CDM Project Potential in the Poultry Waste Management Sector in Bangladesh

Waste Concern

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PREFACE

This report is part of the "Community Based Urban Solid Waste Management in Dhaka being conducted by Waste Concern as Sub Implementing Agency (SIA) for Component 3.3.2 of SEMP.
This report has been prepared by Ijaz Hossain, Chemical Engineering Department, BUET as a Short Consultant for Waste Concern under the Sustainable Environmental Management Project (SEMP) of the UNDP.

This report deals with the prospects of CDM project in the poultry waste management sector in the adjoining areas of the Dhaka city. The report is based on both primary and secondary data. However, the primary data was collected through very limited visits to poultry farms, and the purpose was only to crosscheck the secondary data. Extensive use of Internet resources was made. Given the scope of work this report should be considered to be a pre-feasibility.

EXECUTIVE SUMMARY

This report has investigated the possibilities of doing CDM projects using poultry waste in and around Dhaka city. The report is based on a combination of secondary and primary data. The opportunities in the poultry waste sector arise out of the fact that the present disposal methods are environmentally unsound. Moreover the use of a renewable resource, which would otherwise emit methane due to anaerobic decomposition, makes this a potential area for CDM.

Analysis of the present disposal methods reveal that poultry waste is left in the ground for 6 to 12 months before being used as a fertilizer. No clear-cut methodology could be found either in the IPCC guidelines or in the methodologies approved by EB, UNFCCC. The baseline for CDM projects where methane avoidance is considered was difficult to establish. It is therefore recommended that a baseline study be undertaken. Some CDM options have been analyzed using the 8 months methane avoidance baseline. However, this baseline yields very limited subsidy from CERs, and in most cases adds about 2% to the IRR.

At the present time (2005), 2 million tons of poultry manure is produced in two areas adjoining the Dhaka city. If approximately half of that can be utilized then 5-10 small to medium sized CDM projects can be developed. The following CDM options have been investigated in this report.

(i) COMPOSTING – Converting the manure into a fertilizer by aerobic composting
(ii) DIGESTION – Production of biogas from anaerobic decomposition of poultry manure for use in gas-engine electric generators plus conversion of the digester slurry into a fertilizer
(iii) INCINERATION – Incinerate poultry litter to produce steam to run steam turbine electric generator, and additionally produce potash fertilizer from the ash

The most noteworthy barrier that was identified was the high price of poultry waste in certain areas of the country (Taka 1/kg). It was found that if poultry waste has to be purchased then no option even with CDM subsidy is possible. However, if an owner of a large poultry farm decides to do a CDM project by purchasing not more than 50% of the waste, then cost effective CDM projects can be developed. Based on the preliminary findings of this report, composting was judged to be the most suitable option, both from profitability and ease of management points of view.

The following is a summary of the three CDM options.

CDM OPTION	FINANCIAL IRR	COMMENTS
1. Digestion of Poultry Manure (100 – 200 t/d)	8.9% 10.2% (with CER)	1. Good management critical 2. Low electricity prices + no assurance of utility purchase
2. Incineration of Poultry Litter (200+ t/d)	10.4% 11.6% (with CER)	1. Local air pollution issues 2. Very high initial investment 3. Loss of organic fertilizer 4. Low electricity prices + no assurance of utility purchase
3. Composting of Poultry Manure (50 – 100 t/d)	13.9% 17.8% (with CER)	1. Extremely simple technology 2. Easy management

1.0 Introduction

This report investigates the problems and prospects of doing CDM projects in the poultry waste disposal or utilization sector in Bangladesh. However, within the scope of the work this report merely lays down the boundaries of the issues involved in CDM project development using poultry waste. The report does not go into details of the technical description of any disposal/utilization options available for poultry waste. To develop CDM projects more comprehensive and detailed studies, i.e., feasibility studies, in each suggested CDM area would be required. The report has the following objectives

(i) Present an overview of the poultry industry in Bangladesh
(ii) Discuss the growth of the poultry industry in Bangladesh
(iii) Estimate the amount of waste generated from the poultry industry
(iv) List and comment on the existing disposal/utilization methods available for poultry waste in Bangladesh
(v) Document the existing problems with poultry waste in Bangladesh
(vi) Identify the best method for dealing with poultry waste
(vii) Investigate the CDM technical options using poultry waste
(viii) Present three best CDM profiles
(ix) Make overall comments on the poultry waste issue in Bangladesh with respect to CDM

The poultry industry has seen phenomenal growth worldwide. This fast growth has inevitably resulted in various problems especially in the environmental side because rapid transformation in environmental management is not possible. Guru (2005) has analyzed poultry waste management in the United States and has summarized the issues as follows – "The concentration of poultry production systems has increased the efficiency and overall economic return for poultry producers. This concentration, along with the advent of commercial fertilizers, has led to a change in the way chicken producers now view manure. Manure, once valued as a resource by farmers, is now often treated as a waste. Environmental concerns that arise primarily from the under-utilization or inefficient use of poultry litter contribute to these changing views. However, when properly used and utilized, manure is a resource and should be managed and regulated as such."

The lack of good data in Bangladesh makes it extremely difficult to make a good assessment of CDM potential in the poultry waste sector. Guru (2005) summarizes the data requirement for assessing poultry waste management as follows.

1. Number and location of poultry farms
2. Number of chicken raised at each farm during the year
3. Total waste produced each year
4. Analysis of poultry litter
5. Areas where poultry litter is spread, and
6. Soil analysis of areas where poultry litter is spread.

The total number of poultry farms (as a rough estimate) is probably the only data that is available in Bangladesh. With respect to the location of these farms, there is some countrywide breakdown available, but it is certainly not detailed enough to be used for any reliable assessment. However, since commercial poultry meat and eggs are predominantly consumed in urban areas, the locations of these farms are within 20 to 50 kilometers from the outskirts of the large urban centers. Of the urban centers, obviously the largest share would belong to Dhaka, which is the capital city and by far the largest commercial center. It would not be an incorrect estimate to assume that at least 50% of the total farms of the country are located in areas 100 kilometers from

the Dhaka city. Since Dhaka is very well connected, it is very easily possible to supply Dhaka city from a distance of even 100 kilometers. Three poultry farm concentrations can be identified – Savar, Sreepur/Bhaluka and Keraniganj (Figures 1 and 2). Therefore, it may be assumed that more than 90% of the Dhaka region poultry waste (assumed to be 50% of the Bangladesh total) will be available in these three areas. These locations can be targeted for setting up poultry waste utilization units.

The other data, i.e., analysis of poultry waste and soil analysis are available for very limited cases. With respect to spreading of poultry waste, the data is unclear because land where waste can be spread in Bangladesh is almost non-existent. There is no record of poultry waste being used in any large extent as cropland fertilizer.

An important criterion for CDM projects is investment additionality, i.e., the project must not have favorable profitability without CDM subsidy. The investment additionality justification for poultry waste CDM projects is very well captured by the following analysis provided by Guru (2005) of the University of Arkansas – "A key component of the affected areas is the excess poultry litter generated in its watershed. Excess litter is considered a waste in these watersheds, not a resource to be used as a fertilizer. Therefore, a major solution to the problem would be to transport the litter out of sensitive watersheds and into watersheds that could beneficially utilize it. However, the economies of such an option may not (be) viable. **Therefore, poultry litter marketing needs a subsidy**. If the public lends support to this off-farm management option, litter management can significant(ly) minimize environmental impacts of the poultry industry."

2.0 Methodology

This report is based on both primary and secondary data. The primary data was collected in the following three ways.

(i) Visit to poultry farms
(ii) Discussion with poultry farm managers/owners
(iii) Consultation with poultry experts and consultants

The consultant undertook field visits to the two largest farms in Bangladesh, namely, BRAC poultry farm in Bhaluka and Kazi Farms in Sreepur. In addition, the consultant visited two composting facilities in Bhaluka and Sreepur. Figure 1 shows the two data collection locations in a map of Bangladesh, while Figure 2 shows the poultry farm concentrations in the adjoining areas of Dhaka city.

The consultant through telephone conversations and face-to-face meetings with several poultry farm owners extracted their perspective on the growth of the poultry sector and waste management.

The third source of primary information was a group of consultants preparing a report on sustainable renewable energy under an UNDP funded project entitled "Sustainable Environment Management Project" (SEMP). Since the focus of the study was renewable and sustainable energy, it looked quite closely at poultry waste. The consultant (author) benefited from in-depth discussions with the experts/consultants of the SEMP project regarding utilization of poultry waste.

