Environmental Investigation And Evaluation Of Sericulture Programme And Ayesha Abed Foundation

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INTRODUCTION

Background

BRAC's purpose in promoting sericulture is to provide income generating activities for poor, landless women. Silkworm rearing is a labour intensive activity that is usually done at home and silk is a high-value, low volume commodity that is in demand both nationally and internationally. Sericulture has a large potential of being integrated with other agrarian systems based on household operation (Bari, 1995). Presently there is a demand for 360 tons of silk in Bangladesh. Only 60 tons of silk are produced each year out of which BRAC produces 40 tons. There is tremendous scope for growth in silk production.

Very few studies have been made on the environmental impacts of sericulture and silk-related programmes in Bangladesh. In 1996 the Environment Group at BRAC conducted an initial investigation of BRAC's sericulture programme (Zaman *et. al.*, 1996). Bérubé (1996) did an environmental assessment for RDP phase IV which included a study of the use of chemicals in sericulture and aquaculture activities. This study also included some activities of Ayesha Abed Foundations (AAF) and environmental regulations established by the Government of Bangladesh, but did not provide a complete picture of the environmental affects by these programmes. Only one area (Manikganj) was visited, which may not be representative of the impact on the environment of all the sericulture programmes and AAF activities, and this sample size, used for chemical analysis can not be conclusive. Each programme may be run differently, there are different geographic conditions and other environmental problems are of different levels of severity. The report recommends further study on the impacts of sericulture programmes and determining the chemical compositions of dyes used in dyeing and printing.

In his conclusion Berube concluded that the soil and water analysis he conducted in Manikganj "do not indicate any important environmental problems related to sericulture activities" (Bérubé, 1996). However, the water extracted from the pond where chemicals were disposed of contained a lead amount equivalent to 0.131 mg/l and an amount of 0.190 mg/l in the ditch water surrounding the weaving centre. A lead amount of 0.05 mg/l was traced in the water of the tube well (drinking water).

The soil samples indicated a lead amount of 33.2 mg/kg in the soil extracted from the degumming and dyeing area, 37 mg/kg lead in the soil behind the printing shop (where solid waste is disposed of) and 17 mg/kg of lead in the ditch in which effluents from the weaving centre are discharged. These were all amounts greater than that suggested by the Canadian Environmental Standards Quality Criteria for Contaminated sites.

In a report conducted by Bangladesh Centre for Advanced Studies (BCAS) and the International Institute for the Environment and Development (IIED) on the environmental impact of small scale textile industries in the Third World, it was suggested that "small scale industries employ more inefficient technologies and therefore pollute more than large scale units" (BCAS, 1997). This may also be due to the cumulative impacts of many small scale units, both over time and in a large area such as country-wide. Large industries are potentially less polluting since they can afford cleaner technologies, install waste treatment plants and have better in-house management, although this is dependant on enforcement and monitoring. According to this report, liquid effluents have the most serious impacts since discharged waste water contains a fairly high proportion of heavy metals and dyes. These chemicals cause surface and ground water quality deterioration with consequences for drinking water, vegetation and soil quality, and ultimately the food chain, human health and nutritional values.

According to a recent study published by DOE sericulture activities are not producing significant adverse effects on the environment as yet, but will do so if there is an expansion in the quantity of operations within the country (source: Wahida Huq, representative of the World Bank, Dhaka ?).

PURPOSE OF THIS STUDY

The purpose of this study is to ensure that BRAC's sericulture programme and the activities of Ayesha Abed Foundation related to silk production are socially and environmentally sustainable.

It is important to look at long-term environmental effects of programmes such as sericulture. Though sericulture may have promising outputs, it also uses a large amount of potentially harmful chemicals. Without the proper discharge of such solvents, the cost of future clean ups for the country could be

higher than profits made at present. The harm done on the environment might have other unforeseen effects which no amount of cleaning up could reverse.

The long-term environmental impacts of sericulture activities are potentially large, and must be taken into account to ensure sustainable growth of the sericulture industry in Bangladesh. BRAC is a large player in this industry.

Programme Activities

In 1978, BRAC began its sericulture programme as part of the Manikganj Integrated Project (RDP IV). The sericulture programme addresses income generation, employment, tree plantation, soil conservation, village level nursery establishment, and silk production. Activities in sericulture include

a) nursery,
b) mulberry plantation,
c) silk worm egg supply,
d) silk worm rearing for silk thread,
e) reeling,
f) weaving, and
g) printing and dyeing silk.

The findings of this study will be presented according to these stages.

The Ayesha Abed Foundation (AAF) started its activities at Manikganj in September 1983. The objectives of the centre were to institutionalise the capacity of providing services to new and existing small scale women's producer groups which would create employment and income generating activities.

There are twelve egg-rearing (grainage) centres in Dinajpur, Noagaon, Bogra, Jamalpur, Sherpur, Mymensingh, Gazipur, Manikgonj, Pabna, Rajbari, Magura, and Jessore. BRAC has five silk reeling centres in Manikganj, Jamalpur, Atghoria, Sherpur and Taraganj. There is a silk weaving centre at the Gorpara area office, in addition to weavers contracted in Kumarkhali, Shajadpur and Ullapara. There are six AAF centres in Manikganj, Gorpara, Sherpur, Jamalpur, Jessore and Kustia. Other sericulture activities are located in all the programme areas.

Environmental Impacts of Sericulture Activities

Several of the activities in the sericulture programmes have a positive impact on the environment.

- Mulberry trees, whose leaves are the primary food source for silkworms, are grown extensively around the rural areas of Bangladesh.
- They reduce the risks of salinity, improve both air and water quality, make use of other wise unused land, contribute to soil conservation by root stabilisation against wind and water erosion.
- Provides timber for firewood and reduces pressure on other wood species and manure as fuel provide valuable protein-rich fodder and reduce grazing pressure on other fodder supplies.

Other environmental benefits result from sericulture activities such as the provision of left over pupae from reeling that is high in protein and can be excellent poultry and fish food. The integrated systems of sericulture and pisciculture is an old tradition in South China where the leftover pupae and silkworm moths are used as fish feed in ponds.

Sericulture also involves the use of natural resources and chemicals which can be harmful to the environment and public health. Formalin and bleach powders are extensively used as general disinfectants in all stages of sericulture. Pesticides, such as dyathin-M-45, are used in the mulberry plantations to protect the saplings. Reeling uses a large amount of steam, and consequently a lot of fuel and water. Air quality is affected by boilers emitting steam and gas. Drying cocoons for reeling uses a lot of fuel. Chemicals are also used to manipulate the softness or hardness of the water in reeling. Even rearing has its share of chemicals in the form of disinfectants and acid treatments which manipulate the hatching times of bivoltine eggs (two-seasoned).

Dyes, binders, solvents, oils, urea, kerosene, acid, cleansers, etc. are used at AAF to process their products. Unfortunately, the companies that provide these chemicals do not provide any safety data sheet with the chemicals. The processing of silk fabric involves the use of bleaching agents, chemical dyes and acid. These pollute the soil and water in surrounding areas as waste water is discharged

directly into the adjacent environment without treatment. Solid waste disposal represents an important environmental issue as it is a potential source of soil contamination. Areas in sericulture such as reeling and weaving also generate a great deal of noise pollution.

OBJECTIVES OF THE STUDY

The broad objective of this study is to assess the environmental impact of BRAC's sericulture programme and Ayesha Abed Foundation silk-related activities.

The specific objectives are:

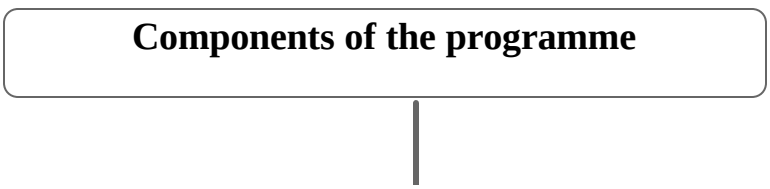
1. Identify environmental and health concerns in sericulture and AAF silk-related activities.
2. Identify chemicals used in these activities and measure the resulting effects on soil and water quality.
3. Assess the potential environmental problems of programmes.
4. Identify remedial measures to reduce the adverse impact of the programme activities on the environment and public health.
5. Establish monitoring criteria to maintain the environmental quality and sustainability of these programmes.

METHODOLOGY

Research Design

Components of sericulture that have any impact on public health and the environment were selected for research. These included activities such as mulberry plantation, silk worm rearing, reeling, weaving, and dyeing. Activities from AAF that also have impacts on the environment such as weaving, dyeing, and printing, were included in the research as they are connected to the sericulture programme.

Fig. 1. Research Design



Description of the study sites

Areas visited for this study included four AAF centres at Manikganj, Jessore, Sherpur and Jamalpur; three reeling centres at Manikganj, Atghoria and Sherpur; two Sericulture Resource Centres (SRC) & grainages at Jhikorgacha and Savar, and one weaving centre at Gorpara. Other sericulture activities around those selected areas were visited during the study period. Area Offices in Pabna, Rajshahi, Kustia and Manikganj were also visited.

Data Collection

The environmental impact assessment of BRAC's sericulture programme and silk-related activities of the AAF was conducted from June 1997 to February 1998. Data was collected in January and February 1998. Data was obtained through (i) field observations, (ii) laboratory analysis of soil and water samples, (iii) interviews, and (iv) case studies. Interviews were held with people involved and employed in the sericulture programme and in AAF, such as sector specialists, managers, PO/PA's, VO's, and villagers around the area employed in reeling, weaving, printing and dyeing. A semi-structured questionnaire targeted at the local people was designed.

The questionnaire focused on:

- Environmental aspects
- Health and safety
- Social aspects

Case studies included in the appendix (appendix....) were done of employees working in each activity of sericulture such as plantation growing, rearing, reeling, weaving, dyeing, and printing. A questionnaire designed for the case studies focused on relevant environmental, health, and socio-economical issues the individuals experienced through the programme. An individual was chosen from each of the sections in sericulture. This was done in order to add a more thorough study of the sericulture programme and include any information that may have been lost in the general observations of this study. The case

studies also include some socio-economic concerns which have not been included into the main body of the report as it was not the objective of this study.

Field observations were made in each location, using a checklist which focused on potential problems caused by sericulture and AAF silk-related activities, including

- public health
- water quality
- soil quality
- crop and fish resources
- public nuisance impacts

Collection and analysis of soil and water samples

Soil and water samples were collected from weaving, dyeing and printing centres. Water samples taken from drainage water ditches, area ponds, and reeling trays were collected in one litre air tight plastic containers. To assess the cause of hand and finger injuries during reeling, a chemical analysis of reeling water was done. The samples were kept at ambient air temperature until they were moved to the laboratory. Soil/sediment samples were collected from dyeing and printing waste disposal sites. Soil samples were collected in 1 kg plastic bag using a small spade and also kept at ambient air temperatures.

Sampling site and number are as follows (S = Soil sample, W = Water sample):

S_1	Gorpara silk dyeing	W_1	Gorpara silk dyeing:
S_2	Gorpara block printing	W_2	AAF Manikganj pond
S_3	AAF Manikganj dyeing	W_3	AAF Manikganj drain
S_4	AAF Manikganj printing		(printing and dyeing)
S_5	AAF Jamalpur	W_4	Atghoria reeling
		W_5	AAF Jamalpur pond

Manikgonj: Site of the largest AAF where dyeing, printing, tailoring, weaving of both cotton and silk is done. Wastewater is disposed into a large pond bordering on brick field on one side, crop fields on another and AAF in the front. The drain water flows directly into the pond. Soil samples S3 and S4 were collected from the printing and dyeing waste dumping site separately. Water sample W2 was collected from the pond where detergent waste water and solid wastes in the form of plastics, cartons, and other wrappings are disposed of. Sample W3 was collected from the drain into which dyeing and printing waste water is disposed.

Gorpara: The Gorpara site supports weaving, printing, and dyeing. It is a small area consisting of two one storied structures. Dyeing is done next to a tube-well and outside of the property there is a small ditch/pond into which most of the waste water flows. Soil sample S1 was collected from this ditch. The water of the ditch is discoloured and there are several pieces of solid waste floating in it. The ditch leads into neighbouring crop fields. Water sample W1 was also collected from the ditch. Clothes are washed with detergent next to the tube-well or on the ground. On the other side of one of the structures, where block printing takes place, is a tube-well near which solid wastes such as printed scraps, other scraps, plastics, leftover dyes and printing material are thrown. Soil sample S2 was collected from this area. There is a crop field just beyond this area outside the compound.

Jamalpur: Contains a smaller AAF two-storied building in which printing, sewing, and tailoring activities are done. Material washing and drip dyeing is done outside the building on a cement surface next to a tube-well. The water flows into a pond which is surrounded by crop fields and neighbouring houses. The water from this pond is not meant to be used but local inhabitants use the water to irrigate their rice fields. The water is discoloured by the dyes and detergent. Soil sample S5 and water sample W5 were collected from the pond.

Atghoria: The reeling centre is located in a one storied building surrounding a courtyard. Water sample W4 was collected from the reeling trays in this centre.

