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**STUDY ON CLEANER PRODUCTION OPPORTUNITIES
FOR SMALL SCALE WOMEN TEXTILE PRODUCERS IN
TANZANIA**

Report Prepared For UNIDO

by

CLEANER PRODUCTION CENTRE OF TANZANIA (CPCT)

P.O.BOX 23235

Dar es Salaam

Tel: 255 51 602338

Fax: 255 51 602339

E-mail: cpct@udsm.ac.tz

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ABBREVIATIONS

ADAT	Artisan Development Agency of Tanzania
CP	Cleaner Production
CPCT	Cleaner Production Centre of Tanzania
DAWASA	Dar es Salaam Water and Sewerage Authority
TBWTB	Tanzania Business Women's Textile Project
TIRDO	Tanzania Industrial Research and Development Organization
TOR	Terms of reference
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization

EXECUTIVE SUMMARY

A study on cleaner production opportunities for small scale women textile producers in Tanzania was conducted by the Cleaner Production Centre of Tanzania (CPCT) in ten selected women textile enterprises. The aim of the study was to identify the barriers and solutions for the introduction of cleaner production in the small scale women textile production units.

It was found that the production units of these women enterprises are located in residential premises and most of them do not have adequate infrastructural facilities. All the production units are managed by the women who are also the chief executives and technical personnel of their businesses.

The production processes of the enterprises essentially are similar although each has its own recipe formulation in the dyeing process. The major unit operations for all the women enterprises were found to be designing and waxing, dyeing, washing, drying, stitching, ironing and selling. The cleaner production assessment team noted that all the women entrepreneurs do not keep record of their production, so it was not easy to establish the authenticity of the input data which were given by the women during the interviews.

The major pollution source in all the production units was found to be the waste water from the dyeing and washing operations. The waste water contains dyes and chemical auxiliaries which include sodium hydroxide, sodium hydrosulphite and detergents. However, the quantity and characteristics of waste water generated in the production units was not established due to lack of such information.

The working environment in some of the production units was found not to be conducive due to lack of proper infrastructural facilities. However, it was noted that all the women wear protective gears when handling chemicals and during dyeing operations.

The study has identified a number of cleaner production barriers and solutions which have been categorized into organizational, systemic, economic, attitudinal, technical and governmental barriers.

Organizational barriers include non-involvement of employees in non-routine activities like cleaner production studies and decision making. There is too much emphasis on production and selling of products such that no time is left for other activities. It is therefore recommended that the women entrepreneurs should be sensitized on the economic benefits of cleaner production. This will enable them to devote more of their time in the CP programme.

Systemic barriers include poor record keeping of production data and ad hoc production schedules. The women entrepreneurs do not keep data for their production such as raw material, chemicals, water and energy inputs. The production schedules of these women enterprises are also prepared on a day to day basis depending on the orders in hand. Consequently, any systemic studies such as cleaner production assessment are not easily accomplished because baseline data collection becomes difficult and time consuming.

Therefore record keeping of production inputs should be encouraged in these production units for easy assessment of inputs and outputs.

A major economic barrier is the lack of investment capital. Most of these small scale women entrepreneurs are short of funds for most investments. Therefore any investment which requires relatively high capital gets the least priority. To eliminate this barrier, financial institutions should be encouraged to develop financial mechanisms to support cleaner production investment proposals from the enterprises.

The attitudinal barrier was mainly the reluctance shown by some of the women entrepreneurs towards the cleaner production assessment. This could be due to fear of being exposed to regulatory authorities or disclosing their production secrets to third parties. This barrier can easily be eliminated by sensitizing the women, through an awareness seminar, on the objectives and procedures of a cleaner production assessment.

Technical barriers which were identified include lack of infrastructural facilities, limited access to technical information and technology limitations. It is recommended that in order to eliminate these technical barriers ADAT, the implementing agency of the Tanzania Business Women's Textile Project, should use the locally available research institutions like the Tanzania Industrial Research and Development Organization (TIRDO), to develop appropriate cost effective technologies for the small scale textile producers. The government should support these efforts by evolving schemes for promoting sustainable technology development.

Governmental barriers include mainly the utility pricing policy of the water supply authority and the lack of enforceable environmental legislation in the country. To eliminate these barriers, the Water Authority should charge water supply on actual consumption rather than the current fixed flat rate being charged per residential house, regardless of the amount consumed. This system is a disincentive to water conservation measures. On the other hand, the government should make the necessary efforts to put in place an enforceable environmental legislation which will make all business entrepreneurs to operate in an environmentally friendly manner.

It has therefore, been concluded that cleaner production opportunities are possible in small scale women textile enterprises if, and only if, the women entrepreneurs are sensitized on the economic, environmental and health and safety benefits of the cleaner production strategy.

Several cleaner production opportunities related to process operations, waste minimization, good housekeeping, disposal of effluents and working environment have been recommended.

1. INTRODUCTION

1.1 Background

Tanzania Business Women's Textile Project is a UNIDO project which is currently being implemented by a non-governmental organization called Artisan Development Agency of Tanzania (ADAT). The project provides theoretical and practical training to small scale women textile producers in product development, surface design and finishing, quality control, entrepreneurial and business management skills, marketing and promotional skills.

The major textile operations carried out by the women in the Textile Project are dyeing and tailoring. Most of the women conduct their operations in the backyards of their residential premises. Bearing in mind the potential health hazards of textile dyeing, the women are encouraged to wear protective gears such as masks, gloves and boots when handling chemicals and dyes during their operations. However, environmental management strategies are not well covered in their training course.

The cleaner production concept has been proved to be a cost effective strategy in curbing the problem of industrial pollution in small and medium scale enterprises. It is logical, therefore, to infer that the same concept can also be beneficial to micro enterprises like the small scale women dyers and printers.

With this fact in mind, the Tanzania Business Women's Textile Project requested the Cleaner production Centre of Tanzania (CPCT) to carry out a study on cleaner production strategies for small scale women textile producers in Tanzania. The study aims at identifying the barriers and solutions for the introduction of the cleaner production concept to the target group with a view to enhancing productivity in the sub-sector and increasing awareness among the women producers with regard to environmental protection and good occupational health and safety practices.

1.2 Production Process

The selected women produce dyed and printed fabrics using tie & dye and batik processes. The dyed fabrics are then made into various products for wearing and furnishing. This study focused only on the wet processing of fabrics. The tailoring section was not considered in this study as it is not a major pollution prone activity.

Major unit operations for tie & dye and batik processes include designing, dyeing, oxidation, washing and drying. A typical process flow diagram for tie & dye and batik dyeing is shown in **Appendix 2**.

The fabric is first designed by drawing the required patterns to be coloured. The areas where colour is not required are covered with wax or tied tightly by a thread. After covering the areas not to be dyed, the fabric is soaked in water and then squeezed to remove excess water. The wet fabric is then dipped in a prepared dye solution. The fabric is then agitated manually in the dyebath for 20-30 minutes in order to get a level dyeing.

The dye solution (dyebath) is prepared by mixing the required amount of dyestuff, sodium hydroxide, and sodium hydrosulphite in hot water.

After the dyeing period, the fabric is hanged in air for 2 – 5 minutes in order to oxidize the dye into final colour. After oxidation the fabric can be washed to remove wax and unfixed dye or it can be redesigned and dyed again in another dyebath in order to get a second colour.