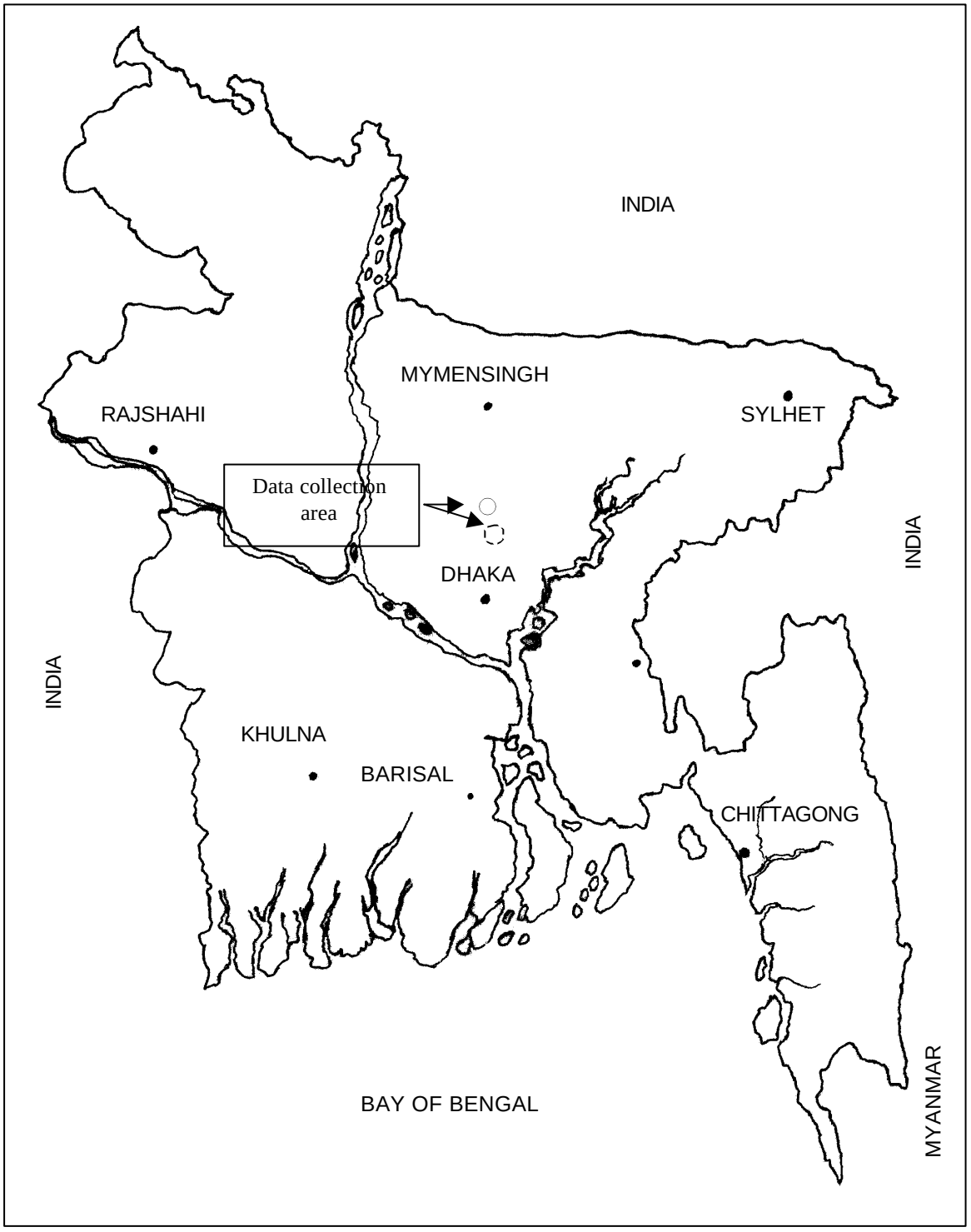

Figure 1 Map of Bangladesh Showing the Data Collection Locations

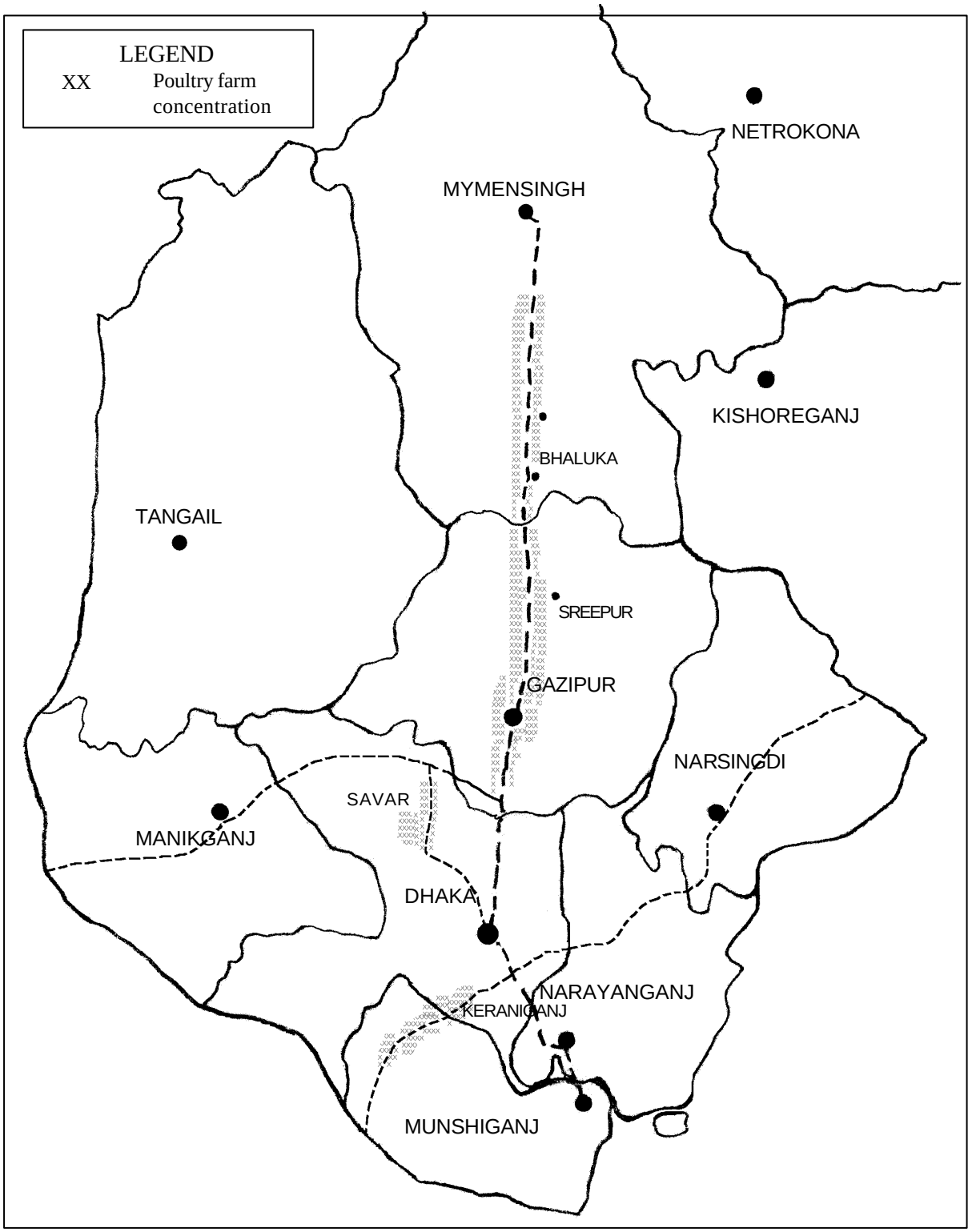

Figure 2 Dhaka City and its Adjoining Areas Showing Poultry Farm Concentrations

3.0 Overview of Poultry Sector in Bangladesh

In the last two decades the poultry industry has grown from a handful of medium sized operations to a large industry. Poultry farms having sizes ranging from a few hundred birds to several hundred thousand birds are mushrooming throughout the country. This phenomenal growth has resulted from the decline in the supply of the other two protein sources, namely, fish and beef. The decline of the fishing industry has been the result of filling up of ponds and the general insecurity of investments in rural areas. Even though fish farms have substituted much of the lost supply, the availability of fish has declined significantly. The high price of most species of fish is the clearest evidence of that. The supply of cattle was always fairly low, and it is the import from neighboring India that has held up the supply. The most readily available and affordable protein is poultry.

It is extremely difficult to get reliable estimates of poultry farms in Bangladesh. Figures as high as 50,000 have been quoted by some. The best estimates of the number of birds in commercial poultry farms for the year 2000 are due to Islam (2003). In Islam's very detailed study on the grain requirements for poultry feed, the author has presented an estimate of poultry in Bangladesh. Table 1 shows the data for the year 2000 as provided in Islam's paper (Islam, 2003). The projected figures calculated by Islam (2003) for the year 2005 appear too low considering the very rapid growth experienced by the sector in recent years. To arrive at more realistic 2005 figures, 6% growth rates for both layers and broilers have been used. Industry analysts are the sources for these growth rates. It is worth pointing out that the figures shown in Table 1 denote the number of birds alive at any given time, and is the figure relevant for this study because the waste on a 365 days basis is produced from this number of birds. It should not be confused with the total number of birds consumed in Bangladesh in a given year. The number of broilers that will be consumed in the year 2005 is over 100 million. This figure differs from that in Table 1 because broilers have a life cycle of only 30-40 days. The number of layers that will eventually get consumed at the end of their egg-laying cycle in 2005 is less than the 46 million shown in Table 1 because the life cycle of a layer is nearly one and a half years.

For the purpose of calculating the overall potential of CDM projects an estimate of the amount of waste produced from poultry farms in Bangladesh need to be computed. Since no reliable data exist, the best estimate would be to use an average per bird dropping. Data collected from several poultry farms – and crosschecked with data available in the Internet – reveal the following daily droppings rate.

Type of Chicken	**Dropping per day**
Layer	136 gm of Manure at 75% moisture
Broiler	40 gm of Litter at 25% moisture

The projection of poultry manure is based on annual growth rates of birds of 5, 4 and 3% for the years 2006-2010, 2011-2015 and 2016-2020 respectively. These growth rates are the best estimates available from industry analysts and poultry farm owners. *The GHG emissions are calculated on the basis of 8 months methane production at the rate of 10 liters of methane per kg of manure*. These projected values of manure and emissions are shown in Table 2.

