

Section 8:

IMPLEMENTATION ISSUES

8.0 INTRODUCTION

This Section discusses the implementation of the Solid Waste Management Strategy for Sohag put forward in Section 7. It considers the priority areas and key issues that need attention above others, and it describes a number of demonstration projects that could be carried out as part of the strategy.

8.1 PRIORITY ISSUES

8.1.1 Technical Priorities

The strategic issues to improve solid waste management in Sohag Governorate have been identified in Section 7. In this section the key issues will be prioritised and suggestions for implementation will be given. Priorities have been set, because it is impossible to address all issues at the same time. Besides, priorities need to be defined in order to make the best use of available physical resources and funding. All the actions that have been given a Priority 1 rating should be the first to be addressed, and Priority 3 actions should be the last.

The relative ranking of the options was made by comparing the different options available. The most urgent issues with the highest priorities are those that are related to solid waste management practices that are most harmful to the environment and public health. The ranking has also been obtained by comparing the costs of different options and their effects on solving key solid waste management problems. In addition, some options have been given a high priority, because they are a precondition for other issues to be addressed, such as the identification of new disposal sites before old dumpsites can be closed and remedied.

Where possible, geographic priorities are mentioned, indicating which areas and *markazes* should receive attention first.

Issues that will be prioritised include options to improve waste collection and transfer, disposal and treatment, re-use and recycling, hazardous waste management, financial sustainability, institutional and organisational strengthening, and community participation and awareness-raising, as discussed in detail in Section 7.

However, in spite of this prioritising it should be kept in mind that the whole system of collection, transfer, disposal and treatment is preferably considered in its entirety in a particular settlement, as the issues are interdependent. If only attention is paid to one element of the waste management system, say composting, then it is easily forgotten that other elements have major influences on the success of composting. For example, waste collection efficiencies need to be improved to enable the plant to operate at full capacity and disposal sites should be available for the rejects (the non-recyclable and non-compostable waste). This is why the concept of integrated waste management is important, i.e. taking into account all the aspects of a solid waste management system and considering the aspects in relation to each other.

Table 8.1 lists all the options for improvement of solid waste management, their relative priority and the geographical areas that need preferential treatment. The reasons for the geographical priorities will be explained in the following paragraph (8.1.2).

Table 8.1: Priority Ranking and Key Areas for Improvement of Solid Waste Management in Sohag Governorate

Improvement Option	Priority	Key Areas
Waste Collection and Transfer		
Evaluate vehicles and containers available in urban and rural areas. Define standard equipment for different settings.	1	Use Sohag City, Bardees and El Kawther as examples
Improve primary and secondary collection and street sweeping for urban areas (1 city/year)	2	Sohag, Tahta, Girga, Tema, Monshah
Set up a system for regular waste analysis	1	Ditto
Establish an emergency clean-up unit	3	Ditto
Improve maintenance: Preventive maintenance and stock control Training Restructuring workshop organisation Upgrading facilities	2	Tahta, Tema, Girga, Dar El Salam
Improve rural waste collection (3 largest villages/year): Study cost of waste collection systems in rural areas Establish regional waste collection system Redistribute vehicles and equipment	3	Start with villages in Monshah. Redistribution in <i>markazes</i> with excess urban collection capacity: Sohag, Baliana, Saqulta, Gehena
Waste Disposal and Treatment		
Introduce controlled tipping procedures	1	All new disposal sites, and existing disposal sites in Maragha, Monshah, Saqulta
Study composting, co-composting and recovery options (feasibility and marketing studies) for places where disposal sites are full or environmentally unsound	1	Girga, Tahta, Tema, Baliana
Select new disposal sites	1	Ditto
Remediate disposal sites that have been closed	2	Ditto
Establish regional disposal sites	2	
Evaluate performance of existing composting plants	2	Sohag City
Study possibilities of co-composting (with dried sewage sludge)	3	Sohag City
Set up a pilot project for segregation at source of organic waste (dry/wet waste)	3	Area in Sohag City
Turn composting plant into regional treatment facility	2	Sohag City
Set up a pilot manual recovery unit alongside a disposal site	3	In a <i>markaz</i> with a lack of landfill capacity, waste with a high non-organic content and