Analysis of the collected samples was done by the Soil Science Department at Dhaka University using standard methods. The parameters selected for water and soil are given below

For water and soil samples:

Parameters	Unit	Copper (Cu)	mgl^{-1}
pH		Chromium (Cr)	mgl^{-1}
Electrolytic conductivity (Ec)	µS	Cadmium (Cd)	mgl^{-1}
Zinc (Zn)	mgl^{-1}	Lead (Pb)	mgl^{-1}

Mercury (Hg)	mgl^{-1}	NO_3-N (Nitrate)	mgl^{-1}
		NH_4-N (Ammonium)	mgl^{-1}
Only for water samples:		PO_4-P (Phosphate)	mgl^{-1}
Parameters	Unit	Sulphate (SO_4-S)	mgl^{-1}
Chemical Oxygen Demand (COD)	mgl^{-1}		

RESULTS AND DISCUSSION

Sericulture

Silk has been produced in Bangladesh since British occupancy The BRAC sericulture program was initiated in the 1980's but only put into full action in 1990. The different stages in the sericulture program are: growing mulberry plantations, breeding silk moths for egg production, and rearing the worms for cocoon production. The post-cocoon stage involves reeling the silk thread off the cocoons, weaving it, then dyeing and printing it. Aside from Gorpara there are no separate dyeing and printing centres for silk. That process is undertaken by AAF.

Staff employed in the programme, POs, PAs, plantation workers, cycle man (plantation overseers), cocoon sorters, and rearers were also interviewed.

REARING

There are 15,000 active rearers in BRAC. In the rearing process rearer buy silk worm eggs from BRAC and begin by placing them on a tray. These trays are placed in a rearing which includes the following material:

A rack and tray shelf make up of bamboo. A "cocooning" net made of plastic. A black cloth, bleaching powder which is used as a disinfectant for everything, formalin which is used as a disinfectant before rearing. A net which clears the worms from the egg remains, foam for humidity control, feathers for brushing the worms, sticks, lime also for disinfecting, and knives to cut the leaves up.

After two days, just before the eggs hatch, they "black box" the eggs which consists of covering them with a black cloth to make sure they hatch equally. After 24 hours the cover is removed and the eggs

hatch. Then begins the "brushing" process which separates the hatched worms from their egg remains. The worms are covered with a thin net on top of which finely cut mulberry leaves are placed. The worms climb onto the net to feed. The net with the worms is brushed with feathers onto a new tray and the egg remains are thrown away. These trays are then placed in a rearing house. Rearing includes the following materials:

There are 5 stages involved in rearing:

1) Metecolop: when the worms just hatch and begin their feeding . They are fed about 2 1/2 - 3 kgs per 100 dfl (40,000 eggs) 4 times a day. This stage takes 3-4 days

2) Docolop: formation changing which takes 2-3 days. Fed about 6 - 8 kgs per 100 dfl.

3) tecolop: the 3rd Stage of growth which lasts 3-4 days. Fed 24 - 30 kgs per 100 dfl.

4) Shodcolop: the fourth stage lasts 4-5 days. Fed 70 -75 kgs

5) Roscolop: the 5th stage, which lasts 6-8 days. Fed 600 - 650 kgs per dfl.

After these stages the worms begin developing their cocoons. After five days the cocoons are collected from the "chandroki", cage and sold to BRAC or to whoever is paying the highest price. Although they buy their eggs from BRAC they are not constrained to sell their eggs to BRAC. BRAC PA's, visit rearers frequently to give advise on rearing techniques.

Each rearer uses a total of about 1/2 kg of bleach powder during both breeding seasons (there are two) for bleaching and disinfecting the rearing house. The bleach is used mostly during the rainy season when there is an increase in diseases. The powder is a commercial bleaching powder supplied by BRAC. Rearing waste is cleaned out twice a day. Used chemicals are thrown into a pit. Excreta from the worms, dead worms, and waste leaves, (*kashar*) are used as fertiliser for rice and vegetables (it was mentioned that this form of compost was a good substitute for chemical fertilizers). There were no separate places set aside for chemical waste (bleach, formalin) in the places visited. Rearers mentioned that contact with worm excreta causes the skin on their feet to burn.

Problems:

Sometimes the eggs do not all hatch properly and rearers do not receive their targeted amount of cocoons. Rearers remarked that this was probably because production and quality of mulberry leaves were poor. The HYV (High Yielding Variety) worms are also susceptible to disease. HYV worms are very sensitive and require temperatures of 23 - 28 ^{0}C, 65-85% humidity, good rearing technique, and good mulberry leaf quality to survive. In the last stages of growth, silkworms need a greater quantity of leaves which means more time spent collecting leaves which the rearers do not have or cannot afford. Electricity failure also caused worms to die in the *chondroki* in one instance. Feeding worms usually take place four times a day (6 a.m.-1 p.m.-5 p.m.-9 p.m. or 3 a.m.-10 a.m.-2 p.m.-5 p.m.-7 p.m.). The biggest expenditure in rearing is time spent collecting leaves.

PLANTATIONS

Mulberry plantations are mainly planted on road sides, with some homestead plantations put in by rearers. Bush plantations are found only in Sericulture Resource Centres (SRCs).

Pesticides are used in plantations. Mulberry sapling root purification (protection from insects) is done by soaking the plant three or four times in a solution of dyathin-M-45 (20 l water + 250 gm chemicals), after which the pesticide waste water is thrown away. Heptachlor powder is used as a protection against termites and applied directly to affected trees. Kerosene oil is sometimes used against the stem borer (insect). Fertiliser consisting of urea, phosphate, potash, cow-dung, and ash is used in infertile areas for saplings. Fifty acres of trees have been planted for next year's plantation. There will be 500,000 trees and 100 acres of bush plantations.

Plantation work includes protecting and checking on the mulberry seedlings, done every two days at each site. Worker's make sure the trees are upright, and watered. She also adds fertilizers and pesticides if the trees need them.

Grainage and Sericulture Resource Centre (SRC'S)

BRAC began its own grainage program in 1995. Before that they bought silk worm eggs from the Bangladesh Sericulture Board and India. There are a total of 15 grainage facilities, of which 3 are rented and 12 are owned by BRAC. BRAC-owned grainage centres are located in Mymensingh, Sherpur, Jamalpur, Gazipur, Manikgonj, Rajindrapur, Ahladipur, Jessore, Pabna, Manda, Natore, Dinajpur. The Sherpur, Bogora and Magura centres are rented. There are 5 individual SRC's at Shamviganj, Ahladipur, Jhikorgacha, Natore and Dinajpur; and 2 TARC-based SRCs at Savar and Srimangal.

Grainage centres produce eggs of the Branish (BRAC + Nishtary) variety. In the grainage centre, 25% of the moths are tested for pavlin disease (hereditary) during seed production and these are discarded. To break the dormancy of *bivoltine* variety (Chinese) the eggs are placed in an hydrochloric acid (HCL) + water treatment at 47 ^{0}C. In the acid treatment everything can be recycled and reused (such as buckets and containers). The acid can be reused for further treatment as long as the acid properties remain. Detergents, formalin, and bleach are also used in the centres. Workers are required wear a masks, aprons, and caps during work. Timing, temperature and washing are critical for acid treatment to break the dormancy of the worms.

Formalin is used in the grainage centres for disinfecting the eggs and the grainage rooms. Up to 2% formaldehyde solution is allowed and is not harmful to the eggs. About 2% percent bleaching powder (depending on egg production) is also used to disinfect rooms and eggs before they are supplied to rearers. The wooden trays on which the eggs are placed are washed and put in a bleaching powder solution for 1/2 hour to disinfect. The left over solution which has not soaked into the wooden tray is dumped into a small soak well (intended only for such waste).

A specialist mentioned that dead moths are either disposed into fishing ponds or given to people to feed their poultry and fish. Birds, such as the Hill Moyna also have a particular taste for it . Cocoon shells from the grainage are sold back for further spinning. The programme organiser (grainage in-charge) handles waste or it is handled in his/her presence by a grainage assistant. All grainages have soak wells so waste does not get disposed of in open areas. Moths and wastewater are placed in separate pits (an open pit for moths, a covered one for soak wells).

Waste such as plastic and paper are burnt in a pit, and chemicals are also thrown away into a pit. Dead moths are buried in the ground after they have been mixed with bleach. Waste disposal occurs inside the grainage compound.

In the grainage centres, worker suffer from health problems such as coughs, colds, and allergies to dust from the wings of the silk worm (during mating). Since sericulture production in Bangladesh is still at such a small scale health problems do not occur to the same extent they do in India and China.

Reeling

There are 4 reeling centres in Atghoria (Pabna), Rangpur, Jamalpur, and Manikganj. The Atghoria, Jamalpur and Manikganj reeling centres were visited during the investigation. Most of the workers at these centres are young, between 20-45 years old.

Altogether, about 100 kgs of silk is reeled per month per centre. About 5 kgs are reeled per day per centre. There are 4 centres so about 20 kgs are produced per day. This uses about a 100 kgs of water. The water used for reeling in the visited centres is taken from ground water. A temperature of about 135 ^{0}C is needed to dry the cocoons. Ninety degree centigrade water is used to boil the cocoons and 45-50^0 C water to reel the cocoons. Fire wood from the local market is used for boiling the water. There is no alternative energy sources in case of an electricity failure for reeling or drying. Electricity is used for operating motors for reeling, and firewood and diesel oil for boilers (steam) is used for cocoon cooking. Light is usually not used in the reeling centres because reeling is done during the day. But it was observed that in some centres such as Atghoria, day light alone was not enough for reeling and it was very dim in the buildings.

About 450 litres of waste water is produced each day in the Atghoria reeling centre which is disposed into a drain. The water is taken from underground sources via shallow tube-well. About 40 kgs of wood is used for boiling in the centre.

In the Manikgonj reeling centre, the reeling waste water is thrown into a tank where it slowly leaches into the ground. Sometimes it is drained directly into a ditch or nearby field. The water is protein-rich and would be good for the soil but is too hot to dispose of directly on the ground. It is generally not utilised again. Nor is ash from the wood used in the boiler used.

There is a rice field around the ditch in the Manikganj reeling centre. In the Atghoria reeling centre the reeling water is changed twice during the work break at 11 a.m. and the old water is thrown in to a drain out to the reeling house. Rejected thread is sent to Bholar hat to make Endy silk (hand charka). No proper reuse of waste was observed in any of the centres during the investigation.

The leftover cocoon shells and dead worms are collected and buried under the ground and covered with ash to prevent bad odours. The dead worms are not used as fertiliser or poultry feed and there has been no initiative from BRAC to do so. The main waste from reeling is pupa leftovers. This is generally thrown away into a hole. It is not used as poultry or fish feed on a large scale because no system exists to prepare it as feed. A long process is involved in preparing the pupae to be used as poultry or fish feed as they have to be dried first or they will rot if left wet.

There is a standard quality of water needed for reeling silk. The quality of the silk is improved if it is reeled in softer water. India uses chemicals to soften its water. Alum is used occasionally in Bangladesh when a high quantity of iron is observed in the water. The alum collects and solidifies the iron and causes it to sink to the bottom. It is very costly to test the water for iron (about 200-300 tk/- per test). Jamalpur is actually the only centre known to have a high quantity of iron and alum is added there on a regular basis.

Reelers develop back pain as they stand and work for 8 hours. Workers who boil the cocoons mentioned that they do not use any gloves or masks. They get severe headaches, gastric pain, and skin burning as they are always exposed to the fire and fumes emitted from the boiling. It was observed that the process of twisting the silk thread creates a great deal of noise. There is not enough light in the

reeling houses of Atghoria. Hand and finger infection from reeling water occurs severely during the *Vadro* month. According to a respondent, less cocoons are produced at this time and so the reelers have to reel more to get the same amount of thread. Therefore their hands are soaked in water the whole day. The sector specialist also mentioned that other health hazards such as ulcers on the hands occurs strangely only one month every year during the monsoon season. They are not clear what causes this. Fungal infection medicine is given to the reelers for free (1 tube = 15 tk/-) and about 1/2 the tube is used per month.

In summary, the total chemicals used in the sericulture portion including plantations, rearing centres, grainage centres, and reeling centres are: alum, acid, detergents, bleach, formalin, pesticides, fertilisers.

Weaving

There are 4 silk weaving centres at Kumarkhali, Bholarhat (Nawabganj), Shirajganj, and Manikganj. Only one weaving centre at Gorpara was visited for this study. This centre is a part of AAF. Activities at Gorpara includes silk weaving, dyeing, block printing, and embroidery.

The thread used in this weaving centre comes from Tangail which AAF buys from the market. It is boiled in flour and water and mixed with starch. After the thread is dried it is rolled onto a bobbin and placed on a spinning wheel. There are about 130 bobbins on a spinning wheel. The thread is turned on the spinning wheel then spun on a loom, and then woven. The thread is spun into a heavier cloth known as Khadi which is backed by a thinner cloth for support.

The main chemicals used in the weaving centres are water, starch, tootha (a sour substance to repel insects--about 1/2 pound used per 6 kgs of starch). There is generally no waste water left. Detergent is used to degum the thread and make the silk soft.

There were health hazards observed on the job. Women get knocked about by the machines, which are in constant motion and their hands are cut often by the thread. Repetitive motions involved in

weaving cause stress on the muscles. BRAC has started providing health check-ups and glasses for those who need them. Some of the workers also suffer from gastric pains and physical aches.

The solid wastes from the Gorpara centre, such as plastics, papers, cartons, discarded silk thread, leftover dyes, and scraps of cloth are thrown in a ditch near a tube-well. Waste water from dyeing is also thrown into the ditch. There are agricultural fields surrounding the ditch (where mustard, tobacco, sugarcane, and yams are grown). Water run off from the ditch is flowing into the next door farmer's field where rice, vegetables, and jute are grown. Sometimes the ditch floods into the road causing problems for neighbouring villagers.