Table 1 Estimates of Poultry Farms, Layers and Broilers in Bangladesh

	Year 2000	Year 2005
Poultry Farms	23,000	25,400 (using 2% growth rate)
Layers	34 million	45.5 million (using a 6% growth rate)
Broilers	8 million	10.7 million (using 6% growth rate)

Source: Year 2000 data from Islam (2003). Year 2005 projection performed using expert judgment after consultation with industry experts and analysts

Table 2 Projections of Poultry Litter and Manure and GHG Emissions per Year

	2005	2010	2015	2020
Litter (25% moisture, no bedding material) (million tons)	0.156	0.199	0.242	0.281
Manure (75% moisture) (million tons)	2.26	2.88	3.50	4.06
CH_4 Emission (tons)	10200	13000	15750	18300
CO_2 eq. Emission (tons)	214000	273000	331000	384000

Source: Expert judgment after consultation with industry experts and analysts

4.0 Options For Poultry Waste Management

The issue of poultry litter management is very well summarized by Guru (2005) of the University of Arkansas – "Ownership of poultry litter may be considered an advantage as well as a disadvantage because farmers face a conflict between owning and using the poultry litter as a resource (i.e., fertilizer), and having to manage excessive quantities of poultry litter. Historically, growers have taken responsibility for all poultry litter generated from poultry production. However, many growers have neither the technical capacity nor the financial resources to handle the poultry litter generated from today's intense production levels."

To understand poultry waste management, it is important at the very outset to make a clear distinction between poultry waste coming from Layers and Broilers. The Ohio State University Bulletin (Naber and Bermudez, 1990) provides a very useful description of the two types of waste and the resulting consequences when using litter as a fertilizer.

"The primary difference between a cage layer manure and broiler and turkey manure is that the broiler and turkey manure is diluted with litter material. Under most circumstances this results in a manure containing mixture that is easier to handle because it is usually drier and has fewer problems with odor and insect control than pure manure. When this material is used as a fertilizer and soil conditioner, the dilution of the manure with the litter material should be considered. An analysis of the used litter for nitrogen, phosphorus and potassium should be used as the basis for the application rate to soils. In most cases, the dilution of the manure with litter means that substantially higher rates of application of the used litter can be used than those previously suggested for cage layer manure."

The differences between poultry litter (that which comes from broilers) and poultry manure (that which comes from cage layers) is summarized in Table 3.

Table 3 Comparison Between Waste From Layers and Broilers

Factors	Layers	Broilers
How kept	Elevated cages	Free movement on a large floor
Bedding	No bedding	4 in. of bedding usually rice husk or saw dust
How waste is collected	Waste falls on cement floor	Waste falls on bedding
How long waste remains in the area where it is dropped	Waste cleaned at regular interval either by raking or by a jet of water	Waste remains mixed with bedding material until the broilers are removed (40-45 days)
State of the waste	Semi-solid in fresh state	Fairly composted
Smell and Handling	Smelly and difficult to handle	Mild odor; mixed with bedding material easy to handle
Disposal suitability	Good for digestion, or composting after C balancing	Good for composting or incineration

Table 3 clearly demonstrates that the wastes generated from the two types of chicken are not the same. This DIFFERENCE is EMPHASIZED in this report. As a result of this difference management practices are very different for the two types of waste. This difference in waste management also implies that different types of CDM projects should be considered for the two types of wastes. In the following paragraphs the information available for poultry waste management are summarized.

Worldwide there are five methods of dealing with poultry waste, and these are.

1. Spreading it in fields without much treatment
2. Composting and using the compost as a fertilizer with or without balancing
3. Use as a feed for ruminants
4. Digestion to produce biogas for a variety of uses including power generation, and producing fertilizer from the digester slurry
5. Incineration to generate heat or produce electricity

These five uses are briefly described below.

<u>Spreading it in fields without much treatment</u>

Undoubtedly the easiest and cheapest option for disposal is spreading waste in fields. This has long been practiced in the USA where land availability has not been an issue. But in recent times, when concentrations of poultry farms started to develop, this option started to become limited. The primary reason behind this is the emerging evidence that there are dangers to over-application of poultry manure to croplands. The Rural NI Portal (2005) mentions the following three problems associated with over-application of poultry manure to cropland.

1. Surface and ground water pollution
2. Aesthetic problems with odors and insects
3. Over accumulation of manure and trace elements leading to reduced crop yields.

The above data resource further states that – "As the manure cannot be applied immediately it has to be stockpiled on the farm, which leads to the problem of space requirement and the manure blowing around the farmyard as it is quite dry."

Composting and using the compost as a fertilizer with or without balancing

It has long been recognized that poultry manure and litter is a good source of plant nutrient mainly nitrogen (N), phosphorus (P) and potassium (K). In addition, poultry waste also contains calcium, magnesium, sulfur and some micronutrients. This knowledge has resulted in fairy widespread use of poultry waste as a fertilizer produced from composting. Several excellent websites are available that deal with poultry waste management. Virginia Cooperative Extension (Mullins and Bendfeldt, 2005) provides good information on poultry litter. Box 1 summaries the potential uses of poultry litter as fertilizer and soil amendment, while Box 2 gives the additional benefits. The additional benefits of poultry waste described in Box 2 are very significant for Bangladesh. This reason for this is that Bangladesh is suffering from depletion of organic content of soils.

BOX 1 Potential Uses For Poultry Litter as a Fertilizer and Soil Amendment

- Crop, pasture, and hay lands
- As a topdressing for lawns, ball fields, golf courses, and other landscapes, particularly if properly composted and screened.
- Land reclamation (e.g., roadside, construction, and mineland)
- Plantation forestry

Source - G. L. Mullins & E. S. Bendfelt (Virginia Cooperative Extension)

BOX 2 Additional Benefits: Organic Matter and pH

Soil organic matter has a positive effect on soil structure, tilth, water-holding capacity, aeration, pH buffering, cation exchange capacity, and microbial activity. Poultry litter contains a considerable amount of organic matter due to the manure and bedding material. Litter can also have an impact on soil pH and liming due to varying amounts of calcium carbonate in poultry feed

Source - G. L. Mullins & E. S. Bendfelt (Virginia Cooperative Extension)

Use as a feed for ruminants

The use of poultry waste as a feed amendment for ruminants is an age-old practice. However, in recent times, the dangers of such practice have become more apparent. This practice is certain to be banned worldwide, and therefore, can be neglected from consideration.

Digestion to produce biogas and fertilizer from the digester slurry

Even though literature on this issue is vast, the prognosis is not clear. Fulhage et al. (2005) best summarize the issue of digesters as follows.

"At first glance, the idea of generating methane gas has considerable merit because it appears to offer at least a partial solution to two pressing problems – the environmental crisis and the energy shortage. Unfortunately, present-day large-scale methane generation requires rather high investments in money and management which considerably reduce the practicality of the idea for the farmer."

Others have also expressed similar views. Hansen (2004) of the Colorado State University Cooperative Extension says "Primarily, disadvantages are the amount of management required due to the sensitivity of the digesters, the high initial investment required for equipment, and the fact that the wastes still must be disposed of after digestion." With respect to its future, Hansen (2004) states – "Research is in progress to make the process more practical for energy production. Bacteriologists are investigating new strains of bacteria and culturing techniques for producing methane. Engineers are investigating digester designs and operation to reduce construction and operational requirements and costs."

Incineration to generate heat or produce electricity

Incineration of poultry litter has been receiving a lot of attention in recent times. Litter (unlike manure) is an excellent fuel because of the presence of bedding material. Its heat content is higher than firewood and therefore lends itself to good combustion. Even though incineration of poultry waste is practically non-existent in the USA, it is fairly common in the UK. Fibrowatt (EPRL, 2005) operates several power plants using poultry litter. However, an environmental watchdog called Energy Justice Network (Ewall, 2004) warns of the dangers of poultry litter incineration as follows – "Poultry waste is NOT a clean fuel. Biomass is NOT "green" energy".

5.0 Poultry Waste Management In Bangladesh

5.1 Disposal Methods in Bangladesh

Poultry waste management in Bangladesh can best be described as non-existent, or at best being ad-hoc. The problems with poultry waste have in recent years become so critical that many efforts are underway to solve the problem in a cost-effective manner. Up to the time when the wastes generated by the poultry farms were below the local environment's absorbing capacity, the problem remained by and large ignored. But just like other similar environmental issues, the pollution load of poultry waste in certain areas of concentrated farms has become so great that poultry farm owners are beginning to understand the problem, and for the first time, are prepared to pay for effective disposal.

Small farm owners are able to deal with the waste by allowing it to compost in their own land. However, in most cases the waste is sold off. The following existing disposal methods have been identified.

(1) Dumping on low ground in and around the poultry farm
(2) Sold to farmers as fertilizers
(3) Sold off as fish feed
(4) Sold off as cooking fuel
(5) Sold off to compost manufacturers
(6) Used in digesters

These are discussed below.

Dumping on low ground in adjoining areas of the poultry farm

This is probably the most prevalent practice especially in the small farms. As it happens this is the most cost-effective solution if enough space is available. Large farms are usually built having a fair amount of spare land, and can therefore easily devote a portion for waste disposal. Small farms on the other hand are built under extremely tight conditions, and it is here that most of the problem lies. These farms invariably tend to dump their waste onto other people's land adjoining the farm. The adjoining plots, some of which are dwellings, are severely affected by smell, dust and surface water pollution. In many place the neighbors have lodged serious complaints.