Improvement option	Priority	Key areas
<i>a local interest in recovery</i>		
Waste Reduction and Recovery		
Encourage and regulate scavenging Improve working conditions on disposal sites Establish collection co-operatives Incorporate scavengers in activities composting plants	1	Where there are many scavengers: Sohag, Tahta
Set up an awareness-raising campaign to encourage household composting and re-use	1	Where land for disposal is not easily available
Encourage small- and micro-enterprises in waste recovery	2	Shandaweel, Akhmim, Sohag
Set up a pilot project for segregation at source and separate collection of packaging materials	2	Large cities, possibly Sohag, Girga, Tahta
Set up a pilot project for segregation at source and separate collection of animal waste	2	Girga
Establish a pilot project for segregation at source, separate collection and recovery of tin cans	3	Needs feasibility study (where supply of tin cans is large, outlet clear, and local unit, CDA or private company interested)
Hazardous Waste Management		
Set up a system for segregation at source and separate collection of clinical waste Encourage local manufacturing of sharps containers Organise awareness-raising and training for staff hospitals and clinics	1	Where waste is delivered to a composting plant: Sohag, Monshah
Establish a regional collection system and central treatment facilities for clinical waste. Explore treatment options other than incineration	2	Ditto
Prepare hazardous waste cells with double lining at disposal sites for industrial hazardous and other hazardous waste	1	Where waste is delivered to a composting plant and where many industries are present or planned: Sohag City, Akhmim, Girga
Identify sources, quantities and characteristics of hazardous waste from industries, households, slaughterhouses, agriculture, etc.	2	Ditto
Study most suitable collection, disposal and treatment options for each of the identified types of hazardous waste	3	Ditto
Financial Sustainability		
Introduce user charges and gate fees, depending on amount of waste generated and ability to pay, preferably obligatory for all	1	Where waste collection will be improved and/or where costs of waste collection are

high: Tahta, Girga, Tema

Improve enforcement litter fines	1	
Improvement option	Priority	Key areas
Study privatisation and create enabling environment for NGOs and private sector Assist them in improving fee collection	2	Where waste collection will be improved: Sohag City, Tahta, Girga, Tema, Monshah
Lobby Governorate and central government for more funds	1	
Allocate more funds to labour and maintenance	1	
Improve bookkeeping practices	1	Start with Sohag City
Encourage self-collection by military camps, hotels, etc.	2	
Increase revenue of composting plant: Improve marketing of compost and dry recyclables Pay incentives to workers according to performance	2	Sohag City
Contract out disposal sites	3	Disposal site with many scavengers and valuable waste, possibly Tahta, Sohag

Institutional and Organisational Strengthening

Strengthen the Governorate solid waste management department	1	
Divide Governorate in five regions and prepare a regional waste management action plan	2	
Establish solid waste management departments at <i>markaz</i> level	1	Where waste collection will be improved: Sohag City, Tahta, Girga, Tema, Monshah
Improve working conditions SWM employees (salaries, bonuses, piecework systems)	1	
Training: decisions-makers and senior officials junior staff and managers	1	Ditto
Training staff composting plant	2	Sohag City
Restructure management of composting plant	2	Sohag City
Investigate possibilities for joint solid waste management by CDAs, private companies and municipalities	3	Where waste collection will be improved and active CDAs: Sohag, possibly Tahta and Girga

Stakeholder Participation and Awareness-Raising

Identify stakeholders in solid waste management, especially disadvantaged groups - Where waste collection and disposal will be improved

Conduct social studies before any implementation - Ditto

Improvement option	Priority	Key areas
Set up systems for community participation and communication in local councils	1	Ditto
Provide support to community-based collection schemes in villages and low-income neighbourhoods	1	
Conduct awareness-raising campaigns focusing on specific target groups on littering	1	Especially where waste collection and disposal will be improved
Provide support to community-based clean-ups, beautification, etc.	2	
Set up a pilot project using economic incentives to encourage waste collection and recycling in low-income neighbourhoods	3	Where waste collection will be improved: Sohag, Tahta, Girga

8.1.2 Geographical Priorities

Waste Collection and Transfer

For waste collection and transfer in urban areas the factors taken into consideration were waste collection inefficiencies, the location and planning of composting plants and the present cost effectiveness of waste collection and transfer.

Table 8.2 shows estimates of collection efficiencies for urban areas of Sohag Governorate.