For batik dyed fabrics, washing is done by first dipping and working out the fabric in hot boiling water for at least 5 minutes in order to remove the wax. After removing the wax, the fabric is then washed again in hot water containing soap or detergent for another 5 minutes. The fabric is finally washed and rinsed in cold water to remove all the unfixed dyes.

When washing tie & dyed fabrics, the hot washing step is not necessary. The fabric is washed in cold water, soaped and then rinsed in plenty of cold water until all the unfixed dyes have been removed.

The washed fabric is then sun dried and ironed ready for sale or made into a garment or other soft furnishing products. Common products among the women include ladies, gents and children wears, handbags, wallets, kitchen sets, toilet sets and dining sets.

2. SCOPE OF WORK

The terms of reference (TOR) for the study were as follows:

- (i) Identifying and selecting a sample of small scale women textile producers for the study in consultation with the Project Coordinator of the Tanzania Business Women's Textile Project (TBWTP).
- (ii) Carrying out cleaner production assessments and identifying barriers and solutions for the adoption of cleaner production concept in small scale textile production.
- (iii) Preparing tailor-made guidelines or manual for cleaner production for small scale women textile producers.

3. METHODOLOGY

3.1 Selection Criteria

The National Project Coordinator of the TBWTP played a major role in the selection of the small scale women textile producers based on the following criteria:

- (i) Must be located in Dar es Salaam;
- (ii) Must have a reliable operational textile business;

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- (iii) The business should be in existence for more than two years;
 - (iv) Must have an existing production workshop of any size;
 - (v) Must have an established sales centre for the textile products; and
 - (vi) Must be permanently engaged in the textile business with one or more employees.

Based on the above mentioned criteria, ten women textile entrepreneurs were selected as shown in **Appendix 1**.

3.2 Cleaner Production Assessment

The audit was mainly focused on the tie & dye and batik operations. The tailoring section making was not considered in this study as it was seen not to have serious environmental problems.

Cleaner production assessment was conducted in accordance with guidelines borne in the UNIDO/UNEP Audit and Reduction Manual for Industrial Emissions and Wastes. Data and information were obtained through regular interviews with the selected women, examination of previous records of the businesses and on-site observations of the operations and production facilities.

The assessment team comprised experienced experts in the fields of cleaner production and textile technology.

4. FINDINGS

The following are the findings of the cleaner production assessment categorized into those related to manpower and management, process operation, waste generation, disposal of effluent and working environment.

4.1. Manpower and Management

All the selected women entrepreneurs under the study are the proprietors and managers of their businesses. The level of education of most of the women is secondary school (form IV) except for one who is a University graduate in law and another woman is a primary school (std VII) leaver.

Most of the women have one (1) to four (4) employees except for one who has ten (10) employees. The employees have technical skills in their jobs either through formal training or on-the job training and experience. The level of education of most of the employees is secondary school (form IV).

4.2 Process Operations

During the assessment period, most of the women were found not to be doing the tie & dye or batik dyeing. Most of them were busy making garments and other products for exhibitions which were due to be held in Zanzibar, Arusha and Mwanza and for customers. Only two women were found doing the actual dyeing process. However, the CP assessment team managed to visit and interview all the women and the team was shown the production facilities available for the dyeing operations.

4.2.1 Designing and waxing

Most of the women entrepreneurs have a working table for designing and waxing purposes. The paraffin wax is normally melted using a kerosene stove. It was noted that any wax which is spilled during waxing of the fabrics is collected and re-used again.

4.2.2 Dyeing

All, except one, lack proper infrastructural facilities for the dyeing operation. All of them use plastic basins for dyeing purposes. Most of them do the dyeing in the backyard of their residential premises or inside a small hut reserved for that purpose.

Major inputs used by all the women in their dyeing operations are vat dyes, sodium hydrosulphite, sodium hydroxide and water. All of the women use fuel wood as a source of energy for heating water.

It was found that all of them use their own experience in formulating the dyebath solutions according to the amount of material they want to dye. All the women use table spoons to measure dyestuffs and chemicals for making dyebaths.

It was noted that the amount of dyestuff used in the dyeing recipes differed from one woman to another depending on whether she likes to produce dark colored fabrics or light shades. The amount of dyes used ranged from 1.5 to 6.5 tablespoons per 4 metre fabric, which is equivalent to about 3% to 13% shade depth. However, since none of them keeps any records of the input materials it was not possible for the assessment team to establish the authenticity of the data provided.

A typical dyeing recipe for a 4 metre fabric consists of 2 tablespoons dye, 2 tablespoons caustic soda, 4 tablespoons sodium hydrosulphite and 15 litres of water. The dyestuff and chemicals are first dissolved in about 1 litre of boiling water and then added to the volume with cold water.

The production capacities of these units are on an ad hoc basis, depending on the orders. Average production capacities range from 30 metres to about 2000 metres per month. Some women re-use the remaining dyebaths but some discard them because they do not produce frequently.

Dyeing parameters such as pH, temperature are not easily monitored due to lack of proper monitoring instruments.

4.2.3 Washing

All the women wash the dyed fabrics in a batchwise process using metal pots for hot wash and plastic basins and/or buckets for cold wash. A typical washing sequence used by these women is shown in **Appendix 2**.

All, except one, get their water supply from a local supply authority, DAWASA. One of the women gets water free of charge from a nearby bore hole. It was noted that none of the women are keen in minimizing water consumption during the washing process as they usually pay a flat rate per month irrespective of the amount used for the production processes and other domestic uses.

The amount of water used during washing is not known since none of the audited women businesses measure the amount of water used for the production. Moreover, the water supply is also used for domestic purposes hence difficult to determine the amount used specifically for the production operations.

Waste water generated during this operation is discharged untreated into a domestic septic tank or poured on the ground and left to sink down the ground. Some women have dug shallow holes for discharging waste water and some use pit latrines to disposal of the waste water. The quantities of waste water generated during the operations were not quantified because most of them were not in production

Characteristics of the waste water are not known. None of the production units have analytical facilities and they do not have the funds to pay for such services.

4.2.4 Drying

All the women dry their processed fabrics using the sun as a source of energy.

4.2.5 Cutting and stitching

Most of the women are equipped with the necessary facilities for the operation such as sewing machines, scissors and overlockers. Energy management audit is required to assess the efficient use of the electric machines.

4.2.6 Ironing

All the women producers use electricity to iron the finished products

4.2.7 Selling

All the women entrepreneurs have sales centres for their products. Most women have specific places for selling their products away from their residential premises. Only one among the audited women uses her living room as her sales centre.

4.3 Waste generation

Waste generation in all the women businesses arise mainly from spillage of dyebath especially during marble dyeing and the discharge of dyebath remnants. Another source is the waste water which arises from the washings of the dyed fabrics. The waste water contains dyes and auxiliary chemicals used in the dyeing and washing operations such as caustic soda, sodium hydrosulphite and detergents.

4.4 Disposal of Effluents

Most of the businesses dispose of the liquid effluent in domestic septic tanks and some discharged it in shallow holes within the residential premises. One of the women entrepreneurs said that she discharges the waste water which contains dyes and chemicals in a pit latrine and the other waste water from washing is discharged into a septic tank.

4.5 Working Environment

As mentioned before, most of the women entrepreneurs carry out the dyeing operation at their residential places. This creates some inconvenience to other people in the family especially those with limited space in their backyards. Some of the women have built temporary huts for the operation. It was noted that the condition in these huts is very hot and thus not very comfortable to work in for a long time.

