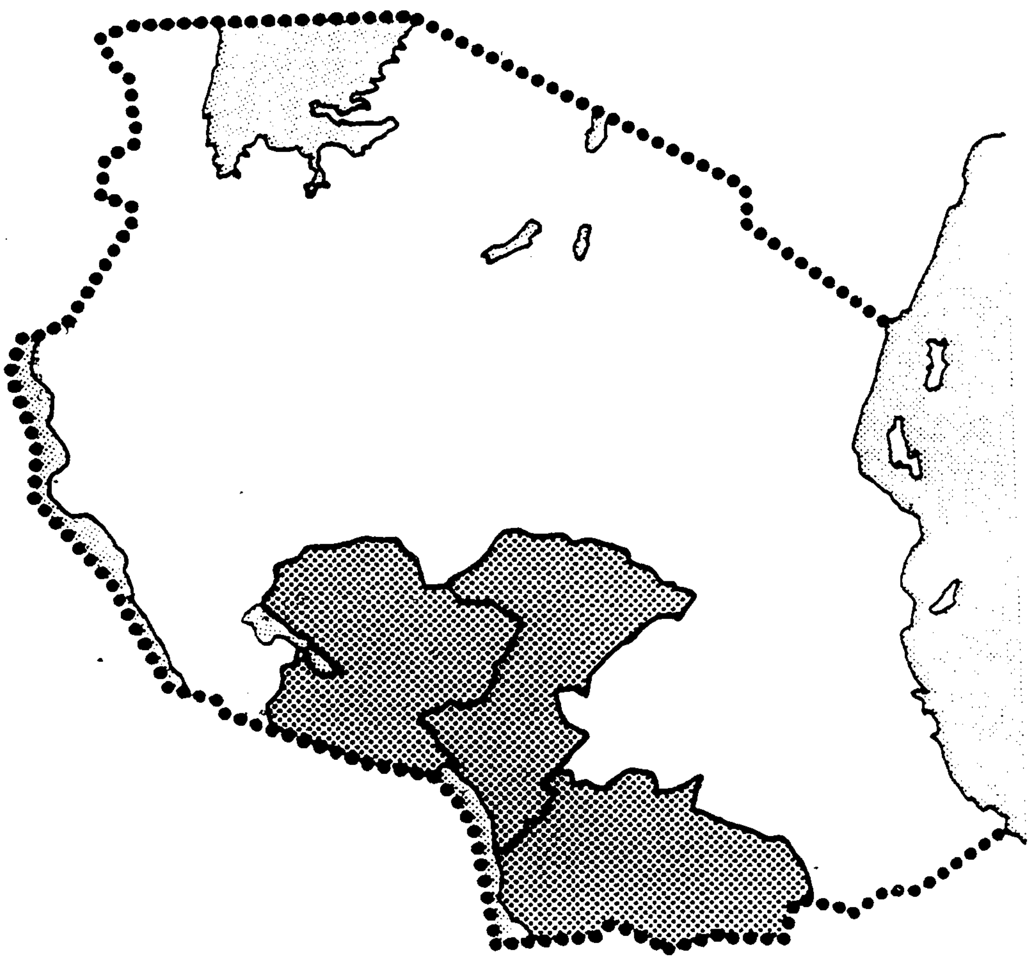
UNITED REPUBLIC OF TANZANIA

ERNATIONAL DEVELOPMENT AGENCY • DANIDA

IMPLEMENTATION OF WATER MASTER PLANS FOR IRINGA, RUVUMA AND MBEYA REGIONS

SUPPLEMENT TO REPORT ON WATER QUALITY SURVEILLANCE 1984



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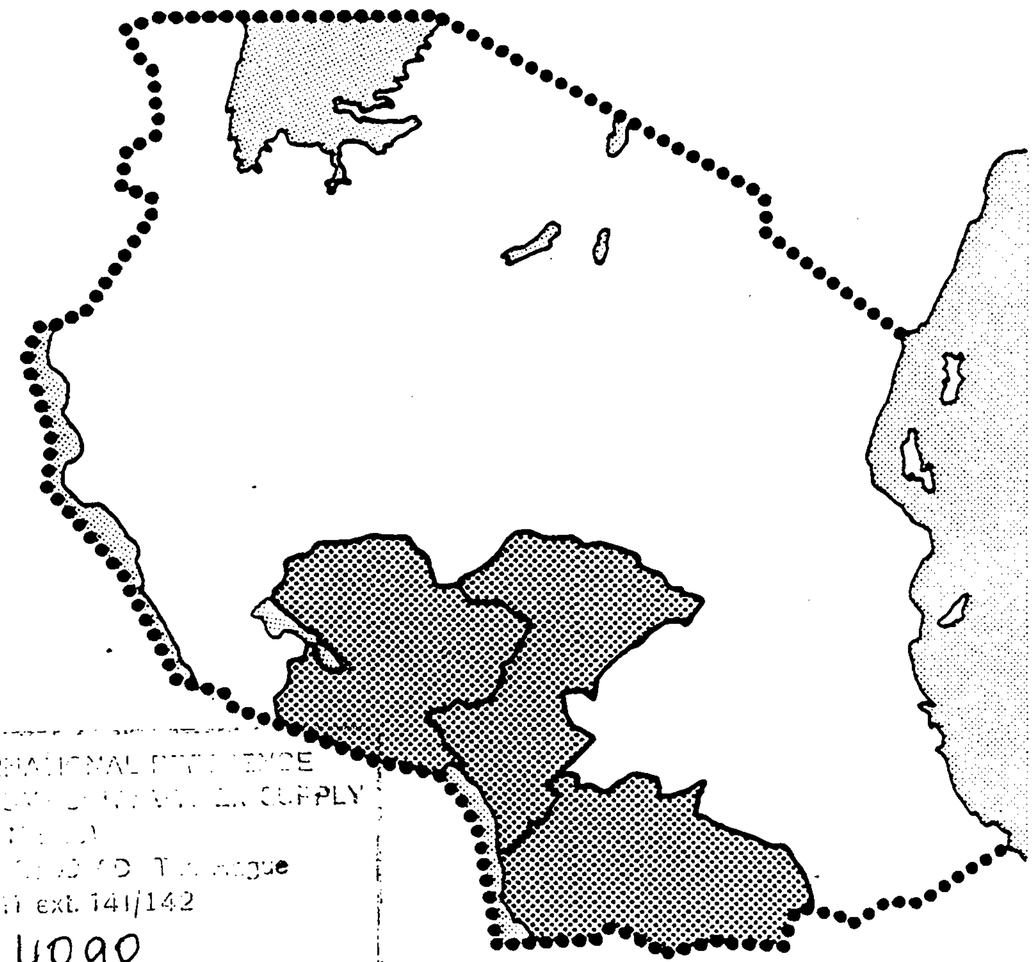

CARL BRO • COWICONSULT • KAMPSAX - KRÜGER • CCKK

[June 1985]

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1 INTRODUCTION AND RESUME

1.1 INTRODUCTION

This report is prepared as a supplement to the Water Quality Surveillance Report dated November 1984 for the Danida Sponsored Implementation Plans in Iringa, Ruvuma and Mbeya Regions of Tanzania.

This report further evaluates the findings of the Nov. 84 report with particular reference to the following points as requested by Danida:

- Identification and costing of suitable portable equipment for both bacteriological and appropriate chemical/physical field testing.

- Consideration and recommendation on sampling and testing routines taking into account varying scheme types, logistics, response requirements and health risk.

- Proposals, in line with the sampling and testing routines as decided above, on the standard of laboratory facility required in the three regional centres in respect of staff, equipment and chemicals together with costs.

- Sampling, testing routines together with laboratory procedures which it will be necessary to establish including the proposed specialist input to investigate and supervise the same.

1.2 RESUME

The aim of a water quality surveillance system at a level which is financially and practically relevant to the character of the implementation project in question is identified as being:

- establishment of new schemes
- identification of a quality pattern for different scheme types
- availability of operational units which can respond to and assist with health problems when they occur in specific areas.

The full functional benefit of such a surveillance system would depend on close co-ordination with the regional health and water supply maintenance authorities.

The intensity of water quality sampling and testing sufficient to achieve the above objectives has been calculated to require two mobile laboratories in each of Iringa and Mbeya Regions and one in Ruvuma Region.

Bacteriological testing is of prime significance in the proposed surveillance system. The membrane filter method of bacteriological testing is selected as most appropriate. Although this necessitates new testing equipment from that presently available, the existing incubator equipment can be economically repaired and adapted to suit.