Dumping on heaped pile and allowed to compost

Farmers compost the purchased waste in their own land by dumping on heaped piles. This practice is an extension of the illegal dumping practice described above, but is the more environmentally sustainable one. The Dumping option is clearly a function of adequate land availability and awareness of the issues involved. However, most of this crude composting practice is haphazard and does not produce a good fertilizer, and more importantly, does not kill all the pathogens. Compared to open dumping, this practice produces much less nuisance like smell, flies, dust and rodents.

Sold off as fish feed

One of the most common uses of poultry litter in Bangladesh is as a fish feed. However, this activity is pursued through an informal channel with no well-established market mechanism. As far as it could be gathered, fish farmers on individual basis make contacts with nearby poultry farms and purchase the litter. The application procedure involves allowing the litter to slowly leach out from jute bags placed on the sides of the ponds. In the earlier days of this practice, some inexperienced fish farmers dumped litter straight into the pond. This sudden addition of large quantity of litter caused large increases in the BOD of the water and killed off most of the fishes. Over time farmers have learnt that a very slow addition method must be employed. In this application, the litter stimulates the growth of algae, which is a good fish feed. Fishes usually do not consume the litter.

Sold off as cooking fuel

This is an extremely specialized use, and has been reported only from Keraniganj at the outskirts of Dhaka city. The shortage of cooking fuels has in many places forced people to look for alternatives. The high heat content of poultry litter (because of the presence of bedding material – rice husk in Bangladesh) makes it an ideal fuel for many purposes. Some innovative people in the Keraniganj area have somehow discovered this property of poultry litter, and have spontaneously developed an appropriate use for it. It is likely that in other areas of the country where cooking fuel is scarce, this practice is also prevalent. Use of cow dung as a cooking fuel is an ancient

practice all over the Indian Subcontinent. Therefore, use of poultry litter should come as no surprise. The only point here is that poultry litter because of the high protein diet given to chicken, is not as harmless as cow dung.

Sold off to compost manufacturers

This is also a very new practice. The increasing difficulty of disposing large quantities of poultry litter has opened up the scope of converting it into a valuable fertilizer. Even though the production steps are straightforward, the correct understanding of the process has not become clear to the compost manufacturers. Despite this being a universally recognized utilization method for poultry manure and litter, its use in Bangladesh is only just beginning.

Used in digesters

Digesting poultry waste in anaerobic digesters is a well-known option. Several efforts have been launched mainly by BCSIR and LGED to popularize this technology. However, a successfully operating one could not be found. Very recently, a private entrepreneur in the Pabna region has set up a large digester, which is reportedly working well.

From the above discussion it should be clear that there are clearly a variety of ways of using/disposing off poultry waste. The issue of poultry waste disposal arises in situations where there is a large concentration of poultry farms in one area. This problem becomes even more critical when not enough agricultural and fish-farming activities are located nearby. In such situations some sort of an effort must be taken to dispose off the waste in an environmentally safe manner. It is very difficult in the absence of reliable data to ascertain the proportion of each of the above six waste management techniques employed at present in Bangladesh. However, using expert judgment based of consultations with industry experts, an attempt has been made to ascertain this proportion, and that is summarized in Table 4.

Table 4 Proportion of Different Poultry Waste Disposal Methods In Bangladesh

Use/Disposal method	Percentage	Comments
Dumping on low ground in and around the poultry farm	> 30%	Most prevalent, and cause of complaints from neighbors
Dumping on heaped piles and allowed to compost	> 35%	Land availability is the key issue. If assistance can be provided, this can be the most cost effective disposal method
Sold off to be used as fish feed (mainly litter)	~ 20%	The impact of this practice especially on the water bodies have not been studied
Sold off to be used as cooking fuel (litter only)	< 5%	Expected to be polluting, but in a fuel scarce scenario this practice is bound to be popular
Sold off to compost manufacturers	< 5%	Not enough compost manufacturers and not cost effective
Used in on-site digesters (manure only)	< 5%	Complicated practice. The performance of the existing ones need careful and critical evaluation

Source: Compiled by author after consultation with poultry owners

5.2 Environmental Impacts of Poultry Waste Disposal

From the above discussions it should be clear that none of the existing practices are acceptable waste disposal methods. Figures 3 to 8 show the environmental impacts of the existing practices, while Table 5 summarizes the major environmental impacts.

Table 5 Major Environmental Impacts of Existing Poultry Waste Disposal Practices

No.	Disposal Methods	Major Environmental Impacts	Mitigation Measures
1	Dumping on low ground in and around the poultry farm	Problems with Odor, Water Contamination and Insects/vermin	Practice should be discouraged
2	Dumping on heaped pile and allowed to compost	Odor, water pollution and Insects/vermin	Proper composting technique should be taught to the farmers
3	Sold off as fish feed	Water pollution and over-fertilization	BOD testing and controlled discharge should be practiced
4	Sold off as cooking fuel	Indoor air pollution	Adequate ventilation should be ensured
5	Sold off to compost manufacturers	Minimal, only slight problem during transportation	Use of covered trucks to minimize odor and spillage
6	Used in digesters	Minimal, but only if all handling measures are adopted	Proper handling in all stages of the operation

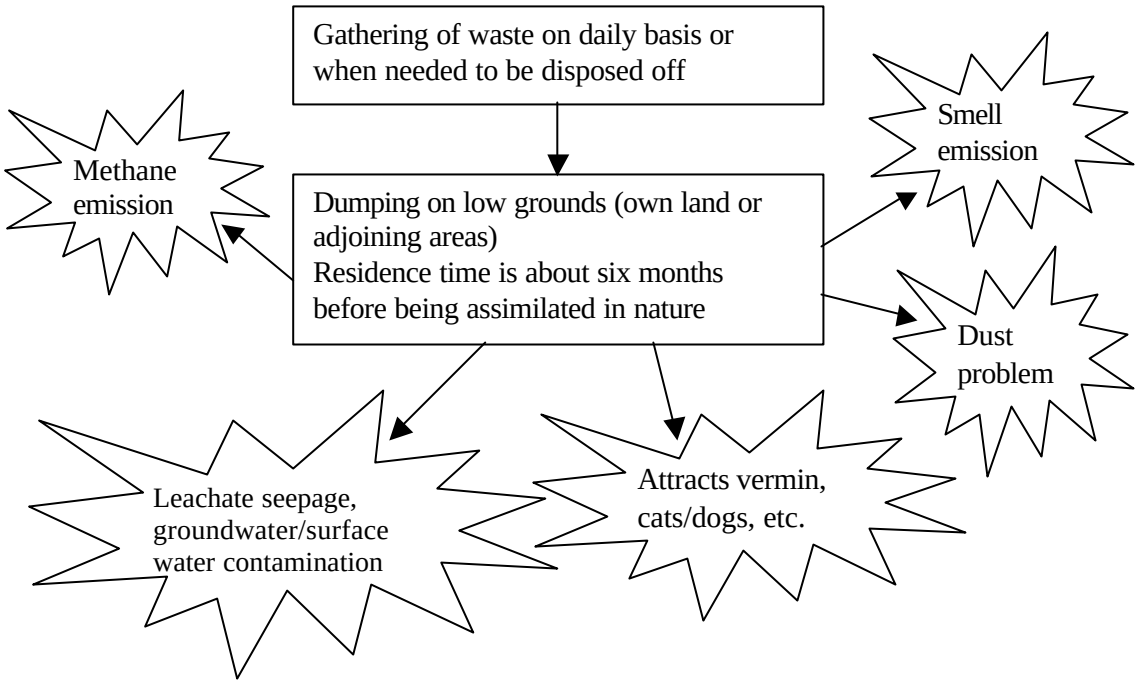

Figure 3 Environmental Impacts of Dumping Poultry Waste on Low Grounds in Areas Adjoining the Poultry Farm