It was also noted during the audit that most of the women use protective gears such as gloves and masks when handling chemicals and during the dyeing operations. They also claimed to drink at least two glasses of milk after every dyeing operation.

The team noted that most of the women businesses have special storage places for chemicals and dyes. The chemicals are stored where non-food items are stored. However, it was noted that some women store their chemicals in their dyeing huts where it is very hot and hence the shelf life of the chemicals is reduced.

One of the women entrepreneurs has a modern workshop which is separated from the rest of the activities of the house. The working condition in this production unit is far much better compared to the conditions prevailing in the rest of the units established by other women producers.

5. CLEANER PRODUCTION BARRIERS

The assessment team identified several barriers which might hamper the introduction of cleaner production in small scale businesses of women entrepreneurs. These barriers have been classified into the following categories:

- Organizational;
- Systemic;
- Economic;
- Attitudinal;
- Technical; and
- Governmental barriers.

5.1 Organizational Barriers

5.1.1 Non-involvement of Employees

The women entrepreneurs are the owners and also the major production personnel of their business units. Other production personnel are basically on temporary basis or casual employees who are, by instruction from the owners, only concerned with their production targets and have no interest in other non-routine activities. It is therefore difficult for these units to establish a cleaner production team as they are run by one person who is the owner, chief executive and employee of her unit; especially when there is total lack of awareness on cleaner production potential for the business.

5.1.2 Decision Powers

The production units of most of these women businesses are located in homes; thus, they are basically family units. Since most of these women are married, any modification or improvement to be implemented in their workshops will need the approval of the husband as a head of the family. Employees in all the production units are not involved in any decision making.

5.1.3 Emphasis on Production and Marketing

Most of these women as chief executives and technical personnel of their production units are concerned with securing orders to produce and to sell their finished products. Therefore, very little time is left for environmental issues. During this study, the team had some difficulties in fixing appointments with some of the selected women entrepreneurs because they were either away attending an exhibition somewhere or just around but busy producing a special order for a certain customer.

5.2 Systemic Barriers

5.2.1 Poor record keeping on production

The study has revealed that all the small scale women textile producers do not keep record of their production data such as consumption of raw material, chemicals, water, energy etc. As a result, cleaner production assessment process becomes difficult.

The CP assessment team also noted that environmental records such as quantity and quality of liquid and solid wastes are not available because the women do not have the capacity and resources to keep that kind of data.

5.2.2 Ad hoc production schedules

The production schedules of the women businesses are prepared on a day to day basis depending on the orders in hand. This is a barrier to any systematic work such as cleaner production assessment or baseline data collection. During the audit period, only two women were found producing dyed fabrics. The rest were either making garments or other products.

5.2.3 Lack of separate line for utilities

Production units are located in residential premises. As a result, source of water and electricity is not separated from the domestic utilization. Thus, it is difficult to account for the water and electricity which is used in the production alone.

5.3 Economic Barriers

5.3.1 Utility cost and availability

Most of the women do not pay for utilities of their production units since they are not separated from the domestic use. In most cases, the utilities are paid for by the husband, who is the head of the family. As a result, any water conservation measures are not attractive to the women since they do not feel the impact on the cost of production.

5.3.2 Lack of investment capital

Like all small scale entrepreneurs, most of these women do not have funds for investments. Most of the women expressed interest in cleaner production and in keeping the environment clean. However, their major barrier in improving their workshops is capital. Therefore, any cleaner production option which might require high investment will not be considered even if it is for the benefit of the enterprise environment or health and safety of the workers.

5.4 Attitudinal Barriers

5.4.1 Fear of regulatory authorities

Most of the small scale women textile producers feared that the cleaner production assessment team might expose them to regulatory authorities that they are polluting the environment. This fear resulted into closing the production units at the time of the visits.

5.4.2 Fear of competition

Like all other entrepreneurs, there is always lack of trust in disclosing their production recipes to a third party especially when they do not know what the other party is going to do with the information. Some had a feeling that their recipes could be copied by their competitors. Consequently, collection of baseline data becomes difficult as some of the information/data could be false.

5.4.3 Lack of job security

Security of employees in most of the small scale enterprises is not certain since most of them work on casual or temporary basis. As a result, any attempts to improve the enterprise through cleaner production will not interest them as they have specific targets to meet for a day. Any non routine work will not be of interest to the employees and it will not be allowed by the owner cum chief executive.

5.5. Technical Barriers

5.5.1 Lack of infrastructural facilities

All the selected small scale women textile producers for the study lack proper infrastructure facilities for conducting cleaner production assessments. The production units of these women enterprises lack proper dyeing equipment, instruments for on-site monitoring of process operations and analytical facilities to measure quantity and quality of their liquid effluents. Any essential measurements and analyses will have to be carried out by external institutions with such facilities. Expenses for such services will not be afforded by such women entrepreneurs. As a result basic data collection for a CP assessment is limited in these small scale production units.

5.5.2 Lack of technical information

The small scale women dyers and printers have limited or no access to technical information. All the women entrepreneurs were not sensitized on environmental management strategies during their training offered by the UNIDO funded project on Tanzania Business Women's textile Project. Moreover, available information on cleaner production benefits in textile production from within or outside the country is not directly related to or tailor -made for the small scale producers such as the small scale women textile producers.

5.5.3 Technology Limitations

The small scale women textile producers have limited facilities for their production operations. These women use basins and buckets as their dyeing equipment. It is difficult to obtain optimal efficiency in this way as some parameters such as temperature can hardly be maintained. It is also difficult to get a level dyeing since the fabric has to be worked out manually in the dyebath.

5.6 Governmental Barriers

5.6.1 Utility pricing policy

Nearly all the women entrepreneurs use water from a local water supply authority, DAWASA. The pricing of water supplied to residential houses is made on a flat rate basis regardless of the amount of water used. Since the production units of these women are located in residential premises, they also pay a flat rate whether they use less water or not. As a result, water is used at liberty without any conservation measures since there is no incentive for minimization of water consumption.

5.6.2 Lack of enforceable environmental legislation

There is no enforcement of environmental legislation in the country to make polluters take remedial measures.

5.7 Other Barriers

5.7.1 Limited Space

Since all the production units operate in home, there is limited space in adding or modifying these workshops

5.7.2 Lack of public pressure

Asked on whether they had experienced any complaints from their neighbours or local authorities with regard to their operations, all the women interviewed said they had never experienced any complaints. This could be due to lack of awareness among the community on environmental pollution being done by the informal sector.

6. RECOMMENDATIONS

Based on the cleaner production assessment carried out in the women textiles businesses, the following recommendations have been proposed in order to enhance productivity in the sub-sector and increase awareness among the small scale women textile producers with regard to environmental protection and good occupational health and safety practices:

6.1 Manpower/Management

Since the women are the chief executives and operators of their production facilities, it is advised that they should be sensitized on cleaner production practices in order to enable them to introduce the concept in their production units. If they realize the benefits of the concept, it will be easier for them to implement any low or no cost options since they are the managers and technical personnel of their units.

6.2 Process Operations

Chemicals used in the dyeing operations are important in obtaining optimal efficiency of the operation. Therefore, it is important that right quantities be used in the process by measuring the required quantities using bench scales (e.g. digital bench scales) instead of spoons since table spoons differ in sizes. Dyeing temperature should be monitored by measuring the temperature of dyebaths using a thermometer.

