rates (112.6 SLR/USD) in September 2010, and approximately equal to USD –$93,800 based on exchange rates in January 2008 (108.6 SLR/USD$).

The interpretation of a negative NPV of this magnitude is that this project, as constituted, would bring members of the reference group (Sri Lankans) more costs than benefits on a discounted basis. Equivalently, Sri Lankans collectively would have been indifferent between losing assets or wealth worth 10,188,185 SLR and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms, as shown in Table 5. The three largest categories of costs are the initial construction cost (62%), the annual operating costs (27%) and household connection costs (5%). If all costs were about 22% lower, with benefits unchanged, the NPV would be positive. The three largest categories of benefits are the avoided cost of operating the current septic systems (47%), the avoided cost of preventing overflows from the current system (45%) and the residual or salvage value of the system at the end of the 25-year economic project life (3%). If all benefits were about 27% higher, with costs unchanged, the NPV would be positive.

The Net Present Value increases for lower values of the discount rate, as illustrated in Table 6. If the discount rate were lower than 6.45% per year in real terms, the NPV would be positive. In this case, the discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation). Whereas 10% is a widely used estimate of the social opportunity cost of capital, some South Asian countries use rates as high as 14% per year. At these rates, the NPV is more negative.

Table 5 – Contribution of individual cost and benefit categories to the project's Net Present Value

Expected Costs	Present Value (SLR in January 2008)	Percentage Share
1. Initial construction cost	29,638,242	*61.9*
2. Value of land for pump site	826,446	*1.7*
3. Connection costs for connections to Ts	2,369,813	*4.9*
4. Organizational meetings and training costs	322,464	*0.7*
5. Annual operating costs	12,950,745	*27.0*
6. Annual organization / administration	1,808,146	*3.8*
Total costs	**47,915,857**	*100.0*
Expected Benefits		
a. Cost saving - value of reduction in blockages	193,454	*0.5*
b. Cost saving - operating septic/pit systems	17,628,089	*46.7*
c. Avoided cost of discharges to canal	1,078,320	*2.9*
d. Avoided cost of preventing community overflows	17,088,929	*45.3*
e. Value of new private toilets	49,852	*0.1*
f. Salvage value of infrastructure in year 25	1,255,226	*3.3*
g. Value of land in year 25 if project ends	92,296	*0.2*
h. Regain use of former community septic land	341,507	*0.9*
Total benefits	**37,727,671**	*100.0*
Net Present Value = Discounted Benefits - Costs	**-10,188,185**	
NPV as a percentage of total costs		*21.3*
NPV as a percentage of total benefits		*27.0*

Table 6 – Variation in Net Present Value under alternative discount rates

Discount rate	**Net Present Value**
(social opportunity cost of capital as an annual rate in real terms (i.e., excluding inflation))	(Sri Lankan Rupees in January 2008)
0	+ 51,346,771
2	+ 27,830,230
4	+ 12,273,963
6	+ 1,826,384
6.45	0
8	– 5,287,049
10	**– 10,188,185**
12	– 13,597,471
14	– 15,984,841
16	– 17,661,605

ANNEX 2: Excel spreadsheet for Net Present Value calculation

Strengthening the Economic Dimension of Focus Cities
Cost Benefit Analysis Worksheet
City: Colombo **Intervention: Sewer Line Extension**

Friday, September 03, 2010

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Expected Costs	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
1. Initial construction cost	8,500,000	8,500,000	8,500,000	8,500,000							
2. Value of land for pump site			1,000,000								
3. Connection costs by households to T's				1,713,627	560,009	336,005	313,605	280,004	30,000	40,000	40,000
4. Organizational meeting and training costs				429,200							
5. Annual operating costs				1,116,000	1,116,000	1,116,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000
6. Annual organization / administration		199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200
Total costs	8,500,000	8,699,200	9,699,200	11,958,027	1,875,209	1,651,205	2,528,805	2,495,204	2,245,200	2,255,200	2,255,200

Expected Benefits	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
a. Value of reduction in blockages				15,655	19,902	22,450	24,828	26,951	27,355	27,766	28,182
b. Cost saving--operating septic/pit systems				1,468,800	1,836,000	2,056,320	2,261,952	2,445,552	2,482,235	2,519,469	2,557,261
c. Avoided cost of discharges to canal				146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880
d. Avoided cost of preventing community overflows				1,395,360	1,762,560	1,982,880	2,188,512	2,372,112	2,408,795	2,446,029	2,483,821
e. Value of new private toilets				43,005	8,601	8,601	8,601	2,867			
f. Salvage value of infrastructure in year 25											
g. Value of land in year 25 if project ends											
h. Regain use of former comm. septic land					500,000						
Total benefits	0	0	0	3,069,700	4,273,943	4,217,131	4,630,773	4,994,362	5,065,266	5,140,143	5,216,144

Benefits minus costs each year	(8,500,000)	(8,699,200)	(9,699,200)	(8,888,327)	2,398,734	2,565,925	2,101,968	2,499,158	2,820,066	2,884,943	2,960,944
discounted annual amounts	(8,500,000)	(7,908,364)	(8,015,868)	(6,677,932)	1,638,367	1,593,238	1,186,506	1,282,463	1,315,581	1,223,498	1,141,572
Net present value	*(10,188,185)*										

Net Present Value	
Real annual discount rate (SOCC)	10%
Net present value *(at start of year 1)*	(10,188,185)

Approximate US dollar equivalent *($90,481)*
@ 112.6 SLR/USD$

2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
40,000	40,000	40,000	40,000	40,000	40,000	50,000	40,000	40,000	50,000	40,000	50,000	50,000	50,000	40,000
2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000	2,016,000
199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200	199,200
2,255,200	2,255,200	2,255,200	2,255,200	2,255,200	2,255,200	2,265,200	2,255,200	2,255,200	2,265,200	2,255,200	2,265,200	2,265,200	2,265,200	2,255,200

Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
28,605	29,034	29,469	29,911	30,360	30,815	31,278	31,747	32,223	32,706	33,197	33,695	34,200	34,713	35,234
2,595,620	2,634,554	2,674,072	2,714,183	2,754,896	2,796,220	2,838,163	2,880,735	2,923,946	2,967,806	3,012,323	3,057,508	3,103,370	3,149,921	3,197,170
146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880	146,880
2,522,180	2,561,114	2,600,632	2,640,743	2,681,456	2,722,780	2,764,723	2,807,295	2,850,506	2,894,366	2,938,883	2,984,068	3,029,930	3,076,481	3,123,730
														13,600,000
														1,000,000
5,293,284	5,371,582	5,451,054	5,531,718	5,613,592	5,696,695	5,781,044	5,866,658	5,953,556	6,041,758	6,131,282	6,222,150	6,314,381	6,407,995	21,103,013

3,038,084	3,116,382	3,195,854	3,276,518	3,358,392	3,441,495	3,515,844	3,611,458	3,698,356	3,776,558	3,876,082	3,956,950	4,049,181	4,142,795	18,847,813
1,064,830	992,975	925,725	862,810	803,972	748,970	695,591	649,552	604,711	561,361	523,777	486,095	452,205	420,600	1,739,578

INDONESIA

I) Description of selected interventions to improve the urban environment

The methods of cost benefit analysis are employed here to examine three interventions directed at improving the urban environment and addressing issues of urban poverty in Jakarta, Indonesia. All of these interventions are located within the district of Penjaringan in North Jakarta. These interventions include the construction and operation of a community water supply system, the development and operation of a program of community-based solid waste management, and a program of urban gutter cleaning and byproducts production. Each of these three activities is described briefly next.

The urban water supply project is set up to serve piped water to approximately 60 households in the sub district known as RW12. Through the formation and operation of a community-based organization, water is purchased in bulk from a private water supply company and stored for subsequent redistribution to participating households. The project includes provision and maintenance of common water pumping and storage works with distribution and metering directly to each household, including billing and accounting functions. Participating households might not have received direct household connections without the project, and now acquire piped water with greater reliability of service and at lower cost than might otherwise have occurred.

The solid waste management project has engaged about 120 households to participate in solid waste recycling in the RW13 sub district. Households separate key materials into containers for collection by project staff. The staff also collects a portion of other solid waste materials discarded within the community, and delivers it to the project's processing site. Operating through a community-based organization, some items, such as plastic packaging, are used as raw materials by group members for the creation of handicrafts such as bags and necklaces. Organic materials are shredded and composted, to provide a horticultural product suitable for use as potting soil or as potting soil conditioner. Handicrafts and soil conditioner are sold to retail consumers and, in larger quantities, through wholesalers. Other materials (plastic bottles, metals) are segregated for resale to specialized recyclers, often on a break-even basis. Items that are not recyclable are returned to the community's solid waste stream, where there is a cost savings associated with the reduced volumes of waste that need to be transported for disposal.

The gutter cleaning project serves a community of about 480 households in the RW8 sub district. With oversight and coordination provided by a community based organization, the project focuses on the network of gutters and micro-drains that are used to move sewage, grey water and accumulated solid waste through and away from the community. These gutters are prone to clogging, poor rates of flow and overflow conditions if not properly maintained. The project hires a crew or workers to clean sludge, waste and debris from the network of gutters with greater frequency and with more extensive coverage than would otherwise occur. Using a processing system that involves bio-activation to remove pathogens, nutrient-rich materials are converted into salable products such as liquid plant fertilizer and a planting medium (potting soil or potting soil conditioner). Some experimentation with the production of bricks and paving blocks has not yet resulted in a product for which there are commercial customers.

These specific interventions have been developed within the framework of a larger program of community mobilization and development, including action research and capacity building. The cost benefit analysis presented here is focused on these three specific interventions, and not on the many other aspects of the larger program of activities and initiatives.

II) Key assumptions and methodology

The purpose of this cost-benefit analysis (CBA) is to estimate separately the expected costs and benefits from undertaking these three projects in the district of Penjaringan in North Jakarta. The amount by which the discounted or present value of the benefits exceeds the present value of costs is reported as the Net Present Value (NPV), and if this NPV is negative, this implies that discounted benefits are less than discounted costs.

Some of the key assumptions that influence the outcome of any cost-benefit study are the analyst's choice of:

- Reference group
- Formative versus summative analysis
- Project economic life
- Social discount rate, and
- Method for addressing foreign exchange and trade effects.

Each of these will be presented briefly in turn. Brief comments on other selected methodological issues follow that.

Reference group

A key step in any CBA is identification of the reference group. This is the set of persons whose benefits and costs will be included in the calculations. Once the reference group is chosen, any benefits or costs that accrue to other people outside of the reference group are not to be reflected in this NPV. As examples, in the case of a project in Penjaringan, it might have been informative to ask for an estimation of expected Net Present Value from the perspective of:

- All of the residents of Penjaringan (only)
- A Community-Based Organization (only) in Penjaringan who will oversee a project's future operations
- The residents of Jakarta
- The residents of Indonesia, or
- Global residents

For each of the three project intervention to be analyzed, each potential choice of reference group would necessitate its own set of calculations, leading to an estimate of its own NPV.

In the current context, one motivation for preparing such a cost-benefit analysis is to provide information about the potential for replicating these types of interventions in other areas of Indonesia, and to influence policies for doing so. These are potentially issues that would be of interest to the various city governments when acting on behalf of the residents of Jakarta, or to the national government of Indonesia when acting on behalf of the residents of the country.

With a view to providing (only) one cost-benefit analysis (for each intervention) with one estimated Net Present Value that can serve this purpose, the present analysis will be undertaken from the national perspective. This study's reference group is the residents of Indonesia, with one modifying assumption. The current projects have benefited from some inflows of funds from the International Development Research Centre, an international agency that is external to the reference group. The cost of IDRC funding and resources provided to Indonesia might ordinarily be treated as zero, if one were strictly following the application of this national reference group. In order that the results can be interpreted for national policy making purposes; by assumption, all of these IDRC resource costs will be included as if they had been generated from sources inside Indonesia. In this way, the results of the analysis can be interpreted "as if" the projects were undertaken with Indonesian resources for Indonesians. These results can help indicate whether investment of domestic resources for these projects would have been beneficial if they had been fully financed domestically.

The implication of this choice of reference group is that this analysis will follow the methods of *social cost benefit analysis*, as opposed to private or financial analysis. In principle, all costs and benefits that accrue to members of the reference group because of the projects should be included in this analysis. Some of these costs and benefits might not be monetized, such as the use of community members' time or changes in community members' health status.

Formative versus summative analysis

This is *summative* analysis, which implies that each analysis is examining only one, pre-specified project alternative for each of the three interventions to be analyzed. As a result, the analysis can be interpreted to indicate whether the reference group is better off with or without each specific project. It is beyond the scope of a summative analysis to explore alternative project designs or alternative projects, such as other technologies and programs for enhancement of the urban environment in Penjaringan.

Thus, as a cautionary note, the results should <u>not</u> be interpreted to mean that each project is the best one or the worst one available, only to show how it compares to the "without project" case. By contrast, a *formative* analysis would take improved project design within its terms of reference, and might examine a range of alternatives with respect to technologies, scale, timing, funding, pricing and so on, to arrive at the most preferred project alternatives.

Choice of project economic life

It is expected that the services to be provided to resident by each of these three project interventions will serve the residents of Penjaringan indefinitely into the future. From time to time, various parts and components may need replacement, but, by assumption, these projects will continue to provide the primary methods of water supply, solid waste

and gutter cleaning, respectively, for the participating households. Even so, each project will be analyzed with an assumed economic project life of 25 years, from the start of construction in 2008 until the end of 2033. Details of estimated annual costs and benefits will be tracked only for this time period.

It is common in cost-benefit analysis to include some residual credit for future expected benefits after the end of the project's economic life. One approach is to treat the project "as if" it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, such as the land and equipment. An alternative approach is to assume that the project will continue indefinitely with annual flows of costs and benefits very much like those in the earlier periods. Future benefits flows, net of future costs (after the end of the project's economic life) would be treated much the same as a perpetual income stream. Instead of itemizing all of these annual transactions, the present value of this series of annual future benefits would be treated as a lump-sum benefit in the project's last year. The former of these two approaches is used in this study.

Social discount rate

The social discount rate is the rate that is used to compare social costs or benefits that accrue at different points in time, such as when adding them up to estimate the Net Present Value. Among economic practitioners, one methodological approach is to choose a rate that is the Social Rate of Time Preference and that indicates how consumers compare consumption at different points in time. An alternative approach chooses a rate that is the Social Opportunity Cost of Capital and that reflects the opportunity cost of funds used by a project. This choice necessitates other adjustments in the methodology, such as whether or not it will also be necessary to itemize financing costs for a project.

When the second approach is chosen, as in this study, there is no need to track the specific sourcing of project funds and cash flows over the project life, nor is there a need to include additional cost entries that reflect what the shadow price of those funds might be in the context of this project. Accordingly, the social discount rate employed here is 10% per year, in real terms, reflecting the Social Opportunity Cost of Capital. As further explained by Zhuang *et al.* (2007), this choice is in line with the conventions followed by numerous international financial institutions, development banks, and others, although some South Asian countries use higher rates.[6]

Method for addressing foreign exchange and trade effects

Economists are often concerned that various distortions (including tariffs, taxes, import quotas and other features of each country's commercial policy and international financial practice) cause the observed market exchange rates for a country's currency not to reflect accurately its opportunity cost to citizens of the country. To address this, some practitioners attempt to estimate the value of all costs and benefits in an international currency (US dollars, Euros) as measured at world market prices. This allows the resulting NPV to be interpreted as representing an amount of purchasing power on world

[6] Zhuang, Juzhong; Zhihong Liang, Tun Lin and Franklin De Guzman, May 2007. *Theory and Practice in the Choice of Social Discount Rate for Cost-benefit Analysis: A Survey*. ERD Working Paper No. 94, Manila, Philippines: Asian Development Bank, Economics and Research Department. http://www.adb.org/Documents/ERD/Working_Papers/WP094.pdf

markets. A second approach, the one used here, is to track all benefits and costs in the domestic currency of the country of study. Since the market exchange rate may not reflect opportunity cost accurately, this approach recommends the adoption of an alternative "shadow exchange rate" that would be used to adjust the value of all tradable goods or services employed in the project. As will be seen, the tradable components of the current project are not significant in size. Although costs and benefits are tracked in Indonesian Rupiah (IDR)[7], no "shadow exchange rate" adjustments are employed here.

Description of the "without project" case

The Net Present Value of a project is an estimate of the value that accrues to the reference group over the life of the project if they undertake the project compared to the value that accrues to them if they do not. Almost always, maintaining the "before project" status quo will not be an option, even without the project. Thus, it is important to identify or explain the key features of this presumed, counterfactual "without project" environment that forms the reference point for estimating a Net Present Value.

For the urban water supply project, the assumption used here is that the community served by this service is fixed in size (in terms of number of households served) and will not grow over time. This seems to be a feature of the project design, in that there is no installed capacity to include more households even if they were to appear. Without the project, households would have continued to procure water from a number of other existing sources described further below, and not from any extension of piped water to their homes from a private or public supplier.

A large portion of the RW#12 sub district served by the water supply project was destroyed by a fire in September in 2009, after the project was already operational. The fire destroyed homes and property along with much of the project's investment in distribution works and metering. Such fires are a relatively common occurrence in these districts of Jakarta. The effect of the fire was to interrupt project activities, stopping benefits and increasing costs during the period that residences and project works could be rebuilt. After a period of some months, the project resumed service to the rebuilt households on essentially the same basis as before the fire. To increase the general applicability of these results to other projects, this analysis is conducted under the counterfactual assumption that the fire did not occur. That is, costs are based on those costs and benefits already incurred prior to the fire, and that were projected to continue if the fire had not happened. In this way, the Cost Benefit Analysis describes and gives results that can be interpreted as assessing "a specific investment in community water supply," and not "a specific investment in community water supply in a community damaged by fire damage in the project's early stages."

For the community-based solid waste management project, it is assumed that the without the project, the community would not have entered into any formalized recycling program. The community would have continued the prior practice of hiring workers to move solid waste by hand cart from households to temporary storage sites to trans-shipment centres. With or without this project, there would be some opportunistic recycling by scavengers of some waste materials (e.g., plastic containers and metals) for which there is an active market.

[7] All currency figures are in constant Indonesian Rupiah, with a market exchange rate of approximately 9,200 IDR per USD in September 2010.

Without the gutter cleaning project, it is assumed that these communities would have continued the former practice of cleaning gutters less frequently, with an emphasis on clearing the larger gutters and not cleaning the full network of narrower gutters as well. Without the project, there would not have been a process for producing liquid fertilizer or planting medium from the collected materials.

Other methodological issues

This analysis is undertaken after the proponents had decided to undertake the project. So, even though all facets of the project were not yet operational at the time of this analysis, this is considered an *ex post* analysis. The analysis is *deterministic* in nature, as opposed to reflecting a stochastic analysis, and it uses the methods of partial equilibrium analysis (as opposed to general equilibrium) in establishing the value of various costs and benefits.

Most of the costs and benefits in this study are estimated at market prices, or expected market prices, even though there may be some market distortions that suggest alternative opportunity costs for the reference group. This practice is dictated in part by data limitations, such as an absence of information about specific labour market conditions for various types of project labour. As explained further below, for some unpriced effects, such as the community members' use of their own time to attend (unpaid) project meetings or to provide project labour, an estimated day rate for unskilled labour is used for members of the general community.

Limitations of this analysis

The analyses of these three selected interventions is undertaken as part of a capacity-building program that has worked with the project team to explain and to demonstrate the use of social cost benefit analysis and its role in influencing policy decisions. The analysis is undertaken near the termination of this project using best available estimates as provided by the project team. Unlike a stand-alone analysis of other investment projects, this analysis is not based on a program of independent collection or field verification of data or of project practices. Although various baseline studies had been compiled for participating communities, none of these exercises fully anticipated that there would be need for specific economic and other data related to cost benefit analysis. As a result, numerous estimates or values relevant to the analysis are not directly supported by project records or other government or public data.

The Jakarta project team had commissioned cost-benefit analyses of these projects in November 2008, and much of the data and estimates reported there have proved very useful tin generating revised estimates for this study.[8] Some significant features of the project interventions have changed since the 2008 study, such as a decision not to produce and sell plants as part of the gutter cleaning or solid waste projects. Numerous other assumptions and aspects of the cost-benefit methodology differ between this study and the one undertaken in 2008.