Ayesha Abed Foundation

AAF began dyeing and printing silk and cotton in 1982. Five AAF's at Manikganj, Kustia, Jessore, Jamalpur and Sherpur were visited for this study. Some included the entirety of AAF operations such as screen and block printing, silk and cotton dyeing, tailoring, and embroidery. Others operated only a few of the activities. The main activities studied in AAF with the most extensive environmental effects include dyeing, printing and weaving.

DYEING PROCESS

Most dyeing and printing activities are done in Manikgonj and Jamalpur. The dyeing procedure is quite simple. The procedure involves first cutting soap into small pieces and placing it in boiling water (heated in an oven fired with wood) which will be used to dye thread. Coloured dye and detergent (soda) is added to the mixture. The thread is mixed and turned in this solution with wooden sticks. It is heated for 20 minutes in the died mixture and then taken out and washed in cold water. Then it is placed in acetate acid for 10 minutes which shines it and keeps the individual silk strands from sticking together. Excess water is squeezed out and the thread is placed out to dry. Sticks are used when emersing thread into the hot water and dye mixture but no other precautions (e.g. gloves). Usually workers need not to touch the chemicals. Everything is done at a dyeing site (usually by a tube-well) and tube-well water (ground water) is used.

BLOCK PRINTING PROCESS

Workers in printing begin their day by mixing colour into hot water (which softens the colour). Then mixing the colours in kerosene (for printing cotton cloth) or acid (for silk). Wooden sticks are usually used to mix the colours but sometimes workers use their hands as well. [They are meant to wear plastic gloves when using their hands but gloves were not observed to be in use during the investigation of this study]. Once the colours are ready, the workers stretch the cloth to be printed on the printing work table and begin block printing. This involves stamping the cloth with designed block which has been stained in the colour mixture. The entire cloth is stamped by individual, separate block prints. Once the printing is over the blocks are washed and put away. They are usually reused or put away. The dye mixtures are not thrown away but are reused. Dyes for silk stay good for about 2/3 months and dyes for cotton about a week. Dyes and colours are created by an on site dying master.

It was observed that the dyes, pastes and antifixer used in printing emit strong smells, causing eye irritations, gastrointestinal pains, ulcers, headaches, and skin burning. Employees usually do not use any gloves or masks.

The materials used in the dyeing process include water, alum, soap, soda, boiling water, acetate acid, kerosene, zinc oxide, and colour (from India and China). All of the materials are supplied by AAF. Tracing is another process used where a design is "traced" onto clothing by workers using a mixture of kerosene + blue and kerosene + zinc oxide. Once this design has been printed on to the clothing the design will be traced by weavers into the cloth. The tracing process uses heavy chemicals which workers mix and apply without using gloves and which also emit a strong chemical stench. The waste water is thrown in a ditch outside of the compound belonging to neighbouring land owners.

WASTE

Waste from the AAF's consists of liquids, solids (in the form of scrap cloth, paper, polythene bags, detergent cartons, plastic containers that held chemicals and dyes) and steam and gas emitted from gas-fired boilers.

Cloth scraps are burnt in nearby areas. Some centres sell the scraps to pillow and mattress makers. The plastic jars are preserved and resold to regular customers and many of the women employees collect the waste boxes and detergents packets to take home and burn as fuel. Otherwise, solid wastes (empty packets, plastic bags, boxes, and cloth) were observed scattered along or inside the pond bank and nearby crop field.

At the time of the field visits there were no waste treatment systems observed in any of the centres. In most of the AAF's visited, wastewater is usually drained in to a pond or a ditch. In the Jessore centre the waste water is dumped into the municipal drainage system. At the Sherpur centre, most waste is in the form of dye and detergent waste water. Currently a ditch is being used for its disposal but a small tank is being planned specially for the waste water. The Kushtia centre uses a pond owned by BRAC to dispose its waste. This consists mostly of detergent water.

The pond water at most of the centres are not meant to be used, however people do use the contaminated water for rice field irrigation. During the rainy season water overflow occurs in the ponds and ditches due to heavy flooding and goes into neighbouring fields. There are fish, water hyacinth, helancha, and other hydrophytes in the pond, and adjacent land use includes other fish ponds, mulberry trees, and crop fields. Potatoes, cucumber, and wheat were also observed to be growing during the investigation. In the Jamalpur centre, dye-water goes into a tank before flowing in to the pond. This contaminates the land near the tank since the tanks also overflow in the rainy season. Neighbouring villagers of the Manikgonj AAF complain about the chemicals dumped into the water as it has noticeable effects on their fish cultures. A plan is underway to have a waste treatment system installed in the AAF Manikganj. Meanwhile, waste water goes into a pond. AAF pays a yearly compensation to neighbours whose ponds or fields are affected by waste from their activities.

In most of the AAF's women generally wash completed products directly in the ponds. BRAC is developing a washing shed with water access and proper drainage to minimise waste washed into

ponds. Such a shed was found in the Jamalpur AAF. These should be completed by April 1998. Ring slabs are currently used for disposing water but these are too small to hold the quantity of water used.

Most chemicals used by AAF (Appendix 1) are bought in Bangladesh from international companies such Cibageigy (Swiss), ICI (German), and BASF, all from which dyes are bought. Other materials used in AAF come from three companies: Evergreen for chemicals and dyes, Lever Brothers and Kohinoor for detergents. Other dye companies include DISIN, Karim Enterprises, and Magnet.

Consumer demand for vegetable dyes is low at present as colours are not as bright as synthetic dyes. Vegetable dye silks are mostly sold in the Gulshan Aarong. There is a higher export demand for such products than a local one, although its popularity in Bangladesh is increasing. Aarong does not do much marketing for vegetable dye products. They are made from eucalyptus leaves, jackfruit dust, onion skins, beetlenut, tea leaves, *lotkon* (from bark of this tree), *daleem khosa*, *ganda phool*, and *hortoki*. Supply of vegetable dye sources is adequate and cheaper than chemical dyes. All the materials are biodegradable and do not pollute the environment.

ENERGY SOURCES

Gas and electricity are used as power sources in the AAF centres. Light comes from electricity and gas is used for steaming and boiling processes. Three sub-centres plan to experiment with solar photovoltaic panels for an electricity supply. All sub-centres are rented. The AAF foundations are the central offices. Embroidery is done in the villages in hired houses on a monthly basis. There is no electricity in the rural areas. Poor light hampers worker's eyes, especially during the rainy season. There is also less natural light in the second half of the year from September to January when day light lasts from 9 a.m. to 6 p.m. AAF plans to eventually buy land for the sub-centres and have them all solar powered. The Boira sub-centre of Sherpur has poor lighting. The women sit on thin mats on top of the bare ground, and feel cold and get dirty easily.

Chemicals and detergents used in different stages of the programme are given in appendix 1 and 2. Steps and activities related to waste generation and disposal are shown in appendix 3, 4, and 5.

HEALTH PROBLEMS

Workers involved in dyeing, printing, and washing activities in the AAF's mentioned that they suffer from coughs, gastrointestinal pains, ulcers, throat infections, thinning nails, dry skin, and hand and eye burning. The colours and materials used in dyeing and tracing emit strong smells, affecting their eyes, throats, nose, hands, and possibly internal functions. Primary treatment in the form of ointment for burns and cuts is provided by BRAC. Tracing chemicals burns hands and eyes and stains fingers and nails. Using thinner for tracing also causes finger. Workers cannot use gloves during tracing because the gloves melt from the kerosene and zinc oxide. Workers were not observed to use gloves for mixing dyes either. They wash chemicals off their hands with normal soap. The Jamalpur AAF has been using a mechanical mixer to mix colours for the last three years. Some respondents mentioned that new employees suffer more than older ones in the washing section, as old workers have become used to the chemicals.

AAF personnel mentioned that women are shifted from task to task so that their exposure to harmful chemicals is lessened. As yet no serious illnesses have occurred. BRAC has begun to pay for doctor visits and medical treatments. A doctor has been hired to come in and give all the employees in AAF a full check-up. After completing one cycle of check-ups the doctor will come once a week on a regular basis. Serious illnesses or problems will be referred by the doctor to a specialist and BRAC will provide funds for those specific cases. Records will be kept of all the employees. As yet there is not enough funds for very high bills. AAF is a developing a benevolent fund from which they will pay for medical cases such as operations and so forth. Eye check-ups are already routine and free for the workers. Medication, glasses and doctor fees are also being provided to employees by BRAC for free. Funds provided for these benefits come from donors contributions and from annual earnings of AAF. Medical care is not provided for employees' families as yet.

The list of chemicals and materials used, waste products and disposal methods in sericulture and AAF are summarised below (Tables 1 and 2).

Table 1. Chemical and materials used in Sericulture programme and AAF

Chemicals/ materials	**Purpose**	**Stage/ Activities**
Formalin	Disinfecting, sterilisation	Rearing, grainage
Bleaching	Disinfecting, sterilisation	Rearing, grainage
Diathin-M-45	Root purification	Plantation
Nogos	Plant disease (insecticide)	Plantation in SRC
Urea, TSP, Cowdung	Bush plant and roadside plant	Plantation, SRC
Hydrochloric acid (HCl)	Acid treatment for bivoltine eggs	Grainage
Colour, paste, antifixer	Degumming, dyeing of silk, cotton	Weaving, AAF
Alum	Remove iron -- soften water	Reeling
Hot water	Boil and reel the cocoons, dyeing, printing	Reeling, AAF
Kerosene, zinc oxide, blue	Tracing	AAF
Detergent, chemicals, dyes (table 5)	Washing, dyeing, printing	AAF

Table 2. Waste produced in sericulture programme and AAF and its method of disposal

Stage of production	Type of waste	Method of disposal
Rearing	Kashar (worm cover, excreta, used leaves), dead worm	buried or dumped into a ditch with other waste
Rearing	Waste chemicals (formalin & bleaching)	thrown out (no specific place)
Reeling	Dead worm, reeled cocoon	buried, used as fertiliser
Reeling	Waste water, hot water	drained into a tank or directly to an adjacent field
Reeling	Smoke from boiler	in the air
Reeling	Ash from boiler	not used
Grainage, SRC	*Kashar* (worm cover, excreta, used leaves), dead worm, dead moths	buried after mixing with bleaching powder
Grainage, SRC	Plastic, paper	burned in a pit
Grainage, SRC	Waste chemicals (formalin & bleaching, HCL)	poured into a pit
Weaving	Plastic containers, paper, cartons, waste silk thread, scrap cloth.	thrown away or sold
Weaving	Leftover dye (colour, paste, antifixer), waste water	thrown into a ditch or pond
Weaving	plastic, scrap cloth, empty paper cartons and bags, detergents packets	taken by worker (to use as fuel), or thrown out to the pond or near by field
AAF	dyes, paint, acids, chemical, detergents, waste water, hot water	-thrown out to the pond or near by field, or collected in a tank and discharged to the pond

Water and Soil Sample Analysis:

To assess the environmental and health risk of chemicals used in sericulture and AAF a few selected chemical parameters were analysed for soil and water. Results are given in tables 3 and 4. The results

of the chemical contents in water and soil and its effect with Maximum Allowable Concentration (MAC) are discussed below.

pH is an important parameter for maintaining aquatic life and is a scale of acidity-alkalinity widely used as a general characteristic of water[1]. The optimum range of pH for aquatic life is 6.8 to 9.0. pH observed in this study at some of the sites is much higher than the optimum value, indicating alkaline water.

Another parameter used to characterise the gross chemical characteristic of water is electrolytic conductivity (Ec μS). Because electrical current is transported by ions in a solution, conductivity increases as the concentration of ions increases. High ionic load indicates high conductivity which indicates organic and inorganic matter washed into the water. At two sites, the conductivity is higher than the DoE (Department of Environment, Government of Bangladesh) standard, which indicates high organic and inorganic loading in printing and dyeing waters.

Chemical Oxygen Demand (COD) is another parameter used to characterise the quality of water[2]. COD of analysed water was within the limit of DoE standards except for samples taken from the printing and dyeing drain in Manikganj.

Nitrate-nitrogen (NO_3-N), Ammonium-nitrogen (NH_4-N), Phosphate-phosphorus (PO_4-P) and Sulphate (SO_4-S) indicate the eutrophic status of water, as these are the chemicals which encourage the growth of phytoplankton and algae. As a result of phytoplankton and algae growth, the Biological Oxygen Demand[3] (BOD) of water increases creates unfavourable conditions for other aquatic

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[1] The intensity of acidity or alkalinity of wastewater sample is measured on the pH scale which actually measures the concentration of hydrogen ion present. Many chemical reactions and biological activities are controlled by pH. Highly acidic or highly alkaline waters are undesirable because of corrosion hazards and treatment difficulties.

[2] COD is the amount of oxygen required by a chemical agent to oxidize all the organic matters present in the sample. COD indicates the presence of undesirable organic matters.

[3] BOD is the amount of oxygen required by microorganisms to oxidize the organic matters present in the sample. In wastewater quality control process, it is very significant to know the amount of organic matters present and the quantity of oxygen required for its stabilization.

organisms including fish. All the chemicals tested are within the DoE prescribed standard except in two water samples where the NH_4-N is very high.