Table 8.2: Waste Collection Efficiencies in Urban Areas of Sohag Governorate

Markaz	Generation ¹ (in Tons)	Capacity ² (in Tons)	Shortage/Excess Capacity	
			Tons	% of Waste Generated
Sohag	21.8	79.4	+57.6	
Dar El Salam	13.6	10.6	-3.0	22%
Baliana	6.7	20.4	+13.7	
Girga	63.4	34.4	-29.0	46%
Monshah	21.8	15.4	-6.4	29%
Akhmim	80.6	26.6	-54.0	67%
Saqlta	9.2	11.2	+2.0	
Maragha	18.2	16.2	-2.0	11%
Gehena	23.0	27.4	+4.4	
Tahta	56.4	12.4	-44.0	78%
Tema	25.6	13.4	-12.2	48%

¹ Based on the data of Prof. Dr. Olfat Anwar El-Sebai. Solid Waste Management Study Sohag, SEAM Project, 1995.

² Based on the capacity of existing equipment that is in operating condition, on a waste density of 350 kg/m³ and on two shifts.

According to Table 8.2 waste collection efficiencies are particularly low in Tahta (78% uncollected), Akhmim (67% uncollected), Tema (48% uncollected) and Girga (46% uncollected).

Besides, it seemed logical that collection efficiencies be improved in areas where a composting plant has been installed, i.e. Sohag City and Monshah.

Another factor that is important in defining areas that need priority treatment, is the cost per tonne of waste collected, as shown in Table 4.24 in Section 4 . The following *markazes* in Sohag Governorate had the lowest cost effectiveness (highest cost per tonne) for their waste management systems: Baliana (LE 10.70/tonne), Tema (LE7.97/tonne), Saqlta (LE6.50/tonne) and Girga (LE 5.62/tonne).

Table 8.3 provides an overview of the ranking of these three factors for all the urban centres in Sohag Governorate.

Table 8.3: Waste Collection Problems Ranked for Urban Centres of Sohag Governorate

Markaz	% waste not collected ¹		Cost of waste/tonne collected		Waste brought to compost plant? ²	Final ranking ³
	%	Rank	LE	Rank		
Sohag	-	-	2.47	7	Yes	8
Dar El Salam	22%	6	2.18	8		10
Baliana	-	-	10.70	1		5
Girga	46%	4	5.62	4		4
Monshah	29%	5	-	-	Yes	3
Akhmim	67%	2	1.19	9		6
Saqlta	-	-	6.50	3		7
Maragha	11%	7	3.13	6		9
Gehena	-	-	1.05	10		11
Tahta	78%	1	5.40	5		2
Tema	48%	3	7.97	2		1

¹ When no shortage in collection was perceived, rank 8 was given

² Composting/recycling: if Yes: 0 points, if No: 3 points

³ The overall score resulted in the ranking shown in this column

The final ranking in Table 8.3 is based on the scores of the *markazes* on the three factors. It shows that the top 4 *markazes* in Sohag Governorate that need improvement of their collection and transfer services are: **Tema, Tahta, Monshah and Girga.**

As stated earlier in Section 4, waste quantities in rural areas in Sohag Governorate are negligible. However, in the future *markazes* could possibly identify large villages and rural towns that need an improvement in their waste collection system. For the time being the waste collection problems are more urgent in cities.

Maintenance

For maintenance of equipment and vehicles other priority areas were defined. They are given in Table 8.4. Their priority is based on: whether the number of vehicles that is out of order, whether they lack tools and/or equipment, whether they have a shortage of technically skilled staff for maintenance, the absence or presence of a sufficiently large maintenance and/or parking area, the absence or presence of a washing and greasing area.

Table 8.4: Problems with Maintenance in Urban Centres in Sohag Governorate

Markaz ¹	Equipment out of operation	Lack of tools and/or equipment	Lack of technically skilled staff	No adequate maintenance area/garage	No washing and greasing area	Overall score
Sohag	-		X			7
Dar El Salam	38%	X	X			4
Baliana	22%					9
Girga	19%		X		X	3
Monshah	-		X			6
Akhmim	-					5
Saqlta	25%					8
Maragha	-					
Gehena	-					
Tahta	50%					1
Tema	40%					2

Note:

¹ For Maragha and Gehena were no recent data available.

Based on Table 8.4 it can be concluded that the *markazes*, which are most in need for support to improve maintenance, are Tahta, Tema, Girga and Dar El Salam.