[8] Parandvash, G. Hossein, "Cost-Benefit Analysis of the HP3-Lestari Pilot Projects in Penjaringan, Jakarta," Unpublished report prepared for Mercy Corps, Jakarta, Indonesia, November 2008.

III) Community based water supply

Evaluation of project benefits and costs

Description of the principal types of benefits

In general, when a public project of this nature provides services to a community, the benefits can take either or both of two principal forms. The first is that there is usually an increase in the total level of services used, and this additional level of service is to be valued according to the community's willingness to pay for it. The second is that there may be a decrease in the former or alternative service that would be in use without the project. This reduction gives rise to some forms of cost savings, which also count as project benefits. Other benefits, above and beyond these water supply effects can come in the form of health and/or environmental improvements.

Applying this reasoning to the community based water supply project suggests the following general categories of benefits:

- Benefit from increased volumes of water use
- Cost saving to other suppliers for not having to provide water by other means such as private water supplier (connection), vendors (fill containers) and groundwater, including the extra time taken by households to collect water from sources outside the home, and the cost of pumps and other methods used by households to extract water from other sources.
- Value of improved reliability of service and improved water quality, including health improvement from use of water with better quality, and potentially from increased use of water for hand washing and sanitation
- Cost saving from lower water losses through leakage or theft, where this gain is a direct result of a new ability to meter the water intake to the community at the source (master meter) and also to meter the individual household uses
- Increase in social capital, trust, empowerment and community capacity from working together at the community level
- Demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach

Potential health benefits to Jakarta from these project interventions

A premise of the study design for this consultancy is the expectation that project interventions will address health and environmental burdens. In the case of the Jakarta Focus City project, the current set of project interventions is not narrowly focused on health improvement. There may be significant benefits to the target communities and the nation from specific project interventions. However, the magnitude of these benefits would not be adequately estimated if the scope of the valuation exercise were to be narrowed to estimating the avoided damage cost of environmental burdens alone.

With respect to the Community Based Water Supply, some of the participating households historically used contaminated groundwater selectively for some domestic uses. Some of these households will continue to do so, since groundwater is available to these households without monetary cost. This water was historically used for washing

clothes and dishes and for bathing younger children. One effect of providing a secure supply of domestic water at low cost directly to the households is that the rate of use of the contaminated groundwater may fall compared to the "without project" scenario. It is possible that some households may stop using it altogether, whereas others may use it less, or for fewer purposes, such as discontinuing its use for bathing young children. If so, reduced human exposure to this contaminant can reduce the harmful effects of water borne disease.

It should be noted that for drinking water and food preparation, few, if any, houses would use groundwater as their source, with or without the project. The water supplied by the Community Based Water Supply is not free of pathogens and also receives treatment in home (usually boiling) prior to consumption, as did the water from the other sources that it is replacing. There are few expected health effects directly associated with increased consumption of water from the new community source. With new low-cost water supplies in each household, there may be higher levels of hygiene (more frequent hand-washing or bathing) leading to reduced rates of some illnesses.

As for the gutter cleaning activities in RW8, the residents of this neighbourhood live without access to a piped sewage system. With or without these project interventions, much of the human waste from their community will continue to flow through a system of open gutters passing each residence. Seasonal flooding of this district will continue to cause the contents of these gutters to overflow into numerous streets and alleyways for portions of each year. Blockages or backups from downstream neighbourhoods can also contribute to overflow conditions in any season of the year.

The anticipated health effects of increased gutter cleaning appear modest and might be related to a reduction in the populations of flies and mosquitoes. This might occur where there are fewer episodes of standing or stagnant water in the gutters, if this results in lower insect populations. Higher insect populations can contribute to increased rates of a number of illnesses, including dengue fever. Improved gutter cleaning will not prevent or fully eliminate either these diseases or residents' exposure to these insects. Where the community currently invests in "mosquito fogging" (pesticide applications targeting mosquitoes), any corresponding reduction in pesticide application could cause a reduction in health side-effects resulting from human exposure to these pesticides. When gutters are not clogged or blocked and run more freely, there may be a reduction in odor and an improvement in aesthetics or community appearance, which changes may be seen as beneficial, if not directly health related.

One other environmental effect that is expected to follow from gutter cleaning is a reduction in waste loading to the downstream canals, which flow from the neighbourhoods across North Jakarta to the nearby ocean. That is, gutters draining the project neighbourhoods will continue to carry significant loads of human and household waste, but the overall loads will be lower. If it were the case that other municipal activities and efforts were used (downstream of the project) to clean up some of this load before it reaches the harbour, there may be a modest savings in these efforts.

Similarly, any improvement in solid waste collection and management in RW13 could cause a decrease in community populations of numerous pests, such as flying insects, cockroaches, mice and rats. These pests may play a role in influencing rates of some community illnesses. Pest control is not an explicit project activity. Especially given the pilot-scale of project interventions, considerable amounts of neighbourhood waste

materials are likely to continue to provide productive habitat for these pests, with or without the project.

Although prior work with the project team and the community showed that some community members were experiencing a cost of illness due to environmental burdens, this is likely to continue to be true with or without the set of project activities now underway. For instance, households in the study area are likely to continue to be exposed to sources of contamination through imperfect access to safe drinking water and contact with contaminated water inside and outside their own community. The rates of exposure to sources of contamination may well be seasonal or episodic, such as with increases in the wetter months or during specific high-rainfall events.

In considering the aggregate effects of the three principal interventions to be studied, there may, on balance, be some environmental and health benefits, but the avoided environmental harm by itself is not likely to be a large or significant benefit relative to other types of benefits within the planned cost-benefit analysis. As a result, it is recommended that the cost-benefit analysis of the three project activities listed above not focus solely on their health benefits.

Specific estimates of project benefits

The costs and benefits are treated as though some occur at the end of each year, starting with the first capital costs for construction, as if these were incurred on December 31, 2008 (or January 1, 2009). The first full year of the project life is 2009 and it bears the label Year 1, with subsequent years numbered consecutively through until Year 25 which ends on December 31, 2033. The estimates are based on the assumption that the actual construction activities could be undertaken quite quickly, with all households connected to the system and receiving benefits through the first year of operation.

For each year of the project life, various categories of costs are listed (numbered 1 – 6) and are aggregated to give a total cost per year. Similarly, various categories of benefits are listed (designated *a* - *e*) and are aggregated to give a total benefit per year. Benefits minus costs for each year are shown next. These annual amounts are then discounted to reflect their present value at the start of 2009. Summing these across years gives the project's Net Present Value.

There are five principal categories of project benefits that are itemized:

a. Value of water to households
b. Labour saving (saved cost of former water acquisition)
c. Health benefits
d. Reduced water loss from metering
e. Value of land at end of project life

Each of these estimates will be described in turn.

a. Value of water to households

There are a number of surveys and estimates, including meter data from the completed project that give an indication of the volumes of water that were being used by the target households with and without the project. Considering all 60 households together, the values used here are 230 m^3 per month without the project and 300 m^3 per household per month with the project.

In the without-project case, households source their water from a number of local sources such as public latrines and standpipes (fee per use), private water vendors, bottled water and refills, and shallow groundwater (very low quality but without monetary cost). The weighted average cost per cubic meter of acquiring this water is 15,000 IDR, plus significant amounts of time and effort for travelling to the source and transporting water and containers. With the project, the cost per cubic meter for water piped to subscriber households is 4,700 IDR.

To arrive at an average value per cubic meter for all 300 m^3 per month, one can consider the first 230 m^3 per month and the subsequent 70 m^3 per month separately. The first 230 m^3 per month is consumed with and without the project. Its value derives not from households' willingness to pay for water consumption but from the social cost savings of not having to provide this water to them. For the first units of this water, that cost is reflected in the 15,000 IDR/m^3 that is paid to acquire the water. [The value of time and labour expended to acquire this water is covered next under benefit category (b)]. Subsequent units within this 230 m^3 per month will have lower values of associated savings, trending down to the 4,700 IDR/m^3 that the new water will cost. The subsequent 70 m^3 per month of additional water consumption can be valued according to the marginal social benefits it provides, illustrated by households' willingness to pay for it. Not counting labour savings, the first units of the new water will have a value to households that reflects the 15,000 IDR/m^3 paid for the without-project supplies, whereas the last unit consumed will have a value of 4,700/m^3—the amount paid for it.

If there is a constant or straight-line decline in value from 15,000 IDR/ m^3 for the first of these units to 4,700/m^3 for the last of them, then the average value of all 300 m^3 per month will be the average of these two amounts, namely 9,850 IDR/m^3 plus the value of labour savings to be covered next. With 300 m^3/month × 9,850 IDR/m^3 × 12 months/year, the value of this water is **35.46 million IDR per year**.

b. Labour saving (saved cost of former water acquisition)

The time savings from not having to travel to an alternate source and to transport water is estimated at 20 minutes per day per household. The shadow value placed on these time savings is 5,500 IDR per hour, an amount that is below the average wage of an unskilled worker in this district (9,700 IDR/hour), and below the suggested minimum wage (5,800 IDR/hour). It may be relevant that some households subscribe to a delivery service offered by private vendors, where this adds a cost of about 5,000 IDR per delivery hour to the private water bill. By their actions in choosing to have water delivered or to self-deliver it, households may be revealing that some of them value their own time to exceed this 5,000 IDR per hour rate, and others value their own time at a lower rate.

The estimated benefit from labour and time savings in not delivering water (as a benefit of a household connection) is calculated as ⅓ hour per day per household × 5,500 IDR/hour × 30.4 days/month × 12 months/year × 60 households, which gives **40.128 million IDR per year**.

c. Health benefits

The benefits estimated in parts (a) and (b) above describe gains from providing water that is similar in quality, with and without the project. Since some of the groundwater used without the project is of very low quality and presents a health hazard from contact with it, there is additional benefit from offering households the project water. Additionally, there may be other health benefits related to greater access to water for household cleaning and for personal hygiene, contributing to improved health outcomes. Importantly, even the project water will require treatment, such as boiling, prior to consumption.

Survey work in the community suggests that many ailments or diseases such as those related to water-borne illness are self treated in the community with medicine, at a cost of about 5,000 IDR per case. More severe problems require treatment at a clinic, at a cost of 135,000 per case. The most serious illnesses require hospitalization at a cost of 1.37 million IDR per case, inclusive of fees, medications, transport and foregone income.

The target population for the 60 project households is about 240 persons. With the project in place, there is estimated to be a decrease per year of 40 cases of illness that is self-treatable with medication, 15 fewer cases per year requiring clinical visits and 4 fewer cases per year of hospitalization. The associated benefit is **7.705 million IDR per year**.

There does not seem to be a clear basis for adding other quality-related benefits to the water from the new source. Water from the project still needs to be boiled, as did water from the other sources. Since the project water may have a chlorine odor that some of the former water did not have, it is not clear if households actually see the water quality to be improved in their daily use, or whether they mainly view an improvement in such factors as the point of access, reliability, and cost to household.

With respect to reliability of water delivery and supply, it should be explained that the project's community-based system does not offer water to each household at the tap 24 hours per day. Due to constraints in the water that is privately supplied, it is often a challenge to procure the necessary volumes of water per day, and the timing of that supply is not reliable. By design, the community system pumps water into storage tanks to serve as a capacity buffer between its own supplier and its customers. When incoming supply is sufficient, water is offered to households according to a rotational schedule among each of three delivery zones, for two, two-hour periods per day. During these supply periods, households can use water and capture and store water on site for use throughout the remainder of the day, all on a fee per cubic meter basis. This requires the households' own expenditures on storage capacity and on the time to gather this water according to the schedule. In May 2010, this part of Jakarta experienced one of the most severe water supply shortages on record, and the project was unable to operate according to the four hours per day delivery schedule due to insufficient supply. Accordingly, with respect to benefit estimates, there is not expected to be any significant reliability gain due to the project.

d. Reduced water loss from metering

The ability to monitor closely all of the water coming in through one meter and going out through 60 household meters provides the project with accurate and timely feedback when there are leakages, systems losses or thefts of water, such as through unauthorized connections. In its early phases, the project has been encountering about 15 m^3 per month of system losses, which means that the project must purchase 315 m^3 per month from its suppliers in order to deliver 300 m^3 per month to its customers. Even so, this is a considerable reduction in the average rate of loss for the city as a whole and for that portion served by the project's private water supplier.

From the perspective of Indonesians as a whole, this reduction in the rate of leakages, system losses and irrecoverable wastage relative to the without-project situation represents a social benefit. The estimate employed here is that for the 315 m^3 per month used by the project, in addition to the 15 m^3 per month of system losses (5%) there would have been a further 25% in system losses that are now avoided due to the project. That water saved is valued at is social opportunity cost, 1,775 IDR/m^3, which cost explained more fully in the explanation of costs in the section which follows. With 315 m^3 per month ×25% saving × 1,775 IDR/m^3×12 months per year, this gives **167,737,500 IDR per year** of additional benefit due to the project.

e. Value of land at end of project life

To compensate for the truncation of project benefits and costs at the end of the 25 year economic project life, the approach followed here is to treat the project "as if" it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, where the principal remaining asset will be the land used.

The remaining infrastructure will mainly consist of the buried delivery lines, meters, the pump, storage tanks and pump house. As will be discussed in the estimation of costs, some assets such as the pump and the storage tank have an estimated service life of about 12 years. Once they are replaced in the middle of the project's economic life, then the replacements and other infrastructure will have negligible salvage value at year 25.

If the project were to end in 25 years, then the land that is now occupied by the pump house could return to its next highest and best use, perhaps after incurring some expense to remove the pump house and pump for example. A one-time entry is included as a benefit at the end of year 25, reflecting 100% (**94.75 million IDR**) of the initial opportunity cost of land used for the project.

Description of the principal types of costs

The main types of costs to be incurred with the project are:

- Cost of construction of water lines, storage tanks and pump house, including all labour, equipment use, machinery, valves, pipes, supplies, required financing, land used by pump house
- Cost of households connecting to new system, including labour, equipment, supplies, meters

- Cost of maintaining and operating the new system and pump house, including labour and electricity charges and fuel, cost of water testing and meter reading, record-keeping, account collection and so on
- Cost of organizing the community members and undertaking community-building processes to form a Community Based Organization capable of running the system in future on a sustainable basis, including participants' time, materials, supplies, equipment

Specific estimates of project costs

As shown in Annex 2, there are six principal categories of project costs that are itemized:

1. Initial investment (common works and land)
2. Household connection expense
3. Implementation costs (annual)
4. Opportunity cost of delivered water (PALYJA)
5. Replacement of pumps, tank
6. CBO set-up and training costs

Each of these estimates will be described in turn.

1. Initial investment (common works and land)

The estimated cost of construction, infrastructure and land is approximately **545.11 million IDR** and it is incurred at the start of the first year. Table 1 shows the principal components within this total. Note that the value of land is reported as its one-time capital value, not an annual equivalent.

Table 1 - Cost of common works, infrastructure and land

	Project components	**Cost (IDR)**	**Percentage of total**
i)	Land	94,750,000	*17.4*
ii)	Master Meter Installation	30,100,000	*5.5*
iii)	Design of Water Supply System	26,500,000	*4.9*
iv)	Preparation Work	38,211,684	*7.0*
v)	Ground Tank, Transmission Pipes, Foundation and Columns	125,077,206	*22.9*
vi)	Operation Room and Roof Tank	82,730,518	*15.2*
vii)	Pipeline Works	133,525,725	*24.5*
viii)	Masonry	7,617,454	*1.4*
ix)	Security Wall	4,497,800	*0.8*
x)	Fences	2,100,000	*0.4*
	Total	**545,110,386**	*100.0*

2. Household connection expense

This value reflects the opportunity cost that each household incurs to connect to the system, such as for pipes, meters, fittings and fixtures, and labour. Some labour was provided by household members and other labour was hired. In practice, there was a scheme to share some of these costs between the project and the households, but such sharing arrangements have no effect on the actual expense incurred.

There is an expense estimate per household of 686,360 IDR, with a breakdown of 345,110 IDR for pipes, materials and accessories, 141,250 IDR for the household meter box and materials and 200,000 IDR for labour. With 60 households, this gives a total expense of **41,181,575 IDR**.

3. Implementation costs (annual)

Table 2 – Costs per month for system operation, maintenance and administration

Item	Quantity required	Units	Cost per unit (IDR)	Cost per month (IDR/month)	% of Total
Maintenance of master meter	1	1	19,400	19,400	*0.4*
Labour: fee collectors (3)	30	hours/month	5,000 IDR/hour	150,000	*2.8*
Labour: book keeper	5	hours/month	6,000 IDR/hour	30,000	*0.6*
Labour: operators (2)	720	hours/month	6,250 IDR/hour	4,500,000	*85.2*
Labour: CBO supervision	5	hours/month	6,000 IDR/hour	30,000	*0.6*
Labour: CBO community and security	5	hours/month	6,000 IDR/hour	30,000	*0.6*
Labour: meter reading	3	hours/month	6,000 IDR/hour	18,000	*0.3*
Labour: cleaning distribution pipes	1		17,000 IDR/unit	17,000	*0.3*
Materials to clean reservoir	1	unit	10,000 IDR/unit	10,000	*0.2*
Stationery	1	unit	20,000 IDR/unit	20,000	*0.4*
Transportation	1	unit	15,000 IDR/unit	15,000	*0.3*
Parts, repairs, preventative maintenance	1	unit	125,250 IDR/unit	125,250	*2.4*
Reservoir cleaning	1	unit	25,000 IDR/unit	25,000	*0.5*
Cost of electricity for pumping	1	unit	290,000 IDR/unit	290,000	*5.5*
			Total per month	**5,279,650**	*100.0*

As shown in Table 2, there is a range of costs associated with the activities coordinated by the Community Based Organization to keep the project operational. In some cases, these labour services or activities, such as oversight of workers, may be provided by members of the organization's executive without direct compensation. Even so, some opportunity cost of time is included for each activity that needs to be undertaken.

The monthly cost is 5,279,650 IDR per month which is equivalent to **63,355,800 IDR per year**.

4. Opportunity cost of delivered water (PALYJA)

An important cost for the project is the opportunity cost of the water that it sources from the private supplier, PALYJA, for sale to the project's customers. The price paid to PALYJA by the project for the water is based on a specific class of tariff that PALYJA offers to some customers. This tariff is more favorable than would be available to lower-volume subscribers, for example. This tariff is 3,550 IDR/m^3, which almost certainly includes some return to PALYJA's fixed and administrative costs and profit.

In estimating the social opportunity cost of this water, one should not include that portion of the tariff that covers PALYJA's fixed costs or administrative overhead, which items are not increased or directly related to the project's use of this 315 m^3 per month. Similarly, if the tariff allows for a regulated rate of return or for ordinary accounting profits to be earned, then those profits should also not be included. From a social perspective, an estimate of the social opportunity cost of this water is about 50% of this published tariff. In economic terms, the rest of the payment made to PALYJA reflects a transfer from one group to another, and not a social opportunity cost per se.

With 315 m^3 per month × 1,775 IDR/m^3×12 months per year, this gives **6,709,500 IDR per year** as the opportunity cost of the water purchases.

5. Replacement of pumps, tank

Some assets such as the pump and the storage tank have an estimated service life (about 12 years) that is shorter than the project's economic life. Accordingly, allowance has to be made to replace these items near the half-way point of the 25 year project life. Thus, at the end of year 12, there is a cost entry for 4 million IDR for each of two pumps, plus 3.5 million IDR to replace the elevated tank. The total cost of these items is **11.5 million IDR**, measured in constant terms (i.e., net of price inflation).

6. CBO set-up and training costs

To initiate a project like this requires community understanding and voluntary participation. It is necessary to hold one or more information and organizational meetings in the start-up phases. Training programs were developed and offered to project staff, members of the Community Based Organization executive committee and to the household participants. Table 3 describes the major components of these activities and the associated costs.

Table 3 – One-time costs for development and delivery of training activities

Training Component	Cost in Year One (IDR)	Percentage of Total
Socialization activities	1,800,000	2.3
CBO assistance	1,400,000	1.8
Leadership training	4,000,000	5.0
Social analysis training	29,500,000	36.9
Consultant supervisor	32,000,000	40.1
Training Management and module development	7,200,000	9.0
Time cost of participants	3,960,000	5.0
Total	**79,860,000**	**100.0**

The opportunity cost of 720 hours of the participants' time is included at 5,500 IDR/hour. Participants were not paid to attend but their time has an opportunity cost that should be reflected in order to capture all of the costs associated with this model of service delivery.