6.3 Good Housekeeping

- (a) Avoid spillages of dyes, chemicals and dye solutions. This can be done by being careful during the weighing of dyes/chemicals and preparation of dye solutions. Whenever spillages of powdered dyes happen, they should be cleaned up immediately using dust absorbent materials, preferably a vacuum cleaner. Spillages of liquid dyes and dye solutions can be cleaned by moping, using minimum water. For corrosive chemicals such as caustic soda, care must be taken to prevent skin contact by using protective gear such as gloves and boots.

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- (b) Repair all leakages and keep taps closed when not in use.
 - (c) Chemicals and dyes should be stored in cool, dry places and in well sealed containers to avoid reduced shelf life. Containers for dyes and chemicals should be kept in good condition and stored at suitable heights for easy access, but away from reach of children. Lids of the containers should be kept on at all times to prevent contamination and moisture absorption, except when removed for access to the contents.
 - (d) All chemicals and dyes should be clearly labeled.
 - (e) Schedule production in such a way that frequent cleaning of equipment is not required.
 - (f) Keep record of all production inputs (chemicals, water, fabric etc.) for easy reference and future audits.

6.4 Waste Minimization

- (a) Avoid spillage of dyes and chemicals.
- (b) Store remaining dye liquor in good containers and re-use it to dye lighter shades or same depth of shades by adding reduced quantities of dyes and chemicals. It is possible to re-use a remaining dye-liquor from a typical dyeing recipe mentioned above to produce a good similar shade to at most three times. The first recycled dyebath can be applied without adding any more dyes or chemicals provided the right temperature is maintained during dyeing. For the second and third recycles, you can add half the required amount of dye and chemicals.
- (c) Minimize and control water consumption in the washing operation. This could be done by washing the dyed fabric using basins instead of running tap water. This will minimize waste water discharge into the environment.

6.5 Disposal of Effluents

- (a) Do not discharge waste water containing chemicals and dyes on the ground. This might contaminate the soil around the house in a long run and eventually contaminate ground water. Waste water discharged into a septic tank should be neutralized with suitable mineral acids in order to avoid corrosion of the pipes and the tank itself. High alkaline waste water could also kill all the micro-organisms in the septic tank which are essential in the decomposition of the waste.
- (b) Waste water should be disposed of in a way that ground water is not polluted. This can be done by constructing or installing special underground tanks made of plastic or concrete materials for discharging the waste water. Joint efforts for municipal collection should be given serious consideration for economical reasons. Alternatively, appropriate evaporation troughs of suitable sizes should be constructed within the premises of the workshop for disposing of the waste water.

- (c) Expertise for proper construction /installation of cesspits, evaporation troughs and layout of disposal/drainage systems should be sought from suitable experts and/or institutions.

6.6 Working environment

- (a) Improve condition of the temporary huts by raising the roofs and putting ceiling boards to reduce the heat from the sun.
- (b) In addition to gloves and masks, workers should wear boots especially during dyeing since waste water discharged on the floor contain corrosive chemicals which could be harmful to people.

6.7 Solutions to CP Barriers

6.7.1 Organizational Measures

Involve employees

An in-house awareness seminar should be conducted in order to sensitise all the workers of the production units about cleaner production and its benefits. With a commitment of the owner/chief executive to cleaner production, the employees will be able to help her in generating options in their respective sections.

Delegate decision powers

Decision powers on women business issues should be left to the women. The husbands should not interfere with the developments of their wives' businesses. Employees should also be given mandate to decide on issues within their areas of competence.

Enhance emphasis on sustainable production

The women entrepreneurs should be sensitized on the benefits of cleaner production and sustainable production as a whole. If they realize the importance and the benefits of cleaner production, we are convinced they will be more cooperative and will devote some of their time in the programme.

6.7.2 Systemic Measures

Keep records of production

Record keeping of production inputs and outputs should be introduced in the women enterprises. This will assist future assessments made on these production units.

Apportion utilities for the production

As most of the production units use water and electricity from the main house which are also used for general domestic purposes, it is advised that the percentage of the utilities used for production purposes be determined in order to get a realistic costing.

6.7.3 Economic Measures

Cost resources

The production units of women entrepreneurs should include cost of water in their productions figures.

Develop special financing schemes

Financial mechanisms for financing CP investments in small scale businesses should be developed. Financial institutions should be encouraged to support cleaner production investment proposals from such businesses.

6.7.4 Attitudinal Measures

Remove fear of environmental audits

Conduct a pre-workshop or awareness seminar to the selected women in order to explain the objectives and procedures of a cleaner production assessment. This will eliminate any suspicions among the women entrepreneurs that they are being audited for regulatory purposes.

6.7.5 Technical Measures

Establish simple infrastructure facilities

Women entrepreneurs should be encouraged to have and set up simple monitoring instruments such as thermometers, bench scales and water meters.

Access to technical information

ADAT in collaboration with other relevant institutions and organizations, like the Cleaner Production Centre of Tanzania, should develop technical information which could be accessed by the small scale women textile producers.

Technology development

ADAT should use local research institutions like the Tanzania Industrial Research and Development Organization (TIRDO) to develop appropriate cost effective technologies for the small scale women textile producers. The government should support the efforts required in this direction by evolving schemes for promoting sustainable technology development.

6.7.6 Governmental Barriers

Utility pricing policy

Water authority should change its policy and put meters on houses rather than the current flat rate charges. Water should be charged on the actual consumption. This will attract the implementation of water conservation measures.

Environmental legislation

The governmental should put in place an enforceable environmental legislation. This will put pressure on any industrial activity to produce in an environmentally friendly manner.

6.7.7 Other measures

Public Pressure

Environmental awareness among the communities should be enhanced to enable the residents to keep an eye on any pollution in their neighbourhoods. This will put pressure on the informal sector to establish proper environmental management strategies in their production units.

7. CONCLUSION

Based on the cleaner production assessment which was carried out in ten selected small scale women textile enterprises, it was found that the production units of these women businesses are located in residential premises and most of them do not have adequate infrastructural facilities.

All the production units are managed by sole proprietors who are also the chief executives and technical personnel of the enterprises.

The production processes of these women enterprises are similar although has its own recipe formulation in the dyeing process. It was found out that all the women entrepreneurs do not keep record of their production; so it was not easy to establish the authenticity of the input data which were given by the women during the interviews. The major unit operations for all the enterprises were found to be designing and waxing, dyeing, washing, drying, stitching, ironing and selling.

The major pollution source in all the production units was found to be the waste water which rise from the dyeing and washing operations. The waste water contains dyes and chemical auxiliaries which include sodium hydroxide, sodium hydrosulphite and detergents.

It was noted that some of the women entrepreneurs use large amounts of chemicals than is required. For instance, one of the women claimed to use 8 tablespoons of sodium hydrosulphite, and 4 tablespoons of caustic soda for dyeing a 4 metres fabric. These quantities are on the high side when compared to a normal recipe which requires 2 tablespoons of caustic soda and 4 tablespoons of sodium hydrosuphite.

The working environment in some of the production units were found not to be conducive due to lack of proper infrastructural facilities. However, it was noted that all the women entrepreneurs wear protective gears when handling chemicals and during dyeing.

The study has identified several CP barriers which might hinder the introduction of cleaner production in small scale women textile enterprises. These barriers have been categorized into organizational, systemic, economic, attitudinal, technical, governmental and other barriers.

