

COMMUNITY MONITORING WORKING GROUP

**VIKUGE PRELIMINARY SITE REPORT,
COAST REGION, TANZANIA**

Final Report



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Special thanks are extended to the Community Monitoring Working Group (CMWG) of the International POPs Elimination Network (IPEN) and the IPEN Secretariat for funding the study and for providing useful comments in complimenting this report.

ABBREVIATIONS

ASP	African Stockpile Programme
CMWG	Community Monitoring Working Group
DDT	Dichloro Diphenyl Trichloroethane
EDCs	Endocrine Disrupting Chemicals
ENVIROCARE	Environmental, Human Rights Care and Gender Organisation
IPEN	International POPs Elimination Network
NEMC	National Environment Management Council
NGO	Non-Governmental Organization
POPs	Persistent Organic Pollutants
Sida	Swedish International Development Agency
SUA	Sokoine University of Agriculture
U.S.A	United States of America

CHAPTER 1

INTRODUCTION

1.1. BACKGROUND

Tanzania like most other African countries is threatened by huge accumulation of obsolete stockpiles of pesticides and veterinary waste. A range of obsolete pesticides compounds such as herbicides, fungicides, insecticides and industrial chemicals have been widely used in the past to protect crops, livestock, buildings and housing, from damage caused by insect pests.

Most of the chemicals were imported in 1970's and 1980's, from different countries and others came in as donations from countries such as China, Japan, Italy, Greece and the U.S.A. Most of the donations were probably made in good faith and the impact of these pesticides was not known then¹. However, some of the chemicals had been banned in other countries already. The stocks, owned by Tanzania's Ministry of Agriculture, accumulated and then expired, were banned or were no longer needed.

Because of the large amounts of obsolete pesticides, the country has no way to adequately store them, and now much of these obsolete pesticides are stockpiled in sacks or leaking and corroded metal drums near settlements, rivers, irrigation systems, or outdoors in mountainous piles. Many of the container labels are missing or have faded, making it impossible to know their contents and origin.

There are many people currently living near or within the contaminated sites and many residents living in the vicinity of the contaminated sites rely mainly on locally extracted groundwater from shallow wells as their primary source of domestic water supply. Some of the residents still use these wells for showering, cleaning vegetables and washing dishes, and/or other cleaning activities. These uncontrolled hazardous waste sites are a major environmental and public health concern that needs attention.

Concerned with these residents' potential health risks from chronic exposures to the contaminated soils and groundwater, the Community Monitoring Working Group (CMWG) of the International POPs Elimination Network, in collaboration with AGENDA initiated a study to prepare a preliminary report on the contaminated site in Tanzania. The Community Monitoring Working Group aims to promote community monitoring of chemicals and ensure ongoing NGO involvement in the Global Monitoring Program for POPs and it serves as a

¹ Agrow: *World Crop Protection News*, May 19, 2000, No. 352; *Los Angeles Times*, March 30, 2000

central point for the collection and dissemination of community generated or sourced monitoring data and information.

According to the detailed inventory of obsolete pesticides and veterinary waste conducted by the Government of Tanzania in 1997-1998, there are 300 sites in Tanzania (ASP, 2003). AGENDA used the Vikuge site, which contains mainly DDT, as a case study. This report will be used to explain the legacy of obsolete stocks and the status of contaminated sites after the conclusion of ASP.

This study will aid in the struggle for a cleaner, healthier and more sustainable environment.

1.2 OBJECTIVE OF THE STUDY

1.2.1 Overall objective

The overall objective of the study was to prepare a preliminary site report and plan for eventual community monitoring so as to promote cleanup.

1.2.2 Specific objectives

The specific objectives of this study were:

- i) To provide a description of site history and characteristics of surrounding environment and social environment
- ii) To estimate the extent of contamination at the site
- iii) To determine levels of contamination in the environment, particularly soil and groundwater (extent of soil and groundwater contamination, including off-site effects)
- iv) To determine risks associated with contamination of the site

CHAPTER 2

METHODOLOGY

2.1. INTRODUCTION

This section covers the methodology used in conducting the study. It explains what the study entailed and approach, scope of work, and the tools used for the study.

2.2 SCOPE OF WORK

Specifically, AGENDA carried out this case study preliminary site report to raise awareness of the potential impact of contaminated site to human health and to promote cleanup. The report includes the:

- (i) Site history;
- (ii) Description of the site characteristics;
- (iii) Levels of contamination;
- (iv) Surrounding environmental components e.g. economic activities within the area and water bodies.

2.3 INITIAL WORK

2.3.1 Literature review

Literature review covered some available literature on the Vikuge contaminated site in Tanzania. The documents that were reviewed include:

- i) African Stockpile Programme Obsolete Waste Disposal Project, Tanzania Country Report; February 2003
- ii) Chemical Waste Management in Tanzania Project, Results of an Inventory Covering Mainland Tanzania (1997 – 1998) by NEMC
- iii) M.A. Kishimba and M. Mihale; “Levels of a Pesticides and Metabolites in Soil at Vikuge Farm, Kibaha District Tanzania – A Classic Case of soil Contamination by Obsolete Pesticides” (2003)
- iv) Pesticides and the Environment in Tanzania, ENVIROCARE, Dar es Salaam, 2000
- v) Socio – Economic Profile for the Kibaha District, Coast Region

2.3.2 Securing Research Permit

The first action in conducting this study was to introduce the objectives and methods of the study to the Ministry of Agriculture and Food Security, which own the Vikuge stock, and Kibaha District Council². This was necessary in order to

² Supervise the implementation of all plans for economic, commercial, industrial and social development in the district

secure the permit to conduct the study. The permits were obtained prior to commencement of the fieldwork. Introduction of the study to the local authorities i.e. Wards and Village was done via a letter from AGENDA to the authorities.

