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2．署名したS/W

3．事前評価表

4．現地踏査記録

5．参考図

6．収集資料リスト

1．署名したM/M

MINUTES OF MEETING
FOR
THE STUDY FOR
DEVELOPMENT OF THE RURAL ELECTRIFICATION MASTER PLAN
IN ZAMBIA

AGREED UPON BETWEEN
MINISTRY OF ENERGY AND WATER DEVELOPMENT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

LUSAKA, 1st Feb, 2006

Mr. O. S Kalumiana
Acting Director
Department of Energy
Ministry of Energy and Water Development

Mr. Toshiyuki Hayashi
Leader,
The Preliminary Study Team,
Japan International Cooperation Agency

The Ministry of Energy and Water Development (hereinafter referred to as "MEWD") through the Ministry of Finance and National Planning (hereinafter referred to as "MFNP") officially requested the Government of Japan to implement the Study for Development of the Rural Electrification Master Plan (hereinafter referred to as " the Study"). In response to the request, The Preliminary Study Team organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") was dispatched and had a series of discussions with the authorities concerned of the Government of Zambia from 23 Jan to 2 Feb, 2006.

Both parties agreed to record the following points as summarized conclusions of the discussions.

1. Signing the Scope of Work Agreed

Ministry of Energy and Water Development and the Preliminary Study Team reached the agreement on the Draft Scope of Work as shown in Attachment I. Both parties have confirmed that JICA Head Office will make the final decision on the Study plan based on the agreement, before signing the Scope of Work. After the final decision by JICA Head Office, MFNP, MEWD and JICA Zambia Office will sign the Scope of Work.

2. Organization for the Study

1) Counterpart

Ministry of Energy and Water Development, and Rural Electrification Authority (hereinafter referred to as "REA") are the counterpart organizations. MEWD is the primary counterpart for the Study Team and responsible for overall coordination and arrangement.

2) Counterpart personnel

Ministry of Energy and Water Development, and REA have assigned

counterpart personnel as shown in Attachment II. The JICA study team will ensure technology transfer to the counterpart personnel by conducting the Study in collaboration.

3) Coordination committee

In order to ensure information exchange with relevant organizations, Coordination committee shall be held in a timely manner. The coordination committee shall be organized by MEWD, and the members would be REA, ZESCO, Energy Regulation Board, and other relevant organizations.

3. Workshop

Workshops will be held to ensure decentralized planning process for target site Selection. Ministry of Energy and Water Development will be responsible for holding and coordinating the workshops. Ministry of Energy and Water Development and REA shall be primarily responsible for presentations at the workshops. JICA study team will assist MEWD and REA, and bear the costs according to the JICA's regulation.

4. Seminar

Seminars will be held three (3) times in a timely manner, in order to confirm result of the progress of the Study among stakeholders. Ministry of Energy and Water Development will be responsible for holding and coordinating the seminars. Ministry of Energy and Water Development and REA shall be responsible for presenting their progress and result of the study. JICA study team will assist MEWD and REA, and bear the costs according to the JICA's regulation.

5. Environmental and social considerations

The Preliminary Study Team explained that JICA Guidelines for Environmental and Social Considerations be applied to the Study. Ministry of Energy and Water Development agreed to comply

with the requirements of the guidelines according to the compliance level, which JICA will finally decide prior to signing the Scope of Work.

5. Training in Japan

Ministry of Energy and Water Development requested that five (5) members of the counterpart should join relevant technical training in Japan. The Preliminary Study Team replied that the request will be conveyed to the officials concerned in the Government of Japan.

6. Office space with necessary equipment

The Preliminary study Team requested MEWD and REA to provide JICA study team with adequate office space with enough furnishing, a telephone line and internet access that are needed to carry out the Study. Ministry of Energy and Water Development replied that adequately furnished office accommodation would be provided including access to a telecommunication connection.