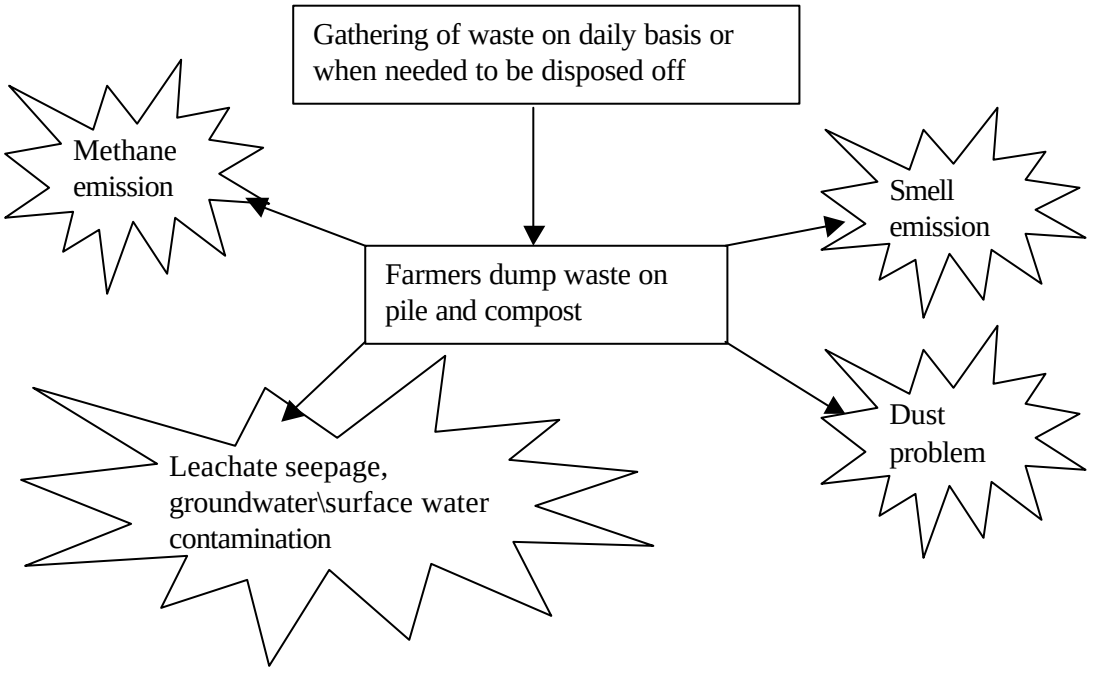

Figure 4 Environmental Impacts of Dumping Poultry Waste on Heaped Piles

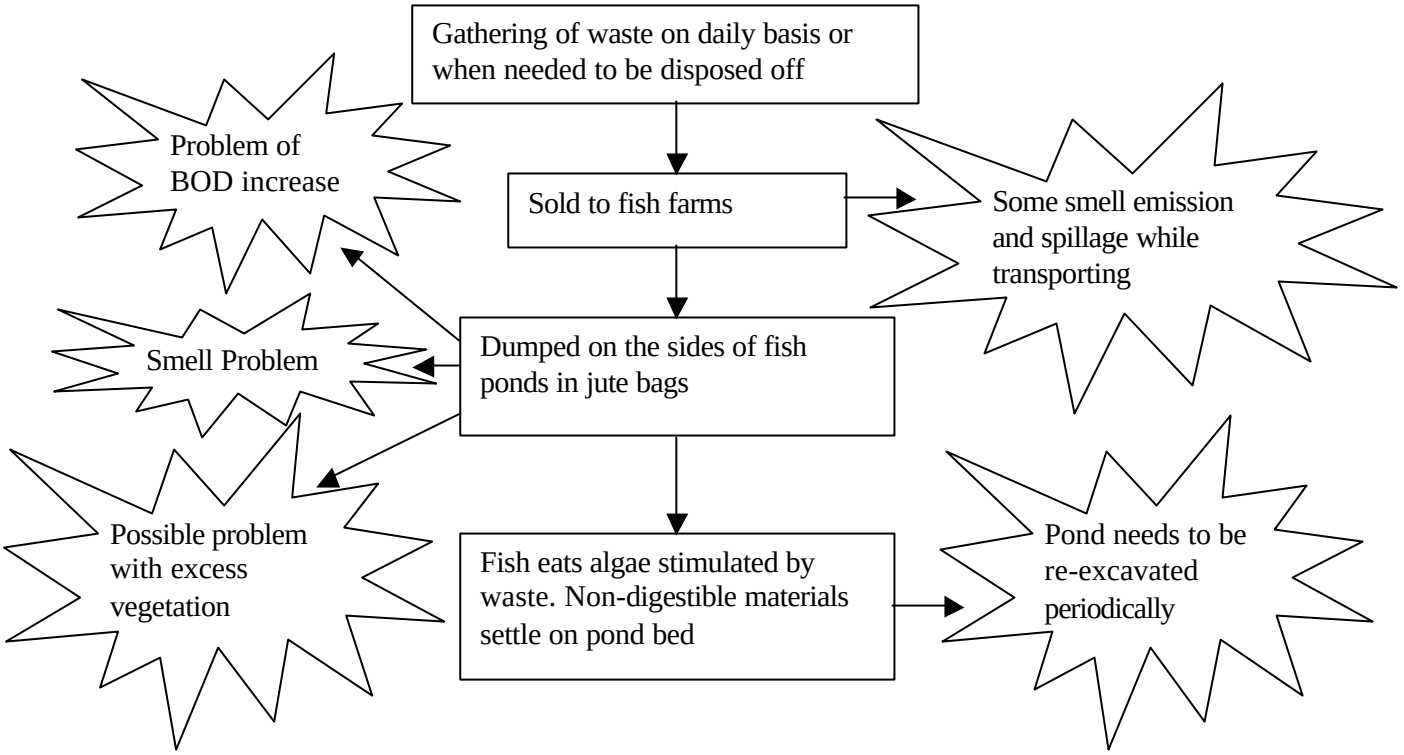

Figure 5 Environmental Impacts Of Using Poultry Waste As Fish Feed

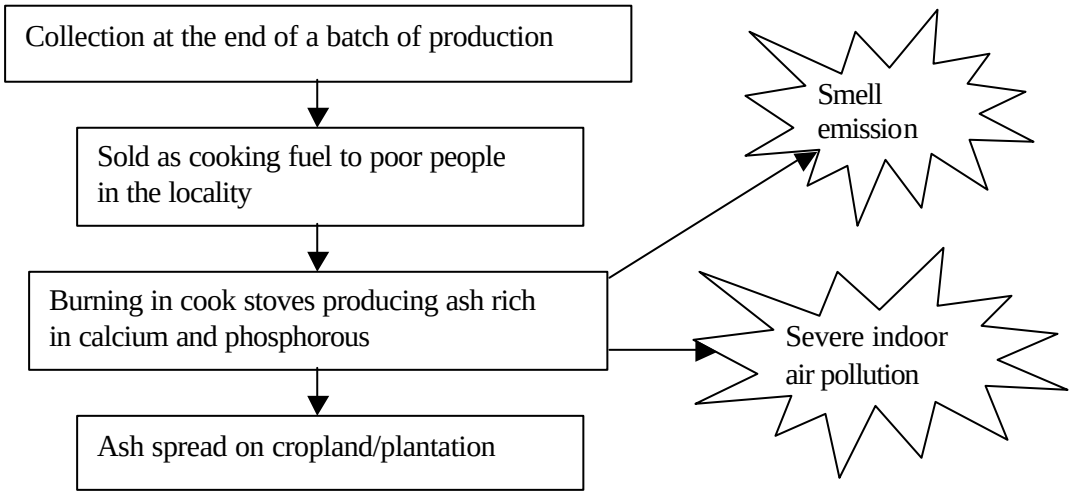

Figure 6 Environmental Impacts of Using Poultry Waste as Cooking Fuel (practiced only with broiler litter)

