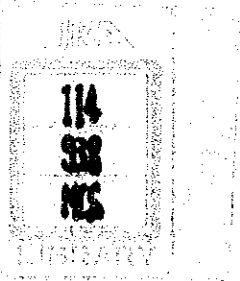


モルディブ共和国赤痢被害及び
協力要請内容調査団報告書

昭和58年2月

国際協力事業団
医療協力部

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昭和58年2月

国際協力事業団
医療協力部

国際協力事業団	
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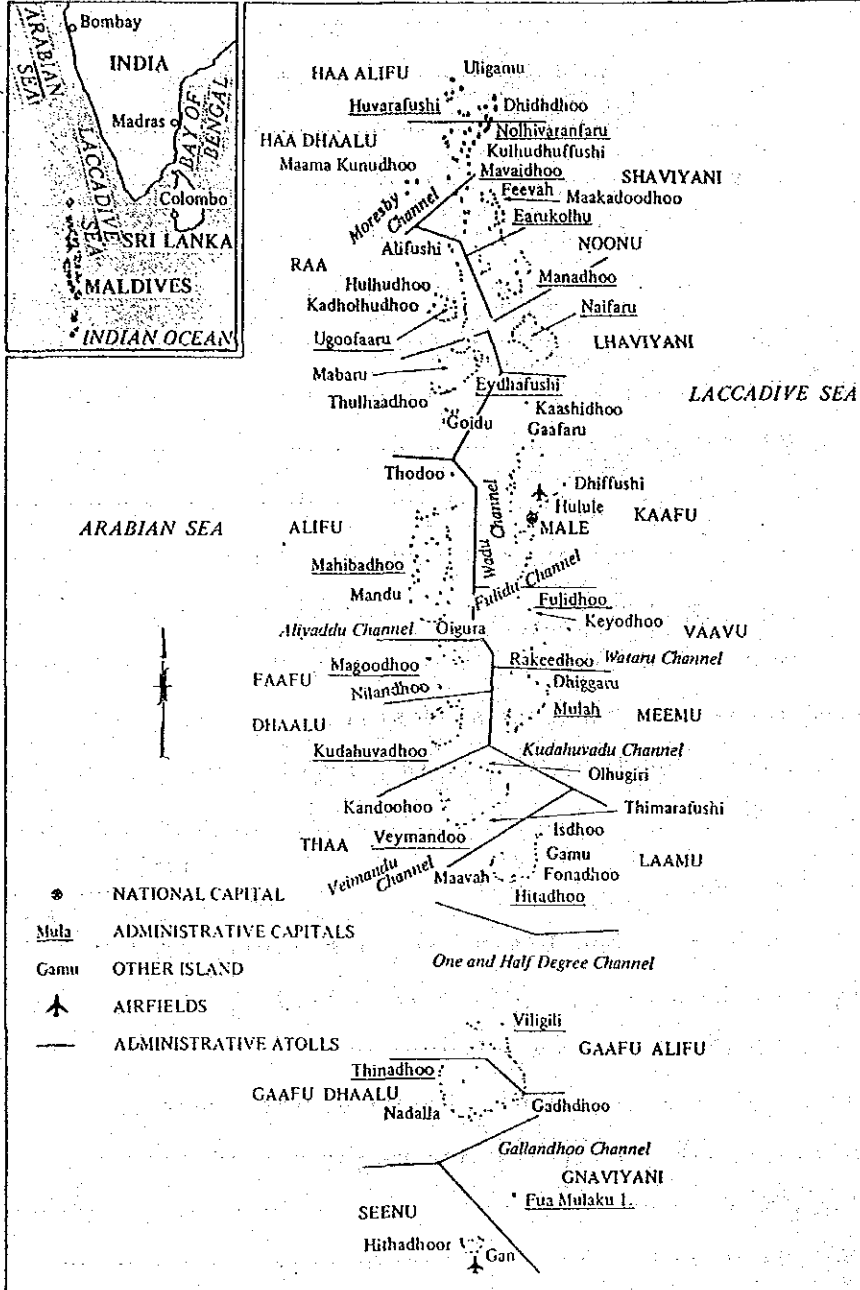
は　じ　め　に

昭和57年4月にモルディブ共和国で発生した赤痢は、またたく間に全島に広まり、死者200名、罹患者30,000名を超える被害を出し、わが国に対しても、その援助要請がなされた。本調査団は、同援助要請の内容及び今後、この種の災害が発生した際いかなる協力が考えられるのかを調査する事を目的として、昭和58年1月29日より9日間派遣された。

医療協力部長

中　澤　幸　一

REPUBLIC OF MALDIVES



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I 調査団の目的及び位置付け

本調査団はモルディブ共和国に於いて、昭和57年4月から発生した赤痢による被害の実態調査を実施することにより、今後日本がこの種の災害の際、いかなる協力の可能性方法が考えられるのか又同国から既に出されている援助要請の具体的な内容を把握する事を目的として派遣された。

II 調査団の構成

団長 今川 八 東 ; 東京都立墨東病院感染症科部長
団員 長谷川 謙 ; 国際協力事業団医療協力部医療協力特別業務室職員

III 日 程

1月21日(金)～1月28日(金)	イエメンアラブ共和国に於ける地震災害実態調査
1月28日(金)(午前)サナ <u>IY758</u> アブダビ	移 動
1月29日(土)(午前)アブダビ <u>UK564</u> コロンボ	〃、大使館、JICA事務所との打合せ
1月30日(日)	◦休 日
1月31日(月)(午前)コロンボ <u>UL101</u> マレ	◦移 動
(午後)	◦ピリンギリ島視察
2月1日(火)(午前)	◦外務省次官との会談
(午後)	◦ベラッサル島視察
2月2日(水)(午前)	◦Central Hospital director との会談、病院施設視察
	◦WHO在モルジブオフィサーとの会談
2月2日(水)(午前)	◦保健省、シニア プロジェクト オフィサーとの会談
(午後)	◦島内各上下水道施設視察
2月3日(木)(午前)	◦外務省次官との会見(調査結果報告)
2月4日(金)(午後)マレ <u>UL102</u> コロンボ	◦移 動
	◦日本大使館及びJICA事務所への帰国報告
2月5日(土)(午後)コロンボ <u>SQ027</u> シンガポール	帰 国
2月6日(日) シンガポール <u>JL710</u> 東京	〃

IV 調査事項

本調査団は、次の調査事項に沿って実施することを事前に、調査団内で確認した。

1. 訪問先

- 外務省
- 保健省
- 病院（隔離所を含む）
- WHO在モルディブ事務所
- マレ島以外の2-3の島
- 在モルディブ在留邦人（宝幸モルディブ（株））
- 在スリランカ日本大使館
- // JICA事務所

2. 調査事項

- (1) 保健行政のシステム（病院、保健所等）
- (2) 赤痢発生時に政府がとった対策
 - ① 患者の治療体制
 - ② 防疫措置
 - ③ 疫学調査
- (3) 諸外国の援助内容
- (4) 日本に対する協力要請の内容

V 総括

1. 被害状況及びその原因

- 1982年4月中旬インド・スリランカを經由してマレ島に入港した漁船の一船員からの輸入に端を発した赤痢の大流行は全国に波及し、9月中旬には患者12,529名（罹患率85.0%）死者200名（致命率1.6%）を算える惨事となり、最終的に罹患者は、31,000（21.0%）に及ぶと推定される。（死亡数は変らず）

〔注 日本では罹患率約0.7～1.0/人口対10万、死亡はほとんどない。〕

- 流行菌形は、S. dysenteriae Type 1が主体であり、薬剤感受性はクロラムフェニコール（CP）、テトラサイクリン（TC）、ST合剤には耐性、ナリディキソン酸（NA）、カナマイシン（KM）には感受性、アンピリシリン（AB-PC）には耐性株と感受性株が混在した。なお日本人観光客が12月下旬モルディブで罹患、東京で分離されたS. Flexineri 2aは当地では常在するとのことである（WHO代表言）。