Attachment I

DRAFT SCOPE OF WORK
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AGREED UPON BETWEEN
MINISTRY OF ENERGY AND WATER DEVELOPMENT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

LUSAKA, **th Feb, 2006

Mr. Adam Hussen
Acting Permanent Secretary
Ministry of Energy and Water Development

Mr. Eiji Inui
Resident Representative,
Zambia Office
Japan International Cooperation Agency

Mrs. Petronela Mwaangala
Permanent Secretary-
(Budget and Economic Affairs)
Ministry of Finance and National Planning

1. INTRODUCTION

In response to the request of the Government of Republic of Zambia (hereinafter referred to as "the Government of Zambia"), the Government of Japan decided to conduct the Study for Development of the Rural Electrification Master Plan in Zambia (hereinafter referred to as "the Study").

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation to the authorities concerned of the Government of Zambia.

The present document sets forth the Scope of Work with regard to the Study.

2. OBJECTIVE OF THE STUDY

The Study aims at preparing the Rural Electrification Master Plan that shall be practical and comprehensive.

3. STUDY AREA

The Study will cover un-electrified rural areas throughout the country including district centers supplied with power by diesel plants.

4. SCOPE OF THE STUDY

4.1 Data Collection and Investigation

(1) Data Collection

-Collect the necessary data such as District Development Plan, village data including population density, ZESCO data, public facilities, environmental data including legal framework from relevant organizations.

(2) Rural Investigation

-Investigate the social and economic situation in some un-electrified rural areas to identify affordability for electricity; and

-Investigate power demand and social impacts after electrification in some electrified areas.

(3) Renewable Energy Study

-Collect the necessary data such as hydrological data, topographical data from relevant organizations.

-Clarify the potential sites for mini-grid electrification using mini/micro hydro power;

-Clarify the potential sites for mini-grid electrification using other renewable energy at desk study level; and

-Carry out some site survey for some potential sites of mini/micro hydro power with counterpart personnel.

4.2 Decentralized Process for Target Site Selection

In order to select the target sites for electrification, decentralized process will be taken as follows.

-Hold an initial workshop at Lusaka inviting representatives from nine (9) provinces to share the knowledge of rural electrification technologies, and discuss and agree on the criteria for initial target site selection.

-Hold workshops at nine (9) provincial centers inviting district representatives to identify initial target sites and collect corresponding data and information;

-Hold a workshop at Lusaka inviting representatives from 9 (nine) provinces to present the interim report and the selected target sites.

4.3 Preparation of Optimal Plan

(1) Integration of GIS Map

-Prepare database containing necessary data for rural electrification; and

-Integrate the database into GIS map including social facilities that will be necessary to prepare the long-term

rural electrification plan.

(2) Consolidation of Target Sites

- Consolidate the target sites considering social facilities such as schools and rural health centers, and economic activities at initial target sites.

(3) Demand Forecast

-Forecast power demand for respective target sites.

(4) Cost Estimate for Alternative Electrification Methods

-Study the existing conditions of transmission lines, sub-stations and distribution lines for grid extension, and prepare basic design;

- Prepare basic design of mini-grid for other selected sites;

-Estimate the cost of alternative electrification methods for respective target sites.

(5) Least cost Analysis

- Based on the power demand forecast and cost estimate, carry out least cost analysis to select electrification method for respective target sites.

(6) Criteria Setting

-Establish the criteria for electrification method and prioritization of target sites, considering not only economic aspects but also environmental and social aspects.

(7) Preparation of Long-term Rural Electrification Plan

-Based on the criteria for electrification method, decide electrification method for respective target sites, either by extension of distribution lines, construction of mini-grid, or installation of Photovoltaic (hereinafter referred to as "PV") systems;

-Based on the criteria for prioritization of target sites, prioritize these target sites;

-Carry out some case study including site survey to ensure quality of the long-term rural electrification plan;

-Prepare dissemination program for Solar Home System, Battery Charging Station and Community Solar System for PV target sites;

-Prepare the long-term rural electrification plan for

twenty years; and

-Prepare the financial plan clarifying how to utilize Rural Electrification Fund and other financial resources, based on the long-term rural electrification plan.