Similarly the existing Hach chemical testing equipment is found to be sufficient and of acceptable accuracy for the project and again will be generally repaired and re-stocked as the most economic alternative.

The necessity for most testing being carried out in the field, results in only a minimal upgrading and re-stocking of regional laboratories being recommended. Existing staff is considered sufficient to operate the mobile laboratories in addition to the minimal regional laboratory functions.

Transport of the necessary mobile testing equipment is proposed by motor bike to minimize the cost impact and to allow complete independence of operation, and obtain best possible responsibility for result and equipment.

In order to establish the proposed system two external assistance inputs are envisaged. One input is by a chemist/ laboratory specialist while the other is by a medical doctor specialized in tropical medicine. Both inputs are budgeted at 2 man-months each.

The budgeted costs of the proposed system including external assistance is Danish Kroner (DKK) 900,000 including 10 per cent contingencies. This comprises input of DKK 325,000 investments and DKK 470,000 expendables. A time schedule has been presented which indicates a possible completion of the establishment and start of operation by the end of 1985, beginning 1986.

2 THE AIM OF WATER QUALITY SURVEILLANCE

The normal purpose of a Water Quality Surveillance Programme is to identify any unacceptable water quality level immediately in order to take preventative action before health problems occur. Even the minimum scale of intensity acceptable to comply with this objective as defined by WHO standards is, however, beyond the practical and financial viability of this project.

We have therefore considered further to our investigations in our Nov. 84 report, any purpose which could be served by a water quality surveillance programme, which does not achieve the minimal requirements of the normal and internationally recognized standard. In making such a consideration, obviously the comparison with making no surveillance programme must be relevant.

The purposes of surveillance relevant to establishment of new schemes is obvious. It confirms the selection of the source in comparison with alternatives in regard to water quality; it establishes a quantitative measure of the improvement achieved in comparison to the traditional sources, and it provides a standard for that particular scheme for future measurements or developments to be compared against.

Further sampling and testing after implementation of the schemes can only serve a limited preventative purpose if this is at a much lower frequency than recommended by the WHO standards. However, regular sampling of any frequency would indicate any long term trend of deterioration of a particular supply and initiate a response, which could reduce the health risk and prevent an epidemie. The regular testing of an individual supply or of a supply type is essential to provide a background of data for establishing a surveillance system that can be used in the case of health problems occurring within a particular scheme or area. In such circumstances the action taken by the health authorities could be supplemented by detailed testing of the scheme elements to determine what and where curative action is necessary.

To obtain full value of the proposed surveillance system it is important that the regional health authorities are aware of the operation, and degree of utilization, which can be made of the system in order that they can react to minimize epidemic or other disease outbreaks.

In all the foregoing it is acknowledged that bacteriological quality of the water supply system is of prime significance.

3 SURVEILLANCE INTENSITY

The recommendations on surveillance intensity must be allied to the aims of the surveillance system as identified in the previous chapter. This intensity is related to the frequency of testing on an individual scheme, to the representative sample of the different scheme types selected and to the number of samples necessary on each scheme.

It is concluded that the minimal sampling sufficient to satisfactorily record the annual cyclical variation of water quality on an individual scheme is 4 samples per year.

Because of the health risk associated with large schemes and the greater consequence of water related disease it is our conclusion that the larger schemes of the project should have a much greater coverage of sampling than the single village schemes. The correct and acceptable sampling intensity for the different categories of schemes must be a question of experience, but we would propose as an initial starting point that all schemes above 10,000 population served should be comprehensively sampled, below 10,000 population a 50 percent sampling and that for schemes with groundwater supply only one scheme is included.

The number of regularly functioning existing schemes, the completed schemes implemented under the Danida sponsored programme and the ones planned for completion under the current implementation plans (1986-88) are summarized in Table 1 below.

Table 1: Inventory of existing schemes and schemes planned for completion before 1988.

Region	Ground water	Surface Water (inhabitants at present) <10,000	10-15,000	>15,000	Total
Tringa	21	30	7	3	61
Ruvuma	22	45	2	-	69
Mbeya	22	40	1	2	65
Total	65	115	10	5	195

The number of schemes which would be surveilled in accordance with the principles stated above is given in Table 2.