Selected heavy metals analysed (Zn, Cu, Cr, Cd, Pb and Hg) show high values of zinc and copper at two sites and high cadmium values at one site. Although the chemical contents were lower than DoE standards, in almost all cases the amount of heavy metal in soil (sediment) was higher than in water (Fig. 1). This suggests that the chemicals are accumulating in the soil. Even though it is low now, it will create significant cumulative hazards for the environment and biodiversity in the near future. Chemicals present in the sediment and water are ingested by aquatic plants and animals, which progressively magnifies through the food chain, affecting fishes, birds, animals and human health.

An excess of these chemicals also cause other environmental and health hazards, some of which are given in table 5. These are chemicals which may come from dyes, pigments, and chemicals used in sericulture and AAF. Other chemicals significant in assessing the environmental hazards of different activities of the programmes include phenol, chloride, alkalinity, arsenic, suspended and dissolved solids, oil, and grease. Due to time and laboratory constraints it was not possible to analyse those parameters. Causes of hand infection in reeling and organic acids in reeling water should also be tested, which could not be done in this study because of time constraints.

It should be mentioned that DoE standards differ from other standards (e.g. Canadian or American (EPA)). The goal should be to minimise impacts on the environment as much as possible, even without regard to an upper limit. Some of these samples may not be above the DoE limits, but they are certainly at elevated levels and could have hazardous consequences.

Table 3. Laboratory Analysis Results of Water

	Results from Sample Analysis					**Standards Proposed by DoE for Industrial Effluents in Bangladesh**		
Parameters	**W_1**	**W_2**	**W_3**	**W_4**	**W_5**	**Inland Surface Water**	**Sewer Leading to Treatment**	**Irrigation**
pH	8.8	10.0	12.5	8.7	8.6	6-9	6-9	6-9
Ec (µS)	1930	410	12400	780	540	1200		
COD (mg/l)	80.0	15.0	275.0	32.0	20.0	200	400	400
NO_3-N (mg/l)	8.0	trace	trace	0.1	0.7	10.0	10.0	10.0
NH_4-N (mg/l)	240.0	3.0	8.0	250.0	18.0	5.0	5.0	15.0
PO_4-P (mg/l)	4.0	trace	4.0	3.0	trace	8.0	8.0	15.0
SO_4-S (mg/l)	0.2	0.2	0.1	0.1	0.4	100	100	100
Zn (mg/l)	10.0	5.0	28.0	7.0	4.0	5.0	10.0	10.0
Cu (mg/l)	3.0	1.0	8.0	5.0	2.0	0.5	3.0	3.0
Cr (mg/l)	0.01	0.03	0.09	0.01	trace	0.5	1.0	1.0
Cd (mg/l)	trace	0.02	0.07	trace	0.03	0.05	0.5	0.5
Pb (mg/l)	trace	trace	0.08	0.02	trace	0.1	1	0.1
Hg (mg/l)	0.02	trace	0.05	trace	trace	0.1	0.1	0.1

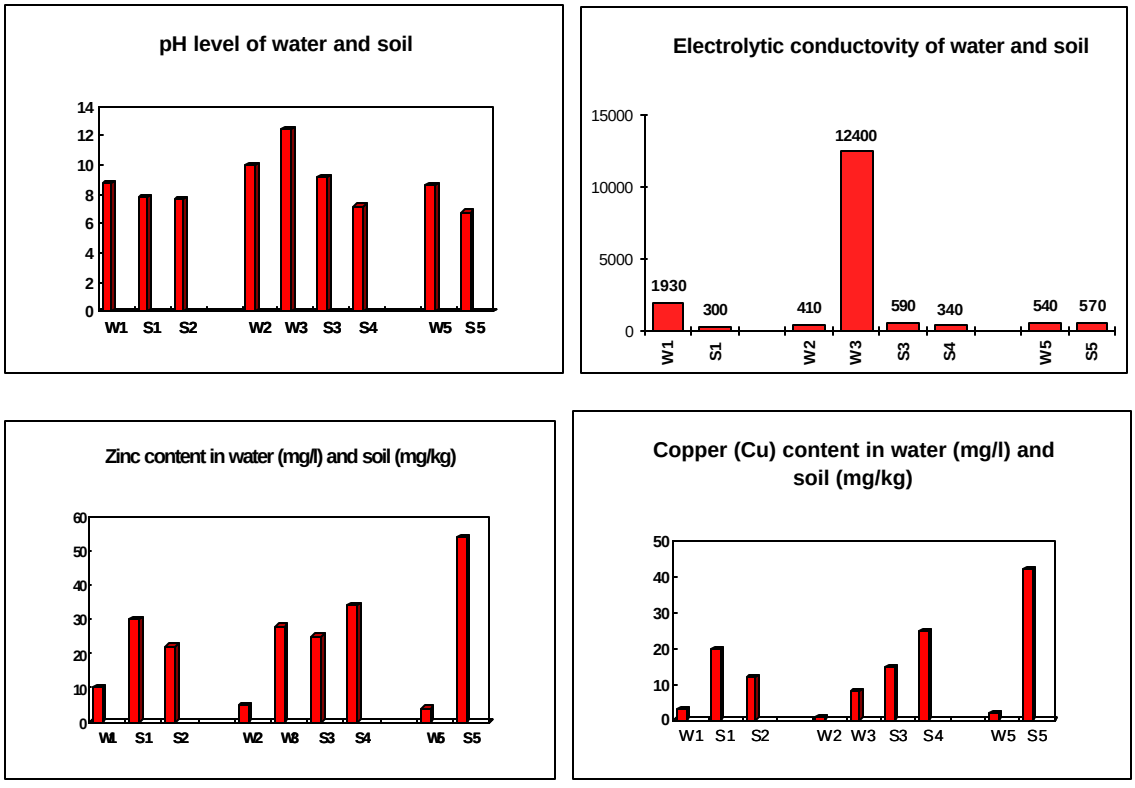
W_1 = Gorpara silk dyeing W_2 = AAF Manikganj pond W_3 = AAF Manikganj drain, (*) W_4 = Atghoria reeling, W_5 = AAF Jamalpur

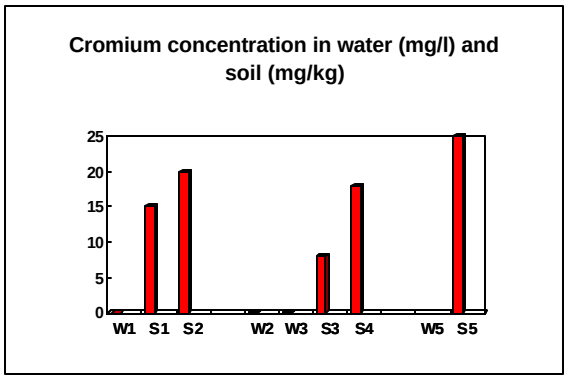
Table 4. Laboratory Results of Soil Samples

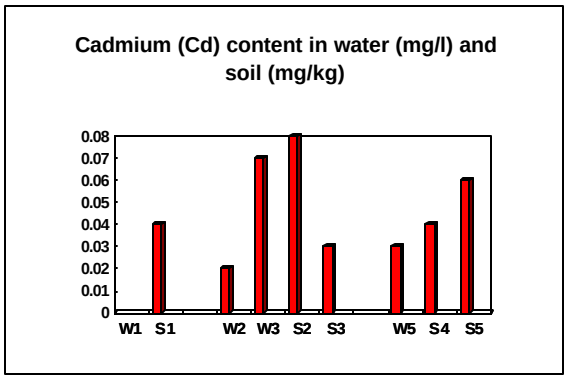
Parameters	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**
pH	7.8	7.7	9.2	7.2	6.8
Ec µS	300	210	590	340	570
Zn mg/kg	30.0	22.0	25.0	34.0	54.0
Cu mg/kg	20.0	12.0	15.0	25.0	42.0
Cr mg/kg	15.0	20.0	8.0	18.0	25.0
Cd mg/kg	0.04	0.08	0.03	0.04	0.06
Pb mg/kg	20.0	38.0	12.0	25.0	42.0
Hg mg/kg	0.05	0.03	0.03	0.06	0.08

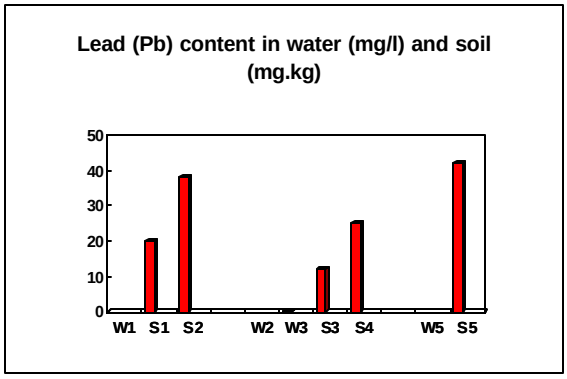
S_1 = Gorpara silk dyeing, S_2 = Gorpara block printing, S_3 = AAF Manikganj dyeing, S_4 = AAF Manikganj printing, S_5 = AAF Jamalpur

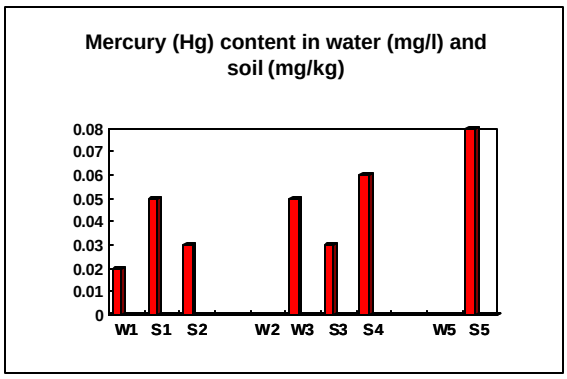
Figure 1: Comparison of Chemical Contents in Water and Soil Sample at Different Sites of Sericulture and AAF











W_1 = Gorpara silk dyeing,

W_2 = AAF Manikganj pond,

W_3 = AAF Manikganj drain,

W_4 = Atghoria reeling,

W_5 = AAF Jamalpur,

S_1 = Gorpara silk dyeing,

S_2 = Gorpara block printing**,**

S_3 = AAF Manikganj dyeing**,**

S_4 = AAF Manikganj printing,

S_5 = AAF Jamalpur

Table 5. Environmental and Health Hazard Assessment of Chemicals Used in Sericulture

Chemicals	Health Effects	Environmental Effects	MAC[4]
Zinc (Zn)	Information is not available	Contamination of agricultural land, food chain.	0.1 mg/l at outlets of pumping and/or treatment works and their substations
Copper (Cu)	Irritant of the stomach and intestines, and can prove fatal at very high doses. Exposure to copper decreases tolerance to zinc	Copper is more toxic to freshwater fish than any other heavy metal except mercury. Contamination of agricultural land	In soil = 100 mg/kg (0.5 mg/l inland and 3 mg/l irrigation)
Chromium (Cr)	Cause ulcers, respiratory disorders, and skin irritation in humans	Acutely toxic to invertebrates at concentration as low as 22 µg per litre and 17600 µg per litre for vertebrates. Hexavalent chromium in the workplace is suspected of being carcinogenic. Contamination of agricultural land	1 mg/1 (EPA, USA) 50 µg/1. (WHO 1983) for drinking water.
Cadmium (Cd)	Cause of itai itai disease, cancer, testicular tumours and the inhibition of growth. Headache, vomiting, chest pains, hypertension, heart, kidney and liver disease. Also causes kidney, stomach and intestine disorders	Critical pathway of cadmium is soil-plant-human in a given ecosystem. Extreme fish toxicity occurs, if water contains more than 1 µg/1 cadmium. Contamination of agricultural land	0.1 mg/m^3 (USA). 0.005 mg/1 (WHO, 1983)
Lead (Pb)	Decrease reproductive ability by men and women. Causes change in blood chemistry, neurological disorders, kidney damage and cardiovascular damage. Low concentrations of lead in drinking water can cause hearing loss and learning disabilities in children, an increased risk of hypertensive heart disease in adults, and accelerated loss of bone mass in post-menopausal women.	Fish and bird poisoning. Contamination of agricultural land	10 µg/l lead can be harmful to children[5]. MAC: 0.04 mg/1 for drinking water. 0.05 mg/1 for running water.
Mercury (Hg)	Impairment of speech, hearing, and thought, difficulty in chewing and swallowing, involuntary muscle movement	When mercury is disposed of in water, it is attracted to particles in the water and settles to the bottom sediments where it can be converted by micro-organisms into methyl	MAC is 0.01 ml/m^3 0.001 mg/1 in drinking water. 0.05 mg/1 in

[4] MAC = Maximum Allowable Concentration

[5] The US Centre for Disease Control issued urgent new warnings , alerting doctors that anything higher than 10 µ/dl lead can be harmful to children

	and impaired gait. Human exposure to the most hazardous form of this metal, methyl mercury, is almost exclusively via consumption of fish.	mercury. The compound methyl mercury is of greatest concern in drinking water contamination. It causes deterioration of the human nerve system. Consuming fish from contaminated water is a more common means of infection, since fish concentrate mercury in their tissue. Contamination of agricultural land.	industrial waste
Phosphates	Information is not available	Eutrophication	0.4 mg/l is MAC (5 mg/l inland water & 15 mg/l irrigation)
Nitrates, Nitrites	Blood diseases in bottle fed infants.	Encourages the growth of algae, which in the process of decay causes de-oxygenation and the extermination of most aquatic life. As a result most animal life disappears, leaving only surface breathing insects.	10 mg/1 NO_3 in drinking water. MAC of 50 mg/1

(ref. Chiras, 1985, Medline, and POP line)

From this study it is found that, all the activities of sericulture and AAF have environmental impacts, although all are not necessarily negative impacts.