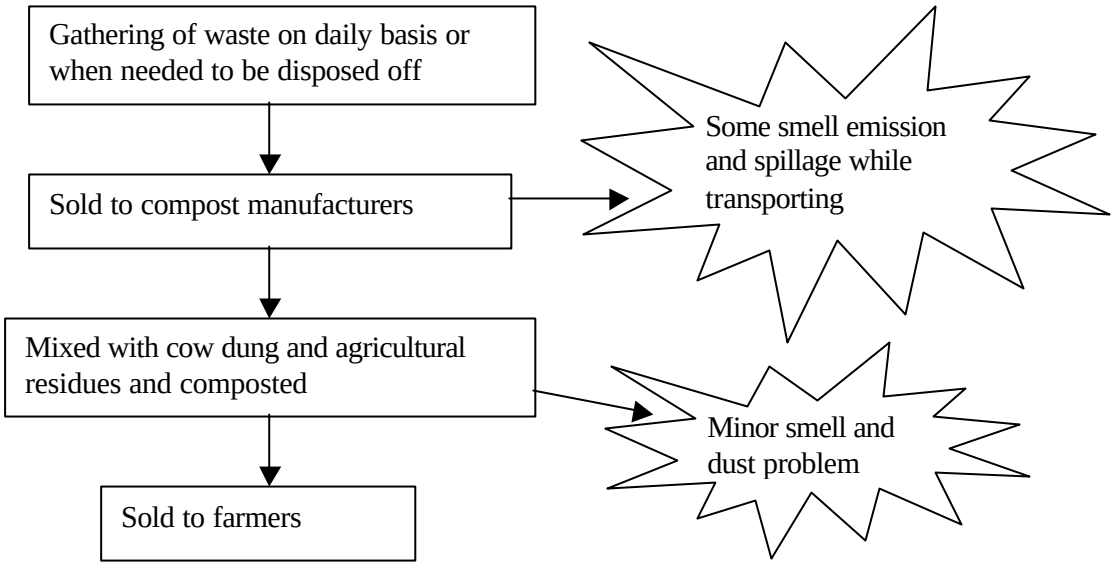

Figure 7 Environmental Impacts of Composting Poultry Waste

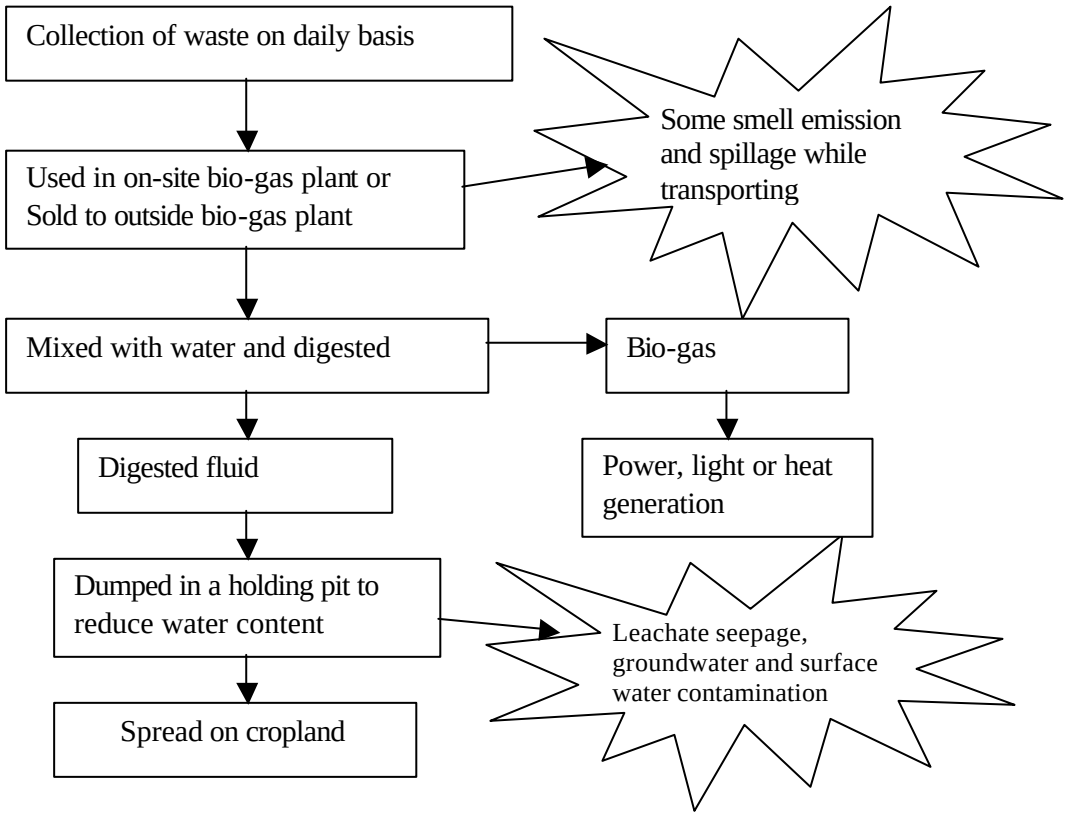

Figure 8 Environmental Impacts of Using Poultry Waste in Digesters for Producing Bio-gas (practiced only with layer manure)

6.0 CDM Options Using Poultry Waste

6.1 Existing Practice and CDM Baseline

The most important thing with respect to developing CDM projects is the baseline. If the baseline is such that not enough emission reduction is possible, then the CERs generated will add very little value to the project. Therefore, CDM projects are only possible when the baseline (existing situation and its trend) is such that a fair bit of improvement with respect to GHG emission is possible. At this point it is instructive to study the existing disposal methods employed in Bangladesh (see section 5.0). Three things relevant to a CDM baseline emerge from those.

(i) A large portion of poultry waste is left in open dump for a considerable period of time before being used as a fertilizer for vegetable gardening and horticulture
(ii) Only a small portion of waste is composted and used as a replacement for chemical fertilizer
(iii) A tiny portion of waste is digested and used to generate electricity

Item i imply that some amount of methane, which is a powerful GHG, will be produced due to the anaerobic conditions in the open dumps. However, how much this emission will be must be established through a detailed baseline study. In a CDM project developed in India (Lata, 2005) it has been established that in Tamil Nadu, poultry waste is left dumped for 6 months before being used as a fertilizer. The study has established that from 200 tons/day of waste, 6000 tons of CO_2 equivalent methane would have been generated annually.

Item ii implies that poultry waste is not exclusively used as a fertilizer. As indicated in section 5.0, a large portion is used as fish feed, and some waste also finds itself in cookstoves. If in a systematic manner poultry waste is marketed as a chemical fertilizer replacement, then the GHG emission reduction by the amount of fossil fuel needed to produce the chemical fertilizer, can be claimed. However, a 100% replacement cannot be claimed because some chemical fertilizer replacement is invariably going on in the baseline. Moreover, if poultry fertilizer is used solely as a cropland fertilizer, then cowdung and even chemical fertilizer may be used in the existing uses. Therefore, leakage would have to be taken into account.

Item iii is clearly not the existing practice because generating electricity through the biogas route is not only expensive, but also is complicated by the requirements of sophisticated management. The efforts thus far in generating electricity using biogas digesters have been more or less failures, and these not likely to be replicated without some external assistance.

6.2 CDM Baseline Methodology

Other than developing a new methodology, which is time consuming and expensive, there are two ways of selecting a baseline methodology. These are (i) For small-scale projects to use the EB, UNFCCC provided baseline, or to use a baseline from one of the approved methodologies, and (ii) Use the IPCC emission factors for the proposed activity as a baseline. A survey of all available methodologies reveals that there are no methodologies that can be readily applied. The IPCC poultry manure management emission factors are extremely conservative, while the one in Small-scale Methodologies dealing with organic matter disposed off through controlled combustion yield too high an emission. The landfill emission factors of the approved methodologies may be used, but this results in low values because emission from manure is valid for less than one year, whereas the emission from a certain amount of landfilled organic matter occurs over a number of years.

6.3 Potential CDM Projects

To have a CDM project any combinations of the following three routes can be adopted.

(1) Show that the poultry waste is anaerobically digested thus producing methane
(2) Produce energy, mainly electricity, that displaces fossil fuel based electricity
(3) Produce fertilizer that displaces chemical fertilizers

From the existing disposal methods/uses of poultry litter/manure as outlined in section 5.0, it should be evident that it is difficult to claim that poultry waste decomposes anaerobically (producing methane) for more than 12 months. Dumping on low ground or onto a pile will certainly produce methane, but neither the duration nor the nature of the dumping is clearly defined.

Producing energy that displaces fossil-based electricity is certainly feasible. These options are clearly additional because all techniques of producing electricity from poultry waste have an unfavorable IRR. Even though some poultry owners on their own initiative are expected to adopt the manure digestion route, it is certainly not likely to be the preferred one because of the high initial investment and low IRR barriers. Thus, a baseline can be established where poultry litter/manure, which is a renewable energy source, replaces fossil fuel based electricity.

Even though composting is the universally recognized and preferred method of poultry waste disposal, the produced compost cannot compete with chemical fertilizer as a cropland fertilizer. Under this scenario it can be argued that CDM subsidy can provide a composting project the necessary boost so that it can produce a cropland fertilizer that successfully competes with a chemical fertilizer. However, it must be borne in mind that a considerable portion of poultry waste are composted using crude methods, and most of the product is used in high value applications such as horticulture and fruit/vegetable gardening. The withdrawal of poultry waste fertilizer from these applications may lead to chemical fertilizers being used. A certain amount of leakage will have to be considered here.

In view of the discussion on baseline provided in section 6.1 and within the context of Bangladesh, the following three types of CDM projects may be considered.

(1) Digestion of poultry manure to produce biogas for electricity generation plus using the digester slurry to produce a fertilizer that replaces chemical fertilizer
(2) Incineration of poultry litter to generate electricity
(3) Composting of poultry litter to produce a fertilizer that replaces chemical fertilizer

Various studies reveal that to power 1 kW of generation the wastes from approximately 1000 chicken is required. In a recent study it was estimated that investment requirement for even a basic unit is more than US$ 2000 per kW. If 1 kW were operated for 330 days for 5 hours a day, 1650 kWh would be generated. Using a very optimistic baseline emission factor of 1 kg CO_2 per kWh, which must include a fair amount of coal based generation, 1.65 tons of CO_2 abatement is possible. At even a price of US$ 10 per ton of CO_2, the CDM subsidy from the CERs for a 10-year period amounts to US$ 165 without discounting the future dollars. The resulting CER subsidy therefore amounts to less than 10% of the initial investment. This is clearly not an attractive proposition. Therefore, a baseline of only power generation is clearly not feasible. It is therefore essential to consider methane avoidance to have a successful CDM project using poultry waste. Several references can be found in literature where the proponents have advocated a baseline where methane is emitted from uncontrolled dumping. Lata (2005) and Vimal (2005) have both advocated such a baseline for poultry waste CDM projects. For the case of an Indian

poultry waste CDM project these authors have argued that the poultry waste is left in an open dump for about six months.

Digestion of poultry manure to produce biogas for electricity generation plus using the digester slurry to produce a fertilizer that replaces chemical fertilizer

As discussed earlier, poultry manure is a very good raw material for anaerobic digestion. Technologies to conduct the digestion are readily available in various countries including India, China and the UK. In Bangladesh, the BCSIR has technologies available that can be readily accessed. However, even though both BCSIR and LGED have experimented with electricity generation using biogas from poultry waste, these efforts can as best be regarded as experimental. For example, the much-advertised Faridpur Muslim Mission project of LGED lies abandoned.

In a paper nearly two decades back Safley et al. (1987) have reported on the digestion of poultry waste – "Anaerobic digestion of poultry manure can be effectively accomplished on the farm. Reasonable gas production (.39 m^3/kg volatile solids added) and subsequent electrical cogeneration (833 kWh/day) have been demonstrated. Maintaining a consistent TS level in the influent is important in getting consistent gas production. The removal of grit from the influent would have the single greatest impact on overall performance by reducing the digester down time. Competent management and personal attention is needed in certain areas of operation, namely, processing of digester influent, maintenance of equipment, and observation of system performance." The high degree of critical management requirement is a key feature of digestion plants. Providing this management using local technology will be extremely difficult in Bangladeshi conditions. Therefore, very expensive imported technology must be used. For a CDM poultry waste digestion project, even in India, which boasts many low-grade indigenous technologies, the project proponents have advocated sophisticated imported technology. Therefore, if both electricity generation and commercially marketable fertilizer production is intended, the technology should be obtained from reputable companies that are able to offer a mature technology. For CDM projects, this aspect is even more critical because all CDM projects must undergo strict monitoring and verification.