It is therefore recommended that in order to introduce cleaner production in small scale women enterprises, the women entrepreneurs should be trained in the theoretical and practical aspects of cleaner production. External cleaner production assessments will not be successful because of the systemic barriers such as lack of record keeping which hinders the smooth carrying out of such studies.

General cleaner production options which were identified during the CP assessments in the ten women textile enterprises include:

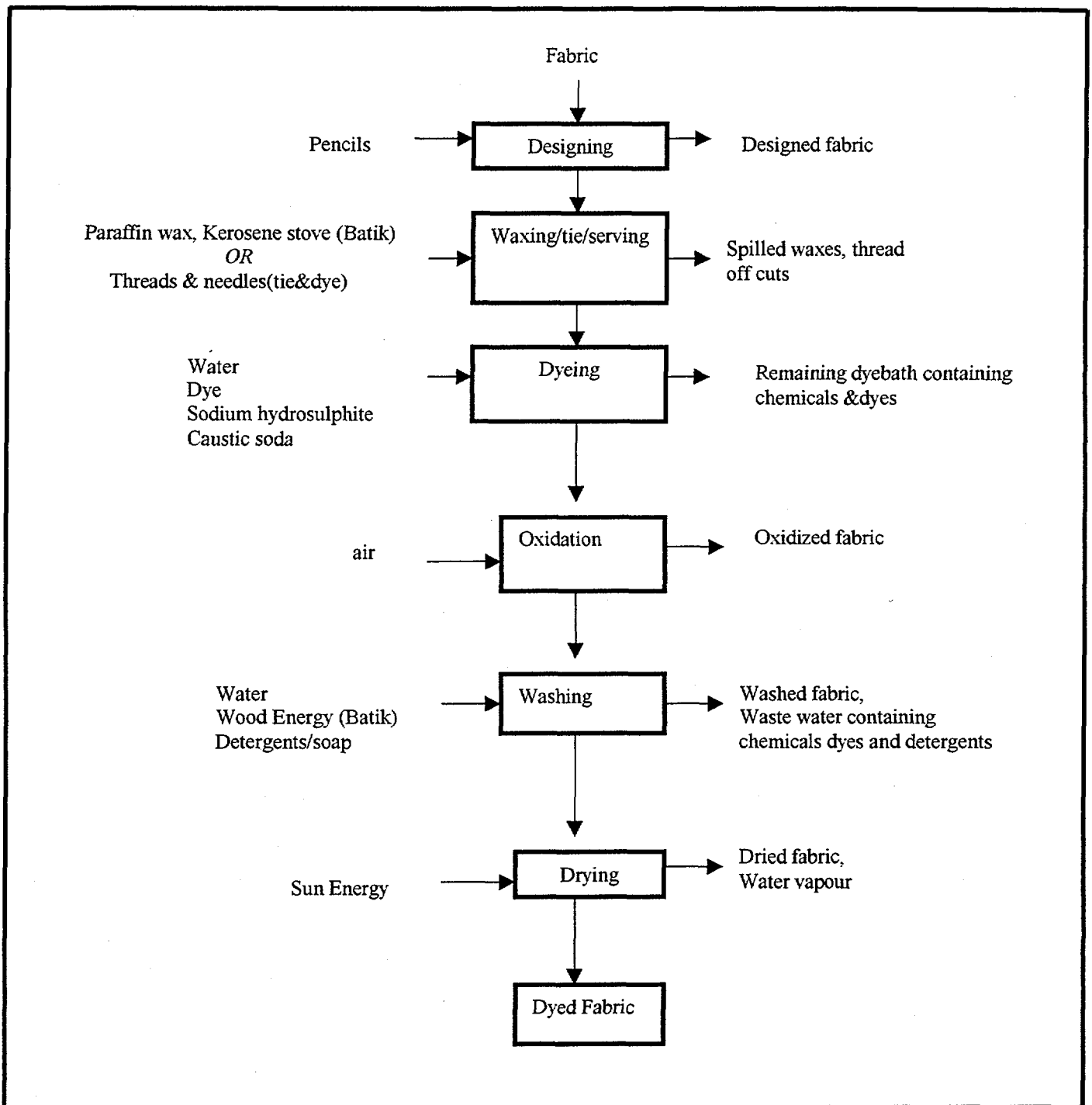
- Improving infrastructural facilities for dyeing operations;
- Reducing the amount of water in the washing operation;
- Introducing record keeping of production inputs and outputs;
- Reducing amount of chemical auxiliaries in the dyeing operation;
- Re-using dyebath remnants;
- Improving conditions in the workshops, especially in small huts which are very hot;
- Wearing boots and other protective gears during dyeing;
- Measuring raw materials accurately using bench scales;
- Controlling and monitoring process conditions;
- Storing chemicals in cool places; and
- Using high quality raw materials.

Appendix 1

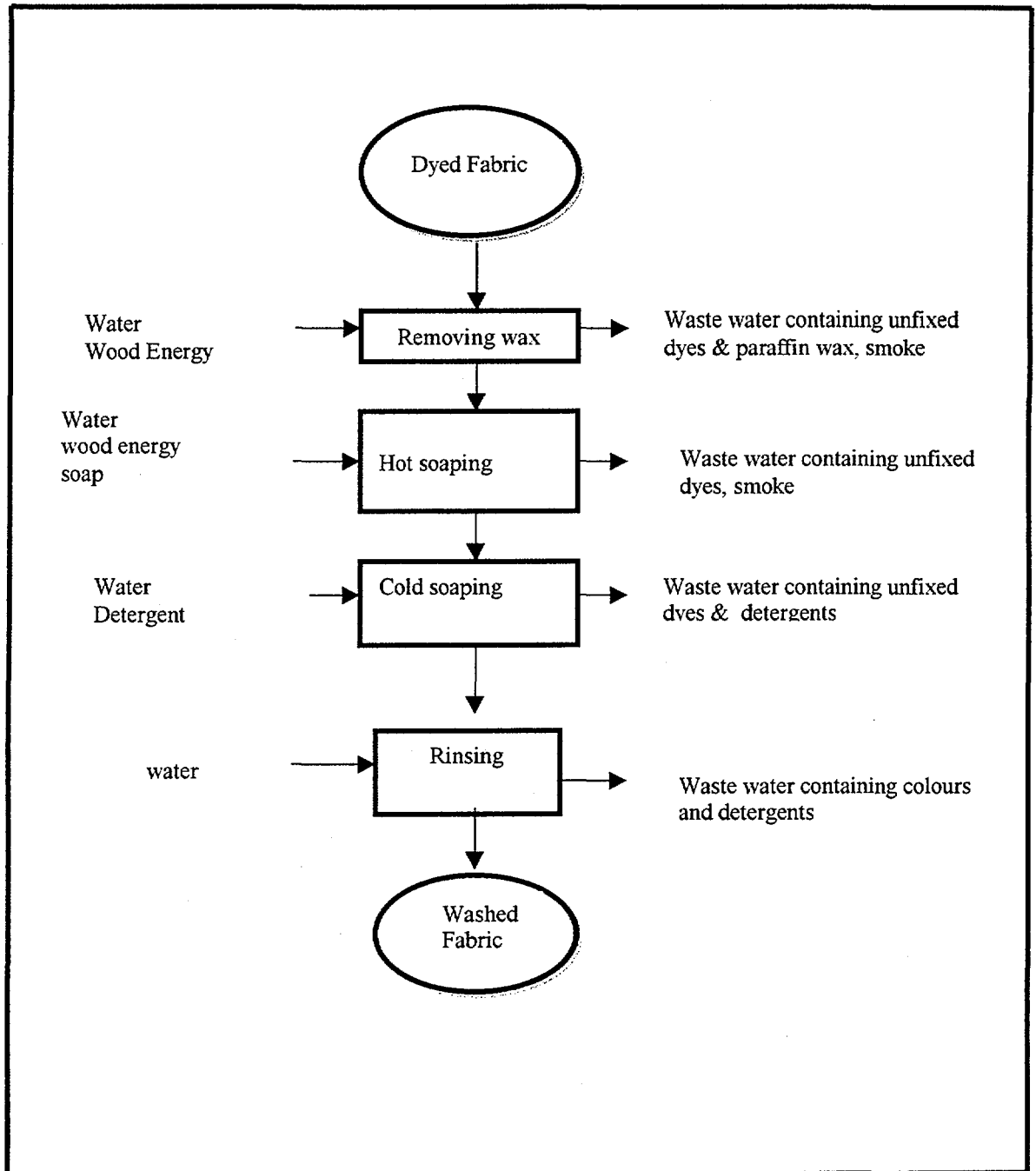
List of Selected Women Textile Entrepreneurs