2.3.3 Site Reconnaissance

A One-day site reconnaissance was done to get an overall picture of the existing situation on the site before commencement of the study. Observations of the contaminated site and surrounding environment were made.

2.3.4 Tools

The study tools such as questionnaire and a checklist were developed after conducting adequate review of existing literature. The questionnaire was designed such that it contained only close-ended questions. The same questions and checklist were used as a guide in focus groups discussions.

2.3.5 Selecting team for field work

Fieldwork involved three researchers from AGENDA and 2 students from the Sokoine University of Agriculture (SUA). The 3 AGENDA researchers have been involved in various field surveys and have experience in environmental management and planning, environmental assessment, environmental engineering and socio-economic analysis.

2.4 FIELD WORK

The following activities were executed during the fieldwork so as to meet the objectives of the study: -

2.4.1 Consultations

A number of interviews and focus group discussions were conducted at National, District and village level. The identification of stakeholders was based on the location, role and relevance of an organization, institution, group or individual to the Vikuge area and on chemical management. An issue raised by one individual or a group of people was crosschecked by discussing it over with other groups. The stakeholders identified and consulted included:

2.4.1.1 The National Environmental Management Council

The National Environment Management Council (NEMC) play a role in all matters, fields and aspects concerning environmental management in mainland Tanzania, which focus on the sustainable management of chemicals waste. The Council has initiated various studies of the area including soil and water analysis and inventory of the pesticides, which was conducted in 1998. Also the NEMC was responsible authority, which packed and shifted the pesticides from the old

store to the new built store. The Council was much more informed than any other institution in Tanzania concerning the Vikuge stocks. Besides Vikuge is one of the target sites under the Africa Stockpile Project.

2.4.1.2 The Ministry of Agriculture and Food Security

The stocks at Vikuge are under the Tanzania's Ministry of Agriculture and Food Security. The Ministry was responsible in receiving, transporting, distributing and management of the consignment. Therefore in order to know the exact amount received from Greece and amount used, the Ministry of Agriculture and Food Security was in position to provide some answers.

2.4.1.3 The Tanzania Metrological Agency

The Tanzania Metrological Agency was consulted to provide reliable data for the climatic conditions of the site and the general area of the Coast Region.

2.4.1.4 NGOs

Plan International is an International Non Governmental Organisation, which had a project of constructing boreholes in Vikuge Village. They conducted tests of water quality and soils in that area.

2.4.1.5 Research Institutions

The team visited different research institution such as the University of Dar es Salaam specifically the Chemistry Department and the Tropical Pesticides Research Institute (TPRI). Two reports 'Levels of a Pesticides and Metabolites in Soil at Vikuge Farm (2000) and Contamination of Water and Sediments by Obsolete Pesticides at Vikuge Farm, were provided.

2.4.1.6 Kibaha District Council

The District Authority is responsible in protecting and the management of the environment. The district council is responsible for taking necessary measures to regulate the use of hazardous and noxious substances, chemicals or drugs and to ensure public health is protected.

Therefore the Kibaha District Authority was a key stakeholder not only for consultation purpose but also to provide the permit to enter into Vikuge Village.

2.4.1.7 Health Centres

Health Centres were visited in the area to establish if there has there been any apparent incident that may be related to pesticides use. This was important to verify complaints raised by the local people. Unfortunately it was found that there

is paucity of information on the linkage between incidences of disease and pesticides use or exposure.

2.4.1.8 Local community members

The site study applied different participatory methods to involve all the concerned community members. Local leaders and local government officials as well as other key informants such as elders, farmers/livestock keepers, women, youths and influential people which live on the near by villages were consulted.

(i) Meeting with village-government representatives

This meeting served to introduce the study to the village government leaders and to collect basic information on the relevant complaint history, historical use of adjacent land, land use (previous, present and future use) use of the pesticides, accidents occurred, statistics on the villages, such as population statistics, characteristics of the study area and local usage of ground / surface waters, and locations of boreholes.

(ii) Interviews with individual

Face to face interviews with individual were partly based upon a list of general questions and partly based on open discussion. Among other topics, the interviews covered issues on the socio-economic development, health and ecological problems in the Vikuge community and possible solutions for those problems as well as the opinion of the communities about the deserted obsolete pesticides in their area and the effects they are likely to have on their daily activities

(iii) Key informant interviews and informal discussion

Informal discussions were held with members of the Vikuge village. Key informant interviews were held with the village environmental committee members, health officer and elders, as well as with a staff of the Vikuge state farm. Informal discussions were held to supplement and/or verify information provided by individuals.

2.4.2 Transect walk

Transect walk from the identified point in the south to another point on the North's and then from West to East of the contaminated site were conducted to gather plants and vegetation for identification as well as to gather information on the site condition and surrounding environs. The collected plants (section 3.5.5.1) were identified by generic and species by the Botanist (Vikuge Farm Manager).