- マレ中央病院は最盛期には全病床を赤痢患者にあて約200名を収容した。
 - 赤痢菌の培養、同定並びに薬剤感受性についての検査体制を取るため、6月中旬より検査技師が1名スリランカ政府より派遣され現在も従事している。
 - 現在も下痢患者の数、赤痢菌分離の有無を病院より日報でWHO事務所は報告を求め励行されているが日報が単にファイルされているのみで月別集計もなされていない。
- この惨事は下記の二大要因によるものと考えられる。

(1) 自然的要因

- ① 患者の輸入された季節が雨期であった。
- ② 島の土質が透水性は良いが溢水しやすい(サンゴ礁ノ)。
- ③ 受水、排水施設及び消毒の不備。
- ④ 魚以外は、ほとんどすべてを輸入に頼らざるを得ない貧困。
- ⑤ 環礁群島で南北820Km、東西130Km、16の大環礁内に約1,300島が点在(うち有人島200)。中心のマレ島まで北端より1.5日~4日、南端より3~6日(天候に左右される)を小形船舶(ドゥニー)で必要とする。

(2) 人為的 要因

- ① 流行菌型が不幸にも毒性の強い志賀菌(*S. dysenteriae*)であり、加えるに当国で下痢患者に常用されるTC、ST、に耐性、AB-PCには耐性株と感受性株に分れたこと。
- ② 感受性を示したKM、NA、は高価のため入手困難であり、インド、西独よりの救援薬品に含まれていなかったこと。
- ③ 流行開始後2ヶ月間は細菌の培養設備がなく、菌の同定、薬剤感受性検査が遅れ、そのため治療薬剤の選択を誤ったこと。
- ④ しかし、前記の理由により漸くAB-PCを主体とせざるを得なかったこと。
- ⑤ 医師9名(うち8名はマレ病院で診療)と病院(マレ島と他島に1)の極端な不足。

注 日本での伝染病院における治療薬剤の主体はKM及びHA系である。GMは注射薬のみで不適、ネオマイシンも臨床的効果は劣る。TC(テトラサイクリン、商品名アクロマイシンなど)ST、(バクターはバクテリン)AB-PC(アンピシリン)KM(カナマイシン)NA(ウイントマイロン)GM(ゲンタマイシン)

(3) 統計処理及び疫学調査の不備

疫学調査及びデータの整理が行われる余裕(能力?)は全くなく、流行の終息(各アトール別)罹患率・死亡率の差などについては、全く不明である。

2. 赤痢流行についての今後の見通し

- (1) およそ赤痢、腸チフスなどヒトのみを宿主とする糞一口経路伝染病の流行は、乾期に発

生する場合と雨期に発生する場合とがある。前者は飲料水不足のため数少ない水場に多数が集り、たまたま、これが汚染されて広がる、後者の場合は、排水状態が悪くなり、便所の汚水があふれ井戸水が汚染される。モルディブの場合は後者の型と考えられる。

(2) 現在もなお極く少数ではあるが赤痢菌陽性の患者がマレ中央病院で発見されている。島民の衛生概念はかなり向上したとは云え、給排水状態に著変なく雨期に再流行の恐れありとみるのが妥当であろう。

3. 医療援助の可能性

(1) モルディブに対する赤痢対策の協力は、昭和57年6月に、我が国に対し、援助要請がなされた際直ちに、何が協力をする際必要なのかを、医師等専門家より聴取し、少なくとも1週間以内位に、医師、看護婦及び必要な薬品及び医療用機材を携行し派遣するのが、最も効果的であったと考えられる。

(2) 昭和58年2月現在対モルディブ赤痢対策に対する外国の協力は、西独、サウジアラビア、インドを中心とする上下水道の改善計画があり、訓練をも含んだこの計画の一部は既に始まっている。

日本に対しても、この20年計画に対する資金面での援助の希望が、外務省次官シャーリフ氏より当ミッションに対してだされた。

(3) 当ミッションは、2月3日のシャーリフ次官への帰国報告の際、3分野からなる現状に対する改善案^{*}を申し述べ更に、今後日本が協力をする際の可能性として、次の2点を述べた。

① 再流行時には、期を失せず(2週間以内)少なくとも1医療班(医1看2~3何れも伝染病院勤務者が適、細菌検査技師1^{*}及び事務1)を抗生剤(KM、NA)及び輸液セット(乳酸カリゲルを主体)及びビタミンB1、Cを携行の上派遣、マレ中央病院の診療援助、あるいは各島を巡回する。期間は5週間交替で3~4ヶ月を目途とする。

(* 一時に大量検体処理のため)

② マレ中央病院の検査技師を1名日本に招き3~6ヶ月間、腸内細菌の分離同定について単に赤痢菌、コレラ菌にとどまらず、全般的な知識、技術を習得させる。(但し病院検査技師レベル)但し帰国後も培地、シャーレ、同定用診断血清感受性ディスクなど消耗器材を供給しなければ徒勞に終る。なお、日本人検査技師の派遣指導は不要である。

附 WHOは発展途上国の下痢対策(コレラ、赤痢、サルモイラ、エルシニア、キャンピロバクター)にも重点を置いている。モルディブはSEARO(南東アジア支局、在ニューデリー)の守備範囲下にある。

※ 改善案

1. Preventive measures

- 1) Sanitary disposal of human feces and maintenance of clean latrines.
- 2) Protection, purification and chlorination of public and/or private water supplies.
- 3) Disinfection about sewage system.
- 4) Fly and rat control.
- 5) Encourage breast feeding throughout infancy, boiled milk and water used for infant feeding.
- 6) Education, particularly of food handlers.

2. Control of patient

- 1) Case report is obligatory.
- 2) Isolation during acute illness.
- 3) Management of contact, two successive negative stool cultures are obtained.
- 4) Search for unrecognized mild case.
- 5) Specific treatment according to the drug resistance of isolated Shigetla strains.

3. Epidemiological surveillance and data arrangement.

- 1) Personal reported form.
 - Sex, ◦ Age, ◦ No. of family, ◦ on set day,
 - day of admission, ◦ day of discharge
 - No. of patients by day/week/month
- 2) Make graph.

(3/Feb/'83 M. F. A. Maldives)

VI 調査結果

1. 赤痢の発生原因とその後の経緯

1982年4月インドからスリランカを経由して帰国したモルディブ人が首都マレに2.3日滞在した後故郷の“GAAF DHAALU ATOLL”に帰り発病し全島に広まった。

当初は、病気自体が何なのか、はっきりと確認できなかったが同年6月に始めて、赤痢であることが判明した。

更に6月にスリランカより衛生検査技師を1名又1983年1月よりWHOより1名の衛生検査技師(英国人)が、マレのCentral Hospitalに来て、検査、病院の検査機能の拡充そしてモルジブ人スタッフの研修を行っている。

同年7月政府は ①非常委員会の設置 ②在マレ病院の24時間勤務体制 ③全島における強制的隔離場の設置 ④医師団7チームを全島に派遣 ⑤TV、ラジオによる予防措置のよびかけからなる緊急対策令を発し、その対策に努めた。

しかしながら、住民の衛生観念の欠除、そして飲料水の供給、汚水処理の問題もあり、またたく間に全国的に被害が広がり、9月現在の患者数は、19のアトール(行政区の単位)で12,529人又死者は200人であった。

最終的な集計は現時点でなされていないものの、WHO在モルディブのProgramme Officer Dr. R. R. Aroraによると患者数は、約31,000人であろうとの事であった。

この災害時に対する、各国の援助はスリランカ、インドを中心にしてなされ、現在は西独サウジアラビア、EEC等の国による教育、訓練を含めた上下水道改良計画(20年間)がその一部につき、実行に移され(西独の援助)、更に残りの計画に対する援助国を要請している。

2. マレ島の医療及び衛生状況

(1) 病院はMaleに1(外来400~500名、80床、うち下痢病棟20床)とHaa-

Dhaaluに1(12床)があるにすぎず医師は全員8名がMale病院に勤務うち1名は3カ月交替でH-Dに出張している。個人の開業医はいない。(資料5)

(2) 19Atoll中、保健所(医介補1、助産婦3が定数)は14のAtollに16ヶ所にある(病院在島は除く)