	Name & Address	Location	
		Workshop	Sales Centre
1.	Alice Machange (Mrs) P.O. Box 9480 Dar es Salaam Tel: 0811 607888	Tegeta	Msasani
2.	Anna Manyilika (Mrs) P.O. Box 75823 Dar es Salaam Tel: 761829 0811 785231	Mwenge	Kinondoni
3.	Digna Nyamwija (Mrs) P.O. Box 13621 Dar es Salaam Tel: 666060	Kinondoni	Kinondoni
4.	Esther Kasenga (Mrs) P.O. Box 65303 Dar es Salaam Tel: 0811 350707	Kimara	Chang'ombe
5.	Flotea Masawe (Mrs) P.O. Box 1751 Dar es Salaam Tel: 761260	Kinondoni	Kinondoni
6.	Getrude Nshimo (Mrs) P.O.Box 65022 Dar es Salaam	Buguruni	Magomeni – Mapipa
7.	Janet Zakaria (Ms) P.O. Box 21353 Dar es Salaam Tel: 761827	Kijitonyama	Kinondoni
8.	Ngiana Mongi (Mrs) P.O. Box 61744 Dar es Salaam	Mwananyamala	Mwananyamala
9.	Nsarye Urassa (Mrs) P.O. Box 65117 Dar es Salaam	Mbezi Beach	Mbezi Beach
10.	Rose Makoyola (Ms) P.O. Box 33240 Dar es Salaam Tel: 0811 607888	Tegeta	Msasani

Appendix 2



Typical process flow diagram of tie & dye or batik dyeing.



Typical washing sequence of batik dyed fabric

**GUIDELINES FOR CLEANER PRODUCTION
OPPORTUNITIES IN SMALL SCALE WOMEN TEXTILE
ENTERPRISES IN TANZANIA**

Prepared for UNIDO

by

CLEANER PRODUCTION CENTRE OF TANZANIA (CPCT)

P.O.BOX 23235

Dar es Salaam

Tel: 255 51 602338

Fax: 255 51 602339

E-mail: cpct@udsm.ac.tz

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GUIDELINES FOR CLEANER PRODUCTION OPPORTUNITIES IN SMALL SCALE WOMEN TEXTILE ENTERPRISES IN TANZANIA

1. INTRODUCTION

These guidelines for cleaner production opportunities in small scale women textile enterprises are based on a cleaner production assessment conducted by the Cleaner Production Centre of Tanzania in ten small scale women textile establishments located in Dar es Salaam. The small scale women entrepreneurs produce dyed fabrics at their residential premises using tie & dye and batik methods. The dyed materials are eventually made into various products for wearing and furnishing.

The assessment which focused on the wet-textile processing (tie & dye/batik), identified several cleaner production opportunities which could enhance productivity (and hence improve the economy) of the enterprises, minimize waste generation during processing/production and improve the working environment in the production units (leading to better health and safety conditions for workers).

These guidelines are meant for the small scale textile dyers and printers. The guidelines provide a brief introduction to the cleaner production concept, ideas and procedures for implementing the proposed cleaner production measures in small scale women textile production units and some sources of cleaner production information.

2. CLEANER PRODUCTION CONCEPT

2.1 Definition

Cleaner Production is the continuous application of an integrated preventive environmental strategy to processes, products and services so as to increase eco-efficiency and reduce risks to humans and the environment.

- *Production process:* Conserving raw materials and energy, eliminating toxic raw materials and reducing the quantity of toxicity of all emissions and wastes at the source
- *Products:* Reducing negative impacts along the entire life cycle of the product from design through raw materials extraction to its ultimate disposal
- *Services:* Incorporating environmental concerns into designing and delivering services

Cleaner production requires changing attitudes, exercising responsible environmental management and evaluating technology options.

2.2 Fundamentals

Cleaner production is as much about attitudes, approaches and management as it is about technology. This is why it is called cleaner production and not cleaner technology. Implementing cleaner production requires basic attitudinal changes at all levels from top management to the shop floor.

The major difference between pollution control and cleaner production is one of timing. Pollution control is an after-the-event, “react and treat” approach while cleaner production is a forward – looking, “anticipate and prevent” philosophy. Prevention, as is well known, is always better than cure!

Cleaner production can minimize or eliminate the need to make trade-offs between economic growth and environment, between worker health/safety and productivity; and between consumer safety and competition in local and international markets. Optimizing several goals at the same time in this way leads to “win-win” situations in which everyone gains. Cleaner production is such a win-win strategy: it protects the environment, the consumer and the worker while improving enterprise efficiency, profitability and competitiveness.

2.3 Benefits

Cleaner production offers several benefits which include:

- Reduced raw material and energy consumption costs
- Enhanced process efficiency and product quality
- Minimized waste quantities of waste
- Reduced waste treatment costs
- Enhanced productivity
- Improved working conditions
- Minimized environmental pollution
- Improved public image of the enterprise
- Proactive compliance to environmental legislation and regulations
- A sustained healthy future for all.

3. CLEANER PRODUCTION OPPORTUNITIES

The cleaner production opportunities which were identified in ten selected small scale women textile enterprises have been classified into the following categories:

- Good Housekeeping
- Technology modification
- On-site recycling
- Occupational Health and Safety

3.1 Good Housekeeping

- (a) Avoid spillages of dyes, chemicals and dye solutions. This can be done by being careful during the weighing of dyes/chemicals and preparation of dye solutions. Whenever spillages of powdered dyes happen, they should be cleaned up immediately using dust absorbent materials, preferably a vacuum cleaner. Spillages of liquid dyes and dye solutions can be cleaned by mopping, using minimum water. For corrosive chemicals such as caustic soda, care must be taken to prevent skin contact by using protective gear such as gloves and boots.
- (b) Repair all leakages and keep taps closed when not in use.
- (c) Store chemicals and dyes in cool, dry places and in well sealed containers to avoid reduced shelf life. Containers for dyes and chemicals should be kept in good condition and stored at suitable heights for easy access, but away from reach of children. Lids of the containers should be kept on at all times to prevent contamination and moisture absorption, except when removed for access to the contents.
- (d) All chemicals and dyes should be clearly labeled.
- (e) Schedule production in such a way that frequent cleaning of equipment is not required.
- (f) Keep record of all production inputs (chemicals, water, fabric etc.) for easy reference and future audits.
- (g) Sensitize workers on waste minimization measures.