2.4.3 Village mapping

A small group of villagers, including Village leaders, members of the village environmental committee and elders were asked to describe the village area in terms of its general boundaries, available institutions, important infrastructure, natural habitats, and local usage of ground / surface waters, and locations of water boreholes. Where possible, distances were indicated on the map (Fig. 2.1).



Fig 2.1 Resource map of Vikuge village

CHAPTER 3

FINDINGS

3.1. SITE LOCATION

The Vikuge contaminated site is located between latitudes 6° 45' and 6° 50' South of the Equator and longitudes 38° 50' and 38° 55' East. It is located about 35 miles (56 km) North East of Dar es Salaam City (Fig. 3.1). The old store and new store covers an area of approximately 100m².

Administratively, the study site is located within the Vikuge State Hay Farm, Vikuge Village, Soga Ward, Kibaha District, in the Coast Region, Tanzania. Five neighbouring villages include: the Misufini and Zogowele villages in the west, the Kongowe village in the north, the Viziwaziwa village in the east and the Soga village in the south. The average distance from Vikuge village to other neighbouring villages is about 5 kilometres.

3.2 ACCESSIBILITY

The site is easily accessible using Dar es Salaam – Morogoro highway and then branching off at the Kongowe town about 4km on un-tarmacked road, which passes through the Kongowe and Vikuge Village to the site. The un-tarmacked road towards the site is of poor quality due to lack and/or inadequate regular maintenance and rehabilitation.

3.3. SITE HISTORY

3.3.1 Vikuge Village

The Vikuge Village was established in 1972 during the policy of Villagisation in Tanzania. The National land policy (1995), the Land Act no 4 of 1999 and the Village Land Act no 5 of 1999 empowers the village assembly to divide the village land according to specific uses such as residential, agricultural, community use and/or public use etc. It also demarcates land to be occupied or used by an individual, family, or group of persons under customary law. Also the village council sets aside land which may be made available for communal activities such as schools, churches, mosques etc. The same Acts provide a mandate to the village assembly to further plan the land uses to be designated to the communal village land.

The Vikuge Village land is thus managed under the village council with the villagers being the beneficiaries. However, the piece of land on which the site is located does not fall under the jurisdiction of the Vikuge Village Council but that of the Ministry of Water and Livestock Development.