Table 2: Proposed initial control schemes for water quality surveillance programme.

Region	Ground water	Surface Water (inhabitants at present) <10,000	10-15,000	>15,000	Total
Iringa	1	15	7	3	26
Mbeya	1	22	2	-	25
Ruvuma	1	20	1	2	24

With 4 samples per year from say 5 sampling points per scheme, this program demands 4 x 5 x 75 samples equivalent 1500 samples/year for serving approximately 0.5 mill capita or 3000 samples per mill capita, which is the same order of magnitude as recommended in the original report dated November 1984, and corresponds to the WHO minimum standard of 2400 test/year/mill capita.

4 TESTING EQUIPMENT

The capacity of the surveillance system will be principally determined by the bacteriological testing system. In order to obtain reliable bacteriological test results the water sample must be kept cool and analysis started within 24 hours, or if the sample is not kept cool, analyses must commence within 4 to 6 hours. For the bulk of the water schemes within the three regions in question a mobile laboratory facility is therefore essential.

In order to obtain sufficiently accurate bacteriological test results for the present purposes it is proposed to utilize e membrane filtering technique such as manufactured by Millipire in place of the Swab Test Kits currently used. While requiring more preparation, care and knowledge than the swab test kit, the membrane filter technique is the only approved standard method suitable for field testing.

With such a system of bacteriological testing it is considered that some 5-15 tests per day can be carried out dependent on locality. It is further estimated that around 100 days per year could be available for testing, taking into account preparation, travelling and other duties. With a means of 5 sampling points at each supply being tested 4 times each year, this would result in an average

$$\frac{10 \times 100}{5 \times 4} = 50 \text{ schemes per year being tested per test unit.}$$

It is anticipated, however, that around half of the testing carried out by the surveillance units will be on establishment of new schemes and testing of schemes which have been specifically requested due to health problems occurring. The level of routine control testing is therefore calculated at around 25 schemes per year. This, however, is the theoretical figure, and it may be expected that a practical figure taking into account logistical, procedural and administrative constraints is nearer 20 or even 15 schemes per year.

Comparing these figures with the surveillance intensities recommended in Chapter 3 and the number of schemes to be visited would require 2 such testing units in each of Mbeya and Iringa Regions and 1 in Ruvuma.

The nature of the test equipment and the pattern of testing which it would be logical to follow results in it being necessary for this work to be carried out by the laboratory technicians and preferably travelling independently of any other commitments.

With the objectives of keeping the costs and practicalities of the surveillance system within control we recommend that motor bikes be utilized for conveyance. The size and weight of the necessary mobile laboratory equipment is such that this could be conveniently located within a fixed set of units attached to the rear of the motor bike leaving sufficient space for one person only.

For the schemes far away from the laboratory it might be convenient to make travels over 1 week where landrover transport will be necessary.

Apart from the described bacteriological test kits it would be necessary to include in this unit the incubation equipment and spare power supply for the same, a few items of physical, chemical test equipment and still retain space for spare fuel. The arrangement proposed is diagrammatically illustrated in Figure 1.

In consideration of existing equipment it has been found that the incubation equipment can be easily and economically repaired and adapted to the new testing system and that the Hach chemical testing kits are of sufficient accuracy and are the most suitable for the purpose of this project. Here again it is found that replacement of chemical and repair kits are an economic alternative to complete replacement which is unnecessary. One new Hach kit has been allowed, however, as a standard and initial re-establishment unit.

The operation of the mobile units would replace much of the work presently being carried out in the required laboratories other than preparation of media and some chemical testing. It is not therefore proposed to extend the laboratory facilities or equipment other than by provision of an autoclave for preparation of media and a small refrigerator for storage of the same in each of Iringa and Ruvuma laboratories.

The zonal laboratory at Mbeya is already equipped to a degree far beyond that necessary for the purposes of this project. However, it must be acknowledged that this laboratory must serve a wider purpose and be of a sufficient standard to justify and attract the level of staff necessary to supervise both the entire water quality surveillance system and also all other zonal water quality and pollution control aspects. An estimated allowance for provision of missing spares for already supplied, but not functional equipment, has therefore been made even when this equipment may be superfluous to the direct needs of this project. It is anticipated, however, that final decision on provision of these spares or other equipment would be deferred until after the visit of a laboratory specialist to closer investigate the situation.