(3) Male中央病院の検査機能は極めて貧弱で(X線のみ1台)、血液の生化学検査は全く実施不可能(尿、血液、虫卵鏡見のみ可能)。

(4) コレラ、赤痢については通常は存在しないと云われているが糞便培養検査の実施は、1982年6月中旬以降のことであり、幼児の下痢が多く、大半が6才までに3回は重症下痢症にみまわれる。(政府MOH係官) S. flex. 2a は当地では普通(WHO代表)

及び(資料3)からも信頼に値しない。

(5) マレ病院における患者の病因分類を資料3に示したが、そのほとんどが臨床症状による診断であり、特に診断不詳が24~26%と1位であることに注目したい。

(6) 病院検査室ではコレラ、サルモネラ(群血清)赤痢菌(S. flex のみは群血清)を備え、感受性ディスクも所有、培地はマッコンキーDHL、TCBSを使用している。

(7) Out Patient Dispensary or Clinic と称する医介補による診療所は全島に約400存在する。

(8) Male のみならず全島は平坦なサンゴ礁であり、数米掘れば水は得られるが塩分含有量多く、雨水を貯留飲用に供することを政府はすゝめているが乾期があり、又モーター電力が高価なために井水を使用している場合が多い。

マレの政府宿泊所 …… 塩分ほとんど感ぜず

ピリンギリ島 …… やゝ塩分あるも石けんは使用可

ベラッサル島 …… 全くの海水

(9) 便所は浅穴を掘り、一杯になると埋めて次々と利用、水洗の場合は未処理のまま排水管(塩ビ又は鉄管)で海岸に放流、糞塊を海水上に認めることもあると云う。

(10) 土質の透過性良好のため、井水の汚染される危険度は非常に高い。又サンゴ礁の特性上所によっては溢水、貯溜し易い。

(11) 調査時は乾期(通常12月~3月)であったためか道路は乾燥し白砂で(サンゴ礁の微細末)ごみも少なく清けつにみえた。

(12) 牛、馬、羊、山羊等の大型家畜はなく、犬も見当らぬ、僅かに猫1匹と鶏数羽を認めたのみ、ネズミは多数跋、WHOの方針で汚染防止のため家畜飼育は禁とのこと。

3. 訪問先との会見要旨

(1) 外務省シャーリフ次官との会見要旨(2月1日、2月3日)

① 上下水道及び廃棄物処理計画が20年計画で約2,600万\$の予算で開始されつつある。主な援助国はサウジアラビア、西独、インド、EEC諸国であり、更に、資金援助国を望んでいる。

現在、上水道の分野で、水タンク設置のプロジェクトが開始されている。

② 赤痢が発生した後政府としては、住民に対し、塩素を入れて井戸の水を飲むように啓蒙したが住民は臭いを嫌い徹底されなかった。

③ ①の計画に対する我が国の資金援助協力を希望した。

(2) Central Hospital (2月2日)

(会見者) : Dr M. Ahmed (病院長)

Mrs Rasheeda (看護婦長)

Mr A. R. Boulter (WHO派遣、検査技師)

- ① 赤痢発生の始まりは、1982年4月、インドからスリランカを経由して帰国したモルジブ人が下痢をし、マレで2～3日入院した後故郷のGaafu - Dhaalu Atollに帰り、そこから各島に伝染していった。

6月になり、始めて赤痢である事が判明した。

- ② 赤痢の最盛期には120人の入院患者がいた。

③ 病院の規模

- 医師 ; 9名
- 看護婦 ; 17名
- Ward 数 ; 4
 - 内科(女子; 23床、男; 19床)
 - 外科(24床)
 - 産婦人科(3床)
 - 下痢(20床)

※ この中に隔離病棟を含むが現在は、下痢症病棟として、使用している。

※ モルディブ国には、この病院の他、Haa Dhaal Atollに1つの病院12床を持ち、3か月交代でCentral Hospitalの医師、看護婦を派遣している。

④ 教育

- 医師は全て、外国で教育を受けている。
- 看護婦は、staff nurse, senior nurse aid, ordinary nurse, junior nurseの4種類あり、staff nurseは外国で教育を受ける又senior nurse aidについては、Central Hospital内に、養成学校を持ち、そこで教育をしている。

⑤ 救急車、船

救急車及び高速艇がある。船はDept. of Public Healthに属しているものの、燃料代が高いため余り使われていないとの事である。

⑥ 検査室

1982年6月にスリランカより検査技師をむかえ、始めて赤痢菌の同定が可能となった。現在はイギリス人のWHO派遣専門家他4人のTechnician、2人のTraineeがいる。

(3) WHO在モルジブ Programme Coordinator との会見(2月2日)

(会見者) Dr. R. R. Arora (WHO Programme Coordinator and Representative Maldives)
Dr. Hans G. Bahnemann (Regional Advisor in Veterinary)

Public Health)

Mr. A. R. Boulter (WHO Technical Officer, Laboratory Operations)

- 現在上下水道計画 (VI-1. 参照) の一部を西独が既に開始しているが今後予想される問題的として、次の点が指適された。
 - イ. 衛生教育をどのような方法で実施し、衛生観念を住民に植え付けるのか、
 - ロ. 浄化設備他、導入機材の保守、維持、管理をどこが責任を持って実施するのか、
 - ハ. ロ. を導入した際、現在住民は各自井戸を掘り (マレ島で、約 5,000 個の井戸がある) 水を使用しているが (勿論無料である)、もしロ. が導入され有料となった場合、住民の反応はどうか、
 - ニ. ロ. の機材の running cost は誰が負担するのか、
- 赤痢発生時、インド、スリランカの医療チームが来て Mobile Team により、各島を巡回診療した。(詳細データは、入手不可能であった)。
- Central Hospital の毎日の下痢患者についての記録 (入退院、菌の検出状況) を提出させている。

(4) 保健省 Project Officer との会見 (2月2日)

(会見者) Ayesh Rasheed (Senior Project Officer)

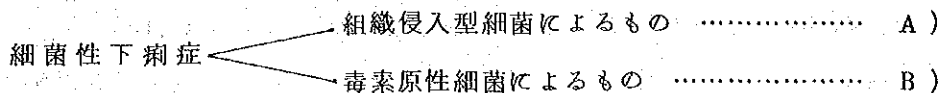
- ① 今回の赤痢による被害は 140 島 (有人島は約 200) にのぼり、患者数は約 3 万人、死者約 200 名にのぼる。
- ② 現在 2 病院の他マレを除く全島で 16 の Health Center があり、そこには Medical Assistance (基礎医学の講習を受けたもの) がいる。
1984 年迄に 23 の Center を設置する予定。
- ③ 幼児の下痢リカン率が高く 6 才までに殆んどの子供が、最低 3 回は、下痢にかかっている。
- ④ 現在、赤痢予防の為各家庭に対し、TV、ラジオを通じ飲み水は塩素処理又は沸かして飲むことを啓蒙する一方、雨水を貯めるタンクの設置を呼びかけているが資金難でもあり、余り進んでいない。

資 料

1. 感染性下痢症
2. Socio Economic Indicators , 1981
3. Patients Treated in the Central Hospital, Male Classified by Diseases, 1980-1981
4. 検 査 伝 票
5. Medical Personnel, 1977-1981
6. Number of patients and deaths in each Atoll (1982年9月16日現在、モルディブ外務省発表)
7. 各国からの援助内容
8. Republic of Maldives
Male ; Report on Water Supply, Sewerage and Waste Disposal Scheme
8-1 Volume 1
8-2 Volume 2

感染性下痢症 (Infectious Diarrhoea)

細菌性とウイルス性に区分



A) 1) 赤痢菌 (Shigella) 宿主は人のみ、サルも罹患する。

A群 (S. Dysenteriae) Type 1 ~ 10

B群 (S. Flexneri)

Type	I	Sub Type	1 a, 1 b
#	II	#	2 a, 2 b
#	III	#	3 a, 3 b, 3 c
#	IV	#	4, 4 a, 4 b
#	V	#	ナ シ
#	VI	#	ナ シ
#	Variant		X & Y