Disposal

Tema, Tahta, El Maragha and Sohag City dump their waste into disused canals which is not good practice. The disposal sites most in need of closure for environmental and public health reasons are located in the following 4 *markazes*:

1. *Tema*:
Disused canal, near residential areas, water pollution hazards, close to fishing area
2. *Tahta*:
Disused canal and other disposal site, close to residential areas and agricultural land, both polluting irrigation water and soil
3. *Girga*:
Disposal site is close to potable water station, also risks polluting water of the River Nile used for irrigation and fishing
4. *Baliana*:
Disposal site is close to irrigation canal, waste is always burning, site is almost full.

The Governorate and the central government need to be lobbied for funds to enable *markazes* to buy new land and search it for historical monuments. Other research of the area, such as hydrological and geological, should be included.

Controlled tipping procedures need to be introduced in all new disposal sites and in the existing disposal sites of Maragha and Monshah, as this would reduce fire hazards and air pollution that affects surrounding agricultural land and it would increase the life of the disposal site. This means that more funds need to be allocated to operation and maintenance of disposal sites.

The most suitable places for establishment of regional disposal sites, be it urban or rural, need further investigation.

After a new site has been selected for the four priority disposal sites above, the old disposal sites need to be closed and remedied, using the example of the remediation of the disposal site in Sohag City and Mansoura, Dakahleya. The views of the residents living nearby can be sought about their preferences for the destination of the site. This will increase their willingness to maintain the area in good shape.

Composting

Solid waste management experts have recommended that no more large-scale composting plants should be built in Sohag Governorate. The possibility of small-scale composting units could be investigated, especially in those areas where there is a lack of land available for landfilling. Sohag composting plant already receives waste from Monshah, but could include waste from other areas such as Akhmim, thus becoming a real regional waste treatment facility.

Co-composting with dried sewage sludge could be experimented with in the existing composting plant of Sohag City. Transportation will not be costly, as the wastewater treatment plant is located next to the plant.

Waste Reduction and Recovery

Waste reduction, re-use, recycling and home composting should especially be encouraged in areas where there is a shortage of land for landfilling, because they will reduce the amount of waste to be landfilled. Working conditions of scavengers can be improved in Sohag and Tahta, where disposal sites are regularly visited by scavengers. Small- and micro-scale enterprises in waste recovery can be encouraged in Shandaweel, Akhmim and Sohag, where the trade in recyclables is already concentrated.

A pilot project for segregation at source and separate collection of packaging materials could be undertaken in large cities, possibly Sohag City to start with, as the quantity of paper, carton and plastics from schools, offices, etc. there will probably be sufficient to make it economically feasible.

Girga would be an appropriate location to start with a separate collection system of animal waste, as this city appears to suffer more from animal waste than other *markazes*.

The most appropriate location for a tin can recycling enterprise needs to be defined through a feasibility study.

Clinical waste management

Systems for segregation at source and separate collection of clinical waste should preferably be undertaken in cities that deliver their waste to a composting plant (Sohag City and Monshah), because segregation of clinical waste will reduce the health risks of the workers sorting the waste on the picking lines and increase the value and safety of the compost.

Hazardous waste management should also be a priority in the areas where a composting plant is located and where many industries are located such as in Sohag City, Akhmim and Girga, because then economies of scale can be realised with a separate collection system or central treatment facility.

Financial Sustainability

The introduction user charges and gate fees is recommended in places, where waste collection will be improved. One cannot ask people to pay, however, without providing a service that is satisfactory and functioning effectively. Besides, when the costs of waste collection are relatively high, additional sources of income like user fees become necessary to cover the costs. However, in this case ways to reduce costs should be sought as well.

Examining the options for (partial) privatisation and creating an enabling environment for NGOs and the private sector alike seem especially appropriate in areas, where waste collection will be improved. In Sohag City already some private waste collection companies and CDAs have shown interest in waste collection.

Improvement of bookkeeping practices should be done in all *markazes*, but maybe this could start in Sohag City and the system developed there could be replicated elsewhere.

Whether contracting out of a disposal site is a feasible option, depends on the presence of scavengers and valuable waste on the disposal site, as well as on a dealer who is interested in obtaining the rights to scavenge under certain conditions. Tahta and Sohag could be suitable places.