The costs of the equipment estimated to be necessary for implementation of a surveillance system as described, is given in Chapter 7. The budget figures provided allow for some unspecified equipment since the principle of repairing equipment as far as possible may result in extra purchases being necessary after more detailed investigation. Also included in the budgets is the necessary chemicals for operation of all tests for a period of 1 year.

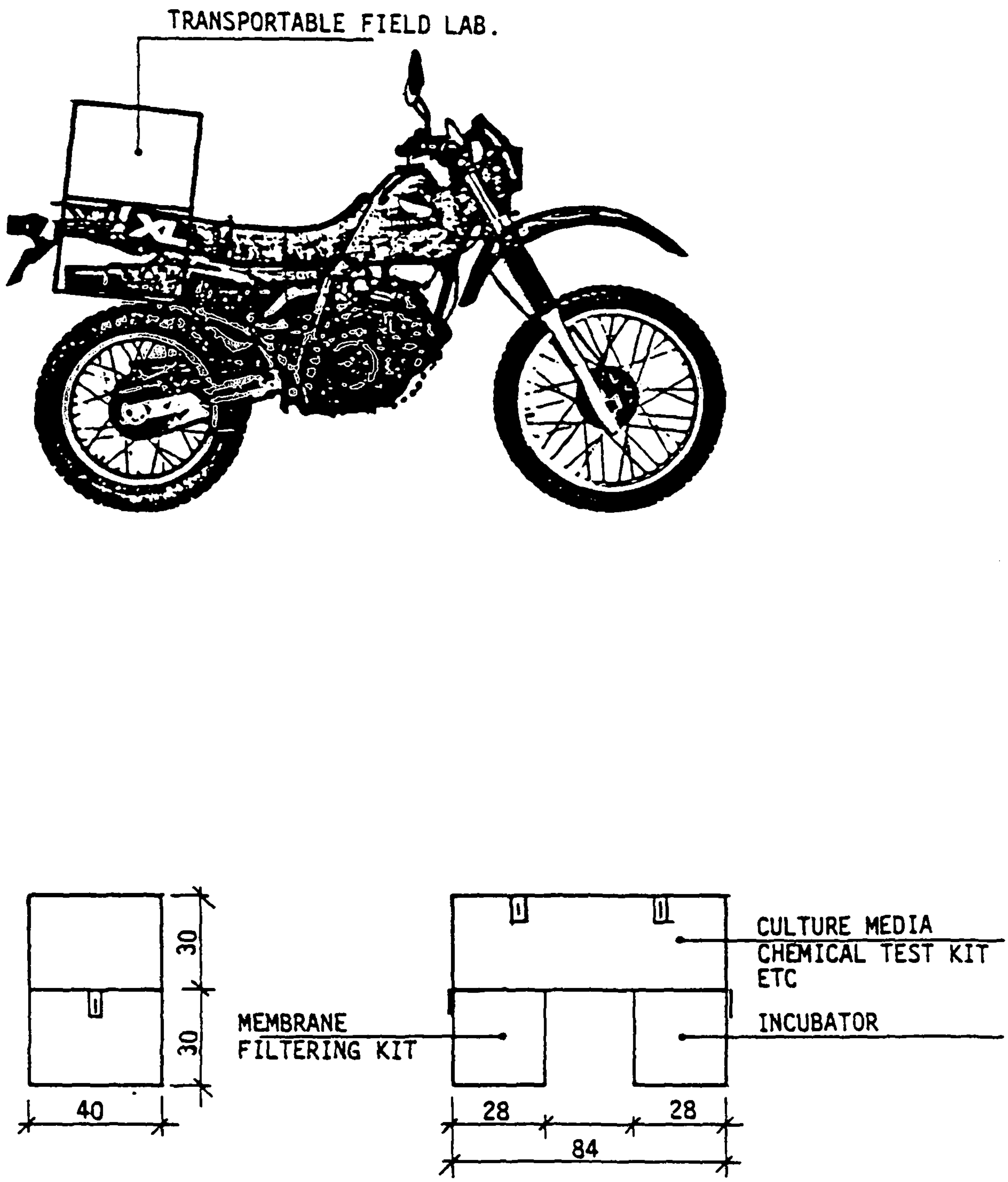

FIG. 1.: TRANSPORTABLE FIELD LAB.