C群 (S. Boydii) Typ 1 ~ 15

D群 Type I & II

注 ① 重症度からみると A > C ≧ B > D 群となる。

② 現在日本では、A群、C群はない。

③ 現在日本の 50% ~ 65% は輸入例。

2) Salmonella

約 2,000 の血清型に分類される。人獣共通伝染病で動物の腸内に存在、腸チブス (D群)、パラチブス A (A群)、パラチブス B (B群) は敗血症型をとり、下痢は少ない。法定伝染病である。

3) 病原大腸菌 (組織侵入型) (Enteroinvasive E. Coli) 旅行者下痢症の主因

4) キャンピロバクター (Campylobacter) 人獣共通伝染病

5) エルシニアエンテロコリチカ (Yersinia Enterocolitica) 同上

以上は、発熱、腹痛、下痢と粘血便が主症状で軽症もあり、細菌学的検査 (培養) によらなければ臨床的鑑別はむづかしい。

B) 1) コレラ菌 (Vibrio Cholerae O-group 1) 細菌学的検査を要する点は A) と同様である。

血清型でオガワ、イナバ、ヒコシマの 3 型に生物型でアジア型と E1-Tor (エル

トール)型に分類、ヒトのみ罹患、アジア型の致命率は20~30%、エルトール型のそれは1~2%。

2) NAG(ナグ)ビブリオ(O-Group1 以外のコレラ菌)。

3) 毒素原性病原大腸菌(Enterotoxigenic Escherichia Cole) …… 旅行者下痢症の主因。

4) 腸炎ビブリオ(Vibrio Parahaemolyticus)。

以上は原則として無熱、軽熱、腹痛、水様下痢で粘血便はない。

但し、4)のみは時に高熱と粘血便をみる。1)、2)、4)は海洋性の細菌で魚介類が汚染される。

注、Aの2)、3)、4)、5)及びBの2)、3)、4)による下痢は、日本では食中毒として処理されている。

SOCIO ECONOMIC INDICATORS, 1981

Republic of Maldives		Independence Day: July 26	
Area	Coverage: 90 000 kms ²	Land: 298 kms ²	Republic Day: November 11
Number of Islands:	Inhabited	200	Religion: Islam
	Uninhabited	1100	
Administrative Units:	Major (Atolls & Capital)	20	Language: Dhivehi (Maldivian)
	Minor (Islands)	202	

1. Population

Total Population: 1977 (Census)	142832
1982 (Est.)	160200
Density (1982 est.)	538 per sq. km
Sex Ratio	111
Median Age	17 years
Age at Marriage	15 years
Infant Mortality Rate (per '000): 1977 (Census)	120
1981 (Est.)	98
Life Expectancy at Birth	46.5 years
Total Fertility Rate	6.4
Dependency Ratio	1.1

2. Industry and Commerce

GDP (In millions of Rf.)	396.00
Per Capita Income (In Rf.)	2540.00
Balance of Payments (In millions of US \$):	
Exports, f.o.b.	13.10
Imports, f.o.b.	-34.60
Trade Balance	-21.50
Current Account Balance	-8.40
Fisheries: Average Catch per Unit Effort (kg)	140
Tourism: Increase in bed capacity	442
Increase in tourist resorts	322

3. Government Finance

Revenue (In '000 of MRF.)	88000
Expenditure (In '000 MRF.)	
Total	143698
Current	77000
Developmental	66698
Budgetary Deficit	55698

4. Health

Population per physician	17300
Population per practicing qualified nurse	15600
Health expenditure as percentage of	
National Budget	5.9
Per capita Health Expenditure (In MRF.)	31.00
Number of Hospital Beds:	
Total	98
Central Hospital, Male'	86
Kulhudhuffushi Regional Hospital	12
Population per hospital bed (1982 est.)	1592

5. Education

Adult Literacy Rate (1977)	81.6
Enrolment Ratio in Primary Level:	
Male'	69
Atolls	60
Enrolment Ratio, 6-10 years (percent)	61
Enrolment Ratio, 11-15 years (percent)	6

بیمارستان مرکزی کابل - ۱۱۱۱
 سال ۱۳۶۰ - ۱۳۶۱
 بیمارستان مرکزی کابل - ۱۱۱۱
 سال ۱۹۸۱ - ۱۹۸۰

PATIENTS TREATED IN THE CENTRAL HOSPITAL, MALE
 CLASSIFIED BY DISEASES, 1980 - 1981

Diagnosis	No. of Patients Treated		بیماری
	Jan-Dec 1980	Jan-Dec 1981	
(1)	(2)	(3)	(4)
Total	66426	76116	جمع کل
Specific Fever (Typhoid, Dengue, Malaria)	18	-	تب های مشخصه (تیفوئید، دنگو، مالاریا)
Fever with Rash	34	1	تب همراه راش
Fever with Vomiting	731	292	تب همراه استفراغ
Non-specific fevers	3729	2819	تب های غیر مشخصه
Diarrhoea and Vomiting	2988	4051	تهوع و اسهال
Asthma/Bronchitis	-	1758	آسمان/برونشیت
Influenza/Upper respiratory Infection	6822	6514	آنفولانزا/عفونت تنفسی فوقانی
Anxiety State/Hysteria	552	529	اضطراب/هیستری
Minor Trauma	5486	5766	آسیب های جزئی
Myalgia (Aches and pains to Head, Chest, Back, and Abdomen)	9871	12164	درد های عضلانی (سر، قفسه سینه، کمر، شکم)
Skin Diseases	5804	7309	بیماری های پوست
Sexual Problems	83	143	مشکلات جنسی
Infertility	264	118	ناباروری
Disordered Menses	352	325	اختلال در قاعدگی
Strokes/Meningitis/Hypertension/Heart failure	638	727	سکته های مغزی/مننژیت/فشارخون/نارسایی قلب
Diabetes/Thyroid disease/Others	67	58	دیابت/بیماری های تیروئید/دیگر
Nutritional/Deficiency diseases	879	1000	بیماری های تغذیه ای/کمبود
Piles	301	574	هموروئید
Surgical Problems	559	253	مشکلات جراحی
Notifiable diseases (Hepatitis, etc.)	154	136	بیماری های قابل گزارش (هپاتیت، و غیره)
Diseases of the Eye	5952	5753	بیماری های چشم
Tonsillitis, Sinusitis	2678	3889	تاندیلیت/سینوزیت
PET Eclmpsia	203	13	تشنج های پس از بیهوشی
Fracture/Dislocations	106	81	شکستگی ها/دررفتگی ها
Delivery	542	540	زایمان
For Medical Examination	1710	1483	برای معاینه پزشکی
Not Yet Diagnosed (N.Y.D.)/ Others	15903	19820	بیماری های تشخیص نشده/دیگر

Source: Central Hospital., Male'

منبع: بیمارستان مرکزی کابل

検査伝票

GOVERNMENT HOSPITAL MALE

Clinical details			
Date		Signature of doctor	
Name:		Age:	Sex:
Hospital No.		Ward/OPD	
Examinations	Results	Examinations	Results
Haemoglobin	G	Anisocytosis	
P.C.V.	%	Microcytosis	
Retics	%	Hypochromia	
Platelet Count	CMM	Poikilocytosis	
Direct Method	(Normal 100,300,000)	Polychromasia	
		Macrocytosis	
		Nucleated Red Cells	

Notes		Signature of technician	
Hb & BP		CL. P. 1	

Central Hospital
GOVERNMENT HOSPITAL MALE

Clinical details			
Date		Signature of doctor	
Name:		Age	Sex
Hospital No:		Ward / OPD	
Check Examinations	Results	Check Examinations	Results
OVA		Occult Blood	
Amoebae Cyst		Fat Globules	
Amoebae Trophozoite		Others	
Flagellate Cyst			
Flagellate Trophozoite			