3.2 Technology Modification

- (a) Control and monitor process parameters such as temperature, by taking actual measurements of the dyebath using a thermometer. Temperature influences the efficiency of the dyeing operation. Therefore, it is important to control it. This will improve the quality of the product as well as reduce the unfixed dyestuff in waste water.
- (b) Control the amount of raw materials, chemicals and dyes by measuring the weights using bench scales instead of spoons. If spoons or other scoops are used, the contents should be pre-weighed to establish the right level for a certain amount.

A recommended general recipe is as follows:

Fabric	– 2 metres
Dye	– 30g
Sodium hydrosulphite	– 20g
Caustic soda	– 10g
Water	– 5 litres

-
- (c) Minimize and control water consumption in the washing operation. This could be done by washing the dyed fabric using basins instead of running tap water. This will minimize waste water discharge into the environment. A washing sequence for dyed batik fabric aimed at minimizing water consumption is shown in the figure below.

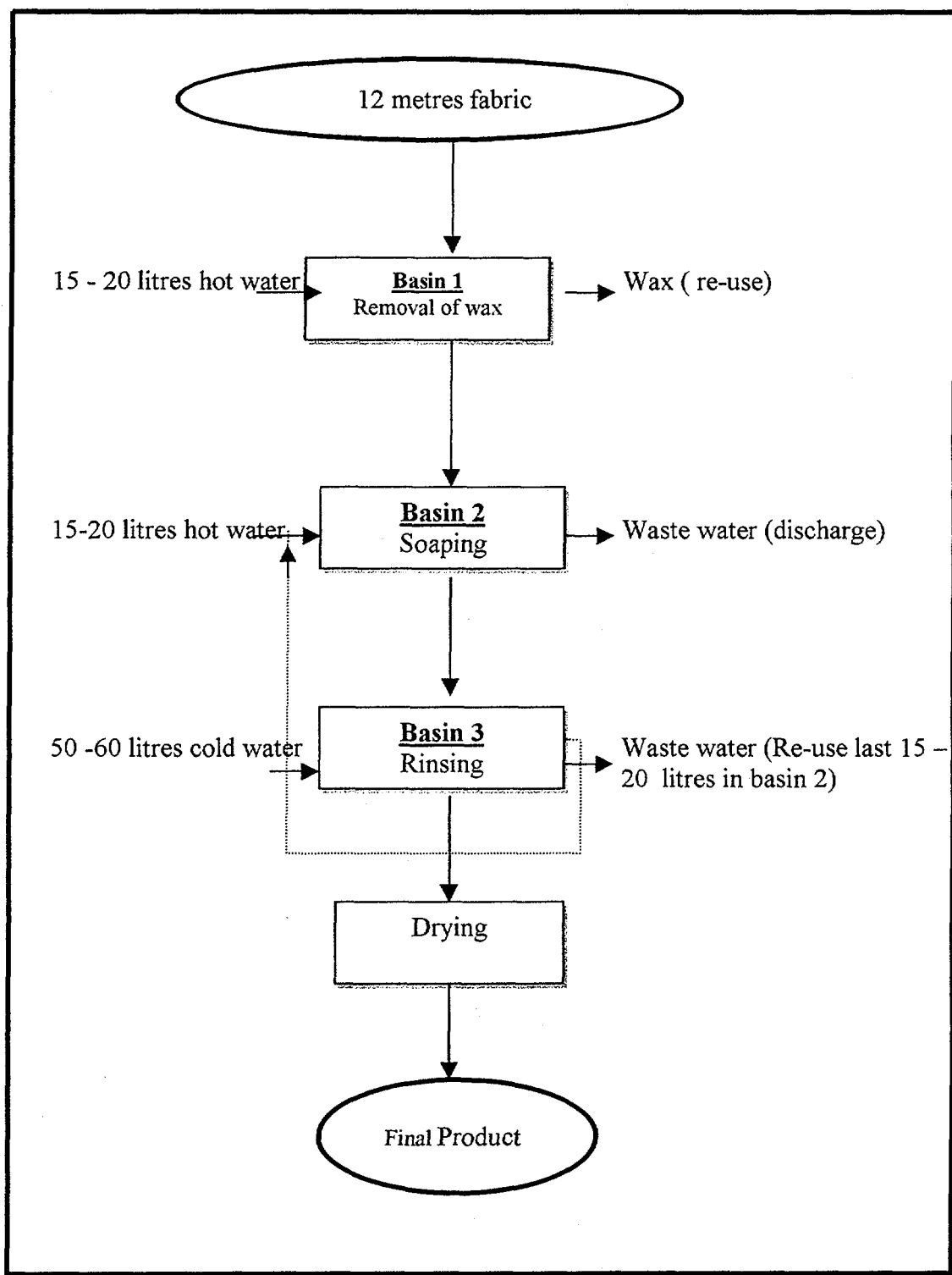


Figure: A Typical Batch washing sequence for dyed batik fabric

-
- (d) Waste water should be disposed of in a way that ground water is not polluted. This can be done by constructing or installing special underground tanks made of plastic or concrete materials for discharging the waste water. Joint efforts for municipal collection should be given serious consideration for economical reasons. Alternatively, appropriate evaporation troughs of suitable sizes should be constructed within the premises of the workshop for disposing of the waste water. Expertise for proper construction /installation of cesspits, evaporation troughs and layout of disposal/drainage systems should be sought from suitable experts and/or institutions.

3.3 On-site Recycling

- (a) Store remaining dye liquor in good containers and re-use it to dye lighter shades or same depth of shades by adding reduced quantities of dyes and chemicals. It is possible to re-use a remaining dye-liquor from a typical dyeing recipe mentioned above to produce a good similar shade to at most three times. The first recycled dyebath can be applied without adding any more dyes or chemicals provided the right temperature is maintained during dyeing. For the second and third recycles, you can add half the required amount of dye and chemicals.
- (b) Collect wax from the washing operation and re-use for waxing fabrics.

3.4 Occupational Health and Safety

- (a) The temporary dyeing huts should be constructed in a way that they are well ventilated and cooled. They should have high roofs to reduce heat from the sun and their floor surfaces should be smooth, preferably finished with cement material, for easy cleaning.
- (b) Respiratory protective equipment which have been approved by the Tanzania Bureau of Standards (TBS) should be provided and worn by the workers during scooping, weighing, preparation of dye solutions and during cleaning of spilled dyestuffs and chemicals. When not in use, such protective equipment should be stored on suitable holders or in boxes to avoid contamination.
- (c) Protective gear such as gloves and foot wear should be provided to dyeing personnel to protect them from corrosive chemicals such as alkalis. The protective clothing should be kept in good condition.
- (d) Weighing of powdered dyes should not be done in an open area where strong wind could blow away the dyestuff.
- (e) A first aid kit, containing items like dressings, should be provided and kept in the workshop.

-
- (f) Information provided by chemical suppliers on the application and safe handling of their products should be made available to all workers dealing with chemicals and dyes.
 - (g) Proper training should be provided to the workers to ensure that they understand the possible hazards associated with handling of chemicals and dyes.
 - (h) Sufficient supervision should be provided to ensure that the precautionary measures are being adopted.
 - (i) Employees handling dyes and chemicals should wash their hands carefully before eating, drinking or smoking. Workers should be prohibited to eat, drink, smoke or apply cosmetics when handling dyes, chemicals and dye solutions.