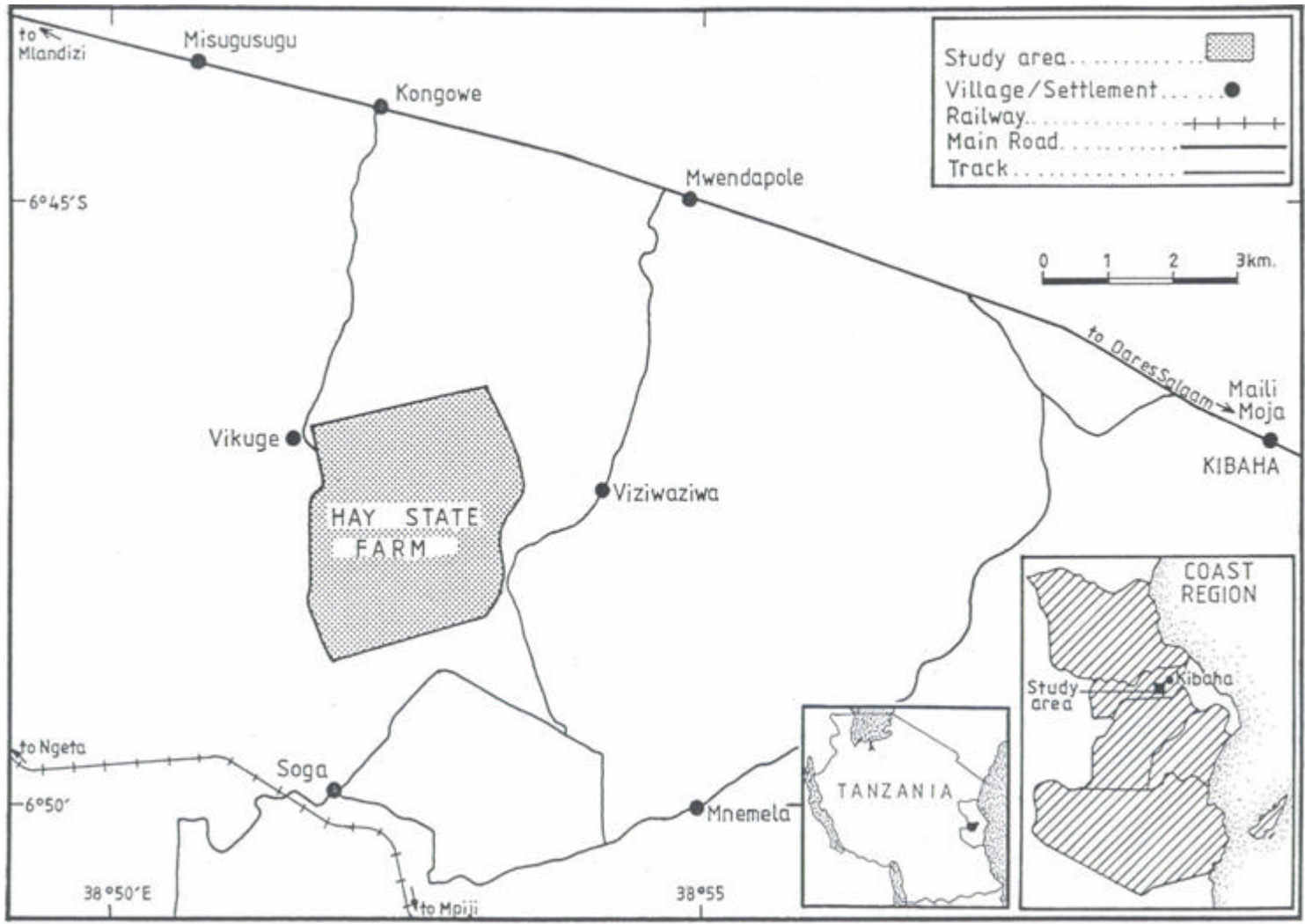


Fig. 3.1 Vikuge site location

3.3.2 Hay State Farm

The Vikuge State Farm was earmarked and developed as a Sisal Plantation in 1974 by the then Ministry of Agriculture and Livestock Development, which acquired it from the local landowners. In 1976 the sisal growing was stopped and the then Ministry of Agriculture and Livestock Development, developed the land into a Research Center for growing seeds for food crops. In 1995 it was revealed that the land was no longer fertile enough to support growing seeds for food crops and the centre was transferred to Msimbe in the Tanga Region. From that time up to now, the area is used for hay production (Plate 1 and Plate 2) and owned by the Ministry of Water and Livestock Development.

3.3.3 Vikuge Contaminated Site

The Vikuge site is a site with some history. In 1986 the Government of Tanzania through the Ministry of Agriculture received a quantity of pesticides in different forms such as liquid, powder, pellets, and sprays as 'donation' from the Government of Greece. The consignment was in poor condition and in damaged packages. Besides, most of the labels on containers were written in Greek, strongly indicating that the pesticides were intended for use locally in Greece. It has to be noticed that the government of Tanzania did totally not expect such amount of pesticides, and so, no preparation was made to receive the consignment.

The stock received was about 600 metric tonnes when it arrived at Vikuge hay farm and was stored under a shed measuring about 50 x 50 meters in open air. The Ministry of Agriculture distributed about 400 tonnes for use particularly in southern region of Tanzania for tsetse fly control³. It is estimated that about 200 metric tonnes remained at the site.

In 1993 the shed collapsed, the pesticides therefore were exposed to direct sunlight, rain and other climatic variations. Slowly the bags started leaking contaminating soils as well as ground water. After years in 1996 with external assistance of the Government of Sweden (Sida), a special store was built, under supervision of the National Environment Management Council (NEMC), the Government of Tanzania repackage. All stocks (Plate 3) were then stored in that dedicated pesticide store, which is situated just 20 meters away from the original storage site.

Ten years after the pesticides were repackaged, one can still smell DDT outside the new store and considerable environmental contamination can be observed. Dead insects are observed on the area and vegetation no longer grow on some patches where the bags once lay. Small pieces of pesticides containers (Plate 4) are scattered all over the place left in the area during re-packaging.

³ 2004, Ministry of Agriculture and Food Security

There have been some initiatives to study the area to establish the extent of DDT contamination in the soils and the effects brought by the leakage (see section 3.5.3.2 below). For example in 1998, the National Environment Management Council (NEMC) conducted a study at the Vikuge contaminated site. At a depth of 1 meter and within the groundwater, sampling and analysis showed concentrations of over 100 mg DDT per kg of soil (NEMC 1998).

In another study by Kishimba and Mihale (2003), analyses of soil samples collected from the old storage site for 80 different pesticide residues and metabolites, revealed alarmingly high concentrations of pesticide to qualify the site as one of the most contaminated sites in the world. Concentrations, as high as 282,000 mg/kg dry weight for total DDT (28.2% by mass) were reported. It should be noted that commercial formulations contain between 5-10% DDT (Kishimba and Mihale, 2003).

The contaminated site has no fencing facility but it is clearly separated by the firebreak route from the hay state farm. Also the area has been left without agricultural activity and without direct roads or direct footpaths.

3.3.3.1 Quantity of the pesticides at Vikuge

The current quantity of the pesticides at Vikuge mainly DDT was estimated based on the size of the new store. During the inventory of obsolete pesticides and veterinary waste conducted by NEMC in 1998, it was estimated to be 12m long x 8m wide x 1.8m height⁴ of pesticides to give 172m³. Further, in 2003 during training on safeguarding (in preparation for ASP project document), the height of pesticides was estimated to be 2.5m. This means the pesticide is now estimated to be 240m³.

To be precisely with the actual amount of the pesticides stored in the new store AGENDA managed to measure the height of the pesticides in the store and was 2m. This means 12m long x 8m wide x 2m height of pesticides gives 192m³. The actual amount of the remaining pesticides and the extent of contamination on the site and the nearby surrounding is based on general estimation as reported above.

3.4.3 Use of Adjacent Land

Most of land of the Vikuge Village has been used for agricultural activities such as farming and livestock keeping. The site is surrounded by farms (blocks) of hay within the radius of 100m except on western part where it is bordered by hay shed. The produced hay is mostly sold to dairy farms in Dar es Salaam and Coast Regions. Within 500m to 1 km, Villagers grow food crops for their own use. Food crops grown include maize and paddy on the lowland areas that become

⁴ 1998, National Environmental Council

periodically flooded with flowing water emanating from the upland including the old store site.

Livestock keeping just like farming is an important economic endeavour of the people of Vikuge Village. Cattle, sheep and goats as well as poultry are kept in the area.