Notes		Signature of technician	
Date		CL. P. 5	
FEACES			

میدیکل پرسونل کے ذریعہ فراہم کیے گئے طبی خدمات کی تعداد (1977-1981) 2-111

MEDICAL PERSONNEL, 1977-1981

Personnel	1977	1978	1979	1980	1981
(1)	(2)	(3)	(4)	(5)	(6)
Physicians	8	7	8	8	9
Staff Nurses	7	6	7	5	10
Senior Nurses	-	-	-	12	13
Nurse Aids	27	23	34	31	34
Health Assistants	17	23	24	15	14
Community Health Workers	19	28	27	25	31
Family Health Workers	-	-	64	123	143
Midwives	123	137	149	154	159
HEALTH CENTRES	22	23	23	23	23
Population per practicing physician	17854	21000	18750	19125	17333
No. of practicing physicians per 10,000 population	0.56	0.48	0.53	0.52	0.58
Population per practicing staff nurse	20405	24500	21429	30600	15600
No. of practicing staff nurses per 10,000 population	0.49	0.41	0.47	0.33	0.64
Population per practicing senior nurse	-	-	-	12750	12000
No. of practicing senior nurses per 10,000 population	-	-	-	0.78	0.83
Population per practicing nurse aid	5290	6391	4412	4935	4588
No. of practicing nurse aids per 10,000 population	1.89	1.56	2.27	2.03	2.18
Population per practicing midwife	1161	1073	1007	994	981
No. of practicing midwives per 10,000 population	8.61	9.32	9.93	10.07	10.19

Note: Calculations for 1977 are based on the census count, 1977. i.e. 142832. The rest are based on Estimated Population. For Population refer Table No: 3. Source: Ministry of Health .

Number of patients and deaths in each Atoll. (16/9/1982)

Atoll	Population	No. of Patients	No. of deaths
Haa-Alifu	8603	568 (6.6%)	3 (0.5%)
Haa-Dhaalu	9924	575 (5.8)	18 (3.1)
Shaviyani	6302	444 (7.0)	12 (2.7)
Noonu	6282	1300 (20.7)	15 (1.2)
Raa	7900	938 (11.9)	19 (2.0)
Baa	5765	56 (0.97)	-
Lhaviyani	5691	667 (11.7)	8 (1.2)
Kaafu	4162	404 (9.7)	5 (1.2)
Alifu	6227	508 (8.2)	14 (2.8)
Vaavu	1078	1 (0.09)	-
Meemu	3095	82 (2.7)	2 (2.4)
Faafu	2012	2 (0.10)	-
Dhaalu	3009	368 (12.2)	13 (3.5)
Thaa	6224	99 (1.6)	-
Laamu	6163	298 (4.8)	8 (2.7)
Gaafu-Alifu	4978	1176 (23.6)	20 (1.7)
Gaafu-Dhaalu	7720	1148 (14.9)	20 (1.7)
Gnaviyani	4204	163 (3.88)	1 (0.6)
Seenu	14096	732 (0.52)	2 (0.3)
Male	32000	3000 (9.37)	40 (1.3)
Total	147500	12529(8.50)	200 (1.6)

- The source of infection was traced back to a person who had just returned to Male' after having been to India and Sri Lanka.

Assistance received from Foreign Government and International Organisation.

INDIA

Bactrim Syrum-100 mg (bottle)	...	Rs. 11800.00
Buscopan-10mg (Tablets)	...	Rs. 5470.00
Chlorampheni Col-250mg (capsules)	...	Rs. 4134.00
Dextrose with saline	...	Rs. 22000.00
Gentamicine 100 mg (Tablets)	...	Rs. 5450.00
Multivitamin Tablets	...	Rs. 26850.00
Sptrin Tablets	...	Rs. 25000.00
Paracitamol	...	Rs. 2500.00
Dispectal (Tablets)	...	Rs. 500.00
		103,704

FEDERAL REPUBLIC OF GERMANY

5000 Tablets	Multivitamin
3000 Tablets	Co-rimoxazal (Septrain)
3000 Capsules	Tetracycline 250 mg.
1000 Vials	Ampicillin 0.5g Injection
500 Vials	Gentamycin 80 mg (Refobacin)
1500 Capsules	Imodium
1000 Capsules	Ampicillin 250 mg
2000 Tablets	Buscopan
500 Ampouls	Buscopan Injection
1000 Capsules	Chloramphenicol with Wit, B
1500 Tablets	Neomycin 0.5 g
1000 Nos.	Disposable Needles 17g x 34 x 1"
500 Nox.	Disposable Needles 16g x 23 x 1"
1497 Nox.	Disposable Syringes 2 Ml.

RED BARNA - SRI LANKA (NORWEGION SAVE THE CHILDREN)

N.kr 200,000 (for the purchase of medicines)

Male: Report on Water Supply,
Sewerage and Waste
Disposal Scheme

Volume I
Introduction

Volume No.1 of this Report was submitted in draft form in March 1981 for discussion. It put forward proposals for the development of water supply and sanitation works in Male to the year 2005, by which time an estimated saturation population of 64,000 persons is expected to be reached. The total capital cost of works required to meet needs to the year 2005 was estimated at Rps. 155 million. Works immediately required at an estimated cost of Rps. 45.45 million were identified and recommended as a first stage of implementation.

Volume No.2 of this Report was submitted in response to discussions on Volume 1 with KfW and with officials of the Maldives Government in April 1981. It identifies in more detail items comprising the 'Immediate Works Programme' suggested in Volume 1, and submits revised estimated costs for those works. More detailed proposals are put forward for completing the sewerage of the whole island; and some technical matters raised in discussion concerning the need for house rainwater collection tanks are dealt with.

The material presented in Volume 2 repeats relevant data and conclusions presented in Volume 1 where this is necessary for an understanding of the matter discussed. Volume 1 material remains unamended as presented in April 1981 for discussion.

TERMS OF REFERENCE

1. The purpose of Volume 1 of this report is to present a scheme of water supply and sanitation works, to meet present and future requirements up to year 2005. The Terms of Reference required us to:
 - Update the report which we made to WHO in 1975, including a reassessment of water demands;
 - assess the current economic and social structure of the island;
 - develop a long-term water resource strategy, together with proposals for ground water conservation;
 - consider alternative proposals for water supplies, and elaborate the more appropriate schemes, with cost estimates;
 - propose sewerage and waste disposal systems to match the alternative water schemes;

- make proposals for project implementation and for the organisation, operation and maintenance of the future systems;
 - propose a tariff and collection system and to carry out cash flow calculations for the alternative water supply and sewerage schemes proposed;
 - select and recommend one water supply and sewerage system for implementation;
 - make proposals for solid water disposal;
 - investigate the possibility of energy generation from biogas.
2. The project area considered is the island of Male including areas within the line of the reef that may be reclaimed before year 2005.
 3. The study team visited Male for 3 weeks in November 1980 to meet the relevant authorities and to collect information including groundwater samples and analyses. We gratefully acknowledge the valuable assistance received from the staff of MWSA and the Male hospital.

SUMMARY OF CONCLUSIONS OF VOLUME 1

Population

1. The present population of Male is estimated to be 35,300, substantially higher than we predicted in our 1975 report. Two constraints will limit the population that could eventually live on the island; the area of land available for development (either existing or capable of being reclaimed), and the quantity of water that can be supplied at an acceptable price.
2. The whole of the existing island is covered by development. There are 62 hectares of lagoon where land reclamation is taking place. Part of this area will be needed to provide material for reclaiming the remainder. Taking this into account we estimate that the maximum land area that could be made available, including the existing island, would be 166 hectares. The present type of low rise development would allow a density of not more than 425 people per hectare, with a saturation population of 64,000. Higher densities would require changes of housing patterns with accompanying social adjustment which we believe would be unwelcome. Availability of land therefore places a serious constraint on the possible maximum population of Male with an upper limit of the order of 64,000.

3. It is difficult at present to estimate accurately how much water could be obtained from roof catchments and wells, which form the natural sources, but it will almost certainly not be enough to supply more than 64,000 people. Further supplies could only be obtained by desalinating sea water. The operating costs of desalination are high and closely linked to the price of oil. The marginal costs of water to supply a population above the estimated maximum would also be high and would involve the allocation of an exceptional proportion of average household income to this utility. Water supply restrictions therefore also constrain the upper limits of the population.
4. For planning purposes it has been assumed that the rate of increase of population will reduce to zero, and the population will stabilise at a maximum of just over 64,000 in the year 2000.