4. TIPS FOR A SUCCESSFUL CP PROGRAMME

In order to realise the full benefits of a cleaner production programme in small scale women enterprises, three important requirements must be fulfilled:

4.1 Management Commitment

A successful cleaner production programme requires strong commitment from you, the owner and/or chief executive of the enterprise. The seriousness of the commitment has to be reflected in your actions and not merely in words.

4.2 Worker Participation

Although your involvement in decision – making and promotion of cleaner production activities is essential, it is important that you actively involve all workers in the cleaner production programme. The involvement and innovativeness of operators is necessary in identifying and implementing cleaner production measures. You could also introduce incentive schemes, bonuses, rewards and other forms of recognition to motivate employees and stimulate them to cooperate and participate in the programme.

4.3 Systematic Approach

For cleaner production activities to be effective and sustainable in an enterprise, it is essential that an organised approach be formulated and adopted. You should therefore have a system for assigning responsibility, fixing targets, reviewing progress and timely implementation of cleaner production activities. This would enable you to establish and adopt a cleaner production programme in your business and subsequently achieve continuous improvement in productivity, environmental protection and occupational health and safety measures.

5. SOURCES OF CLEANER PRODUCTION INFORMATION

A lot of information on cleaner production concept is now readily available from various institutions both within and outside the country although cleaner production information which is directly related to small scale enterprises is limited.

The Cleaner Production Centre of Tanzania, a former UNIDO funded project, has collected a number of cleaner production documents in terms of hard and soft copies which can be accessed by any interested party. The Centre is also connected to an internet, making it possible to access and download any relevant CP information from the different web sites. The centre being one of the National Cleaner Production Centres (NCPCs) established by UNIDO and UNEP is also a member of a worldwide network of cleaner production experts. Therefore, any information which is not available at the Centre can easily be obtained from other network members around the world through e-mail.

The Centre also offers training on cleaner production techniques. In case you need any information on cleaner production, please contact the following:

Director
Cleaner Production Centre of Tanzania
Kimweri Avenue, Msasani
UNIDO Office Complex
P.O. Box 23235 Dar es Salaam
Tel: 255 51 602338/602340
Fax: 255 51 602339
Email: cpct@udsm.ac.tz

Other Documentation Centres on environmental issues in Tanzania are listed in the table below:

Table: ENVIRONMENTAL DOCUMENTATION CENTRES IN TANZANIA

	Source	Subjects covered	Information Available	Accessibility
1.	National Environment Management Council (NEMC), P.O. Box 63154, Dar es Salaam Tel: 0811 340049 0812 340049 Email: nemc@simbanet.net Contact: Dr. M. Ngoile, Director General	Environmental Management	Pollution studies, Biodiversity Conservation studies, policy documents (e.g. National Conservation Strategy for sustainable Development), EIA guidelines, Database on chemicals in Tanzania, Inventory of obsolete chemicals and wastes (Under preparation)	Personal request
2.	Division of Environment, Vice President's Office P.O. Box 5380, Dar es Salaam Tel: (+255) 51 118416/113983 Fax: (+255) 51 113856/113082 Email: vpodoc@intafrica.com Contact: Mr. E. K. Mugurusi, Director of Environment	Policy and Legislation	Policy documents: <ul style="list-style-type: none"> ▪ National Environment Policy ▪ National Environment Action Plan ▪ National Agenda 21 Programme ▪ International conventions and agreements ▪ National Environmental Legislation (Draft) ▪ National Report to the Rio conference 	Personal request
3.	Cleaner Production Centre of Tanzania (CPCT) P.O. Box 23235, DSM Tel: (+255) 51 602338/40 Fax: (+255) 51 602339 Email: cpct@udsm.ac.tz Contact: Prof. C.L.C. Migiro Director	Cleaner Production techniques and technologies	CP publications, Case studies, CP assessment manuals and Local CP experts directory. Ozone Depleting substances Hazardous/Toxic chemicals	Personal request/on-line search through UNIDO.
4.	Centre for Energy, Environment Science and Technology (CEEST) P.O. Box 5511, Dar es Salaam, Tel: (+255) 51 667569 Fax: (+255) 51 666079 Email: ceest@intafrica.com Contact: Prof. M.J. Mwandosya, Director	Energy & Technology, Biodiversity, Greenhouse gases	Reports on Biodiversity, greenhouse gases and Energy efficiency studies	Personal request

	Source	Subjects covered	Information Available	Accessibility
5.	Ministry of Industry and Commerce, P.O. Box 9503, Dar es Salaam, Tel: (255) 51 180049/50 Contact: Permanent Secretary	Industrial Policy	Industrial policy documents: <ul style="list-style-type: none"> ▪ Sustainable Industrial Development ▪ SMEs Policy (Draft) ▪ Investment policy 	Personal request
6.	AGENDA, P.O. Box 77266, Dar es Salaam Tel: (+255) 51 700663, 73198 Fax: (+255) 51 150987 Email: agenda@raha.com Contact: Ms. Saada Juma, Executive Secretary	Environmental Management - Business sector perspective	Research papers and publications which focus on environmental issues in business sector	Personal request
7.	Dar es Salaam City Commission, Sustainable Cities Programme, P.O. Box 9182, DSM, Tel (+255) 51 112659/ 110513/4 Fax: (+255) 51 114014 Email: scp.tanzania@twiga.com Contact: Dr. Batilda Burian, Nat. Project Coordinator	Municipal Waste Management	Research reports and case studies on municipal waste management	Personal request
8.	Tropical Pesticides Research Institute (TPRI) P.O. Box 3024, Arusha Tel: (+255) 57 8217 Fax: (+255) 57 8042 Contact: Director	Pesticides research and registration	Database on pesticide position in Tanzania	Personal request
9.	Government Chemical Lab. Agency, P.O. Box 164, Dar es Salaam, Tel (+255) 51 113320, 113383/84 Fax: (+255) 51 113320 Contact: Dr. E.N.M. Mashimba, Chief Govt. Chemist.	Chemical analysis	List of toxic and hazardous chemicals	Personal request
10.	Tanzania Bureau of Standards, P.O. Box 9258, Dar es Salaam, Tel: (+255) 51 450206/450298 Fax: (+255) 51 450959 Email: Standards@twiga.com Contact: Mr. D. Mwakyembe, Director	Standards of products and Environmental standards	Standards of various products, Environmental standards on air pollution and waste water (Draft)	Personal request
11.	University college of Lands & Architectural studies (UCLAS) P.O. Box 35176, Dar es Salaam Tel: (+255) 51 75004/71853 Fax: (+255) 51 75479/75448 Email: principal@uclas.ud.co.tz Contact: Prof. A.M. Nikundiwe, Principal	Solid Waste Management (in urban areas)	Reports on Solid Waste studies	Personal request

	Source	Subjects covered	Information Available	Accessibility
12.	Chemical and Process Engineering Department – UDSM P.O. Box 35131, Dar es Salaam Tel: (+255) 51 410367 Fax: (+255) 51 410379 Email: hod@cpe.udsm.ac.tz Contact: Head of Department	Environmental Engineering	Consultancy Reports on Waste Management Studies	Personal request