3.5. SITE CONDITION AND SURROUNDING ENVIRONMENTS

3.5.1. Climate

The climate of Vikuge area is typical of Coast region, which is characterised by a marked seasonal rainfall distribution. On average the area receives between 800 -1000 mm of rainfall annually. The minimum average temperatures vary from 21°C in May to 25°C in July. June is the coldest month whereas September is the hottest month, with mid-day temperatures exceeding 30°C.

3.5.2. Topography

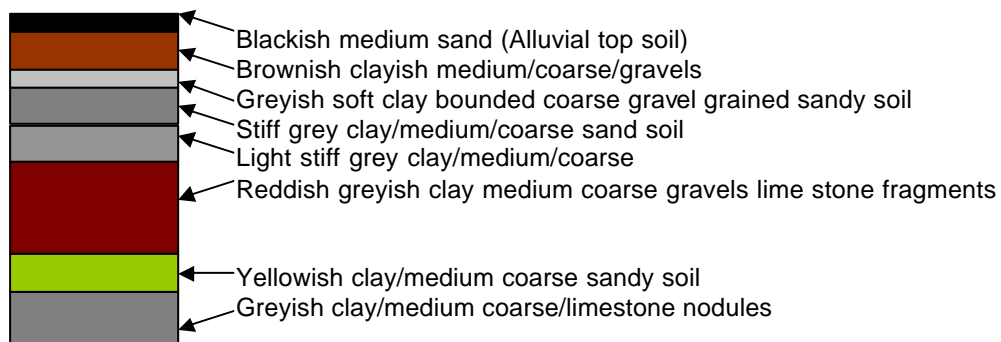
The Vikuge State Farm where the contaminated site is situated on a broad upland with an altitude of 129 - 152m above sea level with undulating terrain. At the old store the area is almost a flatland gently sloping towards the north where Vikuge village is situated.

More specifically the old store happen to be situated at a lower point as compared to the surrounding. There are signs that water stagnates during the rains.

3.5.3. Soil and Geology

3.5.3.1 Vikuge area

Soil stratigraphy of the Vikuge area in general is as shown in the Figure 3.2 and described in the Table 3.1 as was observed during the hand pump well drilling activities done by the Plan International organisation.



Source: Plan International 2001

Fig 3.2. Soil stratigraphy of the Vikuge area

Table 3.1. Average Soil stratigraphy of the Vikuge area

Depth (m)	Type of soil
0-0.5	Blackish medium sand (Alluvial top soil)
0.5-2.0	Brownish clayish medium/coarse/gravels
2-3	Greyish soft clay bounded coarse gravel grained sandy soil
3-5	Stiff grey clay/medium/coarse sand soil
5-8	Light stiff grey clay/medium/coarse
8-14	Reddish greyish clay medium coarse gravels lime stone fragments
14-16	Yellowish clay/medium coarse sandy soil
16-20	Greyish clay/medium coarse/limestone nodules

Source: Plan International 2001

3.5.3.2 Soil of the study area

The topsoils are blackish medium sand soils and finer whitish sand mixture. Some discoloration and places staining of the soil in the area is easily observed. Results of the study conducted by Kishimba and Mihale in 2003 found that organochlorines were the most frequently detected pesticides in the soil samples. The pesticide residue analysis results showed the presence of *p,p'*-DDT and *p,p'*-DDD in more than 86% of the samples, with concentrations from 5,200 to 172,000 mg/kg dry weight (i.e., up to 17.2%) for *p,p'*-DDT and from 4,700 to 69,600 mg/kg dry weight (i.e up to 7%) for *p,p'*-DDD (Table 3.2). The *p,p'*-DDE and *o,p'*-DDT concentrations ranged between 140 – 4,050 mg/kg and 2,000 – 36,100 mg/kg dry weight, respectively. A concentration trend in the order of *p,p'*-DDT > *p,p'*-DDD > *p,p'*-DDT > *p,p'*-DDE was observed in surface samples. These figures for *p,p'*-DDT are higher than the concentrations found in commercial formulations, which are usually between 5 and 10%

Table 3.2. Concentrations of DDT residue in surface soils samples

Sampling Point		Concentration (in mg/kg dry weight) x 10 ³					
		<i>p,p'</i> -DDE	<i>p,p'</i> -DDD	<i>o,p'</i> -DDT	<i>p,p'</i> -DDT	SDDT	DDE/DDT
On site points	A	4.05	69.6	36.1	172	281.75	0.02
	B	0.31	21.5	7.45	30	59.26	0.01
	C	0.7	12.24	6.6	13.8	33.34	0.03
	D	0.14	4.7	2	5.2	12.04	0.02
	E	0.53	41.6	13.46	65.25	120.84	0.01
Away Points	20M	0.27	12.1	3.76	16.82	32.95	0.01
	50M	< 0.1	0.94	< 1.03	< 1.6	0.94	-

Source: Kishimba and Mihale 2003

3.5.4 Hydrology

3.5.4.1 Surface water resources:

There are no major rivers in the study area. However, during the field visits to the area there were apparent signs of a seasonal watercourse running from the south, across the site, towards the lower areas in the north. It seemed that surface water run-off from the site follows the Vikuge village road (Figure 2.1) discharging in the Namtipwa seasonal stream. The Namtipwa stream is used for agricultural activities as well as for washing and domestic use and several ponds have been constructed within the stream (Plate 5). The Namtipwa stream eventually joins the Ruvu river on the north.