Institutional and Organisational Strengthening

Solid waste management departments are expected to be most effective in the places where waste collection is about to be improved, because then these departments can be involved in the planning process and learn by doing.

Training will be most effective if it is in combination with (proposed) changes in waste collection systems, as this urges staff to rethink the existing system.

Joint management between CDAs, private companies and municipalities could be planned for, when new waste collection systems are being prepared.

Stakeholder Participation and Awareness-Raising

Identification of stakeholders and social research should take place as part of improvements of collection and disposal systems. For awareness-raising the same holds.

A pilot project for economic incentives to encourage waste collection and recycling in low-income areas could be started in one of the cities where waste collection will be improved, such as Sohag City, Tahta or Girga.

8.2 DEMONSTRATION PROJECTS

8.2.1 Introduction

In this Section six demonstration projects that aim at Priority 1 issues, are briefly described. They are similar to the Demonstration Projects already implemented in Sohag and Dakahleya Governorates with the support of SEAM (see Section 6).

From Sections 7 and 8.1 it is evident that there are more than six important issues that need to be addressed in Sohag as a matter of some urgency. However, to attempt to address them all at once would be futile, as would be the attempt to address them all alone. All stakeholders mentioned in Section 4 could play a role in the proposed actions.

The suggested demonstration projects can be used by the Governorate as a point of departure to tackle the key issues in solid waste management. Each of the following projects would:

- Be of practical value to Sohag as a whole (i.e. it would have a high degree of transferability to other parts of the Governorate, and perhaps outside the Governorate)
- Be of real and significant benefit
- Involve practical and affordable technologies and/or resource requirements
- Result in findings that, if positive, would be capable of affordable adoption and implementation
- Support the Solid Waste Management Strategy for Sohag Governorate discussed in Section 7

An initial assessment of the costs, duration, location and outputs are given below for each of the demonstration projects. Some of them have already been worked out into detailed proposals, which can be found in the Report on Demonstration Project Concept Notes developed by SEAM Project for Sohag and Dakahleya Governorates and which are available from EEAA/TCOE and the respective Governorates.

8.2.2 Project Proposals

It is proposed that two demonstration projects be established to provide institutional strengthening:

Project 1: Training of city chairmen, chief engineers, heads of cleansing departments and other relevant senior officers; and developing information-exchange networks.

It is clear that city chairmen and senior officers have a limited understanding of and little or no training in the broad concepts of waste management, in addition to too few relevant contacts outside the Governorate. As the efficient use of resources is in their hands, training and networking have the potential to be a very cost-effective demonstration project. Awareness of possibilities for raising user fees should be part of this project as well.

Partners: Governorate, *markazes*, Manpower and Training Directorate, training institute
Location: Throughout the Governorate of Sohag
Duration: 14 months
Cost: 387,750 LE

Outputs:

- A much better informed and trained group of local decision-makers and a system of information exchange
- A more effective implementation of the Solid Waste Management Strategy

Project 2: Set up a database and mechanisms for regular waste analysis.

There is an enormous lack of up-to-date information on the waste generated, collected and disposed of in all markazes. With the facilities for weighing and analysis of waste at the composting plant in Sohag City and the introduction of simple measurement instruments in the other markazes, it would be possible to establish a database for waste quantities, densities, organic content, content of dry recyclables, etc. This information could be used for further assessment of the economics of transporting wastes from the other markazes to the Sohag City composting plant. The data could also be used to assess the viability of other composting plants and recycling facilities in the Governorate as well as to define the most suitable equipment for collection and transportation.

Partners: Governorate, *markazes*, solid waste management consultants, research institutes
Location: First in Sohag City, later in other *markazes*
Duration: 6 months
Cost: To be determined

Outputs:

- A database for waste-related data and standardised analysis methods and mechanisms
- A more effective decision-making regarding solid waste management

It is proposed that two demonstration projects be established to improve public awareness and general health and safety:

Project 3: Increase public awareness of environmental issues and urban cleanliness.

There is a real need to develop public awareness of environmental issues, both in Sohag City and in other markazes. The cleanliness of a city is an excellent indicator of the environmental awareness of its citizens. Littering and beneficial reuse, home composting etc. could receive attention as part of awareness-raising.