Net Present Value and sensitivity analysis

As shown in Annex 2, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of **–518,517,207 IDR**, as at January 1, 2009.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD –$56,415 based on the market exchange rate (9,191 IDR/USD) in September 2010, and approximately equal to USD –$47,540 based on the exchange rate in January 2009 (10,907 IDR/USD).

The interpretation of a negative NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Indonesian residents) more costs than benefits on a discounted basis. Equivalently, Indonesians collectively would have been indifferent between losing assets or wealth worth 518,517,207 IDR and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms, as shown in Table 4. The three largest categories of costs are the initial construction cost (42%), the annual operating costs (44%) and the CBO set up and training costs (6%). If all costs were about 40% lower, with benefits unchanged, the NPV would be positive. The three largest categories of benefits are the avoided cost of labour used to access and deliver water (47%), the value of project water to the households (once delivered) (41%) and the health benefits (9%). If all benefits were about 67% higher, with costs unchanged, the NPV would be positive.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach.

The Net Present Value becomes less negative (i.e., it increases) for lower values of the discount rate, as illustrated in Table 5. However, even if the discount rate were zero, the estimated NPV would still be negative. The initial construction costs are not much affected by the choice of discount rate, whereas future benefits and future costs are each increased in present value terms for lower values of the discount rate. As used here, the 10% discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation). Whereas 10% is a widely used estimate of the social opportunity cost of capital, some South Asian countries use rates as high as 14% per year. At these rates, the NPV is more negative.

Table 4 – Contribution of individual cost and benefit categories to the community based water supply project's Net Present Value

Expected Costs	Present Value (IDR in January 2009)	Percentage Share
1. Initial investment (common works and land)	545,110,386	*42.0*
2. Household connection expense	41,181,575	*3.2*
3. Implementation costs (annual)	575,083,132	*44.3*
4. Opportunity cost of delivered water (PALYJA)	60,902,400	*4.7*
5. Replacement of pumps, tank	3,664,254	*0.3*
6. CBO set-up and training costs	72,600,000	*5.6*
Total costs	**1,298,541,748**	*100.0*
Expected Benefits		
a. Value of water to households	321,871,839	*41.3*
b. Labour saving (saved cost of former water)	364,243,462	*46.7*
c. Health benefits	69,938,593	*9.0*
d. Reduced water loss from metering	15,225,600	*2.0*
e. Value of land at end of project life	8,745,046	*1.1*
Total benefits	**780,024,540**	*100.0*
Net Present Value= Discounted (Benefits–Costs)	**–518,517,208**	
NPV as a percentage of total costs		*39.9*
NPV as a percentage of total benefits		*66.5*

Table 5 – Variation in Net Present Value under alternative values of the discount rate

Discount rate	Net Present Value
(social opportunity cost of capital as an annual rate in real terms (i.e., excluding inflation))	(Indonesian Rupiah in January 2009)
0	–210,275,086
2	–324,902,118
4	–401,872,699
6	–454,733,229
8	–491,859,678
10	**–518,517,208**
12	–538,071,211
14	–552,709,406
16	–563,878,413

ANNEX 2: Excel spreadsheet for community based water supply
Strengthening the Economic Dimension of Focus Cities
Cost Benefit Analysis Worksheet
City: Jakarta **Intervention: Community Based Water Supply System**

May 30, 2010

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Expected Costs	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
1. Initial investment (common works)	545,110,386										
2. Household connection expense	41,181,575										
3. Implementation costs (annual)		63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800
4. Opportunity cost of delivered water (PALYJA)		6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500
5. Replacement of pumps, tank											
6. CBO set-up / training		79,860,000									
Total costs	586,291,961	149,925,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300

Expected Benefits	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
a. Value of water to households		35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000
b. Labour saving (former water acquisition)		40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000
c. Health benefits		7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000
d. Reduced water loss from metering		1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375
e. Value of land at end of project life											
Total benefits	0	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375

Benefits minus costs each year	(586,291,961)	(64,954,925)	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075
discounted annual amounts	(586,291,961)	(59,049,932)	12,318,244	11,198,403	10,180,367	9,254,879	8,413,526	7,648,660	6,953,327	6,321,207	5,746,552
Net present value	*(518,517,208)*										

Net Present Value	
Real annual discount rate (SOCC)	10%
Net present value *(at start of year 1)*	(518,517,208)
US dollar equivalent @ 0.0001088	*($56,415)*

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800	63,355,800
6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500	6,709,500
	11,500,000													
70,065,300	81,565,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300	70,065,300

Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000	35,460,000
40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000	40,128,000
7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000	7,705,000
1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375	1,677,375
														94,750,000
84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	84,970,375	179,720,375

14,905,075	3,405,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	14,905,075	109,655,075
5,224,138	1,084,962	4,317,469	3,924,972	3,568,156	3,243,779	2,948,890	2,680,809	2,437,099	2,215,544	2,014,131	1,831,028	1,664,571	1,513,247	10,120,725

IV) Community based solid waste management

Evaluation of project benefits and costs

Description of the principal types of benefits

In general, when a public project of this nature provides services to a community, the benefits can take either or both of two principal forms. The first is that there is usually an increase in the total level of services used, and this additional level of service is to be valued according to the community's willingness to pay for it. The second is that there may be a decrease in the former or alternative service that would be in use without the project. This reduction gives rise to some forms of cost savings, which also count as project benefits. Other benefits, above and beyond these solid waste management effects can come in the form of health and/or environmental improvements.

Applying this reasoning to the community based solid waste management project suggests the following general categories of benefits:

- Benefit from manufactured compost from organic wastes, value of handicrafts manufactured from packaging and plastics, and the market value of other recyclables (plastics, glass, metal, others)
- Cost saving from reduced cost of hauling these wastes to the transfer site and subsequent waste handling locations
- Cost saving from reduction in labour or other community clean-up, such as by other scavengers who would have worked to capture some of the recyclables
- Less odour and pests due to less accumulation of (uncollected) waste in community, less nuisance or blockage from less waste thrown in canals or burned, and potential health benefits
- Increase in social capital, trust, empowerment and community capacity from working together at the community level
- Demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach

Specific estimates of project benefits

Annex 3 presents a time profile of expected costs and benefits to be incurred over each of the twenty-five years of the project's economic life. The costs and benefits are treated as though some occur at the end of each year, starting with the first capital costs for construction, as if these were incurred on December 31, 2008 (or January 1, 2009). The first full year of the project life is 2009 and it bears the label Year 1, with subsequent years numbered consecutively through until Year 25 which ends on December 31, 2033. The estimates are based on the assumption that the actual construction activities could be undertaken quite quickly, with all households connected to the system and receiving benefits through the first year of operation.

For each year of the project life, various categories of costs are listed (numbered 1 – 8) and are aggregated to give a total cost per year. Similarly, various categories of benefits are listed (designated *a* - *d*) and are aggregated to give a total benefit per year. Benefits minus costs for each year are shown next. These annual amounts are then discounted

to reflect their present value at the start of 2009. Summing these across years gives the project's Net Present Value.

As shown in Annex 3, there are four principal categories of project benefits that are itemized:

a. Value of compost and handicraft sales
b. Savings in transportation costs of solid waste
c. Savings in cleanup labour
d. Value of land at end of project life

Each of these estimates will be described in turn.

a. Value of compost and handicraft sales

There is some variation in the monthly output and sales of both compost and handicrafts. Based on a constant level of throughput over the life of the project, the compost is valued under the assumption that 90 kg per month will be sold on a wholesale basis at a price of 800 IDR/kg, and 30 kg per month will be sold directly to consumers (retail basis), at a price of 1500 IDR/kg.
For the recycled plastic handicraft products, 300 pieces per month can be produced and sold at a price of 25,000 IDR each.

Compost	wholesale: 90 kg/mo × 800 IDR/kg	= 72,000 IDR/month
	retail: 30 kg/mo × 1,500 IDR/kg	= 45,000 IDR/month
	subtotal	117,000 IDR/month
Handicrafts	300 pieces/mo × 25,000 IDR/piece	= 7,500,000 IDR/month

The combined revenue from these product sales is 7,617,000 IDR/month or **91,404,000 IDR per year**.

b. Savings in transportation costs of solid waste

The volume and density of solid waste varies with the seasons, being much more dense (heavier per unit volume) in the wet seasons. The processing of waste by the project reduces the need to transport some waste from the temporary dump site.

The estimated reduction is 1.2 tons per month, which would have cost 117,083 IDR/ton to transport. Accordingly, the monthly saving is 140,500 IDR/month or **1,686,000 IDR per year**.

c. Savings in cleanup labour

Based on earlier estimates undertaken for the project, the amount of solid waste collected by the community's four workers each month is about 28,000 kg. Of this, about 1,200 kg per month is composted or recycled, representing about 4.2% of the total. The savings of 4.2% of these labour efforts is equivalent to 0.17 person-days per month, which with an opportunity cost of 55,000 IDR/day is about 204,524 IDR/month or **2,454,283 IDR per year**.

d. Value of land at end of project life

To compensate for the truncation of project benefits and costs at the end of the 25 year economic project life, the approach followed here is to treat the project "as if" it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, where the principal remaining asset will be the land used.

A one-time entry is included as a benefit at the end of year 25, reflecting 100% (**923 million IDR**) of the initial opportunity cost of land used for the project.

Description of the principal types of costs

The main types of costs to be incurred with the project are:

- Cost of labour, supplies, equipment, materials, financing for the sorting, shredding, composting, hauling, storing and for the by-product and handicrafts manufacturing and marketing
- Cost incurred by households to participate in sorting and storing waste for project
- Cost of land used for sorting, composting, manufacturing and storage activities
- Cost of testing of compost, record-keeping, and administration
- Cost of organizing the community members and undertaking community-building processes to form a Community Based Organization capable of running the system in future on a sustainable basis, including participants' time, materials, supplies, equipment

Specific estimates of project costs

There are eight principal categories of project costs that are itemized:

1. Initial investment (facilities, equipment)
2. Land use
3. Implementation costs (annual)
4. Implementation costs (two- or three-year frequency)
5. Household sorting and supplies
6. Handicraft labour
7. Replacement of shredding machine
8. Training activities at setup

Each of these estimates will be described in turn.

1. Initial investment (facilities, equipment)

Project documents describe 90,000,000 IDR for general infrastructure and construction plus 10,000,000 IDR for the initial compost shredder. This gives **100,000,000 IDR** in total incurred at the start of the first year.

2. Land use

The opportunity cost of land used by the project is **923,304,000 IDR**, based on 1,700,000 IDR per m^2 for the 543.12 m^2 occupied by the project. Even though this land is situated underneath an expressway, it is clear that there are numerous relatively highly valued uses for such lands within the city. Note that the value of land is reported as its one-time capital value, not an annual equivalent.

3. Implementation costs (annual)

The costs of various implementation activities are segregated into those that are incurred annually versus those that are incurred less frequently, such as once every two or three years. As shown in Table 6, there is a range of annual costs associated with the activities coordinated by the Community Based Organization to keep the project operational.

In some cases, these labour services or activities, such as oversight of workers, may be provided by members of the organization's executive without direct compensation. Even so, some opportunity cost of time is included for each activity that needs to be undertaken.

Table 6 – Implementation costs by category for those that are annual or that are incurred once every two years or three years

Category	Total IDR	Percentage of total
Annual expenses:		
Materials and supplies	3,240,000	*10.3*
Maintenance	4,800,000	*15.2*
Labour	12,280,000	*38.9*
CBO supervision	1,430,000	*4.5*
Packaging, outreach and communication	4,800,000	*15.2*
Lab testing services	5,000,000	*15.9*
Total annual expenses	**31,550,000**	*100.0*
Every second year	**5,500,000**	*100*
(tools and equipment)		
Every third year	**18,300,000**	*100*
(tools and equipment)		

4. Implementation costs (two- or three-year frequency)

Table 6 also reports an expenditure every second year for materials, tools and equipment in the amount of **5,500,000 IDR**. Every third year it will be necessary to spend an additional **18,300,000 IDR**, mainly for replacing equipment such as carts, tumblers and weigh scales.

5. Household sorting and supplies

The foundation of the community based solid waste management program is the voluntary participation by about 120 households that have agreed to separate their household solid waste and to make their recyclable portion available to the project. Although these households are not directly compensated for their efforts, the time taken to participate has an opportunity cost and its value is estimated here. The opportunity cost of householder's time is valued at 55,000 IDR per eight-hour day, where ten minutes per day is allocated for waste sorting, separation, storage, and any other aspects of program participation.

An annual cost estimate is based upon on (120 households) x (1/6 hour/day) x (6,875 IDR/hour) x (365 days/year) = 50,187,500 IDR per year. In addition, each of the 120 households receives two collection buckets per year at a cost of 10,000 IDR each, or 2,400,000 IDR per year. The total of these two items is **52,587,500 IDR per year**.

6. Handicraft labour

The making of handicrafts from recycled materials is a skill that can be learned and refined, with some variation in the skill required to make specific types of handicraft items.

With an average production of 300 items per month, and a production rate of three items per worker per eight-hour day, the labour effort is equivalent to employing 100 days of labour per month, shared on a part-time basis among the group. Valuing the opportunity cost of this time at 55,000 IDR/day gives 5,500,000 IDR per month or **66 million IDR per year**.

7. Replacement of shredding machine

Even with careful maintenance as budgeted, it is expected that each shredding machine will only last five years. Over the twenty-five year project life, four replacements are planned at regular intervals, leaving a depleted asset at the end of the 25th year. The cost per machine is **10 million IDR.**

8. Training activities at setup

To initiate a project like this requires community understanding and voluntary participation. It is necessary to hold one or more information and organizational meetings in the start-up phases. Training programs were developed and offered to project staff, members of the Community Based Organization executive committee and to the household participants, on topics such as solid waste management, leadership and organization management, and marketing strategy and business management. The one-time cost estimate is **30 million IDR.**

Net Present Value and sensitivity analysis

As shown in Annex 3, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of **–1,550,781,986 IDR**, as at January 1, 2009.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD –$168,725 based on the market exchange rate (9,191 IDR/USD) in September 2010, and approximately equal to USD –$142,182 based on the exchange rate in January 2009 (10,907 IDR/USD).

The interpretation of a negative NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Indonesian residents) more costs than benefits on a discounted basis. Equivalently, Indonesians collectively would have been indifferent between losing assets or wealth worth 1,550,781,986 IDR and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms, as shown in Table 7. The three largest categories of costs are the land use (37%), the labour for making handicrafts (24%) and the householders' time for sorting and storing waste (19%). If all costs were about 60% lower, with benefits unchanged, the NPV would be positive. The three largest categories of benefits are the compost and handicraft products (87%), the value of the land at the end of the project's economic life (9%) and the savings in cleanup labour (2%). If all benefits were about 165% higher, with costs unchanged, the NPV would be positive.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach. If there is less odour and pests due to less accumulation of (uncollected) waste in community, or less nuisance or blockage from less waste thrown in canals or burned, including potential health benefits, these are not included.

The Net Present Value becomes more negative (i.e., it decreases) for lower values of the discount rate, as illustrated in Table 8. With a discount rate of zero, the estimated NPV is smaller (more negative) than for other positive rates. The initial costs are not much affected by the choice of discount rate, whereas the prominent future costs are each increased in present value terms for lower values of the discount rate. As used here, the 10% discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation). Whereas 10% is a widely used estimate of the social opportunity cost of capital, some South Asian countries use rates as high as 14% per year. At these rates, the NPV is less negative.

Table 7 – Contribution of individual cost and benefit categories to the community based solid waste management project's Net Present Value

Expected Costs	Present Value (IDR in January 2009)	Percentage Share
1. Initial investment (facilities, equipment)	100,000,000	*4.0*
2. Land use	923,304,000	*36.9*
3. Implementation costs (annual)	286,380,613	*11.4*
4. Implementation costs (2- or 3-year frequency)	73,205,435	*2.9*
5. Household sorting and supplies	477,338,842	*19.1*
6. Handicraft labour	599,084,641	*23.9*
7. Replacement of shredding machine	13,945,003	*0.6*
8. Training activities at setup	30,000,000	*1.2*
Total costs	2,503,258,533	*100.0*
Expected Benefits		
a. Value of compost and handicraft sales	829,677,766	*87.1*
b. Savings in transportation costs of solid waste	15,303,889	*1.6*
c. Savings in cleanup labour	22,277,628	*2.3*
d. Value of land at end of project life	85,217,264	*8.9*
Total benefits	952,476,548	*100.0*
Net Present Value= Discounted (Benefits–Costs)	**–1,550,781,986**	
NPV as a percentage of total costs		*62*
NPV as a percentage of total benefits		*163*

Table 8 – Variation in Net Present Value under alternative values of the discount rate

Discount rate	**Net Present Value**
(social opportunity cost of capital as an annual rate in real terms (i.e., excluding inflation))	(Indonesian Rupiah in January 2009)
0	–1,747,230,417
2	–1,752,386,871
4	–1,715,398,652
6	–1,662,057,514
8	–1,605,182,337
10	**–1,550,781,986**
12	–1,501,342,984
14	–1,457,579,630
16	–1,419,359,208

ANNEX 3: Excel spreadsheet for community based solid waste management
Strengthening the Economic Dimension of Focus Cities
Cost Benefit Analysis Worksheet
City: Jakarta **Intervention: Community-Based Solid Waste Management**

Sunday, May 30, 2010

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Expected Costs	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**
1. Initial investment	100,000,000											
2. Land use	923,304,000											
3. Implementation costs (annual)		31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000
4. Implementation costs (2- or 3-yr frequency)			5,500,000	18,300,000	5,500,000		23,800,000		5,500,000	18,300,000	5,500,000	
5. Household sorting & supplies		52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500
6. Handicraft labour		66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000
7. Replacement of shredding machine						10,000,000					10,000,000	
8. Training activities at setup	30,000,000											
Total costs	1,053,304,000	150,137,500	155,637,500	168,437,500	155,637,500	160,137,500	173,937,500	150,137,500	155,637,500	168,437,500	165,637,500	150,137,500

Expected Benefits	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**
a. Compost and handicraft sales		91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000
b. Savings in transportation costs		1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000
c. Savings in cleanup labour		2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283
d. Value of land at end of project life												
Total benefits	0	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283

Benefits minus costs each year	(1,053,304,000)	(54,593,217)	(60,093,217)	(72,893,217)	(60,093,217)	(64,593,217)	(78,393,217)	(54,593,217)	(60,093,217)	(72,893,217)	(70,093,217)	(54,593,217)
discounted annual amounts	(1,053,304,000)	(49,630,197)	(49,663,815)	(54,765,753)	(41,044,476)	(40,107,306)	(44,250,927)	(28,014,952)	(28,033,929)	(30,913,840)	(27,023,969)	(19,134,589)
Net present value	*(1,550,781,986)*											

Net Present Value	
Real annual discount rate (SOCC)	10%
Net present value *(at start of year 1)*	(1,550,781,986)
US dollar equivalent @ 0.0001088	*($168,725)*

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000	31,550,000
23,800,000		5,500,000	18,300,000	5,500,000		23,800,000		5,500,000	18,300,000	5,500,000		23,800,000	
52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500	52,587,500
66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000	66,000,000
			10,000,000					10,000,000					
173,937,500	150,137,500	155,637,500	178,437,500	155,637,500	150,137,500	173,937,500	150,137,500	165,637,500	168,437,500	155,637,500	150,137,500	173,937,500	150,137,500

Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000	91,404,000
1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000	1,686,000
2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283	2,454,283
													923,304,000
95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	95,544,283	1,018,848,283

(78,393,217)	(54,593,217)	(60,093,217)	(82,893,217)	(60,093,217)	(54,593,217)	(78,393,217)	(54,593,217)	(70,093,217)	(72,893,217)	(60,093,217)	(54,593,217)	(78,393,217)	868,710,783
(24,978,495)	(15,813,710)	(15,824,422)	(19,843,977)	(13,078,035)	(10,800,977)	(14,099,709)	(8,926,427)	(10,418,910)	(9,850,102)	(7,382,210)	(6,096,870)	(7,958,918)	80,178,529

V) Gutter cleaning and byproducts production

Evaluation of project benefits and costs

Description of the principal types of benefits

In general, when a public project of this nature provides services to a community, the benefits can take either or both of two principal forms. The first is that there is usually an increase in the total level of services used, and this additional level of service is to be valued according to the community's willingness to pay for it. The second is that there may be a decrease in the former or alternative service that would be in use without the project. This reduction gives rise to some forms of cost savings, which also count as project benefits. Other benefits, above and beyond these gutter cleaning effects can come in the form of additional health and/or environmental improvements.