3.5.4.2 Ground water characteristics

The water table in the Vikuge area is found approximately 5m depth and the direction of the ground water flow is towards the northern direction (constructed boreholes and local wells water were found at a depth of less than 5 meters.)⁵

3.5.4.3 Water Quality

In terms of water quality, the study team could not get access to the data and water analysis report of the boreholes constructed in the area. Plan International and the Chemistry Department of the University of Dar es Salaam did not avail the information to the study team.

3.5.5 Flora and Fauna

3.5.5.1 Flora

Vikuge area is characterised with scanty vegetation, which consist mainly of bush thicket mixed with annual herbs, thorns, deciduous shrubs, grasses, and some few evergreen exotic trees. Before the consignment was brought at Vikuge site, most of the indigenous trees and vegetations for a long time were already affected from the pressure of human activities such as grazing, farming (Sisal plantation) and fuel wood collection. The vegetation found at the contaminated site (the old store site, Plate 6 and new store, Plate 7) include the following types:

- i) Grass cover
 - *Panicum maximum* (Green pank)
 - *Cynodon dactylon* (Star grass)

- ii) Forbs (Primary vegetations)
 - *Indigofera species*
 - *Commelina africana*

⁵ 2002, Plan International

- *Solanum incanum*
 - *Sida cordifolia*
 - *Lactuca capensis*
- iii) Trees and shrubs
- a. Established (Introduced)
- *Eucalyptus species*
 - *Pinus species*
 - *Casia siamea*
- b. Native
- *Dichapetulum stuhmannii*
 - *Dichapetulum mosambiensis*
 - *Combretum schumannii*
 - *Dicrostachys cinerea*
 - *Cassia abbreviata*
 - *Vitex doniana*

3.5.5.2 Fauna

Villagers⁶ reported existence of rabbit, rats, snakes, lizards and different types of flying insects at the old store site and the adjacent land before the consignment dumped on the area. However, after the consignment was bought at the area, big animals ran away and other small insects and worms were victims of the pesticides and this can be observed at the site where dead insects are covering almost the whole area.

3.5.6 Unique and Endangered Species

As far as the study has managed to determine, there are no unique or particularly endangered species (animals, reptile and bird species) present in the near vicinity of the contaminated site.

3.5.7 Local Usage of Ground and Surface Waters

Tap water is readily available at the State Farm (hay production centre) and to the nearby villages including Vikuge village through the Dar es Salaam City Water Supply Company. The Company supplies water from Upper Ruvu Station, which is also source of water for Dar es Salaam City. Tap water from this network is sold at Tshs. 20/= per 20-litres bucket to the villagers, which is a bit expensive for the villagers such that it is mainly used for drinking. Also water from that network is not reliable. Therefore, the villagers mostly get water from unprotected sources such as hand dug wells and seasonal streams, and thus suspected to be a source of water borne diseases. Vikuge Village entirely depends on water from:

⁶ Elders and Village Environmental Committee

- Seasonal streams and wetlands
- Plan International boreholes
- Local wells

3.5.7.1 Seasonal streams, ponds and wetlands

There are three seasonal streams located near Vikuge village and those are known as Kwandende, Namtipwa and Vikuge stream. Water from those streams is mainly used for irrigations especially for vegetables and for domestic and animal drinking.

The Namtipwa stream, which is located on the northern side of the Vikuge village, receives storm water directly from the high lands of the State Farm. This was verified by the presence of the rainwater terrain, which cut across the middle of the contaminated site. Large amounts of the pesticides might be washed away downstream to Namtipwa stream that connects to the Ruvu River, which supplies water for the Dar es Salaam City. Other two ponds, which are located on southern side despite being sources of water for agriculture and domestic use, are also used for fishing.

3.5.7.2 Plan International boreholes

Plan International constructed 4 boreholes in Vikuge Village to provide the villagers with clean and safe water. The Village had a problem of clean and safe water for many years. Unfortunately water quality of one borehole, which was constructed on the edge of Namtipwa stream, was found undesirable for domestic and animal use and the borehole was sealed (Plate 8). The reasons for closing that borehole were not revealed to the study team.

However, with that unknown reason of closure of the Plan International borehole, the Villagers dug another local well along side the closed borehole for domestic use (Plate 9).

3.5.7.3 Local wells located within/nearby the seasonal streams and wetlands

Several ponds and local wells have been constructed within the seasonal streams and have been the only reliable source of water for the Vikuge Village. Water from those wells are used for domestic and irrigation. In terms of the contaminated site there are no wells that had been constructed within the Vikuge state farm.

3.6 LOCAL SITE KNOWLEDGE OF RESIDENTS

The local residents who live and work at the Vikuge area have little knowledge of the pesticides and the effects to human being and environment in general. Initially, staffs of the Ministry of Agriculture tried to raise awareness among staffs

and villagers concerning the adverse impacts that may be caused by the pesticides when the stock arrived but after some time they stopped the exercise. From that time there has been no initiative to educate people on the proper use of chemicals, impact of chemical exposure and importance of avoiding coming into contact with obsolete stocks.