From the discussion and field observations it seems that chemicals, detergents, dyes, pigments, and solid and liquid waste disposal are the main areas of environmental and health concerns. Besides these, use of fertiliser and pesticides may also have adverse effect[6] on silk worm and cocoon production and quality.

HEALTH EFFECTS OF SERICULTURE AND AAF

From the interviews and literature review, it is found that there are several health problems related to sericulture, printing and dyeing activities some of which have already been discussed. These can be

[6]Adverse effects are defined by the U.S. EPA as, "any effects which result in functional impairment and/or pathological lesions which may affect the performance of the whole organisms. Or which reduce an organism's ability to respond to an additional challenge" (Laws, 1992)

caused by direct exposure, or indirect, to environmental pollution and contamination. Health effects of the programme are summarised in Table 6.

Table 6. Health Problem Related to Activities Observed in the Field (Direct Problems)

Activities	**Problems**	**Caused by**
Rearing	Headache, gastric, skin burning on feet and hands	formalin, worm excreta
Grainage	Cough, colds, allergy	chemicals, dust of butterfly
Reeling	– Hand and finger infection – back pain – headache, gastric, skin burning	– hot reeling water, acids from cocoon – standing all day – fire and fumes from boiling
Weaving	eye irritation, gastrointestinal pains, skin cuts, ulcers, headache, skin burning	- intricate work, poor light -materials used in silk dyeing -pulling on silk thread
Reeling and Weaving	Hearing problem	loud noise
Ayesha Abed Foundation	– cough, gastrointestinal, ulcer, throat infection, nail thinning, dryness of skin, hand and eye burning – eyesight	– dyeing, printing and washing – AAF sub-centres

In sericulture, formalin and bleaching powder are extensively used as general disinfectants. Use of formalin without certain precautionary measures causes burning eyes, mucus secretion, and peeling skin. Bleaching powder solution at higher concentration than >50% causes similar hazards. The application of dust formulations may cause respiratory disorders and burning eyes (Ramanathan, 1997).

In grainage, inhalation of fumes during acid treatment of bivoltine eggs and dyeing of silk fabrics using acid baths may cause respiratory disorders. Asthma (believed to be allergic in nature) could be triggered by fine scales in the air released by the fluttering of the silk moths wings during mating. Male silkworms

release more scales as they flutter more frequently during mating. The inhalation of scales can be prevented by wearing masks of three layers of muslin cloth.

During silk reeling, asthma is caused by the smoke emitted from cocoon cooking stoves from firewood and the stench from steam and vapour arising from fluids released from the pupa body. A few reports regarding the incidence of occupational asthma in sericulture in China and Japan are available (Ramanathan, 1997). In India, a clinical survey in 1985 involving two silk features revealed that 36% of the total workers were suffering from bronchial asthma. It also showed that in 16.9% of the workers, it was only due to the air borne antigens originating from silkworm cocoons and pupae and hence, their suffering is of occupational origin.

The people engaged in silk reeling units are prone to fungal and other skin infections like deramatophytosis (ring worm infection) due to constant immersion of hands during reeling in hot and tepid water. Sometimes, this water is often laced with certain chemicals to improve the colour or quality of silk (mostly in India). The feet also become infected due to constant contact with damp floors caused by improper and unhygenic drainage systems in reeling units.

During 1987-88 in China, 64 children of less than 15 years of age were reported to have allergic asthma caused by silk which is reported to be a highly potent allergen (Chaoming et al., 1980). These children were exposed to silk quilts and cloths made of silk waste. The allergenicity of fibroin is much weaker than that of sericin. 14% cases of asthma were also accompanied by conjunctivitis. Using multi-fuel economic ovens for cooking cocoons eliminates the smoke, a major irritant in the silk reeling room. Hot air drying of cocoons dries up the body fluids of the pupa, thus eliminating the irritant vapours during cooking. A cocoon cooking cage with lid has been designed (in India) which minimises vapours and steam from escaping into the room. It is easier to handle and ensures uniform cooking, thus increasing yarn yield.

In AAF, direct contact with dyes and chemicals causes skin diseases in the workers. The fumes of chemicals and dyes may cause lungs disease, eye burning, loss of eye sight, and gastrointestinal problems. Detergents and other cleansing agents affect hands, nails, and skins of the workers.

ENVIRONMENTAL ASSESSMENT

During the investigation it was found that the wastewater and solid waste disposal are the main cause of environmental affects. There are many chemicals, pesticides and fertilisers used in the different stages of sericulture activities, including plantation, rearing, grainage, and weaving. A list of the chemicals are given in the Table 1. These will have a harmful effect on the environment and public health if they are not handled and disposed properly. Fertilizers and pesticides used in mulberry plantations may have an affect on the silk worm life cycle and the quality and quantity of cocoons produced as well as pose negative impacts on the environment.

The irrigation of agricultural land using polluted water containing effluents discharged by AAF and reeling is also harmful to farmers. The concentrated effluents accumulate in the soil on agricultural land as well as in animal life cycles in the water.

Employees who work in rearing, weaving, grainage and reeling suffer from different health problems mentioned in Table 6. This also has impact on their economic status as they work less due to poor health. A large amount of fire wood is used for cocoon boiling and reeling. The smoke may emit toxic carbon monoxide (CO) fumes in to the air. Use of firewood also adds to forest destruction. Hot water and waste water from reeling and boiling, and dyeing waste from weaving goes into nearby areas such as crop fields. These effluents may kill microbes and other sensitive plants and animal in and around the disposal ditches and have impacts on different crops.

In most of the sites visited, the disposal of the chemicals and solid wastes seem to be a neglected issue. Neither staff or programme participants seem to be fully aware of the hazardous effect of these

chemicals. The chemicals and dyeing waste which are thrown just outside the compounds or other nearby areas may pose severe environmental degradation by killing soil microbes, degrading soil fertility, and accumulating in soil, organisms, and plants which affects the food chain through bio-magnification. Local inhabitants are not aware of this. Non-biodegradable solid waste can reduce soil fertility, waster percolation, and drainage.

It is clear from the laboratory analysis of wastewater and sediment from dyeing and printing test areas using a few chemical parameters, that chemicals containing dyes and pigments are accumulating in the sediment. Gradually these will increase, which will have a severe adverse effect on the environment in the near future. Though the sample sizes of analysed water and sediment were not enough to make solid biases, it can still be concluded that environmental hazard is certain. The result of analysed samples might have a higher value compared to DoE standards if at least three sampling tests are done for each site. Most of the chemicals found are persistent in nature and have long residual periods.

The identified environmental impacts of printing, dyeing and sericulture activities have been classified (according to BCAS, 1997) into three general categories: 1. Ecological, 2. Physico-chemical, and 3. Human interest. Adverse impacts of sericulture and AAF are summarised in Table 7.

1. Ecological Environmental Impacts

Fisheries: wastewater containing chemicals, dyes, detergents are disposed in the pond (especially in Manikganj and Jamalpur). These are harmful to the aquatic environment. Adverse effects of some chemicals are discussed in Table 4. Besides these, there might be some other toxic chemicals which harm animal life. Oil and grease from detergents can cause depletion of dissolved oxygen (DO) in receiving water when they decompose biochemically. It is also interferes with photosynthesis and affect fish life resulting in fish die-off. This was noticed in AAF ponds in Jamalpur and Manikganj.

Wildlife: dyeing and printing wastewater flow drained into nearby agricultural land may affect insects, wild flora, and fauna. Toxic and persistent chemicals accumulate in fatty tissues and goes into bio-magnification in food chains.

Eutrophication: means the enrichment of nutrients (NO4, PO4, etc.) in water. Wastewater reaches water to cause luxuriant growth and death of some weeds and algae. Decomposition of these aquatic plants depletes the level of dissolved oxygen in the water and disrupt the aquatic environment.

2. Physico-chemical Environmental Impacts

Land-soil characteristics: wastewater flows over land and solid waste is dumped in open land which may cause changes in soil characteristics. Different types of chemicals from wastewater and solid waste decomposition left on soil may destroy soil microbes and reduce the natural soil fertility. The chemicals may also alter soil texture and permeability of soils.

Water pollution: surface water pollution may occur due to drainage of waste water and flooding of dumping ground by flood or rain water. Residue of chemicals from waste reach ground water through infiltration. Pollutants may persist in ground water over a long period of time and can travel a long distance without any alteration. This causes ground water pollution.

Air pollution: air emissions from reeling, boiler, and grainage contain oxides of nitrogen, sulphur, carbon, volatile organic solvents, dust and soot. These emissions may be toxic to the environment and cause occupational health problems of the work force. These may also cause environmental and health hazards in surrounding areas.

3. Environmental Impacts Related to Human Interest

Human interest related to health, economics, loss of agricultural land, crop production, employment are not discussed in detail. Only health issues were discussed in this report.

Table 7. Adverse Impacts of Sericulture and AAF

Related Activities	**Environmental Parameters**	**Intensity of Environmental Impacts**		
		Significant	**Moderate**	**Negligible**
waste from printing, dyeing, rearing, grainage, and chemical used in plantation	Surface water pollution	**X**		
waste from printing, dyeing, and grainage	Ground water pollution		**X**	
waste from printing, and dyeing	Aquatic diversity	**X**		
waste from printing, and dyeing	Fisheries	**X**		
waste from grainage, plantation, and AAF	Soil characteristics		**X**	
waste from AAF	Agricultural production		**X**	
waste from AAF	Crop quality		**X**	
waste from AAF, rearing, and grainage	Vegetation		**X**	
All kind of waste disposal	Aesthetic	**X**		
Emission from reeling house boiler	Air quality			**X**
As above (table 6)	Human health	**X**		

CONCLUSION AND RECOMMENDATIONS

Fertilizers and pesticides used in mulberry plantations; formalin, bleach, and acids used in rearing and grainage; fuel and hot water used in reeling centres; dyes and detergents used in printing and dyeing in AAF are the most environmentally significant activities of the sericulture programme and AAF activities. The most important issue for environmental and public health concerns is the disposal of waste water and solid waste in these activities.

Although there are some beneficial environmental effects of the programmes discussed earlier such as mulberry plantations and the possibility of using of dead worms as fertiliser, there is no instilled practice of protective measures for health and safety. There is also no proper waste disposal and waste management systems.

Face masks, hand gloves, and gum-shoes are suggested for use when disinfecting rearing rooms and appliances. Care should be taken to avoid inhalation of acid fumes by providing proper exhaust and ventilation facilities in grainages and dyeing units which facilitates the quick dispersal of fumes. The presence of exhaust fans in the pairing/oviposition rooms reduces the concentration of scales in the given environment.

Since the process of reeling is not fully mechanised, it is difficult to avoid immersing the hands in hot water during reeling and cooking. An antifungal skin ointment to be applied on hands and feet for preventing skin disease and using small forceps to lift or cast out cocoons during reeling could be encouraged which may, however, affect reliability/productivity. As per the advice of silk reeling experts, wearing gloves all day is not safer as this prevents the hands from aeration leading to fungal disease.

In the reeling centres, good ventilation, proper drainage to ensure minimum dampness, use of slippers, regular use of ointments and proper/quick disposal of waste cocoons would prevent some of the more common health problems mentioned to a great extent.

Protective environmental measures are not only healthier for people and the environment in general, but also more cost-effective in the long-run. If hidden costs are considered, such as medical bills, production loss due to health effects, poor crop output due to deterioration in land quality, and negative impacts on biodiversity of neighbouring areas, the costs of ignoring environmental protection will be higher than taking appropriate steps now. BRAC's sericulture program may not currently have wide-spread environmental impacts, but as BRAC plans to significantly increase its output by the next century, the potential for environmental harm will increase. This is the most important time to implement sound safety measures, as the program is still in its early stages of development. It will be easier and cheaper to implement waste-treatment systems now and develop more environmentally friendly alternatives to any harmful substances being used.

The proposed waste treatment plant in Manikgonj is a step in the right direction and similar plants should be activated for all large-scale production units. As the sericulture program keeps expanding, health problems will occur that are currently not experienced in Bangladesh due to the small scale of production in silk. It would be advisable to observe health impacts experienced by India and China and implement measures to avoid such impacts later on as BRAC's programme efforts increase.

Although socio-economic aspects are not included in this report, it was observed in the field that there is a need to improve wages, and increment structure and a proper distribution of workload among the workers. There is also a need to supervise shifts from one task to another to reduce long term chemical exposure. For example, tracing to embroidery, printing to washing, reeling to twisting or boiling and so forth.

The following recommendations to lessen environmental degradation and health hazards will help make the programme more environmentally sustainable.

Recommendations/Remedial measures

1. Treatment plant for existing AAF silk dyeing, printing centres:
    - printing and dyeing wastewater
    - washing wastewater (low cost)

It is recommended that, there should be a common place for dyeing silk and or cotton rather than separately at each different AAF. It will also be easier and cheaper to establish one treatment plant.

2. Training (for workers, programme participants, staff) on:
    - environmental impacts
    - health and safety aspects of handling chemicals and dyes
    - waste disposal and management

3. Separate planned disposal site for solid waste
    - bio-degradable
    - non bio-degradable

4. Reuse of waste
    - plastic and hard paper box, containers
    - dead worm as fertiliser, fish meal, feed meal
    - reeling water for irrigation after cooling

5. Close monitoring of
    - waste disposal
    - handling of chemicals and dyes
    - quality of environment (water, land), health
    - practice of existing guide lines (use of gloves, mask etc.)