Applying this reasoning to the gutter cleaning project suggests the following general categories of benefits:

- Value of the manufactured by-products from gutter cleaning including planting medium and liquid plant fertilizer. There has been considerable experimentation with the production of paving blocks and bricks, but these have not yet proven to be commercially viable.
- Value of less blockage of some gutter sections if they are cleaned more frequently with the project, potentially leading to less flooding or overflowing, less odour and pests
- Cost saving from reduction in the cost of gutter cleaning activity that would have happened without the project but which costs are saved with the project
- Less loading of waste to downstream canals and districts since more materials are removed sooner (potential savings of cleaning operations at downstream locations)
- Potential health benefits
- Increase in social capital, trust, empowerment and community capacity from working together at the community level
- Demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach

Specific estimates of project benefits

The costs and benefits are treated as though some occur at the end of each year, starting with the first capital costs for construction, as if these were incurred on December 31, 2008 (or January 1, 2009). The first full year of the project life is 2009 and it bears the label Year 1, with subsequent years numbered consecutively through until Year 25 which ends on December 31, 2033. The estimates are based on the assumption that the actual setup activities could be undertaken quite quickly, with all households receiving benefits through the first year of operation.

For each year of the project life, various categories of costs are listed (numbered 1 – 5) and are aggregated to give a total cost per year. Similarly, various categories of benefits

are listed (designated *a* - *d*) and are aggregated to give a total benefit per year. Benefits minus costs for each year are shown next. These annual amounts are then discounted to reflect their present value at the start of 2009. Summing these across years gives the project's Net Present Value.

There are four principal categories of project benefits that are itemized:

a. Value of product sales
b. Reduced cleaning efforts with project
c. Willingness to pay for expanded service
d. Value of land at end of project life

Each of these estimates will be described in turn.

a. Value of product sales

There is some variation in the monthly output and selling prices of the two main products that are produced. Based on a constant level of throughput over the life of the project, the liquid fertilizer is valued under the assumption that 15 litres per month will be sold at a price of 10,000 IDR/litre. For the planting medium (potting soil), 100 kg per month can be produced and sold at a price of 700 IDR/kg.

Liquid fertilizer	15 l/mo × 10,000 IDR/l	= 150,000 IDR/month
Planting medium	100 kg/mo × 700 IDR/kg	= 70,000 IDR/month
Total		220,000 IDR/month

The combined revenue from these product sales is 220,000 IDR/month or **2,640,000 IDR per year**.

b. Reduced cleaning efforts with project

The gutter cleaning program without the project occurs every three months, and is treated here as being discontinued with the project. That is, with the project, the frequency of gutter cleaning service increases to almost monthly, and additional lengths of the narrowest gutters are cleaned that were not cleaned without the project. The full cost of the new program is included in the estimates of costs (presented below), and so the estimated benefits include the cost saving from discontinuing the former program. The former gutter cleaning program used 20 person-days of community labour each calendar quarter at an opportunity cost of 50,000 IDR per day, which is 4,000,000 IDR per year. In addition, these quarterly gutter cleaning initiatives used transport services for the collected garbage at a cost of 12,000,000 IDR per year, and used transport services for mud, silt and debris at a cost of 18,000,000 IDR/year. The former program also used materials and supplies (such as sacks) at a cost of 14,220,000 IDR per year. These four items sum to **48,220,000 IDR per year**.

In addition, the former program would require the use of two handcarts, plus assorted shovels and hoes valued at 2.84 million IDR, and these would have been replaced about every 12 years. Accordingly, this category of benefits is increased in years one and twelve, by exception, by 2.84 million IDR to reach **51,060,000 IDR per year**.

c. Willingness to pay for expanded service

The project's program of gutter cleaning represents an approximate tripling in the level of quantity of gutter cleaning services compared to the without-project case. The principle by which the increased level of services should be valued is the community's willingness to pay for this service. Individual householders have expressed a positive willingness to pay when surveyed by project staff, even though there is no operational mechanism for individual households to make these payments. Householders may value the aesthetic improvements (including reduced odour), potential health improvements, and they value the reduction in costs and expenses associated with reduced blockages or flooding of gutters due to more frequent cleaning. This increased valuation might also be reflected in higher housing values in communities with gutters that are cleaned more frequently. (Any increased housing values would be evidence of this positive annual willingness to pay, and not a new benefit to be included in addition.) At the community level, various neighbourhood area councils (so called RTs) served by the project have expressed a willingness to contribute voluntarily to the ongoing monthly cost in order to sustain the project's cleaning efforts.

One estimate of household willingness to pay for gutter cleaning services was obtained from a 2009 survey undertaken by the project. It places this value at 3,000 IDR per week per household. Some households expressed a willingness to pay in kind, rather than in currency, such as through giving of their own labour. Since this average willingness to pay is for the entire program of gutter cleaning service, including the one-third of cleanings that replace the former service, only about two-thirds of this benefit amount should be included as the incremental or extra benefit for the expanded level of service. Accordingly, with an estimate of 480 households at 2,000 IDR per week, this gives an aggregate value of **49,920,000 IDR per year**.

d. Value of land at end of project life

To compensate for the truncation of project benefits and costs at the end of the 25 year economic project life, the approach followed here is to treat the project "as if" it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, where the principal remaining asset will be the land used.

A one-time entry is included as a benefit at the end of year 25, reflecting 100% (**180 million IDR**) of the initial opportunity cost of land used for the project.

Description of the principal types of costs

The main types of costs to be incurred with the project are:

- Cost of labour, supplies, equipment, materials, financing for the gutter cleaning and for the by-product manufacturing and marketing
- Cost of land used for sorting, manufacturing and storage activities
- Cost of land used for sorting, composting, manufacturing and storage activities
- Cost of testing of products, record-keeping, and administration
- Cost of organizing the community members and undertaking community-building processes to form a Community Based Organization capable of running the

program in future on a sustainable basis, including participants' time, materials, supplies, equipment

Specific estimates of project costs

There are five principal categories of project costs that are itemized:

1. Initial investment (facilities, equipment)
2. Land use
3. Implementation costs (annual)
4. Equipment replaced each three years
5. Training activities at setup

Each of these estimates will be described in turn.

1. Initial investment (facilities, equipment)

Project documents describe **128,411,667 IDR** for general infrastructure and construction costs at the project startup.

2. Land use

The opportunity cost of land used by the project is **180,000,000 IDR**, based on 1,500,000 IDR per m^2 for the 120 m^2 occupied by the project. The land has been made available to the project without it directly incurring this cost, but this value reflects the land's opportunity cost. It also gives an indication of project costs if it were not possible to secure continued use of this land on more favourable terms than these. Note that the value of land is reported as its one-time capital value, not an annual equivalent.

3. Implementation costs (annual)

As shown in Table 9, there is a range of annual costs associated with the activities coordinated by the Community Based Organization to keep the project operational. In some cases, these labour services or activities, such as oversight of workers, may be provided by members of the organization's executive without direct compensation. Even so, some opportunity cost of time is included for each activity that needs to be undertaken.

The annual cost is **231,980,000 IDR per year**.

Table 9 – Annual implementation costs for gutter cleaning

Category	Total IDR	Percentage of total
Materials and supplies	150,060,000	*64.7*
Maintenance	3,600,000	*1.6*
Labour	13,520,000	*5.8*
Packaging, outreach and communication	64,800,000	*27.9*
Total annual expenses	**231,980,000**	***100.0***

4. Equipment replaced each three years

Project documents describe some equipment that will, on average, have to be replaced every three years. Typical items include hammers, saws, pick-axes and knives. The annual cost to be incurred every third year is **1,760,000 IDR**.

5. Training activities at setup

To initiate a project like this requires community understanding and voluntary participation. It is necessary to hold one or more information and organizational meetings in the start-up phases. Training programs were developed and offered to project staff, members of the Community Based Organization executive committee and to the household participants, on topics such as fertilizer making, leadership and organization management, and marketing strategy and business management. The one-time cost estimate is **54,550,000 IDR.**

Net Present Value and sensitivity analysis

When all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is negative with a value of **– 1,534,835,561 IDR**, as at January 1, 2009.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD –$166,990 based on the market exchange rate (9,191 IDR/USD) in September 2010, and approximately equal to USD –$140,720 based on the exchange rate in January 2009 (10,907 IDR/USD).

The interpretation of a negative NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Indonesian residents) more costs than benefits on a discounted basis. Equivalently, Indonesians collectively would have been indifferent between losing assets or wealth worth 1,534,835,561 IDR and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms, as shown in Table 10. The three largest categories of costs are the annual operating expenses (85%), land use (7%), and the initial setup costs (5%). If all costs were about 60% lower, with benefits unchanged, the NPV would be positive. The three largest categories of benefits are the value of the increased frequency and extent of gutter cleaning services (49%), the value of salable products (3%). If all benefits were about 165% higher, with costs unchanged, the NPV would be positive.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of

this intervention and approach. If there is less loading of waste to downstream canals and districts since more materials are removed sooner (potential savings of cleaning operations at downstream locations) these benefits have not been estimated.

The Net Present Value becomes more negative (i.e., it decreases) for lower values of the discount rate, as illustrated in Table 11. With a discount rate of zero, the estimated NPV is smaller (more negative) than for other positive rates. The initial costs are not much affected by the choice of discount rate, whereas the prominent future costs are each increased in present value terms for lower values of the discount rate. As used here, the 10% discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation). Whereas 10% is a widely used estimate of the social opportunity cost of capital, some South Asian countries use rates as high as 14% per year. At these rates, the NPV is less negative.

Table 10 – Contribution of individual cost and benefit categories to the gutter cleaning project's Net Present Value

Expected Costs	Present Value (IDR in January 2009)	Percentage Share
1. Initial investment	128,411,667	*5.2*
2. Land use	180,000,000	*7.3*
3. Implementation costs (annual)	2,105,691,743	*85.3*
4. Equipment replaced each three years	5,943,079	*0.2*
5. Training activities at setup	49,590,909	*2.0*
Total costs	**2,469,637,398**	*100.0*
Expected Benefits		
a. Product sales	23,963,386	*2.6*
b. Reduced cleaning efforts with project	441,099,334	*47.2*
c. Willingness to pay for expanded service	453,125,838	*48.5*
d. Value of land at end of project life	16,613,280	*1.8*
Total benefits	**934,801,837**	*100.0*
Net Present Value= Discounted (Benefits–Costs)	**-1,534,835,561**	
NPV as a percentage of total costs		*62*
NPV as a percentage of total benefits		*164*

Table 11 – Variation in Net Present Value under alternative values of the discount rate

Discount rate	Net Present Value
(social opportunity cost of capital as an annual rate in real terms (i.e., excluding inflation))	(Indonesian Rupiah in January 2009)
0	–3,473,121,668
2	–2,821,063,654
4	–2,348,481,173
6	–1,999,305,659
8	–1,736,409,309
10	**–1,534,835,561**
12	–1,377,558,628
14	–1,252,791,892
16	–1,152,257,030

ANNEX 4: Excel spreadsheet for gutter cleaning
Strengthening the Economic Dimension of Focus Cities
Cost Benefit Analysis Worksheet
City: Jakarta **Intervention: Gutter Cleaning**

draft: May 30, 2010

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Expected Costs	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
1. Initial investment	128,411,667										
2. Land use	180,000,000										
3. Implementation costs (annual)		231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000
4. Equipment replaced each 3 years		1,760,000			1,760,000			1,760,000			1,760,000
5. Training activities at setup		54,550,000									
Total costs	308,411,667	288,290,000	231,980,000	231,980,000	233,740,000	231,980,000	231,980,000	233,740,000	231,980,000	231,980,000	233,740,000

Expected Benefits	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
a. Product sales		2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000
b. Reduced cleaning efforts with project		51,060,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000
c. Willingness to pay for expanded service		49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000
d. Value of land at end of project life											
Total benefits	0	103,620,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000

Benefits minus costs each year	(308,411,667)	(184,670,000)	(131,200,000)	(131,200,000)	(132,960,000)	(131,200,000)	(131,200,000)	(132,960,000)	(131,200,000)	(131,200,000)	(132,960,000)
discounted annual amounts	(308,411,667)	(167,881,818)	(108,429,752)	(98,572,502)	(90,813,469)	(81,464,878)	(74,058,980)	(68,229,503)	(61,205,768)	(55,641,608)	(51,261,836)
Net present value	*(1,534,835,561)*										

Net Present Value	
Real annual discount rate (SOCC)	10%
Net present value *(at start of year 1)*	(1,534,835,561)
US dollar equivalent @ 0.000108	*($166,990)*

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000	231,980,000
		1,760,000			1,760,000			1,760,000			1,760,000			1,760,000
231,980,000	231,980,000	233,740,000	231,980,000	231,980,000	233,740,000	231,980,000	231,980,000	233,740,000	231,980,000	231,980,000	233,740,000	231,980,000	231,980,000	233,740,000

Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	2,640,000
48,220,000	48,220,000	51,060,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000	48,220,000
49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000	49,920,000
														180,000,000
100,780,000	100,780,000	103,620,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	100,780,000	280,780,000

(131,200,000)	(131,200,000)	(130,120,000)	(131,200,000)	(131,200,000)	(132,960,000)	(131,200,000)	(131,200,000)	(132,960,000)	(131,200,000)	(131,200,000)	(132,960,000)	(131,200,000)	(131,200,000)	47,040,000
(45,984,800)	(41,804,363)	(37,691,129)	(34,549,061)	(31,408,237)	(28,935,970)	(25,957,221)	(23,597,473)	(21,740,022)	(19,502,044)	(17,729,131)	(16,333,601)	(14,652,174)	(13,320,158)	4,341,604

UGANDA

I) Background

The methods of cost benefit analysis are employed here to examine two interventions directed at improving the urban environment and addressing issues of urban poverty in Kampala, Uganda. These interventions include the development and operation of a program to process organic solid waste into feed suitable for poultry and livestock production, and of a program to process organic solid waste into fuel briquettes suitable for cooking use. Each of these activities is described briefly next.

A staple of the Ugandan diet is cooked plantains (bananas) prepared as a dish called *matoke*. The wide availability and prominent consumption of this foodstuff generates abundant solid waste, since the peels are not edible. When this waste is not properly managed, it contributes to litter, nuisance and pest problems in the community. This project intervention seeks to utilize the nutritional value of these waste peels, through manufacturing a meal from the dried peels. This "peel meal" can be used as a feed or feed supplement in the dietary rations fed to broiler chickens and laying hens, and can be formulated into feeds for larger animals such as pigs. Important steps in the production process include gathering and drying the peels, screening and grinding them by use of a milling machine, and mixing and bagging the resulting product for local retail sale. The "project" as analyzed here describes the operation of one milling machine to serve a local market.

With a somewhat similar motivation, the second intervention studied here makes use of more of these banana peels along with other local ingredients to produce a cooking fuel that can be used in common household cooking stoves. Whereas these stoves would most commonly be fueled with wood charcoal, the manufactured briquettes are a local and less costly alternative for the project community. In terms of the local environment, this project gathers and uses solid waste that might otherwise be a nuisance in the community, and reduces the impact of wood-fuel consumption on scarce timber resources. Important steps in the production process include gathering and drying the peels, mixing batches of ingredients into composite mixture, then squeezing this mixture into formed molds under considerable pressure using a manually operated briquette press. This is followed by drying the resulting product for local sale. The "project" as analyzed here describes the operation of one briquette press to serve a local market.[9]

These specific interventions have been developed within the framework of a larger program of community mobilization and development, including action research and capacity building. The cost benefit analysis presented here is focused on these specific

[9] The technologies and practices for briquette manufacturing are becoming well established and vary from place to place according to the availability of ingredients. For documentation of briquette making in Kenya, see: Njenga, Mary, Nancy Karanja, Gordon Prain, John Malii, Patrick Munyao, Kuria Gathuru and Beatrice Mwasi, October 2009, "Community-based energy briquette production from urban organic waste at Kahawa Soweto Informal Settlement, Nairobi," Urban Harvest Working Paper Series, Paper 5. Lima, Peru: International Potato Center, Urban Harvest Global Coordination Office, accessible at www.cipotato.org/publications/publication.asp?cod=005249 or http://www.scribd.com/doc/36693627/ .

interventions, and not on the many other aspects of the larger program of activities and initiatives.

II) Key assumptions and methodology

The purpose of this cost-benefit analysis (CBA) is to estimate separately the expected costs and benefits from undertaking these two projects in the Kampala. The amount by which the discounted or present value of the benefits exceeds the present value of costs is reported as the Net Present Value (NPV), and if this NPV is positive, this implies that discounted benefits are greater than discounted costs.

Some of the key assumptions that influence the outcome of any cost-benefit study are the analyst's choice of:

- Reference group
- Formative versus summative analysis
- Project economic life
- Social discount rate, and
- Method for addressing foreign exchange and trade effects.

Each of these will be presented briefly in turn. Brief comments on other selected methodological issues follow that.

Reference group

A key step in any CBA is identification of the reference group. This is the set of persons whose benefits and costs will be included in the calculations. Once the reference group is chosen, any benefits or costs that accrue to other people outside of the reference group are not to be reflected in this NPV. As examples, in the case of a project in Kampala, it might have been informative to ask for an estimation of expected Net Present Value from the perspective of:

- All of the residents of the areas served by these projects (only)
- A Community-Based Organization (only) in Kampala who will oversee each project's future operations
- The residents of Kampala
- The residents of Uganda, or
- Global residents

For each of the project intervention to be analyzed, each potential choice of reference group would necessitate its own set of calculations, leading to a specific NPV estimate.

In the current context, one motivation for preparing such a cost-benefit analysis is to provide information about the potential for replicating these types of interventions in other areas of Uganda, and to influence policies for doing so. These are potentially issues that would be of interest to the city government when acting on behalf of the residents of Kampala, or to the national government of Uganda when acting on behalf of the residents of the country.

With a view to providing (only) one cost-benefit analysis (for each intervention) with one estimated Net Present Value that can serve this purpose, the present analysis will be undertaken from the national perspective. This study's reference group is the residents of Uganda, with one modifying assumption. The current projects have benefited from some inflows of funds from the International Development Research Centre, an international agency that is external to the reference group. The cost of IDRC funding and resources provided to Uganda might ordinarily be treated as zero, if one were strictly following the application of this national reference group. In order that the results can be interpreted for national policy making purposes; by assumption, all of these IDRC resource costs will be included as if they had been generated from sources inside Uganda. In this way, the results of the analysis can be interpreted "as if" the projects were undertaken with Ugandan resources for Ugandans. These results can help indicate whether investment of domestic resources for these projects would have been beneficial if they had been fully financed domestically.

The implication of this choice of reference group is that this analysis will follow the methods of *social cost benefit analysis*, as opposed to private or financial analysis. In principle, all costs and benefits that accrue to members of the reference group because of the projects should be included in this analysis. Some of these costs and benefits might not be monetized, such as the use of community members' time or changes in community members' health status.

Formative versus summative analysis

This is *summative* analysis, which implies that each analysis is examining only one, pre-specified project alternative for each of the two interventions to be analyzed. As a result, the analysis can be interpreted to indicate whether the reference group is better off with or without each specific project. It is beyond the scope of a summative analysis to explore alternative project designs or alternative projects, such as other technologies and programs for enhancement of the urban environment in Kampala.

Thus, as a cautionary note, the results should <u>not</u> be interpreted to mean that each project is the best one or the worst one available, only to show how it compares to the "without project" case. By contrast, a *formative* analysis would take improved project design within its terms of reference, and might examine a range of alternatives with respect to technologies, scale, timing, funding, pricing and so on, to arrive at the most preferred project alternatives.