3.7 LOCAL LITERATURE ABOUT THE SITE

Different researchers from the University of Dar es salaam (Department of Chemistry) and NEMC conducted different studies at different times. However, none of the studies involved workers at the Vikuge State Farm or Vikuge villagers. Results for all those studies were not made available to the public. Even the Vikuge Hay State Farm officials have no single copy of those studies. Therefore, workers together with villagers have little knowledge about the site and possible impacts that may have been caused by the pesticides.

3.8 MISUSES OF PESTICIDE AND PESTICIDE CONTAINERS

At the time when the chemicals were brought to Vikuge, there were no security measures against vandalism or thefts. As a result people took the pesticides freely for their own use and others for selling in other regions including Dar es Salaam city. Villagers and the community at large were ignorant regarding the safe use and handling of pesticides and a large number of villagers were not able to read recommended safety measures and application. Due to that there were a gross misuse and abuse of the pesticides. For examples: -

- Liquid pesticides were used as a fuel in stoves and oil lamps.
- Spray pesticides were used as a home spray for killing domestic pests and protection from Mosquitoes. Other spray pesticides with attractive smells were used as perfumes, body & clothes fragrances and air fresheners. Women were most victims of such misuse.
- Pesticides and herbicides in the agricultural activities
- Non smell pesticides were used for killing crops destructive animals in the farms and gardens such as monkeys
- Also other pesticides were used in illegal fishing in the nearby water bodies
- The use of pesticide containers: during the study it was reported that pesticides containers were used and are still used as drinking mugs by villagers. Generally, empty containers are used to store foodstuff, water and milk.

3.9. RELEVANT COMPLAINT

3.9.1 Irritating Smell

The villagers complained that during dry season, which is always accompanied with high wind speed, the pungent irritating smell of DDT has been constantly

sensed at the Vikuge Village. This has been accelerated by the fact that the consignment was stored under a shed in the open air and the shed was located less than 1 km from Vikuge Village.

3.9.2 Health Hazards

Adverse health effects reported by Villagers include eyes infections, persistent skin diseases and respiratory track infections. Also the villagers⁷ reported that five elders and one young (boy or girl) have died from the unknown disease of body swelling, which has been recurring at the Vikuge village. While there are no concrete statistics about the number of illnesses or deaths directly related to the presence of these pesticides at Vikuge area, villagers and health officers at Vikuge believe that skin and respiratory diseases could be linked to long-term exposure to or consumption of chemicals dumped in their area.

3.9.3 Water Contamination

Due to costly and unreliable supply of tap water, the Villagers of Vikuge use hand dug wells, which are located within the Namtipwa stream and other streams located on the lower lands. As noted under section 3.5.2 (Topography) and section 3.5.4 (Hydrology) surface run off from the upland including the contaminated site draining towards the lower areas. This suggest that there is high probability of contamination to the streams and ponds. Also, at the Vikuge village, sanitation is such that all households use traditional pit latrines. Such drainage and high water table could contribute to the contamination of the surface water as well as ground water.

3.9.4 Soil Contamination

The residents are of the opinion that the chemicals at the contaminated site are responsible for declined soil fertility in the general area. They complained that, they used to have good harvest of cashew nut, bananas, cassava and maize but currently the harvest have declined. Also those other crops such as oranges and bananas are no longer cultivated in the area due to loss of soil fertility.

3.9.5 Loss of fishing

During the field survey it was reported that in 1989 some villagers used the pesticide for fishing in Lugongwe stream which is located 5 Kilometre from the Vikuge Village. All fishing activities were affected because the pesticides applied killed all fish and its regeneration in the stream. However, recently fishing activities have resumed, but the quality of the catch is not known.

⁷ Village leader discussion group

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

4.1.1 Site history and characteristics of surrounding environment

The Vikuge contaminated site is a site with a long history of over 18 years where in 1986, about 600 metric tonnes donation of partially expired pesticides were stored in an open shed that eventually collapsed in 1993. This study could not establish with certainty whether the consignment was donated to Tanzania in good faith or otherwise.

Ownership and management of the site has remained within one institution, the Ministry of Agriculture and Food Security while the area around the site (Hay State Farm) is under the Ministry of Water and Livestock Development. However the site has attracted other stakeholders such as research institution (University of Dar es Salaam), Environmental Protection Agency (NEMC), Donors (Sida, Netherlands Embassy) etc.

With regards to surrounding environment, location of the village relative to the site provides ideal terrain for contamination from the core site to surrounding village and other ecological components. This is exacerbated by favourable climatic conditions such as sufficient rains received at Vikuge area, which provides chances of chemicals to be transported over long distances.

Groundwater and air (e.g. dust emissions and volatilisation), are the most likely transport *media* (i.e. transporting contaminants to media from which chemicals are directly taken up by organisms)'.

4.1.2 Extent and Levels of contamination of the site

The study team relied on secondary data and information found in literature concerning the levels of contamination of the Vikuge site and did not conduct actual measurements. From other studies, analyses of soil samples collected in 2000 from the old storage site at the farm for 80 different pesticide residues and metabolites have revealed alarmingly high concentrations of pesticide residues to qualify Vikuge as one of the most contaminated sites in the World. Most of the residues found in the soil at high concentrations were organochlorines, their concentrations being up to 282,000 mg/kg dry weight for total DDT (28.2% by mass). Higher concentrations of the residue were found in the surface soil samples and the concentrations of the residue were decreased with increasing depth and distance from the point source.