5 ORGANIZATIONAL SYSTEM

It is intended that the proposed mobile laboratories be operated by the existing staff at the respective regional laboratories. Therefore no additional staffing is proposed.

It is considered paramount that a situation of responsibility coupled with a control system be incorporated in any surveillance system. Thus the mobile laboratory results must be routinely checked at intervals via regional laboratory condition testing and again in turn by zonal laboratory testing. This should be combined with the technical staff being made aware that the tests that are being carried out are serving a purpose and are being utilized. Making each technician responsible for a particular set of equipment and his own schemes with direct responsibility to the laboratory head would be the preferable establishment.

Since the proposed surveillance system is not a preventative measure in itself, a close co-operation will require to be established with the other involved organizations, specially the health organization and the maintenance organization of MAJI. The Information Flow and Action structure as shown on Figure 2, must be established for the surveillance to have any affect.

The proposed combined responsibility and operation of the system would then function as follows:

- Problems within a specific area or scheme would be normally first recognized by the health authorities through the local dispensaries and/or doctors.

- Information would be passed to the water quality surveillance unit, who would test the various elements of the scheme in question.

- After analysis of the results and comparison with previous testing of the same scheme or similar type scheme, the contributory significance of the water scheme to the health problems would be evaluated.

- Dependent on the result of the above and whether problems are established within the scheme or outwith the scheme, appropriate action would be recommended, which may involve temporary boiling of all drinking water or complete shut down in extreme cases.

- If the investigations have established an operational or design fault with the scheme, this would be reported to the maintenance or implementation unit as appropriate for the necessary action.

It is considered that it would be beneficial that on a regular 6 months basis, all records are reported to the central organization in Ubungu for information and statistical analysis.