Choice of project economic life

It is expected that the services to be provided to resident by each of these project interventions will serve the residents of Kampala indefinitely into the future. From time to time, various equipment parts and components may need replacement, but, by assumption, these projects will continue to provide for the processing of some organic solid wastes for the participating households. Even so, each project will be analyzed with an assumed economic project life of 25 years, from the start of construction in 2010 until the end of 2034. Details of estimated annual costs and benefits will be tracked only for this time period.

It is common in cost-benefit analysis to include some residual credit for future expected benefits after the end of the project's economic life. One approach is to treat the project

"as if" it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, such as any land and equipment used by each project. An alternative approach is to assume that the project will continue indefinitely with annual flows of costs and benefits very much like those in the earlier periods. Future benefits flows, net of future costs (after the end of the project's economic life) would be treated much the same as a perpetual income stream. Instead of itemizing all of these annual transactions, the present value of this series of annual future benefits would be treated as a lump-sum benefit in the project's last year. The former of these two approaches is used in this study.

Social discount rate

The social discount rate is the rate that is used to compare social costs or benefits that accrue at different points in time, such as when adding them up to estimate the Net Present Value. Among economic practitioners, one methodological approach is to choose a rate that is the Social Rate of Time Preference and that indicates how consumers compare consumption at different points in time. An alternative approach chooses a rate that is the Social Opportunity Cost of Capital and that reflects the opportunity cost of funds used by a project. This choice of approaches necessitates other adjustments in the methodology, such as whether or not it will also be necessary to itemize financing costs for a project.

When the second approach is chosen, as in this study, there is no need to track the specific sourcing of project funds and cash flows over the project life, nor is there a need to include additional cost entries that reflect what the shadow price of those funds might be in the context of this project. Accordingly, the social discount rate employed here is 10% per year, in real terms, reflecting the Social Opportunity Cost of Capital. As further explained by Zhuang *et al.* (2007), this choice is in line with the conventions followed by numerous international financial institutions, development banks, and others, although some South Asian countries use higher rates.[10]

Method for addressing foreign exchange and trade effects

Economists are often concerned that various distortions (including tariffs, taxes, import quotas and other features of each country's commercial policy and international financial practice) cause the observed market exchange rates for a country's currency not to reflect accurately its opportunity cost to citizens of the country. To address this, some practitioners attempt to estimate the value of all costs and benefits in an international currency (e.g., US dollars, Euros) as measured at world market prices. This allows the resulting NPV to be interpreted as representing an amount of purchasing power on world markets. A second approach, the one used here, is to track all benefits and costs in the domestic currency of the country of study. Since the market exchange rate may not reflect opportunity cost accurately, this approach recommends the adoption of an alternative "shadow exchange rate" that would be used to adjust the value of all tradable goods or services employed in the project. As will be seen, the tradable components of

[10] Zhuang, Juzhong; Zhihong Liang, Tun Lin and Franklin De Guzman, May 2007. *Theory and Practice in the Choice of Social Discount Rate for Cost-benefit Analysis: A Survey*. ERD Working Paper No. 94, Manila, Philippines: Asian Development Bank, Economics and Research Department. http://www.adb.org/Documents/ERD/Working_Papers/WP094.pdf

the current project are not significant in size. Although costs and benefits are tracked in Ugandan Shillings (UGX)[11], no "shadow exchange rate" adjustments are employed here.

Description of the "without project" case

The Net Present Value of a project is an estimate of the value that accrues to the reference group over the life of the project if they undertake the project compared to the value that accrues to them if they do not. Almost always, maintaining the "before project" status quo will not be an option, even without the project. Thus, it is important to identify or explain the key features of this presumed, counterfactual "without project" environment that forms the reference point for estimating a Net Present Value.

For both of these project interventions, the assumption used here is that the community served by this service is fixed in size (in terms of number of households served) and will not grow over time. Without the project, households would not have processed peels for productive uses and would have continued to purchase other types of animal feeds and other types of cooking fuels under the same terms as currently are observed in local markets.

Other methodological issues

This analysis is undertaken after the proponents had decided to undertake the project, so this is considered an *ex post* analysis. The analysis is *deterministic* in nature, as opposed to reflecting a stochastic analysis, and it uses the methods of partial equilibrium analysis (as opposed to general equilibrium) in establishing the value of various costs and benefits.

Most of the costs and benefits in this study are estimated at market prices, or expected market prices, even though there may be some market distortions that suggest alternative opportunity costs for the reference group. This practice is dictated in part by data limitations, such as an absence of information about specific labour market conditions for various types of project labour. As explained further below, for some unpriced effects, such as the community members' use of their own time to attend (unpaid) project meetings or to provide project labour, an estimated day rate for unskilled labour is used for members of the general community.

Limitations of this analysis

The analyses of these selected interventions is undertaken as part of a capacity-building program that has worked with the project team to explain and to demonstrate the use of social cost benefit analysis and its role in influencing policy decisions. The analysis is undertaken near the termination of this project using best available estimates as provided by the project team. Unlike a stand-alone analysis of other investment projects, this analysis is not based on a program of independent collection or field verification of data or of project practices. Although various baseline studies had been compiled for the participating community, none of these exercises fully anticipated that there would be need for specific economic and other data related to cost benefit

[11] All currency figures are in constant Ugandan Shillings, with a market exchange rate of approximately 1,950 UGX per USD in January 2010.

analysis. As a result, numerous estimates or values relevant to the analysis are not directly supported by project records or other government or public data.

III) Peel processing for animal feed

Evaluation of project benefits and costs

Description of the principal types of benefits

In general, when a public project of this nature provides services to a community, the benefits can take either or both of two principal forms. The first is that there is usually an increase in the total level of goods and services used, and this additional level of service is to be valued according to the community's willingness to pay for it. The second is that there may be a decrease in the former or alternative service that would be in use without the project. This reduction gives rise to some forms of cost savings, which also count as project benefits. Other benefits, above and beyond this provision of animal feeds can come in the form of health and/or environmental improvements.

Applying this reasoning to the production of animal feed from waste peels suggests the following general categories of benefits:

- Value of the processed product: "peel meal"
- Cost saving from lower production of substitute processed feeds (maize bran)
- Value of environmental improvement from having less banana peel waste discarded in the community or in the solid waste system
- Increase in social capital, trust, empowerment and community capacity from working together at the community level, and
- Demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach.

Potential health benefits to Kampala from these project interventions

A premise of the study design for this consultancy is the expectation that project interventions will address environmental and health burdens. In the case of the Kampala Focus City project, the important environmental burdens identified in the first consultation, and towards which cost estimates were estimated, were related to issues of poor sanitation and especially water-borne illness and flooding. However, the current set of project interventions is not directed at flood reduction, and even if it were, the population of the target communities that lives in or crosses through the periodically inundated lands near the canal appears to be a relatively small share of the larger project community. Many of the project areas are sloping hillsides, and although some households here may experience some considerable amount of water-borne illness, it is not directly through the effects of flooding or inundation of the land surface, as examined previously.

Although the work of the first consultation showed that community members were experiencing a significant cost of illness due to environmental burdens, this is likely to continue to be true with or without the set of project activities now underway. For instance, households in the study area are likely to continue to be exposed to sources of

contamination through imperfect access to safe drinking water and contact with contaminated water inside and outside their own community. The rates of exposure to sources of contamination may well be seasonal or episodic, such as with increases in the wetter months or during specific high-rainfall events.

Considering specifically the banana peel mills and briquette making, the principal effect of both of these activities on environmental burdens is to reduce the volume of solid waste (discarded peels from food uses). Less solid waste in the community represents less nuisance if that waste would not have been collected promptly. Less solid waste might contribute to less blockage of drainage canals contributing to less flooding, but one needs to consider the small fractional role of banana peels within the total mass of solid waste accumulation. One needs to consider also the many other hydrological dimensions of this area's flooding problems to assess. Less solid waste might represent a lower health cost if there were some connections between the lower solid waste levels and specific types of disease burdens or health effects, where these connections have not been identified by the project team.

Each activity uses these peels as an important input. The end products of these processes (an animal feed ingredient and a cooking fuel) can serve as substitutes for other feed and fuels and can reduce any environmental costs associated with acquiring and using those substitutes at present. Similarly, if there is an expansion of feed use or of fuel use that results from the new supply of these products, those expanded activities might also bring environmental harms of their own.

If local production of livestock increases (due to increased production of feed ingredients from banana waste) there might also be negative health effects resulting from improper storage or disposal of manure, especially during peak rain or flood events. The use of produced briquettes for cooking fuel might increase exposure of household members to harmful combustion byproducts, such as if this fuel burns less efficiently than its current substitute, or if cooking fires are not properly ventilated, or if the total amount of cooking uses goes up. In considering the aggregate effects of the two principal interventions to be studied, there may, on balance, be some environmental and health benefit, but the avoided environmental harm is not likely to be a large or significant benefit within the cost-benefit analysis. There may be significant benefits to the target communities and the nation from specific project interventions. However, the magnitude of these benefits would not be adequately estimated if the scope of the valuation exercise were to be narrowed to estimating the avoided damage cost of environmental burdens alone.

Specific estimates of project benefits

Annex 2 presents a time profile of expected costs and benefits to be incurred over each of the twenty-five years of the project's economic life. The costs and benefits are treated as though some occur at the end of each year, starting with the first capital costs for construction, as if these were incurred on December 31, 2009 (or January 1, 2010). The first full year of the project life is 2010 and it bears the label Year 1, with subsequent years numbered consecutively through until Year 25 which ends on December 31, 2034. The estimates are based on the assumption that the actual set-up and start-up activities could be undertaken quite quickly, with all participants mobilized and the manufacture of products underway throughout the first year of operation.

For each year of the project life, various categories of costs are listed (numbered 1 – 5) and are aggregated to give a total cost per year. Similarly, various categories of benefits are listed (designated *a* - *d*) and are aggregated to give a total benefit per year. Benefits minus costs for each year are shown next. These annual amounts are then discounted to reflect their present value at the start of 2010. Summing these across years gives the project's Net Present Value.

There are four principal categories of project benefits that are itemized:

a. Value of peel meal as animal feed
b. Cost savings from not collecting waste peels
c. Resale value of equipment in year 25, and
d. Resale value of last mill in year 25.

Each of these estimates will be described in turn.

a. Value of peel meal as animal feed

Each peel mill is expecting to operate with an average production level of 2,000 kg/month of manufactured peel meal per mill. This production level is based on a combination of factors reflecting the availability of dried peels as inputs, milling capacity and the willingness of the local market to purchase animal feeds at prevailing prices. Of the 2,000 kg per month produced, about one-half will represent a reduction in other substitute feeds that would have been purchased if this product were not available. That is, this portion provides a cost saving based on the opportunity cost of the substitute feeds. The other one-half of the produced feed is expected to represent an increase in local feed use, compared to what would happen without the project. That is, in response to there being a locally available source of lower cost animal feeds, more community members take up or expand the production of chickens, eggs, pigs and so on.

The substitute feed type that is displaced is maize bran. This is the feed component that mostly closely competes with the manufactured peel meal. The local price of maize bran without the project is about 450 UGX/kg. The local price of peel meal is 250 UGX/kg. The simple average of these two values can be used to approximate the value of that the community gains from this new supply of feed. Thus, the monthly value of the produced feed is: 2000 kg/month × 350 UGX/kg = 700,000 UGX/month. Allowing for a 2% loss or wastage factor per month yields 686,000 UGX/month or **8,232,000 UGX per year**.

b. Cost savings from not collecting waste peels

The project takes in 12 tons of waste peels per month, some portion of which would have been hauled away at some expense, and some portion of which would have stayed in the community causing nuisance and environmental degradation. One effect of using these peels for a productive purpose is to reduce transportation expenses for that portion that would have been collected and hauled away. Another effect is to reduce the nuisance and harm caused by those waste peels that would have stayed in the community. In the absence of other data to value this harm, suppose that all 100% would have been hauled away. That expense is now saved where there are estimates of this monthly cost.

Based on the consideration of the cost of operating a fleet of waste-removal trucks with crews, the estimated cost savings from not having to remove these 12 tons per month of waste is 500,000 per month or **6,000,000 UGX/year.**

c. Resale value of equipment in year 25

To compensate for the truncation of project benefits and costs at the end of the 25 year economic project life, the approach followed here is to treat the project "as if" it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, where the principal remaining asset will be a milling machine and a set of tools and equipment used in the milling process.

As explained further in the explanation of project costs below, and as tabulated in Annex 2, such tools and equipment as shovels and a wheelbarrow are to be replaced every eight years. The equipment on hand at the end of the twenty-fifth year is expected to sell for 20% of its purchase price, which gives: 101,000 UGX × 25% = **20,200 UGX**.

d. Resale value of last mill in year 25

Each mill is expected to last about four years on average at a cost per mill of 2,680,000 UGX. The mill on hand at the end of the twenty-fifth year is expected to sell for **2,000,000 UGX**.

Description of the principal types of costs

The main types of costs to be incurred with the project are:

- Cost associated with collecting and drying the banana peels
- Cost of crowding out other users of peels (briquette makers, composters)
- Cost of milling the peels and distributing them, including life-cycle cost of any equipment used (e.g., milling machine), and
- Cost of organizing the community members and undertaking community-building processes to form a Community Based Organization capable of running the system in future on a sustainable basis, including participants' time, materials, supplies, equipment.

Specific estimates of project costs

There are five principal categories of project costs that are itemized:

1. Initial investment
2. Organizational meeting costs
3. Other equipment (shovels, wheelbarrow)
4. Cost of fuel, oil and raw materials; and
5. Annual operating costs.

Each of these estimates will be described in turn.

1. Initial investment

The principal investment for this type of activity is the milling machine, which, on average, will last four years. The purchase price is 2,480,000 UGX and the other installation and set-up costs are 200,00 with each purchase, giving **2,648,000 UGX** every four years.

2. Organizational meeting costs

To initiate a project like this requires community understanding and voluntary participation. It is necessary to hold one or more information and organizational meetings in the start-up phases. For the first six months of project start-up, there are two to three meetings per month in the community, with 25 person hours per meeting at an opportunity cost of 250 UGX/hour, which gives: (6 x 2.5 x 250 x 25 =) **93,750 UGX** as an organizational start-up cost.

3. Other equipment (shovels, wheelbarrow)

The main purchases of durable equipment are for a wheelbarrow (80,000 UGX every 8 years) and some shovels (21,000 UGX every 8 years), where other expendable items are described under annual operating costs. This is expense is **101,000 UGX** every 8 years.

4. Cost of fuel, oil and raw materials

The main raw materials and supplies used by the project are fuel, oil, dried banana peels, sisal, and sacks. As shown in Table 1, the aggregate cost of these items is 321,134 UGX per month**,** which is **3,853,608 UGX per year**.

Fresh banana peels are collected in the community by individual members of the CBO. These peels are laid out to dry before they are reloaded into sacks and delivered for milling. For every four to six sacks of wet peels, one sack of dried peels is ready for milling. At the point of delivery to the mill, the collector is paid 3,000 UGX per 25 kg sack of dried peels. [From the project's perspective, each sack of dried peels purchased at a cost of 3,000 UGX/sack, with allowance for 2% spillage or production loss results in peel meal with market revenue of (25 kg x 250 UGX/kg x 0.98 =) 6,125 UGX.] This value paid by the project (3,000 UGX/sack) will form the estimate of the social cost of these inputs to the peel milling process. This value reflects the opportunity cost of the independent participants' time and resources used to collect, deliver, and dry the banana peels, including some use of space for drying and storing the peels, and some supplies such as tarpaulins, sisal and (re-usable) sacks. Equivalently, since there is an alternate, but limited, local market for these peels to be sold (unprocessed) for use as animal feed, this value can also be interpreted to reflect the opportunity cost when the project mills these peels instead of using them in unprocessed form.

Table 1 – Cost of fuel, oil and raw materials for peel processing for animal feed

Item	Quantity required	Cost per unit (UGX)	Cost per ton of dried peel meal (UGX)	Cost per month with two tons per month (UGX/month)	% of Total
Dried peels	40 sacks	3,000	120,000	240,000	*74.6*
Diesel fuel for mill	8⅓ litres	2,300	19,167	38,334	*11.8*
Motor oil for mill	0.2 litres	5,000	1,000	2,000	*0.6*
Sacks	20 sacks	1,000	20,000	40,000	*12.5*
Sisal	0.2 rolls	2,000	400	800	*0.5*
		Totals	160,567	**321,134**	*100.0*

5. Annual operating costs

As shown in Table 2, there is a range of other costs associated with the activities coordinated by the Community Based Organization to keep the project operational. In some cases, these labour services or activities, such as oversight of workers, may be provided by members of the organization's executive without direct compensation. Even so, some opportunity cost of time is included for each activity that needs to be undertaken.

The monthly cost is 297,467 UGX per month which is equivalent to **3,569,604 UGX per year**.

Table 2 – Annual operating costs for peel processing for animal feed

Cost Component	Cost per month (UGX)	Percentage of Total
Labour to operate mill	7,000	*2.4*
Opportunity cost of milling space	150,000	*50.4*
Repairs (belts, pumps, labour)	35,417	*11.9*
Protective equipment (gloves, masks)	4,000	*1.3*
Record keeping expenses, payments	30,000	*10.1*
Laboratory analyses (twice/year)	30,000	*10.1*
Management activities / meetings (48 + 10 hrs/mo.) × (600 UGX/hour)	34,800	*11.7*
CBO monthly meetings (1 hour × 25 persons × 250 UGX/hr)	6,250	*2.1*
Total	**297,467**	*100.0*

Net Present Value and sensitivity analysis

As shown in Annex 2, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is positive with a value of **53,847,650 UGX**, as at January 1, 2010.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD $23,774 based on the market exchange rate (2,265 UGX/USD) in June 2010, and approximately equal to USD $27,614 based on the exchange rate in January 2010 (1,950 UGX/USD).

The interpretation of a positive NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Ugandan residents) more benefits than costs on a discounted basis. Equivalently, Ugandans collectively would have been indifferent between gaining assets or wealth worth 53,847,650 UGX and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms, as shown in Table 3. The three largest categories of costs are the fuel, oil and raw materials (46%), the annual operating costs (43%) and the initial investment (10%). If all costs were about 70% higher, with benefits unchanged, the NPV would be negative. The two largest categories of benefits are the value of peel meal as animal feed (58%) and the cost savings from not collecting waste peels (42%). If all benefits were about 40% lower, with costs unchanged, the NPV would be negative.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach.

The Net Present Value becomes more positive for lower values of the discount rate, as illustrated in Table 4. The initial construction costs are not much affected by the choice of discount rate, whereas future benefits and future costs are each increased in present value terms for lower values of the discount rate. As used here, the 10% discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation). Whereas 10% is a widely used estimate of the social opportunity cost of capital, some South Asian countries use rates as high as 14% per year. At these rates, the NPV is less positive.