6. Better working environment at

- AAF sub-centres (proper light, *pakka*/ thick mat on the floor)
- reeling centres (light, changing of water frequently, mask during cocoon boiling)
- shifting tasks between workers (tracing to embroidery, reeling to twisting etc.)

Environmental problems and possible mitigation options for large, small-scale, and cottage-level industries were recommended by the BCAS, 1997 research report to assess the environmental impact of textile and printing industries in Bangladesh. Based on that the following (Table 8) are some options which are relevant for the studied programme:

Table 8. Possible Mitigation Options for the Programme to Minimise Environmental Problems

Problems Related to the Environment	**Possible Mitigation Options**	**Remarks**
High Pollution Effluent • surface water pollution • ground water pollution • soil characteristics • fisheries • eutrophication • crop production • loss of agricultural land • wild life/biodiversity	**Effluent Treatment Plant** • pre-treatment (screening/equalisation/neutralisation) • physico-chemical (coagulation flocculation/activated carbon adsorption/ozone oxidation) • Biological (aerated ponds/activated sludge/rotary biological contractor) **Proper Disposal of Waste** • planned disposal site • minimum use of chemicals, detergents • alternatives to fertiliser, pesticides, formalin	60-70 % reduction in expected
Air Emissions • air pollution • dust pollution	• adequate ventilation • suction equipment • dust collectors • gas scrubber • stack of sufficient height	5 % reduction
Workers and Neighbours • health, safety and disease • lack of awareness • lack of training	• safety measures (gloves, masks, ventilation, light) • alternative to kerosene • regular health check-ups and treatment • training programme • public awareness	10 % reduction
In-house Process • waste of dyes and chemicals • waste of energy and water	• good house keeping • modification of process and equipment • replacement and optimisation of chemicals • conservation of energy (solar panels, biogas)	20 % reduction
Above all: Regular Monitoring		50 % reduction

Table : Observed Environmental Impacts and Remedial Suggestions

Observed Environmental and Health Impacts	**Remedial Measures Suggested**
Direct disposal of chemicals, in the form of waste water into open areas (ditches, ponds, fields). Noticeable discoloration of water and greasy film on surface of water. Kills fish, animals, plants, microbes. Disrupts natural ecosystem of area.	-Treatment plant for AAF printing, dyeing, washing wastewater. There should be a common place for dyeing silk and cotton--then only one treatment plant needs to be established which will reduce costs of treatment . (Please see table 8 for treatment plant options).
Direct handling of chemicals, dyes, or hot water by employees--skin rashes, affected hands, inhalation of strong fumes	-Training on health and safety aspects of handling chemicals and dyes, environmental impacts. -Proper ventilation systems. Use of gloves and masks. Use of forceps during reeling -changing reeling water
Large quantity of wood used for fuel, inhalation of smoke: inefficient fuel use, causes asthma	-Alternate/renewable energy sources. -Ventilation systems -Use of masks
Inhalation of steam during reeling, causes asthma	-Better Ventilation and aeration systems
Large amounts of solid waste left--plastics, cartons, pupae, water, cloth.	-Separate planned disposal site for solid waste--for bio-degradable and non bio-degradable. -Reuse of waste: recycle plastics, cartons. Use dead pupae as fertiliser, fish/poultry feed. Use reeling water (protein rich) for irrigation after cooling. Proper drainage systems which minimises waste
Application of pesticides and fertilizers--causes skin burns during preparation and is harmful to ecosystem	-Use of skin protective devices, glass rod/stick for stirring liquids, face masks -Organic fertiliser and natural pesticides (such as neem plants) should be used

MONITORING CRITERIA

Once the suggestions from this study have been implemented there should be a proper monitoring system set up to evaluate and check the progress of the implementations. This can be done either by programme staff or any other designated staff, as well as some involvement from the Environment group. The possible criteria for monitoring and probable responsible party is summarised below.

1. Monitoring of waste stream

- **water quality:** After establishing the wastewater treatment plant, water quality monitoring should be done at the discharge point of treatment plant. Some selected parameters of water (pH, Alkalinity,

Cr., Cu, Hg, Ar) will be used within DoE standard limit. This can be done by the Environment Group and will be specifically for printing and dyeing waste.

- **waste water drainage:** Waste water disposal should be monitored. Proper disposal of wastewater through a fixed drain in a fixed location is needed. It can be checked regularly by PO or PA, manager or supervisor of AAF. In order to make it into a regular practice Programme staff from head office can also become involved in the monitoring.
- **solid waste disposal practices:** how waste is handled, where it is disposed (e.g. is it disposed into a fixed bin?), whether the guidelines are followed when handling the waste (use of gloves, shoes, mask) can be checked by the manager or supervisor of AAF.

2. Disposal site

A separate site needs to be maintained for waste. Whether different forms of waste are separated before disposing, whether bio-degradable and non bio-degradable wastes are separated, where the waste is disposed, and whether there are separate fixed sites for different waste such as solid, liquid, bio-degradable, non bio-degradable, and toxic wastes should be checked. As well as the kinds of disposal bins or pits that are available These can be checked by the manager or supervisor of AAF as well as the Environment group.

3. Waste reuse (relevant questions):

- **consumer of recycled waste:** Is there any demand for the waste? From who: BRAC members and workers or outsiders? Is the waste sold? To whom?.
- **distribution pattern:** What do they do with the waste, what purposes do the different wastes have?
- **practice of reuse:** How often is the waste collected? If containers are reused are they cleaned first?

These can be monitored by PA/PO and sometimes by the supervisor.

4. Training impact

- awareness level: How much do the employees know about the health effect of chemicals and dyes they handle?
- practice of prescribed guideline by workers and programme participants. Monitoring should be done of whether workers are using gloves, masks, and mixing sticks during work and whether they are disposing waste in the proper way and place.
- practice of chemicals and waste handling and disposal. Workers should be asked about waste handling and how they should handle chemicals, dyes, and detergents.

This can be done by Manager, supervisor and the Environment Group.

5. Health and safety

- health and disease frequency: checking skin, eyes, and hand infections. Frequency of other health problems such as gastric pains, back pains, and nail thinning should be noted.
- work place: availability of light, and water supply at reeling, light and materials used on the floor of subcentres should be checked and maintained.

These can be done by Environment group, medical doctor, and Head Office staff.

To make the programme environmentally sustainable and economically viable it would be better to have inter programme co-operation (e.g. reuse of waste as fertiliser, feed meal), routine practice of these monitoring checklist by field staff, proper management and monitoring set up to follow up the recommendations practices.

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Appendix 1. Yearly Statement of Detergent Use in AAF Centres

S.L	**Quantity Used Per Year**					
#	**Name of Item**	AAF Manikganj	AAF Jamalpur	AAF Sherpur	AAF Kushtia	AAF Jessore
1.	LUX (Pieces)	4226	613	962	1044	2255
2.	WHEEL (Pieces)	495	5248 (?)	2028(?)	2064(?)	3782(?)
3.	JET POWDER (Pieces)	1247	1955	628	543	818
4.	THINNER	71 (tin)	12 (tin)	10 (kg)	3 (kg)	4 (kg)
5.	OBZALIC (kg)	795	346	140	59	172
6.	HYDROZE (kg)	544				
7.	NISAPOL (kg)	2126	100	65	466	240
8.	Gum of Babla Tree	851 (kg)				
9.	Soda s	388.37 (kg)				

Appendix 2. AYESHA ABED FOUNDATION

MANIKGONJ REQUISITION OF COLOUR AND CHEMICALS FOR 1997

PIGMENT GROUP

S.L. No.	**DESCRIPTION**	**CONSUMPTION in 1996** (Kgs)	**REQUISITION for 1997** May - Dec. '97 Total (Kgs)
1.	Tarpin Oil	5328	3767.40
2.	Binder	4665	3265.50
3.	Titanium	460	322
4.	Pink	24.500	17.15
5.	Green Yellow	15.500	10.85
6.	Green	30	21

7.	Golden Yellow	69.500	48.65
8.	Red	206.500	144.55
9.	Blue	151	105.70
10.	Turquoise Blue	24.500	17.15
11.	Orange	67	46.30
12.	Black	759	531.30
13.	Violet	100.700	70.49
14.	Apriton	2453	1717.10
15.	Ammonium Bottle	66 (Pieces)	46 (Pieces)
16.	Cariar (?)	363.500	254.45
17.	Rose M-152	16	11.20
18.	Alcopin Gum	30.500	21.35
19.	Neotex BIF	935	654.50
20.	N.K. Fixture	1377	160.65
21.	Autosol W.R.	11 (Litres)	7.70
22.	L.G. Net Gum	9.500	6.65
23.	Bright M-60	7	4.90
24.	White Paste - 5334	162	113.4o
25.	E.L - 1	4	2.80
26.	Okzal R-Con	3.500	2.45
27.	Hardener	3	2.10
28.	Mat Paste	10 (Litres)	7
29.	Green Yellow F.G.	1.500	1.05
30.	Golden Yellow G.R.	6	4.20
31.	Red F.F.G.	14	3.80
32.	Blue FF GP	9	6.30
33.	Turquoise F.G.	4	2.80

34.	Orange G.R.	6.500	4.55
35.	Violet BR	8	5.60
36.	Black NO	60	42
37.	Rishan F53	1	.70

VAT GROUP

S.L. No.	**DESCRIPTION**	**CONSUMPTION in 1996** (Kgs)	**REQUISITION for 1997** May - Dec. '97 Total (Kgs)
1.	Blue B.D.I	11.65	8.16
2.	Brown B.R.	11.47	8.03
3.	Brown R.	4.71	3.30
4.	Green G.N.	3.100	2.17
5.	Hydren Blue (SOI)	6.1500	4.31
6.	Violet	7.455	5.22
7.	Olive D.R.	2.100	1.47
8.	Violet Grey	11.190	7.83
9.	Turmeric S.B	2.555	1.79
10.	Pink	6.510	4.66
11.	Orange	7.66	5.36
12.	Magenta	1.190	0.83
13.	Turquoise Blue	2.200	1.51
14.	Black Sulphur	88.600	62.02
15.	Caustic	44 Bags	33 (bags)
16.	Hydrous	326	228.20
17.	Nisapol	2306	1614.20

18.	Sodium Bicarbonate	689	482.30

PROSIAN GROUP

S.L. No.	DESCRIPTION	CONSUMPTION in 1996 (Kgs)	REQUISITION for 1997 May - Dec. '97 Total (Kgs)
1.	Yellow 4 G.	11.487	8.04
2.	Yellow 3 R.	9.95	8.97
3.	Yellow 8 G.	.400	.28
4.	Red 5 B.	17.285	12.10
5.	Orange 2 R.	18.252	12.78
6.	Blue 2 R.	6.422	4.50
7.	Olive 3 G.	3.980	2.79
8.	Turquoise G.	9.970	6.98
9.	Blue G.	5.360	3.75
10.	Brown 3 R.D.	20.965	14.68
11.	Black	18	12.60
12.	Navy Blue	3.40	2.38
13.	Blue 7 R.	2	1.40

SEBA/ICI (ENGLAND)

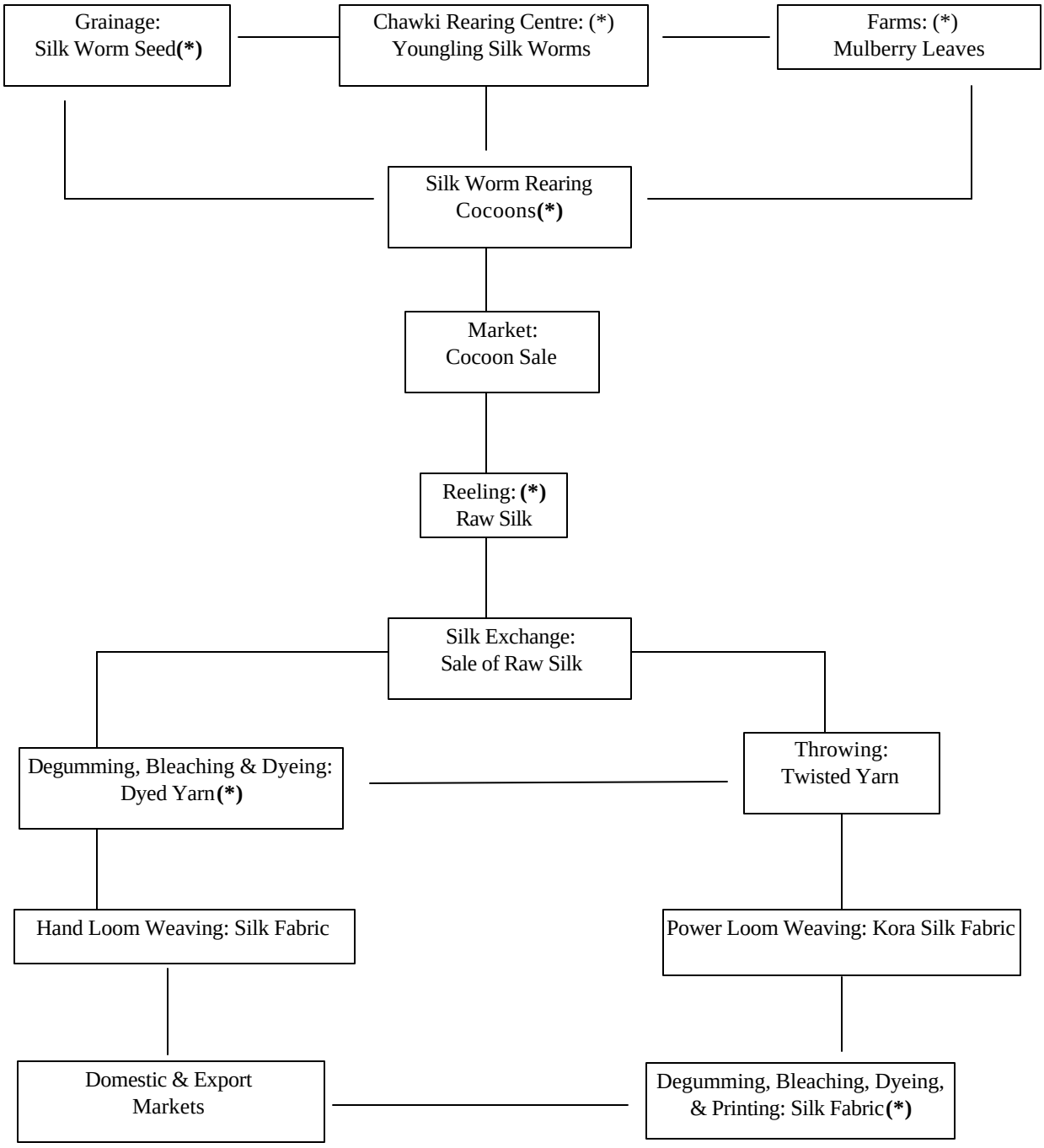
S.L. No.	DESCRIPTION	CONSUMPTION in 1996 (Kgs)	REQUISITION for 1997 May - Dec. '97 Total (Kgs)
1.	Black	103.900	72.73
2.	Blue	12.135	8.49
3.	Violet	4.851	3.40
4.	Orange	1	.70
5.	Brown	4.90	3.43
6.	Turquoise	3.200	2.24