Large-scale digestion plants have an additional burden of having to handle the large amount of liquid slurry from the digesters. The following issues relate to the liquid slurry.

(1) The volume of the slurry is twice that of the original waste. Therefore, if waste disposal was the primary objective, this option creates more problems than it solves

(2) The liquid slurry cannot be handled without first concentrating it, which is not only difficult, but also requires heat (which can however be got from the waste heat of the generators if electricity generation is opted for). At present, there is no market for liquid fertilizers, which in any case are not balanced

(3) The drying option to produce a solid fertilizer is even more complicated. The problems of dealing with an unbalanced fertilizer also exist in this case

The issues mentioned above are certainly not insurmountable, but are nevertheless daunting. Experimental and even pilot-plant level technology should not be used. It should however be made clear that the above discussion applies to large-scale units. If small-scale units handling wastes from small to medium sized farms having less than 20,000 birds are being considered, the issues become altogether different because in that case the liquid slurry can probably be used in the farm's fruit/vegetable gardens and/or sold in the vicinity after some persuasion.

The small units have the disadvantage of low IRR. In other words the price of electricity would be much more than that purchased from the utility. If small units were being considered, then many such units would need to be bundled. Bundling is difficult because it is very difficult to find the entity that will do the bundling, and the monitoring of these small units, which are known to be notoriously unreliable, will pose an immense problem. High transaction cost is expected to wipe out most of the CER benefits.

Incineration of poultry litter to generate electricity

This CDM option is included for the sake of completeness. Worldwide there is a move away from incineration practices, and with CDM's strong sustainable development requirement, it is highly unlikely that project proponents would opt for this route. Moreover, the financial viability of this option is clearly not there even considering CER sale and subsidy for renewable electricity.

Incineration of poultry litter is predominantly practiced in the UK with the US studying its feasibility (EPRL, 2005). In the U.K., it is estimated that 1.4 M metric tons of poultry litter are produced annually (with an energy equivalent to 700,000 tons of coal). Technology is well advanced in using this material as a fuel for heating poultry houses and in commercial electric power generating stations. Units are now in operation that adhere to all the rigid EEC guidelines on emissions of odours, particles and gases. The fertilizer value of the ash produced is being tested in field trials and guidelines drawn up for the disposal of this material. However, an international environmental NGO called *Energy Justice Network* (Ewall, 2004) in its website has launched a vigorous campaign against incineration of poultry waste. *Energy Justice Network* contends that it is unsafe to incinerate poultry waste predominantly because of the arsenic in the fly ash.

Composting of poultry waste to produce a fertilizer that replaces chemical fertilizer

Among the three options, composting is undoubtedly the best option for the disposal of poultry litter. The following are the principal reasons why composting rather than digestion or incineration is the preferred option for poultry litter.

(1) The material at the time of discharge from the shed has already undergone some composting
(2) The biogas potential of poultry litter is one-third that of poultry manure
(3) Handling the bedding material (rice husk or saw dust) in the liquid slurry poses a lot of problems and the digester requires periodic cleaning
(4) Even though the incineration option from the point of view of poultry litter heat content is very attractive, it is not an economically viable option

Very simple and manageable composting techniques can be applied to convert the poultry litter into a very useful fertilizer. The bedding material however has very little fertilizing value and in most cases acts only as a filler material adding bulk. Because of the nature of the bedding material its availability in the first season of application may be very little, but in subsequent seasons, it will continue to enrich the soil with organic material. The bedding material can be conveniently pulverized so that it provides the much-needed organic content to Bangladesh's depleted soils, and in this respect the bedding material becomes an equally valuable product. In the Bangladesh context therefore, poultry litter fertilizer can very successfully compete with chemical fertilizer.

Composted poultry litter through N-P-K balancing can be converted into a cropland fertilizer that displaces chemical fertilizer. If the Executive Board of the UNFCCC (the body that approves CDM project) can be convinced of this Baseline, then CDM projects can be constructed. Since

poultry litter is easy to handle and has very little odor compared to poultry manure, very large units can be built, thus helping lower CDM transaction costs. The poultry litter may be collected from 10-20 medium-to-large sized farms and composed in a central plant. The central unit should be independent of the farms, and should concentrate on producing the organic fertilizer. The litter should be purchased from poultry farms through long-term contracts.

6.4 Availability of Poultry Waste for CDM projects

Even though poultry waste is an environmental hazard and nuisance in many places around the country, it would be wrong to assume that its supply is automatically assured for a CDM project. The first and foremost barrier in this regard is the value of poultry waste in many places of the country. In certain regions of Bangladesh, especially where the soil is fairly depleted of organic matter, poultry waste fetches nearly Tk. 1 per kg. *If a CDM project has to purchase waste at this price, then no CDM project is possible even at US$ 10 per ton of CO_2.* In this scenario, a CDM project is only possible, if and only if, the waste belongs to the CDM project owner, or the baseline can be made more favorable. This, therefore, effectively limits the number of CDM projects that can be pursued. Moreover, only one of the above three potential CDM candidates is worth considering.

The only reliable estimate of the number of poultry, but for the year 2000, is available from the work of Islam (2003). Industry survey shows that the poultry population is growing at 5% per annum. It is difficult to say for how long this fast pace of growth will continue, but one thing is certain, and that is, poultry will become the overwhelmingly dominant source of protein in Bangladesh. Therefore, further growth is in store for the poultry sector. This study focuses on the Dhaka region only. Since only the urban population consumes commercial poultry and eggs, and Dhaka city is the largest urban population center (and the most affluent as well), it would not be incorrect to assume that at least 50% of the poultry population is located in a 100-kilometer radius from the center of Dhaka city. However, because of considerations such as optimum size, accessibility by trucks, concentration in one area and readiness of poultry owners to sell waste, it is assumed that only 50% of the poultry in the Dhaka region could be targeted for collection of waste.

Table 6 shows the availability of poultry waste in a region approximately 100 kilometers from the Dhaka city. One hundred kilometers may appear too high, but it must be borne in mind that Dhaka is the capital city and the predominant consuming center, and also that poultry farms as far as Sreepur/Bhaluka are supplying poultry and eggs to the Dhaka city. This trend has been accelerated by the improvement in the road network. As can be seen from Table 6, the prospect of using poultry litter (that which comes from raising broilers) has been shown to be extremely low. Poultry litter is not as environmentally unacceptable as poultry manure, and gets consumed fairly quickly often in applications where emission of methane is restricted. The baseline, hence emission reduction, for the digestion and composting options is not favorable. There are two further disadvantages associated with poultry litter. First, the waste gets mixed with bedding material and remains for nearly 5-6 weeks on the floor of the broiler shed resulting in semi-aerobic composting (NOT anaerobic composting). Second, the bedding material does not compost easily and is not good for anaerobic digestion. The only technically feasible CDM project option is. *Incineration*. Using manure, however, several projects are possible. The competing technologies in the Bangladesh context are *Composting and Digestion*. But from financial and management requirement points of view, the clear choice is *Composting*.

Table 6 Availability of Poultry Waste Around Dhaka City for CDM Projects

	Layers		Broilers	
	Number in millions	**Manure in million tons (75% moisture)**	**Number in millions**	**Litter in million tons (25% moisture)**
Total available	23	1	5.5	0.08
Realistic potential	12	0.5	3	0.04
Number of Small scale CDM projects (50-100 t/d)	15 – 20 (Composting)		Not feasible	
Number of Medium scale CDM projects (100-200 t/d)	6 – 8 (Composting or Digestion)		1 (Incineration)	

6.5 CDM Project Summaries and Comparison between different Options

Within the scope of this study it was only possible to undertake a limited investigation of the CDM opportunities. Thus, preliminary estimates of emission reduction, initial investment and profitability for the three probable CDM projects have been provided. A template that summarizes some salient points has been used to present the three CDM projects discussed above (sections 6.6, 6.7 and 6.8). These studies can as best be treated as pre-feasibility studies, and it is worth emphasizing that to do CDM projects, detailed feasibility studies would need to be undertaken. With respect to doing CDM projects with poultry waste the following general conclusions can be drawn.