Table 3 – Contribution of individual cost and benefit categories to the Net Present Value of peel processing for animal feed

Expected Costs	Present Value (UGX in January 2010)	Percentage Share
1. Initial investment (peel milling machine)	7,868,346	*10.4*
2. Organizational meeting costs	93,750	*0.1*
3. Other equipment (shovels, wheelbarrow)	180,352	*0.2*
4. Fuel, oil and raw materials	34,979,354	*46.3*
5. Annual operating costs	32,401,438	*42.9*
Total costs	**75,523,240**	***100.0***
Expected Benefits		
a. Value of peel meal as animal feed	74,722,193	*57.8*
b. Cost savings, not collecting waste peels	54,462,240	*42.1*
c. Resale value of equipment in year 25	1,864	*0.0*
d. Resale value of last mill in year 25	184,592	*0.1*
Total benefits	**129,370,890**	***100.0***
Net Present Value= Discounted (Benefits–Costs)	**53,847,650**	
NPV as a percentage of total costs		71.3%
NPV as a percentage of total benefits		41.6%

Table 4 – Variation in Net Present Value under alternative values of the discount rate

Discount rate	**Net Present Value**
(social opportunity cost of capital as an annual rate in real terms (i.e., excluding inflation))	(Ugandan Shillings in January 2010)
0	152,982,150
2	118,766,698
4	94,460,803
6	76,818,379
8	63,740,592
10	**53,847,650**
12	46,217,393
14	40,223,391
16	35,433,202

Annex 2 - Excel spreadsheet for peel processing for animal feed

Strengthening the Economic Dimension of Focus Cities
Cost Benefit Analysis Worksheet
City: Kampala **Intervention: Peels Processing for Animal Feed**

Monday, June 07, 2010

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Expected Costs	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
1. Initial investment (peel milling machine)	2,680,000				2,680,000				2,680,000		
2. Organizational meeting costs	93,750										
3. Other equipment (shovels, wheelbarrow)	101,000								101,000		
4. Fuel, oil and raw materials		3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608
5. Annual operating costs		3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604
Total costs	2,874,750	7,423,212	7,423,212	7,423,212	10,103,212	7,423,212	7,423,212	7,423,212	10,204,212	7,423,212	7,423,212

Expected Benefits	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
a. Value of peel meal as animal feed		8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000
b. Cost savings, not collecting waste peels		6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000
c. Resale value of equipment in year 25											
d. Resale value of last mill in year 25											
Total benefits	0	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000

Benefits minus costs each year	(2,874,750)	6,808,788	6,808,788	6,808,788	4,128,788	6,808,788	6,808,788	6,808,788	4,027,788	6,808,788	6,808,788
discounted annual amounts	(2,874,750)	6,189,807	5,627,098	5,115,543	2,820,018	4,227,722	3,843,383	3,493,985	1,878,993	2,887,591	2,625,083
Net present value	*53,847,650*										

Net Present Value	
Real annual discount rate (SOCC)	10%
Net present value *(UGX at start of year 1)*	**53,847,650**
US dollar equivalent @ 1,950 UGX/USD$	*$27,614*

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
	2,680,000				2,680,000				2,680,000				2,680,000	
					101,000								101,000	
3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608	3,853,608
3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604	3,569,604
7,423,212	10,103,212	7,423,212	7,423,212	7,423,212	10,204,212	7,423,212	7,423,212	7,423,212	10,103,212	7,423,212	7,423,212	7,423,212	10,204,212	7,423,212

Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000	8,232,000
6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000
														20,200
														2,000,000
14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	14,232,000	16,252,200

6,808,788	4,128,788	6,808,788	6,808,788	6,808,788	4,027,788	6,808,788	6,808,788	6,808,788	4,128,788	6,808,788	6,808,788	6,808,788	4,027,788	8,828,988
2,386,439	1,315,559	1,972,263	1,792,967	1,629,970	876,564	1,347,082	1,224,620	1,113,291	613,718	920,075	836,432	760,393	408,924	814,880

IV) Briquette making for use as a cooking fuel

Evaluation of project benefits and costs

Description of the principal types of benefits

In general, when a public project of this nature provides services to a community, the benefits can take either or both of two principal forms. The first is that there is usually an increase in the total level of goods and services used, and this additional level of service is to be valued according to the community's willingness to pay for it. The second is that there may be a decrease in the former or alternative service that would be in use without the project. This reduction gives rise to some forms of cost savings, which also count as project benefits. Other benefits, above and beyond this provision of cooking fuel can come in the form of health and/or environmental improvements.

Applying this reasoning to the production of fuel briquettes suggests the following general categories of benefits:

- Value of the processed product: briquettes
- Cost saving from lower production of substitute heating fuel (charcoal)
- Value of environmental improvement from having less banana peel waste discarded in the community or in the solid waste system
- Increase in social capital, trust, empowerment and community capacity from working together at the community level
- Demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach

Specific estimates of project benefits

The costs and benefits are treated as though some occur at the end of each year, starting with the first capital costs for set-up and start-up, as if these were incurred on December 31, 2009 (or January 1, 2010). The first full year of the project life is 2010 and it bears the label Year 1, with subsequent years numbered consecutively through until Year 25 which ends on December 31, 2034. The estimates are based on the assumption that the actual set-up and start-up activities could be undertaken quite quickly, with all participants mobilized and the manufacture of products underway throughout the first year of operation.

For each year of the project life, various categories of costs are listed (numbered 1 – 5) and are aggregated to give a total cost per year. Similarly, various categories of benefits are listed (designated *a* - *d*) and are aggregated to give a total benefit per year. Benefits minus costs for each year are shown next. These annual amounts are then discounted to reflect their present value at the start of 2010. Summing these across years gives the project's Net Present Value.

There are four principal categories of project benefits that are itemized:

a. Value of briquettes produced
b. Cost savings from not collecting waste peels
c. Resale value of equipment in year 25, and
d. Resale value of last briquette press in year 25.

Each of these estimates will be described in turn.

a. Value of briquettes produced

A briquette production enterprise expects to operate with an average production level of 3,000 briquettes per month from one briquette press. This target production level is based on a combination of factors reflecting the availability of dried peels as inputs, capacity of the press and the willingness of the local market to purchase briquettes at prevailing prices. Of the 3,000 briquettes per month produced, about 2,500 will represent a reduction in other substitute fuel that would have been purchased if this product were not available. That is, this portion provides a cost saving based on the opportunity cost of the substitute fuel. The other 500 briquettes are expected to represent an increase in local cooking fuel use compared to what would happen without the project. That is, in response to there being a locally available source of lower cost cooking fuel, the level of use of cooking fuel increases.

The substitute fuel that is displaced is wood charcoal. Some wood charcoal will continue to be used along with the project briquettes, since the two fuels' combined combustion properties are better than using the new briquettes alone. The rate of substitution is that four briquettes plus 200 UGX worth of charcoal can do the equivalent amount of cooking as 1500 UGX worth of charcoal. Thus, as a substitute fuel, every four briquettes saves (1500 - 200 =) 1300 UGX or 1300/4 = 325 UGX per briquette.

The selling price of briquettes seems to vary between four and five pieces for 1,000 UGX, and so an average of these prices gives 225 UGX per piece. The simple average of these two values (225 UGX per briquette and 325 UGX per briquette) can be used to approximate the value that the community gains from this new supply of fuel. Thus, the monthly value of the produced briquettes is: 3,000 briquettes/month × 275 UGX/briquette = 825,000 UGX/month, or **9,900,000 UGX per year**.

b. Cost savings from not collecting waste peels

To produce a batch of 22 briquettes (0.5 kg/piece), the project uses 10 kg of carbonized peels, which are created from 16.7 kg of dried peels, which are dried from 240 kg of fresh peels. Thus, to produce 3,000 briquettes per month will require (3,000/22 x 240 kg ≈) 33 tons of fresh peels.

When the project takes in 33 tons of waste peels per month, some portion of them would have been hauled away at some expense, and some portion of them would have stayed in the community causing nuisance and environmental degradation. One effect of using these peels for a productive purpose is to reduce transportation expenses for that portion that would have been collected and hauled away. Another effect is to reduce the nuisance and harm caused by those waste peels that would have stayed in the

community. In the absence of other data to value this harm, suppose that all 100% would have been hauled away. That expense is now saved, where there are estimates of this monthly cost.

Based on the consideration of the cost of operating a fleet of waste-removal trucks with crews, the estimated cost savings from not having to remove these 33 tons per month of waste is 1,375,000 UGX per month or **16,500,000 UGX per year.**

c. Resale value of equipment in year 25

To compensate for the truncation of project benefits and costs at the end of the 25 year economic project life, the approach followed here is to treat the project "as if" it winds up and to reclaim a benefit in the last year for the remaining (social) value of all assets, where the principal remaining asset will be the briquette press and a set of tools and equipment used in the production process.

As explained further in the explanation of project costs below, and as tabulated in Annex 3, such tools and equipment as shovels and a wheelbarrow are to be replaced every eight years. The equipment on hand at the end of the twenty-fifth year is expected to sell for 20% of its purchase price, which gives: 101,000 UGX × 25% = **20,200 UGX**.

d. Resale value of last briquette press in year 25

Each briquette press is expected to last about ten years on average at a cost per press of 1,100,000 UGX. The five-year-old press on hand at the end of the twenty-fifth year is expected to have a remaining value of **550,000 UGX**.

Description of the principal types of costs

The main types of costs to be incurred with the project are:

- Cost associated with collecting and drying the banana peels
- Cost of crowding out other users of peels ("peel meal" producers, composters)
- Cost of processing the peels into briquettes and distributing them, including cost of other ingredients and life-cycle cost of any equipment used (e.g., briquette press), and
- Cost of organizing the community members and undertaking community-building processes to form a Community Based Organization capable of running the system in future on a sustainable basis, including participants' time, materials, supplies, equipment.

Specific estimates of project costs

There are five principal categories of project costs that are itemized:

1. Initial investment
2. Organizational meeting costs
3. Other equipment (shovels, wheelbarrow)
4. Cost of supplies and raw materials; and

5. Annual operating costs.

Each of these estimates will be described in turn.

1. Initial investment

The principal investment for this type of activity is the briquette press, which, on average, will last ten years. The purchase price is 1,000,000 UGX and the other installation and set-up costs are 100,000 with each purchase, giving **1,100,000 UGX** every ten years.

2. Organizational meeting costs

To initiate a project like this requires community understanding and voluntary participation. It is necessary to hold one or more information and organizational meetings in the start-up phases. For the first six months of project start-up, there are two to three meetings per month in the community, with 25 person hours per meeting at an opportunity cost of 250 UGX/hour, which gives: (6 x 2.5 x 250 x 25 =) **93,750 UGX** as an organizational start-up cost.

3. Other equipment (shovels, wheelbarrow)

The main purchases of durable equipment are for a wheelbarrow (80,000 UGX every 8 years) and some shovels (21,000 UGX every 8 years), where other expendable items are described under annual operating costs. This is expense is **101,000 UGX** every 8 years.

4. Cost of supplies and raw materials

The main raw materials and supplies used by the project are fuel, water, dried banana peels, cassava flour, hydraulic oil, batch labour and packaging. As shown in Table 5, the aggregate cost of these items is about 640,227 UGX per month**,** which is **7,682,727 UGX per year**.

Table 5 – Cost of supplies and raw materials for briquette making for cooking fuel

Item	**Quantity required**	**Cost per unit (UGX)**	**Cost per batch of 22 briquettes (UGX/batch)**	**Cost per month with 3,000 briquettes/month (UGX/month)**	**% of Total**
Dried peels	⅔ sack	3,000	2,000	272,727	*42.6*
Water	5 litres	25	125	17,045	*2.7*
Cassava flour (as binder)	1 kg	1,000	1,000	136,365	*21.3*
Packaging	1 unit	880	880	120,000	*18.7*
Batch labour	½ hour	250	125	17,045	*2.7*
Hydraulic oil	1 unit	15	15	2,045	*0.3*
Heating fuel	2 briquettes	275	550	75,000	*11.7*
		Totals	4,695	**640,227**	*100.0*

Fresh banana peels are collected in the community by individual members of the CBO. These peels are laid out to dry before they are reloaded into sacks and delivered for carbonizing. For every four to six sacks of wet peels, one sack of dried peels is ready for processing. These peels are then carbonized reducing the volumes and weights further. As with the peels used for peel meal, the value of the dried peels prior to carbonizing them is UGX 3,000 per 25 kg sack. At the point of delivery, the peel collector is paid 3,000 UGX per 25 kg sack of dried peels. This value paid by the project (3,000 UGX/sack) will form the estimate of the social cost of these inputs to the briquette-making process. This value reflects the opportunity cost of the independent participants' time and resources used to collect, deliver, and dry the banana peels, including some use of space for drying and storing the peels, and some supplies such as tarpaulins, sisal and (re-usable) sacks. Equivalently, since there is an alternate, but limited, local market for these peels to be sold (unprocessed) for use as animal feed, this value can also be interpreted to reflect the opportunity cost when the project uses these peels instead of others feeding them in an unprocessed form.

5. Annual operating costs

As shown in Table 6, there is a range of other costs associated with the activities coordinated by the Community Based Organization to keep the project operational. In some cases, these labour services or activities, such as oversight of workers, may be provided by members of the organization's executive without direct compensation. Even so, some opportunity cost of time is included for each activity that needs to be undertaken.

The monthly cost is 285,167 UGX per month which is equivalent to **3,422,004 UGX per year**.

Table 6 – Annual operating costs for briquette making for cooking fuel

Cost Component	**Cost per month (UGX)**	**Percentage of Total**
Opportunity cost of pressing space	150,000	*52.6*
Repairs (replacement parts, sieves)	16,667	*5.8*
Protective equipment (gloves, masks)	4,000	*1.4*
Record keeping expenses, payments	30,000	*10.5*
Laboratory analyses (twice/year)	30,000	*10.5*
Management activities / meetings (60 + 10 hrs/mo.) × (600 UGX/hour)	42,000	*14.7*
CBO monthly meetings (1 hour × 50 persons × 250 UGX/hr)	12,500	*4.5*
Total	**285,167**	*100.0*

Net Present Value and sensitivity analysis

As shown in Annex 3, when all of these costs and benefits are totaled for each of the years of the project's economic life and discounted, the Net Present Value is positive with a value of
136,926,688 UGX, as at January 1, 2010.

Recognizing that current market exchange rates might not accurately reflect the opportunity cost of foreign exchange to the reference group, one should be cautious in converting this value to other currencies at market exchange rates since the resulting value may over- or under-estimate the value of the project to the project's reference group. Subject to this caveat, this NPV would have been approximately equal to USD $60,453 based on the market exchange rate (2,265 UGX/USD) in June 2010, and approximately equal to USD $70,219 based on the exchange rate in January 2010 (1,950 UGX/USD).

The interpretation of a positive NPV of this magnitude is that this project, as constituted, would bring members of the reference group (all Ugandan residents) more benefits than costs on a discounted basis. Equivalently, Ugandans collectively would have been indifferent between gaining assets or wealth worth 136,926,688 UGX and undertaking this project.

It may be instructive to examine how the various components of costs and benefits outlined above contribute to the resulting NPV in monetary (discounted present value) or percentage terms, as shown in Table 7. The two largest categories of costs are the supplies and raw materials (68%) and the annual operating costs (30%). If all costs were about 130% higher, with benefits unchanged, the NPV would be negative. The two largest categories of benefits are the cost savings from not collecting waste peels (63%) and value of briquettes produced (38%). If all benefits were about 60% lower, with costs unchanged, the NPV would be negative.

Some of the potential benefits of this project intervention have not been evaluated here due to a lack of information about them. Specifically, any benefits felt at the community level due to an increase in social capital, trust, empowerment and community capacity from working together have not been evaluated. Similarly, no value is estimated for any demonstration benefits of pilot project activities in informing other potential adopters of this intervention and approach.

The Net Present Value becomes more positive for lower values of the discount rate, as illustrated in Table 8. The initial set-up costs are not much affected by the choice of discount rate, whereas future benefits and future costs are each increased in present value terms for lower values of the discount rate. As used here, the 10% discount rate reflects the social opportunity cost of capital measured in real terms (i.e., net of inflation). Whereas 10% is a widely used estimate of the social opportunity cost of capital, some South Asian countries use rates as high as 14% per year. At these rates, the NPV is less positive.

Table 7 – Contribution of individual cost and benefit categories to the Net Present Value of briquette making for use as a cooking fuel

Expected Costs	Present Value (UGX in January 2010)	Percentage Share
1. Initial investment (briquette press)	1,687,606	*1.6*
2. Organizational meeting costs	93,750	*0.1*
3. Other equipment (shovels, wheelbarrow)	180,352	*0.2*
4. Supplies and raw materials	69,736,420	*67.9*
5. Annual operating costs	31,061,667	*30.2*
Total costs	**102,759,795**	***100.0***
Expected Benefits		
a. Value of briquettes produced	89,862,696	*37.5*
b. Cost savings, not collecting waste peels	149,771,160	*62.5*
c. Resale value of equipment in year 25	1,864	*0.0*
d. Resale value of last press in year 25	50,763	*0.0*
Total benefits	**239,686,484**	***100.0***
Net Present Value= Discounted (Benefits–Costs)	**136,926,688**	
NPV as a percentage of total costs		133.2%
NPV as a percentage of total benefits		57.1%

Table 8 – Variation in Net Present Value under alternative values of the discount rate

Discount rate	**Net Present Value**
(social opportunity cost of capital as an annual rate in real terms (i.e., excluding inflation))	(Ugandan Shillings in January 2010)
0	379,154,175
2	295,804,102
4	236,450,784
6	193,277,686
8	161,216,591
10	**136,926,688**
12	118,169,588
14	103,421,146
16	91,626,915

Annex 3 - Excel spreadsheet for for briquette making for use as a cooking fuel

Strengthening the Economic Dimension of Focus Cities
Cost Benefit Analysis Worksheet
City: Kampala **Intervention: Briquette Making**

Monday, June 07, 2010

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Expected Costs	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
1. Initial investment (briquette press)	1,100,000										1,100,000
2. Organizational meeting costs	93,750										
3. Other equipment (shovels, wheelbarrow)	101,000								101,000		
4. Supplies and raw materials		7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727
5. Annual operating costs		3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004
Total costs	1,294,750	11,104,731	11,104,731	11,104,731	11,104,731	11,104,731	11,104,731	11,104,731	11,205,731	11,104,731	12,204,731

Expected Benefits	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
a. Value of briquettes produced		9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000
b. Cost savings, not collecting waste peels		16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000
c. Resale value of equipment in year 25											
d. Resale value of last press in year 25											
Total benefits	0	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000

Benefits minus costs each year	(1,294,750)	15,295,269	15,295,269	15,295,269	15,295,269	15,295,269	15,295,269	15,295,269	15,194,269	15,295,269	14,195,269
discounted annual amounts	(1,294,750)	13,904,790	12,640,718	11,491,562	10,446,875	9,497,159	8,633,781	7,848,891	7,088,239	6,486,687	5,472,891
Net present value	*136,926,688*										

Net Present Value	
Real annual discount rate (SOCC)	10%
Net present value *(UGX at start of year 1)*	**136,926,688**
US dollar equivalent @ 1,950 UGX/USD$	*$70,219*

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
									1,100,000					
					101,000								101,000	
7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727	7,682,727
3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004	3,422,004
11,104,731	11,104,731	11,104,731	11,104,731	11,104,731	11,205,731	11,104,731	11,104,731	11,104,731	12,204,731	11,104,731	11,104,731	11,104,731	11,205,731	11,104,731

Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000	9,900,000
16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000	16,500,000
														20,200
														550,000
26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,400,000	26,970,200

15,295,269	15,295,269	15,295,269	15,295,269	15,295,269	15,194,269	15,295,269	15,295,269	15,295,269	14,195,269	15,295,269	15,295,269	15,295,269	15,194,269	15,865,469
5,360,898	4,873,544	4,430,495	4,027,722	3,661,566	3,306,716	3,026,087	2,750,989	2,500,899	2,110,036	2,066,858	1,878,962	1,708,147	1,542,607	1,464,319

TUNISIA

Ébauche d'analyse économique

Pour les fins de l'analyse économique présentée ci-dessous, les estimés de coûts les plus élevés ont été utilisés lorsque plus qu'un estimé était disponible, et les estimés de bénéfices les plus faibles ont été utilisés lorsque plus qu'un estimé était disponible. Il est par conséquent possible de croire que cette analyse **sous-estime** la rentabilité réelle de la valorisation des eaux de pluie et eaux grises.

Supposons une terre de superficie typique de 0.2 ha (2,000 m2) et un ménage fermier de 5 personnes.

1. Offre en eau

Il a été estimé qu'en moyenne un habitant de Soukra produit de 80 à 100 litres d'eaux grises par jour. Donc un ménage de 5 personnes pourrait produire de 400 à 500 litres (0.4 à 0.5 m3) d'eaux usées par jour. En toute probabilité cette quantité augmentera dans le future puisque la consommation en eau est typiquement fonction du revenu: Plus le revenu est élevé, plus la consommation en eau par habitant est élevé, toute autre chose étant constante. Pour les fins des calculs présentés ci-dessous, il est supposé qu'un ménage de 5 personnes produit en moyenne 1 m3 d'eaux grises par jour. Ceci correspond à une quantité annuelle approximative de 365 m3.

Les calculs basés sur les statistiques météorologiques ont aussi révélés qu'une quantité d'environ 500 m3 par année d'eau de pluie pourrait être capturée à l'aide d'un réservoir d'une capacité de 260 m3.