Water supplies

5. The Terms of Reference asked us to propose a strategy for the long term protection of natural water resources, comprised of the fresh water aquifer and that portion of the rainfall that can be caught and stored for use.
6. At present about 98 1/2% of fresh water supplies are taken from shallow wells and the remaining 1 1/2% from roof catchments. It is estimated that the net withdrawal from the aquifer (the quantity drawn less the quantity returned) is 698 m³/d. This is substantially greater than the maximum we recommended as being the safe net abstraction in the 1975 report.

The quality of well water has generally declined although the deterioration is irregular. The aquifer has become increasingly polluted by faecally contaminated wastewater allowed to percolate into the ground. As many as one third of the population have installed water flushed toilets and many of these discharge to the aquifer either directly or through septic tanks with soakaways. The result is that more and more wells are becoming unusable as sources of drinking water and some are now so polluted that they cannot even be used for washing or ablutions. In an attempt to overcome this problem people are resorting to laying private sewers, but this is a haphazard activity creating maintenance problems as the sewers are not properly designed or constructed. If the aquifer is to be preserved as a safe source of fresh water, an effective sanitation system will have to be provided soon.

There is no direct evidence that the volume of the fresh water lens is decreasing, although further investigations will be needed to verify this. The rainfall during four of the past five years has been significantly above the average of previous records and this may have contributed to the maintenance of the lens. A programme to monitor the performance of the aquifer should be accorded the highest priority and will have to be undertaken for a number of years to determine how much water can safely be abstracted. Steps should also be taken to maximise the recharge by constructing soakaways for water which falls on impermeable surfaces such as roads and roofs.

7. Rainwater will be exploited to the maximum by providing domestic storage tanks, and by constructing communal rainwater catchment systems where this is practical. The capital cost of rainwater catchment schemes is high but the operating costs are low, and the system is easy to run and reliable when used in conjunction with well water. There is a limit to the opportunities open for rainwater catchment schemes and we estimate that the maximum yield that can be obtained in this way in terms of average supply is about 700 cubic metres per day, which is 21% of the estimated demand in 2005.
8. The reliable yield of the natural water resources will not be known until a programme of monitoring boreholes has continued for several years. If, as we think is possible, the aquifer could provide a net abstraction as high as 950 cubic metres a day, then the combination of rainwater and ground water would be sufficient to meet projected demand up to about 1989, and 92% of the demand in 2000 when we predict saturation population will be reached. These projections assume that all reasonable steps are taken to limit water demand.
9. The balance of demand, over and above that which can be provided from natural resources, must be obtained by desalinating sea water. We have concluded that the most appropriate form of desalination will be by the mechanical vapour compression process. The operating costs of this plant will be high, and will be linked closely to the cost of oil. It is therefore a prime objective of the water supply development programme to delay the introduction of desalination as long as possible. The earliest date by which a desalination plant may have to be in operation is 1985, and the latest date 1990. The decision depends upon calculations of safe abstraction from the aquifer.

10. Since 1975 a 200 mm diameter sewer has been laid along 430 metres of Marine Drive, and two 200 mm marine outfalls have been laid to discharge at points beyond the reef. Considerable lengths of private drain have been laid to connect into this sewer or to discharge directly to the shore line elsewhere. Some pipes are at very shallow depths with little or no fall and are subject to frequent blockages. To minimise these blockages small catchpits are provided at some houses with wire mesh screens over the outlets. The emptying of these catchpits and cleaning of the screens is an offensive, time consuming activity with associated health hazards.

About 36% of the population continue to use the gifili system for disposing the faeces as described in the 1975 report. This proportion is decreasing as people install water flushing systems.

11. In view of the density of the population, the need to preserve the aquifer and the apparent willingness of people to spend considerable sums of money on private systems. We consider that there is no acceptable alternative to a properly constructed and maintained waterborne sanitation system.

For a conventional sewerage system to operate satisfactorily, considerable quantities of water have to be supplied to the people served by the system. It is generally accepted that a flow of the order at 20 litres per capita per day (lcd) is needed to ensure that solids are flushed through the sewer pipes. Such quantities could not be supplied from the island's natural water resources, and the provision of desalinated water to operate sewer system would be prohibitively expensive. The alternative considered in the 1975 report was to provide a supply of sea water for flushing purposes as is done in some other cities, notably Hong Kong. The 1975 report rejected the distribution of sea water and on further observations confirm that such an arrangement would almost certainly lead to progressive deterioration of the aquifer, increasing the chloride content to 1 600 mg/l or more. There would however, be no objection to providing a conventional sewer system with salt water flushing to serve the reclaimed areas which are not underlain by fresh water.

12. After considering alternative sanitation systems for the existing town we have concluded that the most appropriate arrangements would be to construct sewered septic tanks with flushing water provided from wells, and using low volume, hand flush squattier pans which will keep the flushing water demand down to about 8 lcd. The reclaimed areas which have no underlying

fresh water will be served by a conventional sewer system with salt water flushing.

13. The 1975 report proposed that sewage should be discharged to the sea after screening or disintegration. Since that time two small outfalls have been laid serving Marine Drive and these operate satisfactorily with no evidence of serious pollution. It is proposed that the outfall arrangements recommended in the previous report should be unchanged.

Programme of works

Water supplies

14. We consider that the most important function that should be initiated as soon as possible is the investigation and monitoring of the aquifer. This should commence during 1981 and the most important aspects will be the sinking of six monitoring boreholes which should be repeated annually. The services of an hydrology expert will be needed for about two months a year over a programme extending for seven years during which time the characteristics of the aquifer will become more clearly understood. By 1983 it is expected that there will be sufficient information about the aquifer performance to predict the maximum safe net abstraction and to programme the provision of desalination plant.

Designs will also proceed immediately for the provision of storage tanks, pumps and chlorinators for the mosque wells. These will be installed during 1982.

Rainwater collection and storage schemes will be constructed during 1983 and 1984, starting with the Northern Scheme, followed by the Eastern Scheme. The Southern Rainwater Scheme will follow when the development proposals in this area have been finalised.

The provision of small house tanks will continue through to 1984, and distribution networks will be laid during 1983 - 1984 (Phase I) and 1985 - 1994 (Phase II).

Sewerage

15. There is a present need to improve the sanitation of the whole of the existing town. A system of sewerred septic tanks will be constructed with the effluent discharged through a marine outfall to deep water. We propose

that construction of this system should start in 1983 and should be completed in two years.

The sewerage system will be extended to serve the reclaimed areas as they are developed and in these areas a conventional sewer system will be laid with sea water distributed for flushing purposes.

Financial constraints may limit the rate at which the sewerage system can be built, and the initial works may have to be restricted to works with immediate priority.

Finance

Capital expenditure

16. Two alternative development options have been considered, both of which would meet the requirements of the Terms of Reference:

Option A - limiting net abstraction from the aquifer to 650 m³/d with the balance of demand supplied first from rainwater catchments and then by desalination. With this option desalination plant would have to be operating by 1985.

Option B - Allowing net abstraction from the aquifer to rise to perhaps 9 m³/d. With this option desalination plant would be operating by 1990.

For both options a sewerage system to serve the whole island should be constructed as soon as possible to avoid further deterioration of the aquifer.

17. Option B is more economical with much lower present values of cash flow. The choice rests on the calculation of safe net abstraction. The proposed aquifer investigation will provide information on which this decision can be taken.

The total capital cost of water supply and sanitation facilities for Option B will be Rs. 155 m (US\$ 21 m) and the cost of Option A would be similar.

The average per capita cost of service in the year 2000 will be

	Rs	US\$
water supply	1,180	157
sewerage	1,306	174

18. These per capita costs are higher than would normally be expected or affordable in a developing country. They arise largely because of the major physical constraints of Male resulting from the need to preserve the aquifer and the absence of alternative natural water sources.
19. The total amount of capital resources likely to be available for this sector in the period 1981-85 is between \$6 m and \$8 m. This is substantially less than the projected cost of the full investment programme for Male needed to comply with the Terms of Reference summarised below.