7.	Green	15.29	10.70
8.	Turmeric	10.73	7.51
9.	Red	16.65	11.66
10.	Orange	2.980	2.09
11.	Acetic Acid	226	158.20
12.	Tinapol	10.950	7.67
13.	Softener	29.700	20.79
14.	Tronic Acid	5.500	3.85
15.	Acid Magenta	1.400	.98
16.	Rilapale	35	24.50

OTHERS

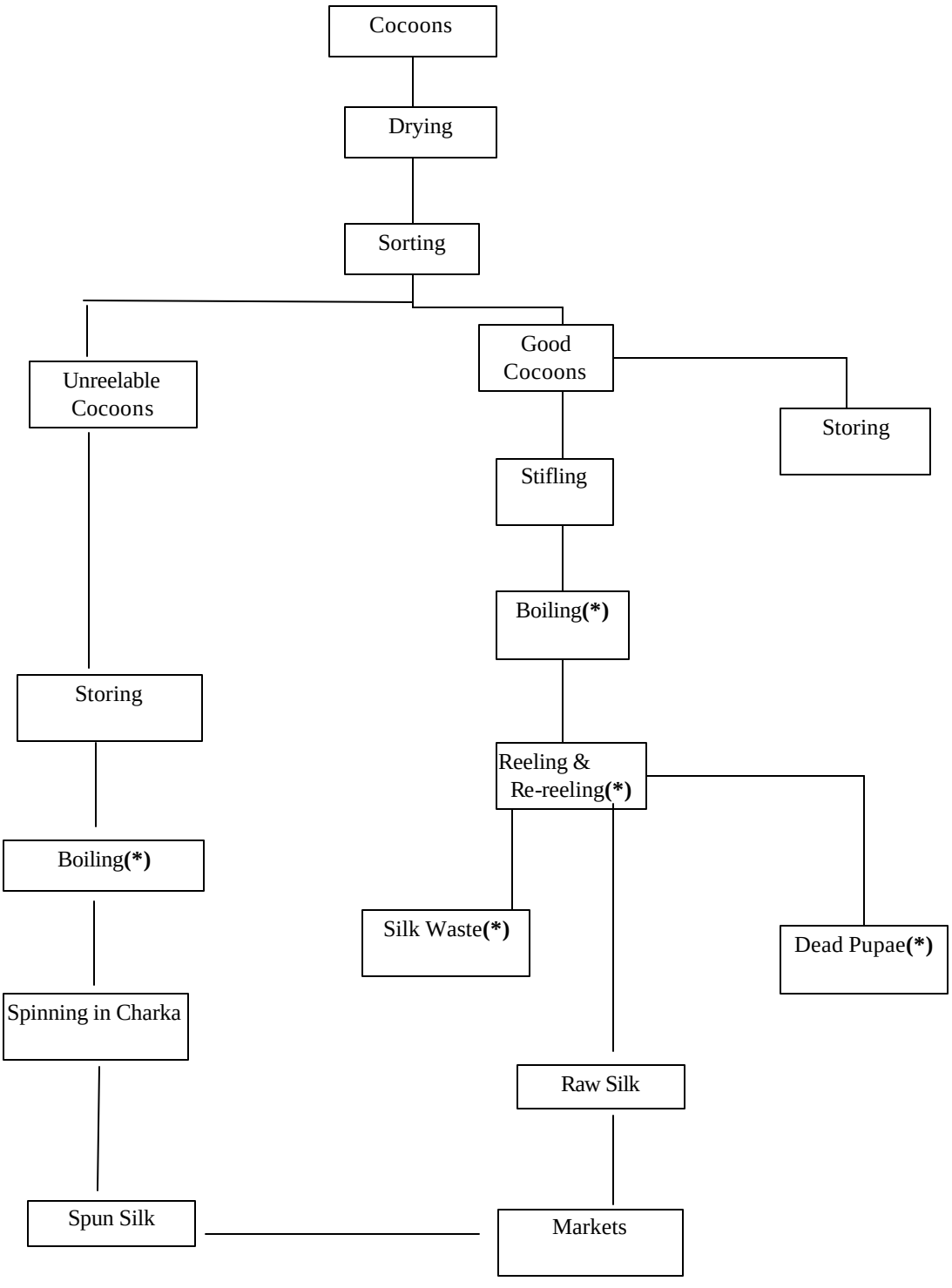
S.L. No.	**DESCRIPTION**	**CONSUMPTION in 1996 (Pieces)**	**REQUISITION for 1997 May - Dec. '97 Total (Pieces)**
1.	Lux	5129	3590
2.	Wheel	509	356
3.	Jet Powder	714	500
4.	Rayon	2900 (tbs.)	2030 (tbs.)
5.	Cotton Thread 31/1	3200	2240
6.	Cotton Thread 42/1	2600	1820
7.	Cotton Thread 82/1	1400	980
8.	Gum of Babla Tree	(kg)	595.70 (kg)
9.	Soda s	388.37 (kg)	271.86 (kg)

Appendix 3. PRODUCTION PROCESS IN MULBERRY, SILK



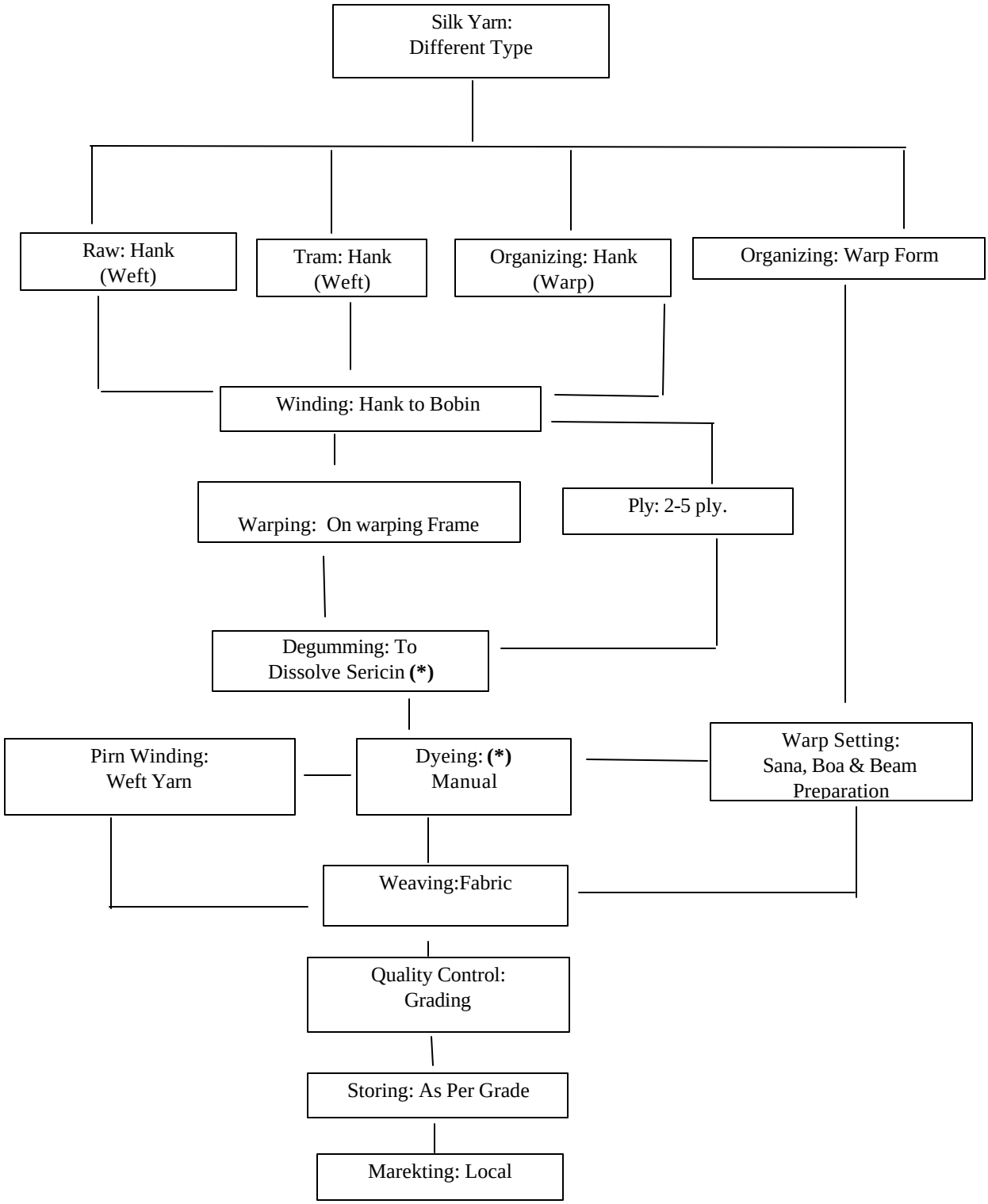
(*) environmentally concern (waste, health)

Appendix 4. REELING AND SPINNING PROCESS



(*) environmentally concern (waste, health)

Appendix 5. SILK WEAVING PROCESS



(*) environmentally concern (waste, health)

There is a report on the possibilities of household reeling. About 50% of Thailand's silk is produced via household reeling, where individual women have small reelings machines in their house and they reel silk and sell it to the market. Almost the whole process of sericulture can be contained within household production in Thailand. Women breed the silkmoths, raise the eggs, rear the silkworms and reel their own silk. Machines cost anywhere from 100 - 300 taka, are simple to make and use. Household reelings have positive implications for the environment as it reduces the concentration of pollutants into the environment and spreads the use of such pollutants over many places in small amounts rather than in one place in large amounts.

CASE STUDIES

CASE STUDY - Rearer

Moriam is about 42 years old and lives with her husband and four children (two boys and two girls). She rears silkworms as well as poultry and would like to rear cows eventually. She rears silkworms about four times a year for which she receives 1,500 tk/- per batch. She receives about 150 tk/- a month for her ducks and chickens. Her husband works on other people's land for which he receives about 3,000 tk/- a month and he also pulls a rickshaw for which he receives 140 tk/- per week. Her eldest son is 16 and attended school up to class 8 and her second son is 14 and attended school up to class 7. Now they work with their father. Her eldest daughter is 12 years old and is in class 6. The other daughter is 8 and enrolled in class 3. They both attend a BRAC school.

She has no loans from BRAC but took an interest free loan of 5,000 tk/- from her family which she has not paid back yet. She saves about 600 tk/- per month which she keeps at home. She has been rearing for ten years, five years of which she reared for the Bangladesh Sericulture Board (BSB) and the last five years with BRAC. She received one month of training from BSB.

Moriam will keep all her rearing materials for the next rearing stage and throws waste into a hole. Moriam has received no health training. She does not have any work related health problems, but does experience burning in her hands from the worms faeces. She has a separate room for rearing. She gets her household drinking water from a tube-well.

Her general day includes waking up at 4:00 a.m. to feed the silk worms. Their feeding times include (4:00 a.m., 11:00 a.m., 4:00 p.m., and 10:00 p.m.). She prays at about 4:30 - 5:00 a.m. and then begins her house work. At 7:00 a.m. she starts cooking breakfast and lunch and at around 8:00 a.m. she collects mulberry leaves for the worms. She comes back at around 9:30 a.m. and feeds the worms at about 11:00 a.m.. She does more housework. At 4:00 p.m. she feeds the worms again then she begins cooking dinner (their meal times are around 8:00 a.m., 5:00 p.m., and 8:00 p.m.). She feeds the worms again at 10:00 p.m. Her own work is limited during rearing seasons.