A project of this kind would be of low cost and would have the potential to be very effective if undertaken by committed and influential local people. It could involve local institutions like the Nile Information Institute and NGOs. In particular school curricula and television programmes that can reach the whole Governorate, should receive attention.

Partners: Governorate, Directorate of Education, Nile Information Centre, NGOs, media
Location: Medium-sized city in Sohag Governorate
Duration: 8 months
Cost: 301,950 LE

- Greater awareness of environmental and public health matters
- More civic pride
- Cleaner streets and open spaces
- More reuse and recovery

Project 4: Community participation and communication in solid waste management.

The involvement of different groups of residents, commercial and industrial establishments, and institutions in the design and implementation of solid waste collection schemes, in recycling activities and disposal of waste could be developed further. It could also be standardised into the procedures and working mechanisms of the local councils

Partners: Governorate, *markazes*, Directorate of Social Affairs, Directorate of Youth and Sports, NGOs, media
Location: Start in three cities, gradually extend to the other *markazes*
Duration: 18 months
Cost: To be determined

- Regular flow of communication between different stakeholders on solid waste management especially between governmental institutions and citizens
- More involvement of communities in design and implementation of solid waste management improvements
- Greater awareness of environmental and public health matters

It is proposed that one demonstration project be established related to solid waste disposal:

Project 5: Identification of acceptable new disposal sites (including landfills) and the beneficial remediation of existing formal and informal dumpsites including the evaluation of the possibilities of developing a regional waste disposal scheme with controlled landfill site in a desert area.

The identification of landfill sites is a priority as the current dumping practices of some cities are unacceptable. Some of the existing dumpsites, especially those creating urban environmental impairment and those on the flood plain of the River Nile, should be closed and remedied.

At present, waste is disposed of in desert areas when it is convenient and economical to do so; in some areas disposal to desert sites is not economical as the transportation distances are too great. However, this might not be the case desert sites could be identified either for the disposal of waste from one city, or a number of cities could together develop a regional final disposal scheme. Any such scheme could include one or more transfer stations, although transfer stations can be costly and options would need careful examining in order to establish optimal solutions.

Final disposal options to desert land should be evaluated (including costing) for all urban areas where waste disposal is currently unsatisfactory, or where it may be expected to become so in the future.

A single city or group of cities should be selected and the identified landfill site for that city (or group of cities) should be developed. The disposal site for rejects from the composting plant in Sohag City deserves special attention.

As an important and integral part of the demonstration project the beneficial closure of environmentally unacceptable and/or exhausted final-disposal sites should be examined and implemented, using the experience gained in Sohag City (Awlad Nosseir).

Hazardous waste cells inside disposal sites could also be developed as part of this demonstration project.

Partners: Governorate, *markazes*, NGOs

Location: All major cities in Sohag Governorate
Duration: 9 months
Cost: 2,624,600 LE

- Identification of all major dumpsites in need of remediation
- Closure and remediation of one or more dumpsites
- Operation manual for remediation of dumpsites
- Report on possibilities for regional waste disposal schemes
- Manual for involving communities in destination dumpsite after remediation
- Manual for design and operation of hazardous waste cells in disposal sites

It is proposed that one demonstration project be established related to hazardous and clinical waste:

Project 6: Develop a comprehensive cradle to grave healthcare waste handling and disposal scheme, involving the assessment of special collection services for clinical wastes and methods of disposal (e.g. incineration, microwave treatment prior to disposal).

The waste from hospitals and clinics is amongst the most dangerous elements of municipal waste. The proper handling of this waste would reduce current, very real, and often life-threatening hazards to everyone coming into direct contact with this waste, and to the general public.

Partners: Governorate, *markazes*, Directorate of Health, hospitals
Location: A selected hospital or group of hospitals in a city
Duration: 9 months
Cost: 514,580 LE
Outputs:

- Acceptable system of clinical waste segregation, collection, transportation and disposal
- Supply of suitable, approved containers for segregated storage
- Guidelines on safe means of handling healthcare waste

8.2.3 Phasing of Demonstration Projects

All the activities to which the demonstration projects relate have been categorised as of top priority (in Section 8.1) and should, in consequence, be undertaken as a matter of urgency. However, it would be impracticable to attempt to start and run all the demonstration projects concurrently thus the demonstration activities should be programmed so that they can be carried out effectively to generate a maximum of experimental data upon which to base future decision-making.