	1980-84	1985-89	1990-94	Total	%
Foreign (RS 000)	67,446	22,824	15,613	105,883	68.4
Local (Rs 000)	36,034	10,429	8,362	48,825	31.6
Total (Rs 000)	97,480	33,253	23,975	154,708	100
(US\$ 000)	12,997	4,434	3,197	20,628	100

It may therefore be necessary to adjust the phasing of the programme and the concentrate initially upon:

- aquifer monitoring and investigations;
- chlorination of wells;
- sewerage of the existing area, initially covering the areas where the aquifer is most vulnerable; and
- the northern rainwater collection scheme and associated distribution pipework.

This possible re-phasing would restrict initial investment to US\$ 6 m.

20. The implications of reduced capital expenditure would be that only the areas with the most serious aquifer pollution problems could be seweraged, and the ultimate population that could be supplied with water would be limited to about 50,000. Development on the reclaimed areas would be restricted with the requirement that any development taking place there should provide and pay for its own water supply and sanitation needs.
21. For the full investment programme recurrent expenditure at 1980 prices would rise seven-fold over the next 15 years, from Rs 215,000 in 1980 to Rs 1.6 m in 1994.

22. There are at present no direct charges for water supply or sanitation services on Male. Some households were, however, reported to have paid up to Rs 2,000 for the right to connect into a private sewer which gives some indication of willingness to pay for such services. Charges would need to be introduced gradually with the public educated to accept the need to pay for the facilities.

In order to recover only operation and maintenance costs charges be around Rs 30 to Rs 40 per month (3 to 4 per cent of estimated 1980 household incomes). This is under the World Bank yardstick which indicated that ability to pay rarely exceeds 5 per cent of income.

23. Possible charging methods have been described and cash flows have been projected including capital and operating expenditure and income that could be expected to be generated from water and sewerage tariffs.

There may be scope for recovering some of the capital costs direct from the consumers, but given the damage that could result if people do not connect, it is recommended that the level of charge should be such that people are not discouraged from connecting to the new systems.

Organisation and Staffing

24. Water and sanitation services on Male are the responsibility of the Maldives Water and Sanitation Authority (MWSA) which operates as a Department of the Ministry of Health. The proposed investment in water supply and sanitation will bring substantial increases in the scale of MWSA activities which will require changes in legal status, internal organisation, staffing and management systems.

We propose that MWSA should remain as a government department but greater flexibility and legal powers. In the long term it may prove worthwhile to reform Authority into a separate public corporation, but we do not consider it would be advised to do this at present.

25. Proposals have been made to expand the organisational structure to embrace technical and two non-technical sections which will deal with: -

Technical sections

Male water supply
Male sanitation
technical services

atolls water supply and sanitation

Non-technical sections

finance and accounting

administration and personnel

A water and sanitation co-ordinating committee should be established to co-ordinate the Authority's services with other aspects of public health. Membership should extend to other interested Ministries and Departments such as the Public Work Department, Public Maintenance Division, Land Registration Division, Department of Finance, National Planning Agency, Architectural Section and the Ministry of Provincial Affairs. Representatives of donor agencies might usefully attend as observers.

26. Additional staff will be required to implement and operate the extended services. The most critical additional requirements are in the categories of sub-professional (technical) staff and skilled operators and craftsmen. Recruitment, training and remuneration will need to be reviewed if the Authority is to attract and retain the rich calibre of staff in competition with the private sector.
27. The Authority will need additional legal powers to regulate land use, plan and co-ordinate the development of infrastructure services, control water use, and combat water and contamination of water. The special problems of Male require further specific power to limit the amount and rate of abstraction from the aquifer, and to ensure that as much contaminated water as possible is returned to the aquifer. For these purposes byelaws will be introduced to specify the maximum capacity of pump which users can install and require the provision of adequate soakaways to return uncontaminated water to the ground. These powers might be extended to ensure that rain-water from house roofs is properly stored and collected, or piped to soakaways.
28. Suitable management systems and procedures will be required as MWSA activities grow in scale and extent. Further facilities will be needed to accommodate the Authority functions including additional office space, a laboratory, a drawing office, a technical depot and transport facilities.
29. We have investigated the possibility of installing biogas generators to provide a source of power from waste products.

Possible feedstocks would be organic solid wastes or sewage sludge. The

quantity of solid waste would be small and we do not consider it worthwhile to investigate biogas generated from this source.

If the whole of the island's ultimate population of 64,000 were sewered, and the sewage settled to produce sludge which was then digested for biogas, the maximum power that could be produced would be 3,170 kwh per day: this is equivalent to about 13% of the present average power generation. Assuming that the gas would replace diesel fuel for prime movers, then the investment in biogas equipment would provide an internal rate of return of 1 to 2% in real terms (1980 prices).

The sanitation system we have proposed would provide for a conventional sewerage system to serve only about one third of the development, the other two thirds using sewered septic tanks. The quantity of gas that can be produced by digesting septic tanks emptyings is not known precisely but it is unlikely to be more than about one quarter of that for fresh sewage, measured in terms of the population served. The biogas production would therefore not be more than the equivalent of 1580 kwh per day. We do not consider it would be worthwhile to provide biogas generation equipment for this relatively small power output.

Solid Waste

30. At present the people of Male make private arrangements for the removal of solid waste from their houses, offices, and shops. The system is effective in that the town is kept exceptionally clean. However, there are no formal arrangements for the disposal of the waste, which is dumped on the foreshore where it decomposes or is washed away or buried by the action of the tides. This causes some areas of the foreshore to be unsightly and could be a health hazard.

The most economical system for the safe disposal of solid wastes is usually by a controlled sanitary landfill, and this system is adopted in many developing countries. At Male however, land is severely limited and the area of land required for landfill could not be made available on the main island. The alternative arrangements which we have considered are either:

- incineration; or
- sanitary landfill on another island.

Both of these alternatives would be costly. The cost of an initial in-

incinerator installation would be Rs 9 million, and would consume 1000 litres of fuel oil a day. No suitable location has been identified for a sanitary landfill away from Male, but assuming that a site could be found, waste handling and transshipment points would have to be built, a vessel acquired and facilities provided at the landfill. It is unlikely that these would cost less than an incinerator.

Whichever system is adopted the waste must be conveyed to the incinerator or transshipment point. This could be achieved by providing communal waste collection points generally at the traditional sites for waste tipping. Alternatively, a house to house collection service could be instigated with waste stored and collected in plastic sacks.

In view of the high cost and relatively low priority of the solid waste disposal problem no firm recommendations have been made for capital expenditure on solid waste disposal facilities at this stage. However, it is proposed that a site for an incinerator should be identified and reserved, and the possibility of a sanitary landfill on another island should be further investigated.

Republic of Maldives
Male: Report on Water Supply, Sewerage
and Waste Disposal Scheme

Volume II
PROPOSALS FOR IMMEDIATE WORKS

Introduction

Volume No.1 of this Report was submitted in draft form in March 1981 for discussion. It put forward proposals for the development of water supply and sanitation works in Male to the year 2005, by which time an estimated saturation population of 64,000 persons is expected to be reached. The total capital cost of works required to meet needs to the year 2005 was estimated at Rps. 155 million. Works immediately required at an estimated cost of Rps. 45.45 million were identified and recommended as a first stage of implementation.

Volume No.2 of this Report was submitted in response to discussions on Volume 1 with KfW and with officials of the Maldives Government in April 1981. It identifies in more detail items comprising the 'Immediate Works Programme' suggested in Volume 1, and submits revised estimated costs for those works. More detailed proposals are put forward for completing the sewerage of the whole island; and some technical matters raised in discussion concerning the need for house rainwater collection tanks are dealt with.

The material presented in Volume 2 repeats relevant data and conclusions presented in Volume 1 where this is necessary for an understanding of the matter discussed. Volume 1 material remains unamended as presented in April 1981 for discussion.