Donc, les hypothèses quant à la quantité d'eau qui pourrait être récupérée sont celles-ci:

- Eaux grises : 365 m3
- Eaux de pluie : 500 m3
- Total : 865 m3

2. Coûts de capturer les eaux grises et eaux de pluie

Les coûts suivants ont été estimés:

Coûts de capturer les eaux de pluie:

- Tuyauterie (pour collecter l'eau de pluie et la transporter au bassin de stockage): 500 TND

- Bassin de stockage (capacité de 220 m3): 4,500 TND

  Coût total de capturer les eaux de pluie: 5,000 TND

Coûts de capturer et traiter les eaux grises :

- 3,000 TND

Donc, le coût total (investissement) de capturer les eaux de pluie et les eaux grises est estimé être environ 8,000 TND. Ce qui revient à environ 1 TND par m3 capturé.

Toutefois, dans le premier rapport technique, cette somme a été estimée être **11,000 TND**. Pour les fins de l'analyse économique, ce coût a été utilisé.

3. Coûts de construction et d'opération de cultivation

Pour les fins de calcul, les hypothèses suivantes étant donné une superficie de 0.2 ha:

- 4 serres de 256 m2 chacune seront érigées;
- 1 pépinière de 220 m2 sera érigée.

Coût de la culture maraichère en serre:

- Coût de construction des serres:
  4,000 TND par serre;

- Irrigation goutte à goutte
  590 TND par serre

- Motoculteur
  9,740 TND

- Charge (frais d'opération qui comprennent semence, engrais, pesticide et coût en main d'œuvre):
  700 TND par serre

Dans le Quatrième Rapport Technique, les charges ont été estimés à:

Tomates : 825 TND par serre
Piment : 814 TND par serre
Fraisier : 1116 TND par serre
Laitue : 193 TND
Melon : 613 TND

Donc si une cultivation de tomates et une cultivation de laitue par exemple au cours d'une année prenaient place, les charges seraient d'environ **1,000 TND**. Ce coût sera utilisé.

- Remplacement des plastiques qui couvrent les serres (plastique):

  400 TND par serre. Il est estimé que la durée de vie de ce plastique est de 4 ans.

Coût de la pépinière:

- Investissement initial:
  2,200 TND (tel qu'estimé dans le Premier Rapport Technique).

- Filet (qui couvre l'ombrière):

690 TND (tel qu'estimé dans le Premier Rapport Technique).

4. Revenus des produits de serre

Revenus des tomates

Il a été estimé qu'une serre pourrait produire approximativement 2.5 tonnes de tomates qui se vendent à environ 1 TND par kilo. Pour les 3 serres, cela pourrait générer des revenus d'environ 7,500 TND par année. La marge brute est estimée à 2,422 TND par serre (pour toutes les cultures maraichères) dans le Premier Rapport Technique. Donc pour les 3 serres, cela ferait à peu près 7,266 TND. Ici, le revenu brut est de 8,700 TND.

Dans le Quatrième Rapport Technique, les revenus sont estimés à :

Tomates : 1,607 TND par serre
Piment : 947 TND par serre
Fraisier : 2419 TND par serre
Laitue : 383 TND par serre
Melon : 835 TND par serre

Le chiffre de **2,500 TND** par serre est donc retenu.

Revenus des cultures dérobées

Estimé à 1,200 TND pour les 3 serres.

5. Revenus de pépinières

Estimé à 9,000 TND par an dans le Premier Rapport Technique. Toutefois, il n'y a pas encore eu de vente de produits résultant de la pépinière. Ainsi, pour les fins de l'analyse, un estimé de 4,500 TND a été utilisé.

6. Économies pour l'ONAS

À la suite de plusieurs conversations avec l'Office National de l'Assainissement (ONAS), il a été estimé qu'il en coûte à l'ONAS entre 0.500 et 0.800 TND par m3 pour transporter et traiter les eaux grises des citoyens de l'Ariana-Soukra. En utilisant la somme de 0.500 TND et une quantité de 350 m3 d'eaux grises par ménage, cela représente une économie annuelle de 175 TND qui représente un bénéfice économique de la valorisation des eaux grises.

Annex 2 Excel Spreadsheet

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Coûts																				
1. Capture des eaux																				
Eaux de pluie	8,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eaux grises	3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Culture maraichère																				
Serres (4,000 TND par serre)	16,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Charges (1,000 par serre)	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Motoculteur	9,740	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation goutte (590 par serre)	2,360																			
Plastique (400 par serre)	1,600	0	0	0	1,600	0	0	0	1,600	0	0	0	1,600	0	0	0	1,600	0	0	0
3. Pépinière																				
Construction	2,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Filet	690	0	0	0	690	0	0	0	690	0	0	0	690	0	0	0	690	0	0	0
Coût total	**47,590**	**4,000**	**4,000**	**4,000**	**6,290**	**4,000**	**4,000**	**4,000**	**6,290**	**4,000**	**4,000**	**4,000**	**6,290**	**4,000**	**4,000**	**4,000**	**6,290**	**4,000**	**4,000**	**4,000**
Revenus																				
1. Tomates	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
2. Cultures dérobées	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
3. Pépinières	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Revenu total	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**	**13,200**
Bénéfice net financier	**(34,390)**	**9,200**	**9,200**	**9,200**	**6,910**	**9,200**	**9,200**	**9,200**	**6,910**	**9,200**	**9,200**	**9,200**	**6,910**	**9,200**	**9,200**	**9,200**	**6,910**	**9,200**	**9,200**	**9,200**
Économies pour l'ONAS	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175
Bénéfice net économique	**(34,215)**	**9,375**	**9,375**	**9,375**	**7,085**	**9,375**	**9,375**	**9,375**	**7,085**	**9,375**	**9,375**	**9,375**	**7,085**	**9,375**	**9,375**	**9,375**	**7,085**	**9,375**	**9,375**	**9,375**

SÉNÉGAL

1. Description de l'idée d'affaires

L'idée projet porte sur la création d'une pépinière horticole dans la cuvette de Malika pour les producteurs des périmètres maraîchers avoisinant la décharge de Mbeubeuss. Les agriculteurs regroupés en association amélioreront leurs revenus par la production de plantes fruitières, forestières et ornementales sur un périmètre communautaire.

Il s'agira pour l'exploitation associative d'acquérir un périmètre agricole aménagé en parcelles de pépinières équipé de 3 ou 4 puits en vue d'assurer la production de :

- plants forestiers pour les projets de reboisement étatiques, communaux, ou d'autres structures disposant d'activités de reboisement ;
- plants fruitiers pour la fourniture de plants des vergers environnants ;
- plantes ornementales et d'appartement pour la décoration des bordures de route ou la décoration d'intérieur des habitations.

L'exploitation collective sera gérée par le regroupement des maraîchers de Malika qui bénéficiera d'un appui pour renforcer ses capacités organisationnelles et structurelles et d'un accompagnement dans la gestion de l'exploitation. Sur le plan technique, les membres de l'association bénéficieront d'un renforcement des capacités en matière de conduite de pépinières et en matière de gestion administrative de la pépinière. Une ligne de crédit sera aussi mise en place pour accompagner les maraîchers dans l'introduction des activités de pépinières dans leurs parcelles respectives.

L'implantation de la pépinière collective devrait permettre d'améliorer les revenus des maraîchers de Malika et à long terme permettre la reconversion des maraîchers vers des pratiques agricoles à plus grande valeur ajoutée et plus particulièrement vers la production de plants fruitiers, forestiers et ornementaux.

2. Etude de marché

2.1. Description du sous secteur de l'horticulture au Sénégal

Le sous-secteur de l'horticulture prend en charge les productions maraîchères, fruitières et des plantations d'agrément. Elle a connu ses débuts au Sénégal par les jardins d'essais ou jardins d'acclimatation de légumes tempérés, de fruits et de plantes d'agréments. Longtemps considéré comme parent pauvre dans les politiques de développement du Sénégal, l'horticulture a d'abord été reconnu comme activité secondaire, non essentielle par les Sociétés régionales de développement rural (SRDR), avant d'être revalorisée par l'Etat comme vecteur de développement agricole en 1984 suite aux longues années de sécheresse. La volonté étatique de renforcer le développement de la filière horticole a été paraphée par la mise en place d'un plan directeur horticole et la création de la direction de l'horticulture en 1994.

Les Niayes de Dakar sont le principal pôle de production horticole de la région de Dakar. Constituées d'anciens lacs asséchés et de cuvettes, elles assurent une bonne part de la production horticole pour l'approvisionnement de l'agglomération dakaroise en produits frais. La production horticole au Sénégal pour la campagne 2008 est estimée à 464 000 tonnes (ANSD, 2008). Par ailleurs, Il ressort que 69% des revenus agricoles de Dakar proviennent de la production maraîchère alors que la part de la production de l'arboriculture fruitière est estimée à 18%.

2.2. Le potentiel du marché

2.2.1. L'arboriculture fruitière

Le Sénégal dispose de conditions pédoclimatiques favorables à la culture de fruits et légumes le long des Niayes notamment, dans la région de la Casamance et la vallée du fleuve Sénégal.

2.2.1.1. Offre et évolution de la production

L'arboriculture fruitière est une activité importante dans la grande zone des Niayes. Les régions de Thiès et de Dakar constituent la seconde zone de production fruitière (avec environ 10 à 15% de la production nationale) après la région naturelle de la Casamance. La production arboricole concerne les fruits dits tropicaux (mangues, papayes, coco, goyaves) et les agrumes (orange, mandarine, citron). Selon la Direction de l'agriculture, la production du Sénégal en agrumes en 2000 est évaluée à 39 319 tonnes dont 15 670 tonnes pour les bananes et 95 931 tonnes pour les mangues (tableau 1).

Tableau 1
Données de la production fruitière en 2000

Horticulture, production fruitière, agrumes (en tonne; Source Direction de l'agriculture)	39319.00
Horticulture, production fruitière, bananes (en tonne; Source Direction de l'agriculture)	15670.00
Horticulture, production fruitière, mangues (en tonne; Source Direction de l'agriculture)	95931.00
Horticulture, production fruitière, pastèque (en tonne; Source Direction de l'agriculture)	155264.00

Source : ANSD (2009), Base de données des indicateurs socio-économiques du Sénégal

Selon les estimations de la Direction de l'Horticulture, la production fruitière connaît depuis quelques années une croissance annuelle moyenne de 2 %, passant de 85 600 tonnes en 1988 à 122 000 tonnes durant la campagne 2002. Dans les périphéries lointaines de Dakar et dans la région de Thiès, florissent des vergers de plus ou moins grande envergure pratiquant la culture de la mangue, papaye, orange.

2.2.1.2. Commercialisation

L'essentiel du marché est commercialisé dans le marché local. Face à une évolution des habitudes alimentaires dans les centres urbains, la demande urbaine en fruits est croissante. Il existe également un marché en plein essor d'exportations de fruits. L'horticulture tournée vers l'exportation attire désormais des investissements étrangers. En outre, les producteurs et exportateurs de petite et moyenne envergure, mieux organisés, ont augmenté leurs volumes, tout en répondant aux sévères exigences sanitaires et phytosanitaires des pays occidentaux en l'occurrence. La présence d'infrastructures aéroportuaires internationales dans la capitale constitue de remarquables facteurs de soutien à la croissance de ce secteur. Ainsi, 19 274 tonnes de produits horticoles ont été exportées en 2004 dont 4 900 tonnes portent sur les mangues toutes destinations confondues (DPS – Statistiques douanières des exportations).

L'arboriculture fruitière est soutenue par le développement continu des industries de transformation des produits agro alimentaires dans les centres urbains à travers la mise en place de micro entreprises. Généralement investies par les GIE de femmes, les activités de

transformation des fruits et légumes investissent également de vastes champs industriels offrant ainsi un meilleur positionnement des produits locaux au Sénégal et ailleurs dans le monde. Cette activité de transformation de produits agroalimentaires offre en amont une production diversifiée de fruits et légumes étendue dans le temps. Des investissements importants sont déployés dans la culture de la mangue ce qui lui confère la place de fruit le plus cultivé au Sénégal et du fruit le plus exporté.

Les plus répandues restent les manguiers et les agrumes. Les prix pratiqués pour les plants d'arbres fruitiers varient en fonction de la taille et de l'âge de la plante. Les plants greffés sont les mieux vendus. Les prix de ces plants oscillent entre 1000 FCFA et 2500 FCA pour les plants âgés de huit mois à un an tandis que les plants ordinaires (non greffés) sont vendus à 500FCFA l'unité d'un même cycle.

2.2.2. La foresterie

2.2.2.1. Etat des lieux de la production de plants forestiers

La direction des eaux et forêts polarise la production de semences et plants forestiers au plan national. Elle fournit les plants à l'ensemble des grands projets de reboisement et de développement forestier, et produit des semences forestières certifiées. Elle est généralement associée aux grands projets de reboisement ou d'agroforesterie de moyenne et de grande envergure. A travers ses différents sites de production de plants forestiers elle approvisionne gratuitement en plants les nombreux projets ou toute personne qui le souhaite sur simple demande.

2.2.2.2. Potentiel marché de plants forestiers

La Grande Muraille Verte est un vaste programme de reboisement qui ira de Dakar à Djibouti. Ce projet de la Communauté des Etats Sahélo-sahariens (Cen-Sad) soutenu par l'Union Africaine, a pour ambition de lutter contre l'avancée vertigineuse du désert et la mise en valeur des zones saharo- sahéliennes pour une gestion durable des ressources naturelles et la lutte contre la pauvreté. Cette bande verte fera quinze kilomètres de large et plus de sept mille kilomètres de long.

La contrainte majeure à ce marché de plants forestiers demeure l'éloignement du site de réplication des plants. La zone de reboisement de la Grande Muraille Verte est située à plus de trois cents kilomètres de Dakar. Les mauvaises conditions de stockage, de conditionnement et de transport pourraient entraîner des pertes importantes en cours d'acheminement.

L'intérêt de la production de plants forestiers dans le cadre de ce projet pilote de « production horticole alternative » pourrait résider dans les travaux d'aménagement de la bande de filao de Malika.

Dans le cadre de campagne de fixation de dunes blanches le long de la Grande Côte Nord (Dakar- Saint Louis), le Sénégal a organisé plusieurs opérations de plantations de filaos (*Casuarina equisetifolia*). Une première réalisation a été faite de 1949 à 1958 sur une superficie de 424 ha, complétée par différents programmes soutenus par la coopération internationale de 1974 à 1981. La bande de plantations côtières a pu atteindre 182 km pour une largeur de 200 à 500m soit une superficie de 6400 ha. (FAO, 1992). Cette bande a contribué à la protection et à la sécurisation des cuvettes maraîchères des Niayes. Un plan d'aménagement de ces plantations côtières a été élaboré pour la rénovation et la regénération de ces plantations.

En effet, ces plantations qui jouent des rôles écologiques et socio-économiques très importants sont caractérisées par une dégradation relative occasionnée essentiellement par les coupes frauduleuses du bois pour le chauffage mais aussi par le prélèvement du sable de ces dunes blanches. Les plantations présentent aussi à plusieurs endroits des cas de vieillissement précoce du fait de la trop forte densité (2 000 à 2 500 tiges/ha) mais aussi de la faible capacité de régénération naturelle du filao. Le *Casuarina equisetifolia* , s'est montré le plus apte parmi la centaine d'espèces testées à fixer les dunes vives dans des conditions écologiques difficiles liées à la proximité de la mer, aux vents violents et réguliers chargés d'embruns et aux sols sablonneux peu fertiles. Cependant, la longévité de cette espèce ne dépasse guère la cinquantaine d'années et ne se régénère pas naturellement sous le climat sénégalais.

La rénovation des plantations de Filao à travers le « Projet d'aménagement et de développement de la zone des Niayes » se fera par le biais de nouvelles plantations, compte tenu donc de la faible capacité de régénération naturelle de l'espèce, et en impliquant les populations locales. L'implication des populations locales dans ces campagnes s'opère aussi bien dans la production de plants que dans les opérations de reboisement.

A Malika, l'Inspection régionale des Eaux et Forêts de Dakar a conclu un accord avec le Groupement des de Malika pour l'aménagement de la bande de filao de Malika dans le cadre du plan de gestion 2009-2013 de ce grand projet de réhabilitation de la bande de filao allant de Dakar à Saint Louis. Le lancement du projet a accusé du retard et débutera en 2010. Le groupement des forestiers de Malika s'est engagé à couper et reboiser chaque année 2 hectares de terres correspondant avec une production d'arbres de requise de 1500 tiges à l'hectare. Au regard de la grande sollicitation des services forestiers pour la fourniture de plants, l'inspection recommande et préconise la mise en place de pépinières locales. Ce projet d'aménagement du littoral constitue sans nul doute, un réel marché de plants forestiers et en l'occurrence de plants de *Casuarina equisetifolia* pour la pépinière à mettre en place. Les plants de filaos sont commercialisés entre 100 et 150 franc le pied d'environ 6 mois. Ce qui laisse penser qu'on peut avoir deux (2) cycles de production dans l'année. Toutefois, la plantation des filaos n'est favorable qu'en période saison des pluies ou à défaut disposer d'un moyen d'irrigation. Le Sénégal ne disposant que d'une saison pluvieuse et dans le cas précis de Malika, un seul cycle de production pourra être écoulé dans l'année.

2.2.3. La production florale

A Dakar, la floriculture est une activité pratiquée par de petits producteurs le long des axes routiers notamment : le boulevard du Centenaire de la commune de Dakar (ancienne Route de Rufisque), l'avenue Bourguiba, le long de l'autoroute (de l'aéroport à Mbao), la route de Ouakam, la rue Dial Diop. Des poches de floriculture naissent dans les cités résidentielles, surtout les quartiers habités par les couches aisées (Fann, Point E, Les Almadies, Mermoz, etc.) et les nouveaux quartiers (voie de dégagement Nord, Sacré Cœur 3, etc.).

Peu d'études statistiques ont été consacrées au secteur de la floriculture. La production de plantes florales n'a pas fait l'objet d'estimation quantitative, ce qui rend difficile une analyse conséquente du marché des plantes florales. Environ 410 exploitants ont été recensés en zone périurbaine et urbaine de Dakar le long des axes routiers. Ils sont constitués d'horticulteurs formés au centre de développement horticole (CDH) de Cambérène mais majoritairement constitués de migrants de l'intérieur du pays qui en font leur métier après une initiation au métier dans les exploitations comme ouvrier.

2.2.3.1. Les plantes d'appartement

Le marché des plantes d'appartement est généralement tourné vers les particuliers pour la décoration des intérieurs. Les citadins de Dakar accordent de plus en plus d'intérêt à la décoration intérieure des habitations par les plantes. L'extension croissante de Dakar vers les zones de Malika et Tivaouane Peulh laisse augurer un marché potentiel pour les plantes d'ornement.

2.2.3.2. Les plantes d'ornement

Il existe également un marché de production de plants pour l'ornement et l'entretien des espaces publics, la décoration des allées et bordures de route relevant des communes d'arrondissement et de la Ville de Dakar mais aussi de structures privées comme les ambassades, les hôtels. Les marchés sont généralement octroyés sous forme d'appel d'offres auxquels quelques rares producteurs soumissionnent. Ils sont plutôt sollicités comme sous traitant auprès de privés ou de structures ayant gagné des marchés de fourniture de plantes ornementales.

Les producteurs de plantes ornementales et d'appartement se sont regroupés en association Regroupement des professionnelles des plantes ornementales dans la zone des Niayes mais la structure ne présente pas un grand dynamisme organisationnel et structurel. Le niveau d'adhésion est très faible et n'a pas enregistré beaucoup d'activités.

2.2.3.3. Les fleurs coupées

La production de fleurs coupées est peu répandue à Dakar. On retrouve toutefois quelques unités de production de fleurs coupées comme *Sénégal Fleurs*, *Jacaranda* ou *Floricounda*. Celles ci s'activent aussi dans la production de plantes d'ornement et d'appartement. On y retrouve des chrysanthèmes, des roses, les marguerites, les lys, les crêtes de coq, les gypsophiles, les glaïeuls, les schisanthus… Ces unités disposent d'une pépinière locale qui produit essentiellement des tournesol et crêtes de coq mais importe le plus souvent leurs plants. La grande part des plants repiqués sont importés (mufliers, chrysanthème, gerbera). Les plants importés présentent une meilleure qualité que celle produite par la pépinière locale. C'est ce qui explique l'option faite par certaines entreprises comme Sénégal Fleurs d'importer les plants même si les coûts sont plus importants. Un potentiel marché de plants de fleurs coupées à travers ces structures de production de massifs de fleurs, d'arbres d'alignement ou ornementaux peut donc être présent à condition de produire des plants de qualité à la hauteur de ceux importés.