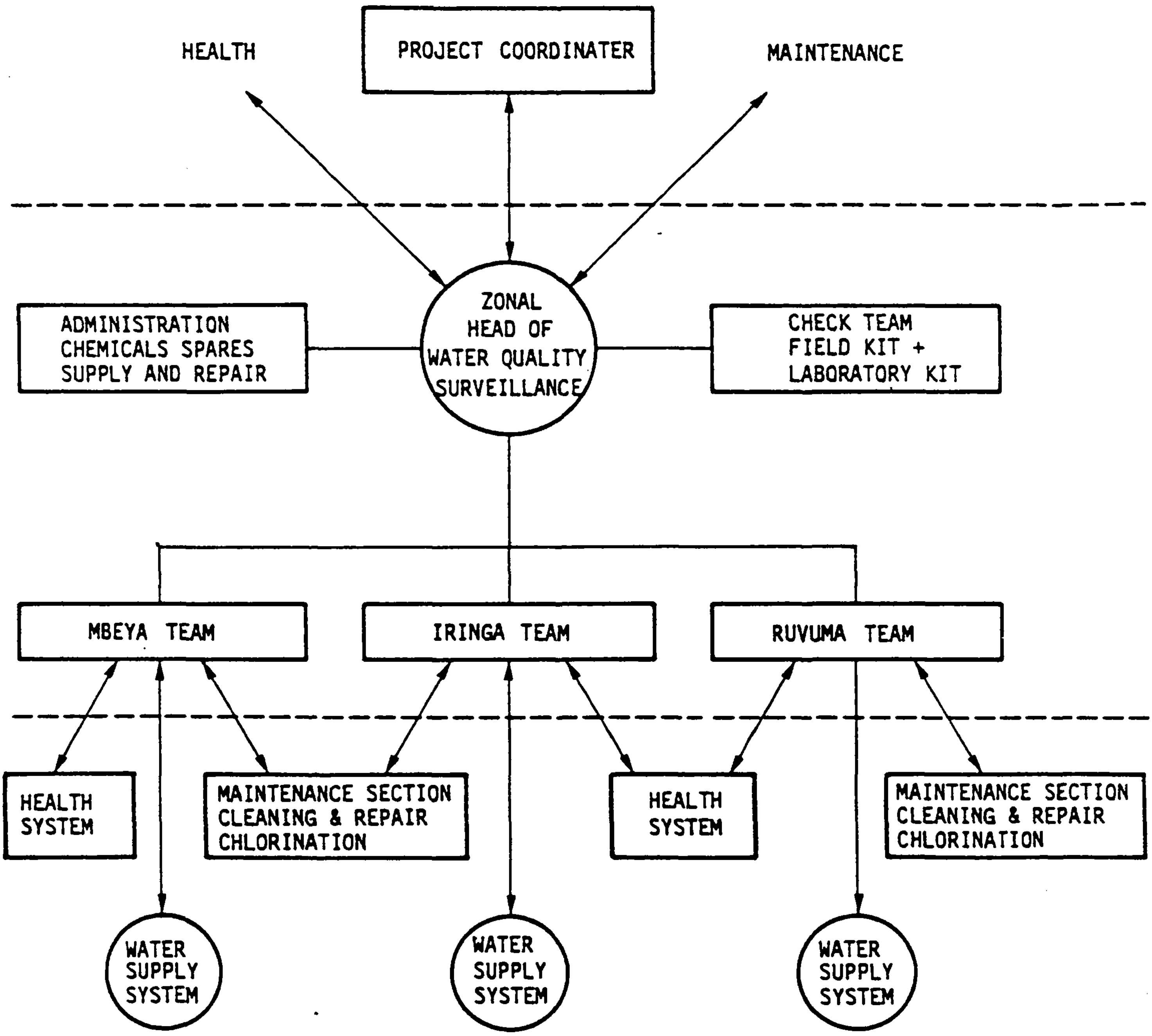

FIG. 2: INFORMATION AND ACTION STRUCTURE

6 SPECIALIST ASSISTANCE

It is considered that the system as previously described cannot be established without some guidance and procedural set-up. For this purpose it is proposed that a chemist/laboratory specialist be appointed for a period of 2 months to carry out the necessary operations as follows:

- purchase and dispatch the necessary equipment
- repair as necessary and calibrate or establish calibrating systems for the appropriate equipment
- identify all additional repairs or replacements necessary
- establish analysis control standards
- establish report standards and documentation practice.

It is also considered important, however, that the necessary alarm system from the local health authorities are geared to the overall aims and capabilities of the surveillance system. For this purpose it is further proposed that a doctor from the Danish Serum Institute also be utilized for a period of 2 months to establish this parallel awareness within the health sector. The doctor would be further responsible for establishing an evaluation of the reliability and interpretation of the bacteriological testing.

Both experts would spend some time in preparation for their missions, approximately 1 month - 1½ months in Tanzania and 1-2 weeks final reporting. A further input from the chemist may be envisaged after a period of 1-2 years to evaluate the achievements of the surveillance system and to recommend on alterations.

The cost estimates of the specialist assistance proposed in this chapter is included in Chapter 7 together with the travelling and subsistence costs involved.

7 COST ESTIMATES

The estimated costs of the surveillance system as described in the previous chapters are summarized below.

Item		Cost (1,000 DKK)
A. Investments		
6	Bacteriological Test Kit	100
2	Refrigerators	10
3	Autoclaves (pressure boilers + heating)	10
	Supplement of existing equipment	65
	Repair kits and tools	20
5	Honda 250 cc off-roads incl. spares	100
	General unspecified supplement	20
Sub Total		325,000
B. Expendables		
	Filters, medias, etc.	30
4	Months exp. assistance	280
2	Travels expenses - Tanzania/Denmark	30
2	Months local transport, accomodation and expenses	90
	Spedition, transport of goods	40
Sub Total		470,000
Allow Contingencies (10%) say		105,000
Grand Total		DKK 900,000

Excluded from the above budget are the following:

- local staff salaries and accomodation
- fuel and other running/maintenance costs.

By comparison with the above budget the cost of one heavy duty mobile laboratory as marketed in Denmark at the present time is DKK 1,200,000.

8 TIME SCHEDULE

In connection with the previous proposals a tentative time schedule has been prepared to indicate the possible programme that could be achieved.

• Proposal Acceptance	15/7-85
• Equipment Ordering	15/7-1/8-85
• Delivery in Tanzania	1/11-85
• Preparation of instructions and tests	15/10-1/11-85
• Visit of Specialist in Tanzania	1/11-15/12-85
• Report and Supplementary Equipment Ordering	15/12-85-15/1-86