Soils exposed to hazardous chemicals like these pesticides can be severely damaged by alteration of their physical and chemical properties and thus reducing the ability to support plants (Manahan 2001) as well as other living organisms. This is evidently clear in the study area where there has been no plant growth and the soil has remained sterile for more than fifteen years now.

With regards to the quality of water, Plan International and Department of Chemistry of the University of Dar es Salaam did not avail the results of water analysis to the study team.

4.1.3 Risks Associated with Contamination of the Site

It is undeniable truth that chemicals dumped at Vikuge area are poisonous and are hazardous to the environment and health of the community. Un-proper storage in the past has resulted in soil and ground water pollution with (amongst other pesticides) DDT. It is suspected that over the last decade, much of the product has penetrated the soil, ultimately washing into nearby wetlands, streams and wells due to the following reasons.

- **Use of Contaminated water:** The contaminated site is located in the higher area at the state farm and the residential areas of the nearby communities are located on downhill. This provides a high probability of contamination to the streams and wells. Water from those streams and wells are used for domestic purposes and irrigation.
- **Agricultural production and Livestock Keeping:** Villagers grow food crops for their own use such as vegetables, maize, rice, cassava, potatoes and paddy on the lowland areas that become periodically flooded with flowing water emanating on the high-rise areas including the old storage site.

Also Vikuge area is a hay production centre, with hay being grown within a radius of 100 metres from the old storage site and the hay is mostly sold to dairy farms in Dar es Salaam, Coast Regions and other nearby regions.

- **Gross misuse and abuse of pesticides:** Some community members used empty containers, which had previously contained pesticides for keeping water, milk, local brew as well as drawing water from deep wells. This is indeed very hazardous to one's health because it is impossible to wash the containers thoroughly. Also pesticides were used as a fuel in stoves and oil lamps, home spray, perfumes, body & clothes fragrances and air fresheners etc.
- **Direct ingestion:** Observed disappearance of marine features in the Lugongwe stream where pesticides were applied for fishing and agricultural activities along the streams are an evidence of the environmental and human

beings contamination as the fished marine features and agricultural products (home grown vegetables) were eaten by the community members.

Terrestrial animals can also be exposed through ingestion of contaminated surface water, soil, or foods, generally as a dose. These foods include plants that can take up contaminants from surface water, groundwater, soil, or air. Surface water, sediment, soil, and prey organisms can therefore be thought of as *exposure media*.

The potential effects of exposure to chemicals, which are now found as contaminants in human body fat and breast milk, are numerous. Unusual outbreaks of diseases (such as persistent respiratory track infections, persistent skin diseases, eye infections and general body swelling) those were not common to the community members living nearby the contaminated site were reported. The problem, which is facing Vikuge residents, is that most medical doctors in Tanzania are not currently trained to diagnose or treat pesticide illness or injury and it is likely they would not believe a mother who thought her infant was sick because of pesticides in her breast milk or her environment. The manifestations of chemical toxicity may be subtle and easily missed if a medical doctor is not familiar with pesticide illness and injury. The relative paucity of data relating to obsolete chemicals contamination to date is a direct result of the lack of monitoring activities.

The current situation is critical due to impacts caused by those chemicals on the environment and risks posed to the human life. A lasting and sustainable solution for environmentally sound management of these chemicals wastes is need.

4.2 RECOMMENDATIONS

Main recommendations from the study include:

- 1) Immediate signage : The area should be marked clearly with signs to keep people and livestock away from the site.
- 2) Undertake urgent remedial action of the site to contain and stabilise contaminants.
- 3) Clean up of contaminated soil and creek sediments in order to protect human health and the environment.
- 4) Increase public awareness on the impact of the chemical wastes to human life and environment, including targeted education for affected villages.
- 5) Carry out a thorough analysis of environmental components to establish level of contamination in wider environment.
- 6) Release of all data regarding groundwater/well contamination.
- 7) A well-planned and carefully carried-out risk assessment to help evaluate potential health problems for a contaminated site and identify important exposure parameters for risk management.

- 8) Perform community monitoring to establish the long-term impacts to the environment and the human health. Community monitoring may provide needed evidence to determine cause-effect relationship between environmental health of a given community and chemicals found in their environment.

Plan for community Monitoring and clean up

SN	Gap	What to do
1.	Site Characteristics <ul style="list-style-type: none"> • Social economic • Environmental 	<ul style="list-style-type: none"> • Further studies on Socio-economic activities (establish impacts on farming and livestock keeping activities – low soil fertility) • Mark the contaminated area
2.	Extent of Contamination at the site	<ul style="list-style-type: none"> • Verify results of NEMC and University of Dar es Salaam • More data on water, plants, weeds, and wildlife
3.	Level of contamination to the surrounding environment	<ul style="list-style-type: none"> • Determine levels of contamination in environment e.g. soil, water, plants, weeds, and wildlife • Investigating chemical residues in raw food commodities • Determine the body burden levels on the people
4.	Risks	<ul style="list-style-type: none"> • Determine risks associated • Scientific statistic • Verifying complains
5.	Risk management strategy	
6.	Low knowledge	<ul style="list-style-type: none"> • Create awareness of the problems and its implications

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ANNEX



Plate 1: Hay Farm



Plate 2: Hay Farm



Plate 3: Stock of Pesticides in New store



Plate 4: Pieces of pesticide containers



Plate 5: Local well located at Namtipwa stream



Plate 6: Old storage site



Plate 7: New storage site



Plate 8: Closed well



Plate 9: Closed well along side a local well