1. The amount of poultry waste available around Dhaka city can provide enough waste for a dozen small to medium scale CDM projects
2. In most places around the country, poultry waste has a market value, and in this regard the baseline practices, which are totally environmentally unacceptable, are profitable options for poultry farm owners
3. Poultry litter is not suitable for CDM projects because methane emission in baseline practices is not significant
4. Poultry manure can be considered for CDM projects, but because the methane emission occurs for only a few months as opposed to several years for land-filled organic waste, the CDM CER benefits are very limited
5. Poultry waste in many places has a high price. IRR calculations show that if poultry manure has to be purchased, then no project is feasible even with CDM subsidy
6. If at least 50% of the waste is available free of cost and CDM subsidy is available, then the three CDM projects considered in this study becomes feasible under the following special conditions.
   (i) Composting – Low operating cost
   (ii) Digestion – Electricity price > US$ 0.4/kWh
   (iii) Incineration – Electricity price > US$ 0.5/kWh
7. Since the Government has a plan to promote renewable electricity, the utility may be willing to purchase electricity at the high price indicated above

8. The COMPOSTING project may appear very attractive (see Table 7) but it must be borne in mind that 50% of the manure is assumed free. A 10% increase in the price of manure puts the project in the red

9. Between COMPOSTING and DIGESTION, the preferred option is Composting predominantly because of its simplicity. The requirement of close supervision in the Digestion project makes it a very unattractive one for Bangladesh

10. Incineration of poultry litter is possible, but the project would require large subsidy beyond the CDM subsidy. In the US and UK, the subsidy is provided in the electricity tariff

Table 7 Summary of CDM Prospects in Bangladesh Using Poultry Waste

CDM OPTION	**Financial IRR**	**BASELINE**	**COMMENTS**
1. Digestion of manure (Electricity generation from biogas + fertilizer from digested slurry) (100 – 200 t/d)	8.9% 10.1% (with CER)	8 months of Open Dumping + Emission at the power plant	3. Critical management 4. Low electricity prices and no assurance of utility purchase
2. Incineration of Poultry Litter (200+ t/d)	10.4% 11.6% (with CER)	8 months of Open Dumping + Emission at the Power Plant	5. Concerns regarding local air pollution 6. Very high initial investment 7. Loss of organic fertilizer 8. Low electricity prices and no assurance of utility purchase
3. Composting of Poultry Manure (50 – 100 t/d)	13.9% 17.8% (with CER)	8 months of Open Dumping	3. Extremely simple technology 4. Easy management

ASSUMPTIONS

1. The CDM project is assumed to be an extension of a large poultry farm such that 50% of the poultry waste is available free of cost
2. Transportation cost of purchased waste is Taka 200 per ton of waste. Transportation cost for in-house waste has been assumed to be one-third of that
3. Grid power plant emission (operating margin) = 0.7 kg CO_2 eq./kWh
4. PRICE – Manure/Litter = Tk. 0.50/kg, Fertilizer = Tk. 3/kg, Electricity = 4 US cents per kWh, Ash Fertilizer = 10 US cents per kg
5. Price of CER assumed to be US$ 8/ton of CO_2

6.6 Analysis of Poultry Manure Digestion

Project Opportunity: Anaerobic digestion of manure to produce biogas to be used for power generation

	Baseline	**Project Opportunity**
Description	Poultry manure left in open dump for between 6 to 12 months and used as organic fertilizer. Fossil fuel (mainly natural gas) burnt in power plant	Biogas production in digesters for use in an engine generator and through composting of the digester slurry produce fertilizer
Cost Components	None	Trucks for manure collection; Land for digesters; Digestion plant; Electricity generating plant; Compost fertilizer producing plant
Benefits		Income from sale of power and fertilizer; Emission reduction at power plant; Reliable power supply
Additionality		Removes cost effectiveness barrier
Plant Capacity (330 days per year operation)	200 t/d waste	1.5 MW + 40 t/d organic fertilizer (from digester slurry)
Project Boundary	Poultry farms and national grid power plants	
Power Production per year (80% capacity factor)		11.2 GWh
CO_2 eq. Emissions (tons/yr)	6434 (methane emission) 7818 (at the power plant)	0 (methane avoidance) 843 (methane combustion at the power plant)
CO_2 Savings (tons/yr)		13409
Income from Sale of CERs @ $8/t CO_2 (million $/yr)		0.11
Initial Investment (million $)		4.6
Cost of Poultry Litter (million $/yr)		0.24 (50% of total – other 50% assumed free)
Annual O&M (million $)	0.05	0.28
Income from Sale of Electricity @ $0.04/kWh (million $/yr)		0.45
Income from Sale of Fertilizer @ $0.0462/kg) (million $/yr)		0.57
Years of Benefit (Project Life)		20
IRR without CDM subsidy		8.9%
IRR with CDM subsidy		10.1%
Other Benefits		1.5 MW displaced from the national grid; Will make the poultry farms more profitable. Efficient use of a renewable resource; Displaces fossil fuel

6.7 Analysis of Poultry Litter Combustion for Electricity Generation

Project Opportunity: Poultry litter burned in a combustor to produce steam to run steam electricity generators

	Baseline	**Project Opportunity**
Description	Poultry litter used variously, as organic fertilizer, as fish feed and as a cooking fuel. Methane emissions for approximately 8 months. Fossil fuel (mainly natural gas) burnt in power plant	Use of poultry litter as a fuel for generating electricity after raising steam in a boiler
Cost Components	None	Trucks for litter collection; Steam thermal power plant; Ash collection and handling system
Benefits		Income from sale of power and ash (fertilizer). Emission reduction at power plant
Additionality		Removes cost effectiveness barrier
Plant Capacity	200 t/d waste	7.7 MW
Project Boundary	Poultry farms and national grid power plants	
Power Production per year (85% capacity factor)		57.3 GWh
Initial Investment (million $)		15.4
Cost of Poultry Litter (million $/yr)		0.24 (50% of total – other 50% assumed free)
Annual O&M (million $)	0.05	0.75
CO_2 eq. Emissions (tons/yr)	6434 (methane emission) 40134 (at the power plant)	0 (methane avoidance)
CO_2 Savings (tons/yr)		46568
Income from Sale of CERs @ $8/t CO_2 (million $/yr)		0.37
Number of years CER income stream available		5 (2008 – 2012)
Income from Sale of Electricity @ $0.04/kWh (million $/yr)		2.29
Income from Sale of Ash @ $0.05/kg (million $/yr)		0.31
Years of Benefit (Project Life)		20
IRR without CDM subsidy		10.4%
IRR with CDM subsidy		11.6%
Other Benefits		Environmentally sound waste management (assuming that all emissions\discharges are managed in environmentally sound manner) 7.7 MW of fossil fuel electricity displaced from national grid Renewable energy

6.8 Analysis of Composting Poultry Litter

Project Opportunity: Composting Poultry Litter to produce a cropland fertilizer that can replace chemical fertilizer

	Baseline	**Project Opportunity**
Description	Poultry manure left in open dump for 6 to 12 months and used as organic fertilizer	Through efficient composting technique convert the waste into fertilizer that may be applied directly to plants or, through upgrading by balancing the N-P-K, the fertilizer can be converted into a cropland fertilizer
Cost Components	Negligible	Trucks for manure collection; Land for composting; Sheds for storage; Composting boxes and handling equipment
Benefits		Income from sale of fertilizer
Additionality		Removes cost effectiveness barrier
Plant Capacity	200 t/d waste	80 t/d compost fertilizer
Project Boundary	Poultry farms	
Initial Investment (million $)		0.85 (including land)
Cost of Poultry Manure (million $/yr)		0.28 (50% of total – other 50% assumed free)
Annual O&M Costs (million $/yr)	0.05	0.94 (including manure transportation costs)
CO_2 eq. Emissions (tons/yr)	7570	0 (methane avoidance)
CO_2 eq. Savings (tons/yr)		7570
Income from Sale of CERs @ $8/t CO_2 (million $/yr)		0.61
Number of years CER income stream available		5 (2008 – 2012)
Income from Sale of Fertilizer @ $0.0462/kg (million $/yr)		1.35
Years of Benefit (Project Life)		20
IRR without CDM subsidy		13.9%
IRR with CDM subsidy		17.8%
Other Benefits		Environmentally sound waste management Displaces chemical fertilizer when used in croplands Improve organic content of Bangladeshi soils

7.0 Conclusions

Even though CDM can be used to tackle the environmental problems resulting from poultry waste disposal/utilization, the issues involved are not straightforward. The following two major stumbling blocks have been identified

(i) The baseline for this operation (existing poultry manure management) is not clear-cut. None of the existing IPCC guideline adequately covers this emission

(ii) The baseline adapted from landfill is the most readily applicable one, and is as follows – 6 to 12 months of 8 to 12 liters of methane emission per kg of waste. With this baseline it is difficult to justify doing CDM projects in the poultry waste management sector

In the context of Bangladesh, the cost of procuring the poultry waste need to be thoroughly investigated because the prevailing unsustainable disposal methods are fairly profitable for poultry owners, and if poultry waste has to be procured at high prices then the environmentally sustainable management practices would require a subsidy even beyond CDM subsidy.

Despite the above two limitations, there is plenty of waste available in three areas around Dhaka city to permit several small-scale CDM projects to be developed, but detailed feasibility studies are required before these can be undertaken.

COMPOSTING was found to be the most cost-effective and manageable option. This option can be pursued even without CDM. However, with the sale of carbon credits, the project becomes more attractive. Digestion is the next best option, but such projects would require very good management and excellent cost control. The incineration of poultry litter is an option that would require an electricity tariff much higher than the prevailing one.

Climate Change vulnerability is projected to be most intense in rural areas. Adverse effects are expected in agricultural outputs and on fish population. Good management of poultry waste not only strengthens the industry, but also provides a valuable organic fertilizer that rejuvenates soil. Two to three decades back the cheapest source of protein was fish. The rural population obtained more than 90% of their protein from fish caught in homestead and common ponds. Today, even in rural areas fish is more expensive than poultry grown in commercial farms. Thus, in an arena of dwindling fish supply, poultry will play a major role in the supply of protein at affordable prices. Additionally, since properly treated poultry waste is a good fish feed, the sustainable growth of the poultry industry can have a beneficial impact on the fish industry. These mitigation activities therefore possess adaptation to Climate Change co-benefits.

8.0 Recommendations

The following two recommendations for promoting CDM projects in the poultry waste sector are made.

(i) The prospects of CDM in the poultry waste sector should be investigated by immediately launching feasibility studies

(ii) It appears that the baseline using the existing very conservative IPCC guidelines is not very attractive for CDM projects. The Executive Board of the UNFCCC should be consulted on the baseline aspects of poultry waste management, and a more detailed study on baseline should be initiated so that a new more realistic methodology can be developed

9.0 References

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