The advantage of rearing within a household level across various households, is that environmental impacts are less concentrated. Any significant environmental effects from rearing will be diluted because of the distance and space factors involved within household rearing. Waste disposal is spread out thus having less of a concentrated impact on the environment.

Moriam should be given health and environmental training as part of her work with BRAC. She should wear shoes and other protective garb when working with worms to prevent stinging that is caused by silkworm faeces and gloves and a mask when using disinfectants and other cleaning agents in the rearing house.

CASE STUDY- Plantation worker

Tulsi is around 27 years old. She has three children, two sons and one daughter. Her eldest son is 14 years and in class 6, her second son is 11 and in class 3, her daughter is 8 and in class 2. She spends about 100 tk/- per month for a tutor for her children. Her husband died of TB four years back. As a mulberry plantation worker she receives about 20 tk/- per day which totals about 520 tk/- per month (Friday is a non-working day). She has had no education but can sign her name. She took out a 9,000 tk/- loan and bought two rickshaw vans. The vans earn her about 20 tk/- per day (she rents them out). A twenty week instalment has already been paid. She owes about 225 tk/- per week. She puts aside about 5 tk/- savings every week and has 3,500 tk/- saved up with BRAC.

She has a pregnant milking cow and will earn money for its milk after two months. She also rears ducks and chickens for their eggs which gives her an average of 300 tk/- per month. She has been working in mulberry plantations for four years and working with BRAC for eight years. She once received an exchange of wheat for her mulberry leaves.

She gets training from BRAC every six months on planting and caring for mulberries. She has had some health and safety training from BRAC. Health care from BRAC is not free but medicine is sold at a lower price than in the market. She uses a tube-well for drinking water.

She usually wakes up at 5:00 a.m. and takes out her cow, after which she cleans the house and cooks. She sends her children to school and then goes to the tree sites. She comes back at 6:00 p.m. cooks dinner and looks after the animals. Her children return from school around 12:00 p.m.. She goes to sleep at about 8:00 p.m. There is a DFL service charge on rearers for leaves.

COMMENTS:
Tulsi would benefit from more health and environmental impact training.

CASESTUDY - Reeler

Rashida is 20 years old. She lives with her parents and has eight siblings, two brothers and four sisters. Her eldest brother is a rickshaw puller in Dhaka and her eldest sister is married and lives with her husband. Rashida is married but separated from her husband. Her father sells vegetables in the market. Her mother raises ducks and chickens. Her younger brothers are enrolled in a government school. One is 8 and in class 4, the other is 7 and in class 2. Her middle sister is 15 and also enrolled in government high school (she receives a subsidy of about 300 tk/- for attending school up to class 10). Her younger sisters are aged 3 and 4, and not in school.

Rashida and her family own only the house in which they live which is on about 16 decimals of land. She borrowed 3,000 tk/- to buy a bull which she will eventually sell and pays the loan back in bi-weekly instalments. The bull will be worth 7- 8,000 tk/- after two years. She has already paid back 50% of the loan.

She earned 1,200 tk/- in December from reeling. She as well as her father support the family. Sometimes her elder brother sends them money. Her father does not work as much and makes about 20 tk/- a month. She has been reeling for seven years and received her training on the job. She reels from 8:00 a.m. to 5:00 p.m. everyday. She has had no health or safety training. She had fever once and went to the hospital which cost her 350 tk/-. Her reeling manager at BRAC helped her pay some of the fees. There are no health benefits available from BRAC, only first aid. She gets her drinking water from a tap at work and from a tube-well at home.

She begins her day at 6:00 a.m., cleans the house and begins cooking with the help of her family. She lives in a one-room house with her family. She comes to office at 7:00 a.m. after a 1/2 mile walk and begins reeling. She takes her lunch break at 11:00 a.m. and starts reeling again at 12:00 p.m. At 1:00 p.m. she takes a five minute rest. She works until 5:00 p.m. after which she unrolls the thread, opens out the reels and leaves it in storage. She goes home, changes her clothes and takes a bath, takes a walk etc. She eats at 8:00 p.m., spends time with her family and goes to bed by 10:00 p.m.

COMMENTS:
Rashida will benefit from free doctor visitations and attending health and paralegal meetings set up by BRAC.

CASE STUDY- <u>Weaving</u>
Asia is a 40 year old weaver who is married and has three children. She lives with her husband, two of her children and her mother-in-law. She has two daughters, one is a married 20 year old who lives with her husband, the other is about 15 or 16 and enrolled in college. Her third child is a boy aged 13 and is enrolled in a non-governmental high-school. Her husband is 45 and a shopkeeper as well as an ironing-man.

Asia cannot read or write but can sign her name. She took a 7,000 tk/- loan from BRAC to pay for medicines for her husband's illness. She also took another loan of 7,000 tk/- to buy a house. The house is now worth 25,000 tk/- She paid both these loans back and is on her third loan of 7,000 tk/- to pay for her daughter's college fees and books. She plans to pay this back in seven months. Three months have already been paid for (about 360 tk/- per week).

Her average income from weaving, depending on the amount she produces, is about 1,200-1,300 tk/-. She also owns goats and chickens from whose produce she receives about 2000 tk/- yearly. They eat the eggs produced by the chickens. Her earnings are spent on food, school, rent for the store they run, rickshaw fare and 400 tk/- for a tutor for the children. Their store rent is about 200 tk/- per month. Her daughter's education costs about 20 tk/- per month and her son's about 18 tk/-. Asia does not have any savings. Her

husband earns about 1,400-1,500 tk/- from his shop and from ironing clothes. Her oldest daughter works in the same weaving centre and earns about 1,200-1,300 tk/-.

Asia was married at 15 and had her first child a year later. She has been working with BRAC for twenty-five years and always in weaving. As BRAC was smaller then there was not much work and she earned only around 50-100 tk/- per month.

Asia received about one year of training on site from the weaving master. She did not receive any training for health, paralegal issues, social awareness and so forth because they were held during work hours and she could not afford to lose the time. She did learn some legal issues. She does not take any health precautions while working. Her strength has also begun to wear down. A year ago she went to see an outside doctor for a nose bleed and her total bill for medicine and doctor fees came to 5,000 tk/-. She did not receive any money from BRAC (she quoted "no help from BRAC ever"). There were no arsenic tests done on the weaving centre tube-well.

Asia's day consists of waking up at around 6:00 a.m. and letting the goats, chickens and ducks out. She cleans the house, cooks, and gets the children ready. She comes to work at 8:00 a.m. and stays till 5:00 p.m. She eats her lunch which she prepared at home in the weaving centre. It takes her about ten minutes to go home from work. When she returns she lets the animals back in, cooks dinner while the children study, then eats. She goes to sleep by around 10:00 p.m.. They received four days holiday for Eid.

She receives about 3.5 tk/- for one yard of Khadi cloth and 2.5 tk/- for one yard of backing. It takes her about 1/2 an hour to make a yard. It is painful and repetitive work.

COMMENTS:
Asia would benefit from paid time to attend health and other BRAC meetings. Paying workers for their time will give them an incentive to attend these meetings and become more exposed. Weavers are also prone to a injury as their job demands a great deal of physical exertion and contact with heavy, moving objects. They should be supplied with medical and health check-ups through BRAC for free. Salaries should also be adjusted according to level of experience and time spent with the organisation. Much of Asia's physical health has been given over for BRAC's benefit as well as for her own employment.

CASE STUDY - Dyeing

Noor Jahan has worked in the dying, printing, and weaving centre for the last 5 years. She first did handloom work and then moved on to dyeing silk. She is 25 years old and lives alone with her children. According to her, her husband was a rickshaw driver but died of fear and fever. All his land went to her in-laws. She has three sons of whom two live with her. Her eldest son lives with her brother and is a screen printer in Dhaka. When he visits her he provides her with some money and she also receives money from her parents for food and clothes. Her earnings from BRAC total about 600 - 650 tk/- a month. She does not save any money as all her earnings go into living and medical expenditures for her and her family. Noor Jahan has no formal schooling and therefore cannot read or write but can sign her name. Her two younger sons are both enrolled in a BRAC school. Her second son is in class 3 and her youngest son who is 8, is in class 1.

She has not taken out any loans through BRAC, although she is eligible to do so as a VO member, because she has no other source of income, only her family, so repaying the loans on a regular basis would be difficult. She has savings of 1,000 tk/- with BRAC.

Noor Jahan did not receive any formal training for her job but learnt skills on the job. She has had no training on health or safety, but has had some exposure to health/safety issues through health forum meetings which are held in each village organisation. Health awareness programs through BRAC are taught each month per village but there are no topics on chemicals in the health forums.

She had cases of fever and headache two months ago, during the dying month period which she said was caused by winter cold. She went to the local doctor (MBBS) which cost her 15 tk/- and he suggested that she take saline (worth 200 tk/-). She did not receive money from BRAC for her medical problems. She did go to the BRAC dispensary which did not help her so she went to the local doctor.

Her eyes burn because of the chemicals and working with the oven. She says that she cannot afford nutritious food. She gets her water from a tube-well both at work and at home. She uses outside sources of water for washing during the wet season.

Her usual days consists of waking up, cleaning the house and cooking breakfast and lunch. She feeds her sons and herself, sends them to school and then she goes to the BRAC centre. She then begins the dyeing process (described above). She works until about 12:30 p.m. after which she stops for lunch. When she returns she spends the rest of the day drying the thread and aerating it. She does this until 5:00 p.m. then returns home. At home she cooks dinner, cleans the house, and spends time with her sons. She does not have electricity. Sometimes she prays or goes straight to sleep. She grows potato, pumpkin and some other vegetables.

COMMENTS:
Noor Jahan would benefit from free regular medical check-ups provided by BRAC as well as time off for health and nutrition informational sessions. As she in charge of the disposal of dyes and dyeing chemicals she should be trained on proper disposal methods and health issues. She could also benefit from paid time to attend other BRAC social and paralegal informational sessions.

CASESTUDY- Printing
Molina is about 26 or 27. She lives with her mother, her son, and her sister. Her husband, whom she married at the age of 12, died in 1989 of an ulcer. Her son is in class 3. Her mother is paralysed. The whole house runs on her earnings (her sister does not contribute). She attended school up to class 5. She is a skilled block printer and prints mostly silk, or cotton if silk is not available. She has been working in BRAC since 1989 as a block printer on which she was trained by a skilled printer on the job. She earns up to 1,500 to 1700 per tk/- month. Most of these earnings are spent on medicine for her mother, food, and a little for her son's schooling. She also paid for another sister's wedding.

She took a loan about five years ago through BRAC and made a house which cost 6,000 tk/- which she paid back. She took another loan for her sister's wedding which she has also paid back. She has saved 7,000 tk/- through the post-office and 1,500 tk/- with BRAC. She does not put aside a fixed amount of savings each month.

She has not had any training on health or safety issues. She sees an eye doctor about once a year because of the pressure on her eyes from constant block printing. She doesn't go to the monthly health meetings at 10:00 p.m. as they are too far away and conflict with her work time. (She gets paid according to the amount of yards she prints). She attended a health forum training once but has had no official training on chemicals.

She has had chest pain caused by her work (block printing requires continuos stamping), she was treated by an outside doctor (not BRAC's) which cost her 1,000 tk/- for X-rays and medicine. She still has pain due the eight hours of constant stamping. There is an incredible stench of kerosene in the work area but she is used to the smell and has no problems with it. She sometimes gets an eye ache or a headache so she takes a break. She gets paid 1.65 tk/- per one block on one yard. If there are two colours on one yard she will get paid 2.40 tk/-. It is 2.40 tk/- per extra block.

She obtains her drinking and cooking water from tube-wells both at home and at work. She does her washing by a river near her home. She walks 2 1/2 miles to work or takes a rickshaw.

Her normal day consists of waking up at around 5:00 a.m., cleaning her house and cooking breakfast and lunch. After which she takes care of her paralysed mother by washing, cleaning and feeding her. Her mother has been paralysed for four months and cannot talk but her condition is improving. Molina spends 600 tk/- per month on medicine for her mother. Her son's school is next to her house so he goes to school on his own which begins at 9:00 a.m. She spends about 100 tk/- per month on a private tutor who teaches her son for an hour everyday (Bangla, English, math etc.). She arrives at BRAC by 8:00 a.m. and starts the block process (as described above). At 5:00 p.m. she washes the blocks, puts away the cloth, and reports how much she's done. She gets paid on a monthly basis. She walks home, cleans, takes care of her mother and starts cooking dinner. She eats and spends time with her son. She usually goes to sleep by 10:00 p.m. She does not grow any vegetables because she doesn't have enough land--only 0.03 acres. Her house consists of a kitchen, two bedrooms, a bathroom (toilet). She eats rice and vegetables for breakfast and lunch and fish for dinner. She spends about 400 tk/- for groceries per month. She has taken no further loans because she has no investment source by which to pay it back. She is very skilled in printing.

COMMENTS:
Molina would also benefit from free medical check-ups and doctor visitations. This would reduce the pressure on her income paying for outside medical assistance. She should be trained on safe handling of chemicals and would benefit from paid time to attend health meetings and other relevant BRAC meetings. This would compliment BRAC's aim to improve women's socio-economic status through awareness and other training programmes. As Molina is a skilled and experienced employee her salary base should possibly increase as recognition and reward for her years of work.