L'activité connaît un essor considérable avec l'accroissement de la demande en fleurs naturelles lors de cérémonies familiales telles que les mariages, baptêmes, mais surtout des diverses sollicitations d'ambassades, d'hôtels, de restaurant pour la décoration de salles de réception, de conférence ou autres.

Par ailleurs, la floriculture a aussi été identifiée parmi les grappes émergentes et prioritaires définies par le Sénégal dans sa stratégie de croissance accélérée. Ces grappes ciblées devraient permettre d'accélérer la croissance économique dans le court et le moyen terme, en tenant compte des attraits et des atouts, mais également des tendances du marché international et de la compétitivité des productions. La rigueur du marché international impose pour une production de classe internationale de disposer de bonnes semences et de plants de qualité. Aussi le développement de plants de haute facture agronomique commence par une production en pépinière de qualité.

L'activité nécessite néanmoins des investissements de grande envergure et des techniques culturales bien élaborées. Le climat chaud, poussiéreux, qui caractérise la majeure partie du territoire sénégalais, se prête peu à la culture des fleurs et nécessite la mise en place

d'ombrières ou de serres, alimentées par un réseau d'électricité pour réguler la dissémination de la lumière pour les plantes. Le mode d'alimentation en eau pratiqué est le goutte à goutte.

2.2.3.4. Structuration des prix

Les exploitations florales et de plantes ornementales produisent des glaïeuls, des oeillets, des bougainvilliers, les errantum, les troyennes, les cretons, la petosse, le Pelea, les Montserrat des gerberas, des roses, des plantes exotiques, des liliums. Les prix de ventes des plantes sont fonction de l'espèce, de la taille du plant et du conteneur. L'intervalle de prix est compris entre 100 et 3000 FCFA suivant les espèces.

En définitive, l'étude de marché révèle que la mise en place d'une pépinière permanente de production de plantes forestières, fruitières ou florales révèle qu'un marché potentiel s'offre à la pépinière des producteurs maraîchers de Malika. En effet, la proximité avec la grande zone de production fruitière des Niayes de Dakar et de Thiès offre une large opportunité d'écoulement de plants fruitiers issus de la pépinière. Le projet de rénovation de la bande de filao qui relie Dakar à Saint Louis et qui démarre par Malika fournit une possibilité de reboisement de deux hectares de filaos par an. En outre, l'extension de la ville de Dakar vers Malika et ses environs offre des capacités de développement de la production de plants d'appartement ou d'ornement pour les nouvelles habitations.

3. Faisabilité technique

La pépinière est une parcelle de terre dédiée à la multiplication des plants. Les plantes sont semées et élevées jusqu'au stade où elles sont aptes à être introduites à leur emplacement définitif. La technique développée pour ce projet vise à mettre en place une pépinière de type permanent dans une perspective de fourniture de plants forestiers, fruitiers, et d'ornement de qualité pour le marché local.

3.1. Besoins en bâtiments

Les besoins en bâtiments sont estimés ainsi qu'il suit :

- les bâtiments de stockage de petits matériels agricoles : ce bâtiment abritera les pelles, masques, brouettes, pioches, binettes. Il peut s'étendre sur un espace de 5m /3m soit environ 15 m2;

- le bâtiment de stockage de produits phytosanitaires. Cet espace de 3m/3m soit 9 m2 permettra de stocker les produits dangereux : pesticides, insecticides et acaricides ;

- les vestiaires : cet abri de 5m/3m soit 15 m2 servira de local pour le gardien et de vestiaires pour le personnel de la pépinière ;

- deux cabines de toilettes ;

- clôture de protection. Le périmètre de la pépinière devrait irrévocablement disposer d'une clôture de protection solide afin de faire face à toute forme d'intrusion ou d'occupation étrangère. Un mur de protection préserverait la pépinière de la divagation des animaux mais aurait aussi une fonction de brise vent essentiel pour la bonne croissance des plants. Le mur aura une hauteur de 1.5 m. Le coût du mètre linéaire est de 2000 FCFA.

Tableau 2
Coût des bâtiments

aménagement puits	375000	2	750 000
Sanitaires	650000	2	1 300 000
Magasins de stockage petit matériel	1500000	1	1 500 000
magasin stockage produits phytosanitaire	900000	1	900 000
Clôture	800000	1	800 000

3.2. Besoins en équipements

3.2.1. Sources d'eau

Afin de prendre en charge les besoins en eau de la structure, il sera aménagé deux puits. Les puits comporteront une buse en ciment avec un mode d'exhaure mécanique. La pompe mécanique et l'ensemble des accessoires est commercialisée à 200 000FCFA. Quelques particuliers s'activent dans le travail de forage de puits à Malika. Le prix du forage d'un puits de 14m de profondeur est estimé à 175 000 FCFA. Au total, l'aménagement du puits va couter 375 000 soit pour les 2 puits qui sont prévus : 750 000 FCFA

Tableau 3
Récapitulation des investissements en bâtiments

Désignation	Coût
Bâtiments	
Equipement	

3.2.2. Petits matériels agricoles

Les besoins en matériel agricole sont estimés ainsi qu'il suit :

- 10 pelles rondes ;
- 10 pelles carrés ;
- 4 brouettes ;
- 5 pioches ;
- 20 arrosoirs ;
- 5 binettes.

Tableau 4
Besoins en petits matériels agricoles

Désignation	Unité	Coût unitaire (FCFA)	Total (FCFA)
Pelles rondes	10	2 500	25 000
Pelles carrés	10	3 000	30 000
Brouettes	4	17 500	70 000
Pioches	5	4 500	22 500
Arrosoirs	20	6 000	120 000
Binettes	5	3 500	17 500
TOTAL			**285 000**

Le matériel doit être renouvelle chaque année.

3.2.3. Les conteneurs

Plusieurs types de conteneurs sont utilisés en pépinière selon la nature et la taille des plants. Les gaines plastiques sont les plus employées dans les pépinières locales. Les conteneurs de plants forestiers sont généralement les plus petits avec une hauteur de 15 cm et un diamètre de 5cm et les plants fruitiers contenus dans des gaines de dimension avec un diamètre de 15cm sur une hauteur de 25cm. S'agissant des plantes florales, suivant la taille et la nature du plant les deux types de conteneurs peuvent être utilisés. Pour les 9000 plants qui seront produits durant l'année, un nombre forfaitaire de 4500 conteneurs des deux formats est envisagé.

Les gaines plastiques sont commercialisées sous forme de paquets de 50 pour les petits modèles et des paquets de 100 pour les grands modèles.

Tableau 5
Besoins en conteneur

Nature des plants	Nbre de gaines	Diamètre des gaines	Nbre de paquets de gaines par cycle	Coût du paquet par cycle	Nombre de cycle par an	Coût Total
Plants forestiers	15 000	5cm de diamètre	300	900		270 000
Plants fruitiers	36 000	15cm de diamètre	360	3200		1 152 000
Plantes florales	9 000	5cm de diamètre	90	900		81 000
		15cm de diamètre	**45**	**3200**		**144 000**
Total						**1 647 000**

Le coût d'acquisition des gaines est de 1 647 000 FCFA par cycle de production.

3.2.4. Mélange terreux

La terre d'empotage en pépinière doit présenter les caractéristiques suivantes:

- elle doit être légère ;
- elle doit présenter une cohésion suffisante ;
- elle doit avoir une bonne capacité de rétention d'eau ;
- elle doit comporter une quantité importante de matières organiques ;
- elle doit être assez fertile ou rendue telle par l'addition de 2 kg de NPK/m^3 de terre.

Dans la majorité des pays à climat aride, un mélange d'une partie de sable, une partie d'argile et une partie de terreau doit convenir. La quantité de terre nécessaire pour un travail de pépinière à base de conteneurs est directement liée à la taille des conteneurs utilisés. Selon le guide délivré par la FAO pour les techniciens en pépinière, pour remplir 100 000 petits conteneurs, il faut 28 mètres cubes de terre; pour 100 000 des plus grands conteneurs, il faut 442 mètres cubes de terre, soit 16 fois plus. Si on applique ce modèle

comme méthode rapide pour estimer la quantité de terre nécessaire pour remplir les conteneurs en fonction du nombre de plants.

Pour les plants forestiers, les besoins en terre seront estimés à 4,2 mètres cubes de terre. Pour les plantes fruitières, ils sont évalués à 159 mètres cubes de terre et les plantes ornementales à 21 mètres cubes.

Au total, 184.2 mètres cubes de terre sont nécessaires pour la production de 60 000 plants de pépinière pour l'année. Le camion de $8m^3$ de sable de dunes est commercialisé à 50 000FCFA.

L'analyse sur le terreau de la décharge a révélé le fort potentiel agronomique du terreau de Mbeubeuss pour les végétaux à cycle long. Toutefois, les analyses physico-chimiques du terreau ont fait état d'une contamination du terreau de Mbeubeuss aux métaux lourds. Cette suspicion de contamination impose d'émettre des réserves quant à l'utilisation de ce terreau dans la production de plants fruitiers. Les plants fruitiers pourront être empotés sur un substrat ne comportant pas (pour des raisons de suspicion de présence de métaux lourds) de terreau de la décharge.

Toutefois, ce terreau pourrait être assurément être appliqué aux plants forestiers et ornementaux. Les exploitants du terreau établi dans la décharge commercialisent le terreau selon les tarifs ci-après :

Tableau 6
Coût du terreau produit à Mbeubeuss

Conteneur	**Prix (CFA)**
Camion de $10m^3$	50 000
Camion de $8m^3$	35 000
Camion de $4m^3$	25 000
Charrette	7 000
Sacs de 50kg	2 500
Sacs de 25kg	1250

Le mélange terreux utilisé pour l'empotage et le rempotage des plants fruitiers sera constitué par un terreau amélioré constitué par une association à base de :

- litière de filao (produite le long de la mer) ;
- fientes de volaille et/ou le fumier de cheval, ou d'ovin.

Ces intrant sont disponibles sur le marché de Malika à raison d'environ 3000F la charrette. Si on considère que le besoin en terreau est équivalent au besoin en terre, les besoins en terreau pour la production de plants fruitiers sont estimés à 159 mètres cubes.

3.2.5. Semences

La semence de qualité est exempte de poussière et de débris et ne comporte aucun parasite et agents pathogènes. Elle est surtout déterminée par son fort potentiel de germination. Les semences sont soit récoltées, soit obtenues à partir d'une bonne source nationale ou étrangère de semences. Pour assurer une bonne qualité de la semence, la récolte des fruits doit être effectuée à partir d'arbres qui possèdent les caractéristiques souhaitables.
Pour les plants forestiers, le service forestier à travers le Programme National Semences Forestières (PRONASEF) contribue à la diffusion de semences au plan national. Les semences forestières sont obtenues sur demande.

S’agissant des plants fruitiers, elles peuvent être obtenues par récolte ou auprès de fournisseurs

Afin de s’assurer de disposer des plants et des graines saines, il sera installé un parc semencier et un parc à bois. Le parc semencier sert à produire des semences de porte greffe et le parc à bois, les greffons nécessaires à la greffe des plants. Pour les fleurs, un carré de pied mère sera

Du fait de la difiiculté d’évaluer les semences nécessaires, un forfait de 200 000 frs CFA doit être budgétisé selon les techniciens.

3.2.6. Produits phytosanitaires

Deux types de produits phytosanitaires sont nécessaires dans la mise en œuvre de la pépinière. Il s’agit du Carbofuran, nécessaire pour la lutte contre les termites et des produits antiacridiens en cas d’attaque de sauteriaux. Les produits antiacridiens sont cédés gratuitement à la Direction de la Protection des Végétaux.

Le carbofuran est commercialisé à 3000 FCFA le kilo et les besoins sont estimés à 2 sacs de 25 kg.

3.2.7. Besoins en personnel

L’entretien de la pépinière nécessitera un travail permanent de deux ouvriers agricoles chargés des travaux quotidiens de la pépinière et d’un gardien du périmètre. Ces personnes pourraient être engagées parmi les membres de l’association. Dans la zone de Malika, les ouvriers agricoles journaliers sont rémunérés à 2000F/jour tandis que les permanents sont payés à 60 000F/ mois.

3.3. Contraintes du sous secteur

Il est important de rappeler que le Sénégal est un pays sahélien situé à l’Ouest du continent africain. Son économie repose principalement sur l’agriculture qui occupe 70% de la population active. Cette agriculture est fortement dépendante des aléas climatiques avec une pluviométrie moyenne estimée à 500 mm par an dans la région de Dakar.

L’activité de pépinière présente un certain nombre de contraintes qu’il convient d’énoncer :

- le foncier : la pression foncière à Dakar est telle que les terres agricoles de la ville de Dakar sont colonisées par les habitations. Les terres réservées à l’agriculture s’amenuisent d’année en année car les zones agricoles se situent là ou s’opère le développement de la ville ;

- l’approvisionnement en eau : la nappe devient de plus en plus profonde au large de Dakar et l’eau de plus en salée ;

- les attaques parasitaires ; en effet plusieurs maladies et ravageurs attaquent les végétaux dans la zone des Niayes ; pour les plants fruitiers, il s’agit plus fréquemment d’insectes (termites, mouches des fruits…) ; pour ce qui est des maladies, on peut noter l’anthracnose, le cercosporiose entre autre. Noter néanmoins que ces ennemis ne constituent pas un obstacle infranchissable, il existe des moyens de lutte chimique et culturaux appropriés pour les maintenir à des seuils tolérables.

4. Analyse financière

4.1. Les espèces produites

Le projet sera déployé sur un ha avec une production projetée de 60 000 pieds par an. La production sera répartie suivant les espèces identifiées dans l'étude technique:

Tableau 7
Répartition de la production

Nature des plants	Quantité	Valeur relative (%)
Plants fruitiers	36 000	60
Plants forestiers	15 000	25
Plantes florales et ornementales	9 000	15
Total	60 000	100

4.2. Les hypothèses de travail

L'analyse financière du projet s'appuie sur les données de l'étude technique au regard des hypothèses ci-dessus mentionnées dans le tableau N° 11

Tableau 8
Hypothèses de travail

Taux de déperdition jusqu'à la vente (%)	5
Durée commercialisation production et préparation cycle suivant	2 mois
Prix vente plant forestier	150
Prix de vente manguier	1 000
Prix de vente plant ornemental	100
Prix de vente agrume	1 000
Prix de vente divers	500
Achat gaine (conteneurs) OK	1 647 000
Achat semence OK	200 000
Petit équipement OK Pourquoi ce cout est repete dans le Table 12 ?	285 000
sable de dune	1 150 000
Terreaux	1 908 000
Produits phytosanitaires	150 000
Salaires mensuels 2 ouvriers et 1 gardien	180 000
Facture électricité/an	240 000
Facture eau/an	226 800
Coût expert en appui cout initial d'investissement	250 000

Coût formation cout initial d'investissement	400 000
Frais de location terrain 1 ha	2 500 000
Fonds de promotion **C'est quoi ?**	5 000 000
Impôts	0

Tous les couts dans ce tableau sont des couts annuels ?

Les couts annuels d'operation semblent se totaliser a (sans le fonds de promotion) : 9,136,800 – 650,000.

Par principe de prudence, l'analyse est réalisée sur la base des prix plancher recensés dans l'étude de marché.

4.3. Les investissements nécessaires

Les investissements initiaux portent sur les bâtiments. Ils intègrent aussi le fonds de roulement.

Tableau 9
Besoins en investissement initiaux

	PU	NOMBRE	TOTAL
Terrain	0	0	-
amenagement puits	375000	2	750 000
Sanitaires	650000	2	1 300 000
Magasins de stockage petit matériel	1500000	1	1 500 000
magasin stockage produits phyto	900000	1	900 000
Clôture	800000	1	800 000
frais de constitution gie	79000	1	79 000
raccordement electricité	19000	1	19 000
Petits matériel	285000	1	285 000
Raccordement eau	17000	1	17 000
Fonds de roulement			11 732 300
Total y compris fonds de roulement			**17 382 300**

Le petit matériel ne fait pas l'objet d'un amortissement du fait que l'on considère qu'il est renouvelé au cours de chaque cycle de production. Il est pris en charge dans les postes de fonctionnement. Les équipements pris en charge sont formés par le puits et son équipement ainsi que le matériel d'arrosage et de pompage.

Le fonds de roulement est calculé sur un an afin de prendre en charge les besoins sur le cycle de production et la période de commercialisation de la production qui peut durer 2 mois au moins. Au total, le cycle de production commercialisation et la préparation du cycle suivant est estimée à 12 mois.

4.4. Le budget de mise en œuvre

Le tableau ci après prend en charge les données contenues dans l'étude technique du projet.

Tableau 2
Besoins de démarrage

Achat gaine par an	1 647 000
Achat semence par an	200 000
Petit équipement par an	285 000
Sable de dune par an	1 150 000
Terreaux par an	1 908 000
Produits phytosanitaires par an	150 000
Salaires mensuel 2 ouvriers et 1 gardien	180 000
Facture électricité/an	240 000
Facture eau/an pour le fonctionnement des toilettes	226 800
Coût expert en appui pour la première année	250 000
Location terrain 1 ha	2 500 000
Coût formation durant la première année	400 000
Fonds de promotion	5 000 000

Le besoin en fonds de roulement calculé sur l'année est de 11 732 300 Frs non pris en charge le fonds de promotion de 5 000 000 Frs qui sera une ligne de crédit que le projet pourra loger dans une institution de micro finances.

4.5. Les résultats

Couts										
Couts d'investissement	4,365,000									
Couts annuels	-	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800
Cout total	4,365,000	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800	9,136,800
Revenus										
Ventes de plants 1	-	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000
Ventes de plants 2		18,000,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,000
Revenus totaux 1	-	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000	37,000,000
Revenus totaux 2		18,000,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,000
Revenus nets annuels 1	(4,365,000)	27,863,200	27,863,200	27,863,200	27,863,200	27,863,200	27,863,200	27,863,200	27,863,200	27,863,200
Revenus nets annuels 2	(4,365,000)	8,863,200	8,863,200	8,863,200	8,863,200	8,863,200	8,863,200	8,863,200	8,863,200	8,863,200

Valeur présente nette (CFA)

	VPN 1	VNP 2
3%	185,656,395.55	56,166,927.98
4%	176,183,477.88	53,181,408.05
5%	167,353,133.10	50,399,759.36
6%	159,112,949.92	47,805,325.01
7%	151,415,406.11	45,383,002.73
8%	144,217,361.31	43,119,083.60
9%	137,479,607.30	41,001,108.97
10%	131,166,468.76	39,017,743.52

Conclusion

Le présent projet se propose de mettre en place une pépinière de production de plantes florales, fruitières et forestières à l'intention des producteurs maraîchers de Malika. Sur une superficie totale de 1 hectare, cette pépinière ambitionne de produire 60 000 plants l'année dont 60% seront réservés à la production de plantes fruitières, 25% pour les plantes forestières et 15% pour les plantes d'appartement et d'ornement. Le revenu net de la première année d'exploitation est de 25 000 000 Frs.

La production fruitière sera essentiellement destinée aux vergers de la zone des Niayes mais pourra approvisionner toutes les demandes de l'intérieur du pays. Le projet de rénovation et d'aménagement de la bande de filao sur le littoral Nord allant de Dakar à Saint Louis offre une opportunité de marché de plants de *casuarina equitifolia* notamment à l'intention du groupement forestier de Malika qui a conclut un accord avec l'inspection régionale des eaux et forêts de Dakar pour le reboisement de 2 hectares par année. Les plantes d'ornement et d'appartement pourraient trouver un marché favorable dans la nouvelle zone d'extension de la ville.

La pépinière communautaire constituera un projet-école pour les producteurs de Malika. Les maraîchers intéressés à se reconvertir dans l'exploitation de pépinières de plantes florales et forestières et disposant déjà de parcelles pourraient bénéficier d'une ligne de crédit pour leur faciliter l'accès aux intrants et la réalisation de petits travaux d'adaptation dans leurs parcelles maraîchères. Elle sera gérée de manière collégiale par un comité de gestion qui comprendra deux sous comités : un sous comité de production et un sous comité de commercialisation.