Estimated costs are shown in summary form in the text of Volume 2. Detailed estimates; basic costs, unit rates, and measured rates are included in the Appendix to Volume 2.

1. Terms of Reference for Volume 2

1.1 After a meeting with KfW we confirmed that our further work now reported on in Volume 2 should include, inter alia, the following:

- (i) A detailed specification of the aquifer investigation and monitoring programme.
- (ii) A specification of the works needed for development of the mosque walls, with typical drawings and a detailed estimate.
- (iii) Preliminary designs, plans, typical details and a detailed estimate of the Northern rainwater catchment scheme.
- (iv) Preliminary designs, details and a detailed estimate of the immediate sewerage and sewage disposal programme.
- (v) A schedule of disbursements for items (i) to (iv) divided into periods of six months. For the schedule we will assume that instructions to proceed with the designs are given on 1st January 1982. Physical contingencies and price escalation will be shown separately. Price escalation will be taken as 10% for materials purchased by international tender. Escalation of on-shore costs and those relating to goods and services from Sri Lanka, India and Singapore (the main traditional suppliers) will be assessed.
- (vi) The uncertainty of estimating rates will be qualified as far as possible.
- (vii) The advantages and disadvantages of constructing new mosque wells to take water at a low level will be reviewed.
- (viii) A solid waste collection scheme will be described incorporating disposal by incineration. A suggested layout plan with estimation of capital and operating costs will be provided. It will be noted that the scheme is likely to have a low priority in Male where the environmental problem of inadequate disposal facilities are not thought to be serious. A lower cost scheme may be acceptable but has not yet been identified. This will be discussed further with the Maldivian Authorities.

1.2 The foregoing are dealt with in the appropriate Sections of Volume 2.

8. Programme: Construction Proposals and Costs

Programme

- 8.1 A proposed programme for design and construction of the Immediate Works is shown in Figure and Table 8.1. The assumption is made that site surveys and design will commence on 1 Jan. 1982. Six months is initially required for detailed design works and the production of contract documents. A further 3 to 5 months is required for tendering, analysis of tenders, and the award of contracts. Construction is therefore expected to commence at the late end of 1982; and it is estimated the Northern Rainwater Collection scheme can be completed in 14 months, and the sewerage construction substantially completed in 20 months.
- 8.2 Results from the trial dewatering in the initial aquifer investigations will need to be obtained before the sewerage contract documents can be finalised. These results are expected to be available during March 1982.
- 8.3 The following contracts are envisaged as being necessary to achieve earliest completion of the mosque wells, and for the main construction contracts not to be delayed by delivery of pipes.

Contract No.	Nature
1	Construction of works at mosque and commercial wells: with pumps and equipment supplied by a nominated sub-contractor.
2	Supply of water pipes and sewer pipes for Contracts 3 and 4.
3	Construction of Northern Rainwater collection scheme and associated distribution system: with pumps and equipment supplied by an approved sub-contractor.
4	Construction of the sewage scheme; with pumps and equipment supplied by an approved sub-contractor.

Contracts 3 and 4 could be combined in one contract.

- 8.4 Delivery periods of 3 months for shipping of manufactured items to Male are allowed in the programme. Delays to the whole programme of construction will occur if these delivery times are exceeded because of the following relationship between materials supplied and execution of contracts:

- (a) the drilling rig must be supplied before the Initial Investigations of the Aquifer can commence;
- (b) the pumps and associated starters etc. must be delivered before work at any Mosque well or communally used well is completed;
- (c) pipes for the Northern Rainwater scheme and the Sewerage Works must be delivered in sufficient quantity to permit work to start on those schemes at the dates shown.

8.5 The delivery of the drilling rig is crucial to the whole programme. If the Initial Investigations of the Aquifer are delayed, this will delay completion of the Sewerage Works contracts because the design and method of execution of the sewerage works depend upon the results of the dewatering trials to be conducted in the Initial Investigations. Whilst some dewatering trials can be conducted on excavations taken down by hand; observation borings are required adjacent to such excavations to determine the effect of pumping on the freshwater/saline water interface below the dewatering position.

8.6 Although it may not be possible to obtain project authorisation before 1 Jan. 1982, it would be possible before then to call for quotations for the supply of a drilling rig. The preferred supplier could be notified of the possibility of his being required to supply the rig as soon as possible after an official order can be placed with him on or about 1 Jan. Enquiries could be made similarly with respect to shipping space available to get the rig to Male. If these investigations show serious delay to the programme, other means of obtaining equipment (by hire, or by order on a drilling contractor) could be investigated.

8.7 Quotations for drilling rigs would be obtained from manufacturers or suppliers in either Singapore, India or Western Europe. At least three quotations would be obtained and the choice would be made on the basis of cost, quality, and time for delivery.

Nature of contracts

8.8 On the Northern Rainwater collection scheme over 150 existing rainwater downpipes will have to be connected into the collector mains, and some of these downpipes and associated rainwater guttering will need repair. On the Sewerage project, each house site will need to be visited to decide

where a septic tank can be constructed, of what size it should be, and the route for the connecting house lateral to the sewer. There will be an estimated total of 1,460 house sites to deal with. To detail all these requirements in the Contract Drawings would cause several months delay in their production and be excessively costly in design time. We do not think this procedure is warranted.

- 8.9 Instead we propose that the Contract Drawings will provide detailed type designs for the range of layouts and renovation problems likely to be encountered, and quantities will be based on an appraisal of the numbers of each type likely to be experienced. In respect of the Rainwater collection scheme, a plan showing the roof areas to be incorporated and the number of rainwater downpipes to be utilised will be provided, together with details as to how downpipes are to be connected in typical instances and how gutters are to be repaired if necessary. In respect of Sewerage, three sizes of septic tank (at least) will be shown in detail, and full details will be given as to how house laterals are to be constructed.
- 8.10 The Bills of Quantities will provide for pricing of items as shown on the Contract Drawings, plus additional items which will permit fair adjustment of payment where additional work has to be undertaken. For example, it may be decided that most house laterals will not exceed 7 m in length and a standard price will be called for laterals not exceeding this length, with an extra over payment allowed for each 1 m in excess of 7 m. Similar provisions will be made in respect of work on the Mosque well sites, communal well sites, each rainwater downpipe, and each septic tank, so that detailed remeasurement of quantities of excavation, concrete, shuttering reinforcement etc. is avoided.
- 8.11 Specifications will require Contractors to survey requirements ahead of constructional operations, and to submit proposals in each case for prior approval by the Engineer before the work proceeds.
- 8.12 Fully detailed drawings will be provided for sewerage and water pumping stations, storage reservoirs and other structures, but in view of the flat nature of the topography and the gradual ground slopes we propose that sewer invert levels be denoted on plans and that longitudinal sewer sections need not be produced.

Costs

8.13 The total estimated costs for the Immediate Works were given in Figure and Table 8.1 at 1981 prices. Table 8.2 shows additionally the foreign element of expenditure and the possible effect of inflation. The following notes apply to the costs shown.

Inflation Costs down to the inflation line are priced at rates which are deemed to be sufficient to cover prices ruling through to December 1981. Thereafter the inflation allowance has been taken as 10 percent per annum (compound) for the foreign element of costs, and 20 percent per annum (compound) for the balance. The inflation allowance for payments made during the first half of any calendar year has been taken as the mean of the rate from one year end to the next.

The Foreign element of total costs includes the foreign elements within unit prices e.g. rates for concrete include the foreign element of cost for cement etc. Where, however, imported labour is deemed to be necessary, the whole cost of this labour is shown as a foreign cost inclusive of local lodging allowances since expatriates are expected to pay in US dollars.

Contingencies are now put at 15% of the estimated cost of Works in view of the further progress made in studying designs. (They were formerly put at 20% in Volume 1).

Engineering costs have been applied at the rate of 10% on Works costs plus contingencies, excluding the cost of the Initial Investigations and Monitoring of the Aquifer which already include engineering.

The total of 10% for engineering appears sufficient to cover design, production of contract documents, and site supervision of the construction up to mid-1984 when the work should be substantially completed.

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