(8) Case Study

-Choose four (4) target sites with different characteristics for grid extension and one (1) site for mini-grid powered by mini/micro hydro with higher priority;

-Carry out site survey of pre-feasibility study level at these sites with counterpart personnel; and

-Assess the survey result with the provisional parameters used to prepare the long-term electrification plan, and feed back the assessment result to the long-term plan for optimization.

(9) Technology Transfer

-Transfer the technology to Ministry of Energy and Water Development (hereinafter referred to as "MEWD") and Rural Electrification Authority (hereinafter referred to as "REA") for updating the long-term rural electrification plan based on GIS.

- Transfer technology to MEWD and REA for planning and implementing electrification projects through site survey.

4.4 Policy Analysis and Recommendation

(1) Planning and Implementation Procedure

-Review the present rural electrification planning and implementation procedure, and analyze the institutional arrangement and their capacity;

-Examine planning and implementation procedure, and institutional arrangement and their capacity, based on the practical experience obtained in the case study;

-Recommend alternative procedure including the management of Rural Electrification Fund, and the participation of local governments and private sector; and

-Clarify the roles and necessary capacity of MEWD and REA for planning, implementing and monitoring rural electrification projects under the alternative procedure;

(2) Business Models

-Analyze investment and recurrent costs, and tariff for different rural electrification projects;

-Prepare business models including private sector participation and subsidy schemes;

-Recommend policy alternatives for promoting such business models;

(3) Promotion Policy

-Assess the present power tariff based on the willingness to pay investigation, the business models and other relevant factors;

-Recommend alternative tariff policy for promoting rural electrification;

-Analyze the present practices such as capital contribution and initial payment for connecting electricity through the rural investigation;

-Identify impediments to the increase of electrification rate;

-Recommend alternative policy for increasing electrification rate;

(4) Implementation Program

-Prepare implementation program for the long-term rural electrification plan including the financial schemes and strategy, the promotion policy, the business models, and the capacity development for MEWD, REA, and other relevant organizations and stakeholders;

(5) Environmental and Social Considerations

-Based on the rural investigation and analysis, identify environmental and social impacts envisaged by rural electrification;

-Recommend mitigation measure for adverse impacts; and

-Recommend strategy for enhancing favorable impacts.

4.5 Preparation of Rural Electrification Master Plan

-Integrate the long-term rural electrification plan, the financial plan and strategy, the policy recommendation, and the implementation program into Rural Electrification Master

Plan.

5. STUDY SCHEDULE

The Study will be conducted in accordance with Tentative Time Schedule as shown in Appendix I attached herewith.

6. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Zambia:

(1) Inception Report (20 copies)
(2) Progress Report (20 copies)
(2) Interim Report (20 copies)
(3) Draft Final Report (20 copies)
(4) Final Report (20 hard copies and a soft copy)

7. DIVISION OF TECHNICAL UNDERTAKING

The division of technical undertakings by JICA and the Government of Zambia is detailed in Appendix II attached herewith.

8. UNDERTAKING OF GOVERNMENT OF ZAMBIA

(1) To facilitate smooth conduct of the Study, the Government of Zambia shall take necessary measures:

a) to permit the members of JICA study team to enter, leave and sojourn in Zambia for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees.

b) to exempt the members of JICA study team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into Zambia for the implementation of the Study.

c) to exempt the members of JICA study team from income tax

and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of JICA study team for their services in connection with the implementation of the Study.

d) to provide necessary facilities to JICA study team for remittance as well as utilization of the funds introduced into Zambia from Japan in connection with the implementation of the Study.

(2) The Government of Zambia shall bear claims, if any arises, against the members of JICA Study Team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of JICA study team.

(3) MEWD and REA shall act as a counterpart agency to JICA study team and also as coordinating body in relation to other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

(4) MEWD and REA shall, at its expense, provide JICA study team with the following in cooperation with other organizations concerned:

a) Security-related information on as well as measure to ensure the safety of JICA study team;
b) Information on as well as support in obtaining medical services;
c) Available data and information related to the Study;
d) Counterpart personnel;
e) Suitable office space with necessary equipment; and
f) Credentials or identification cards

9. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the

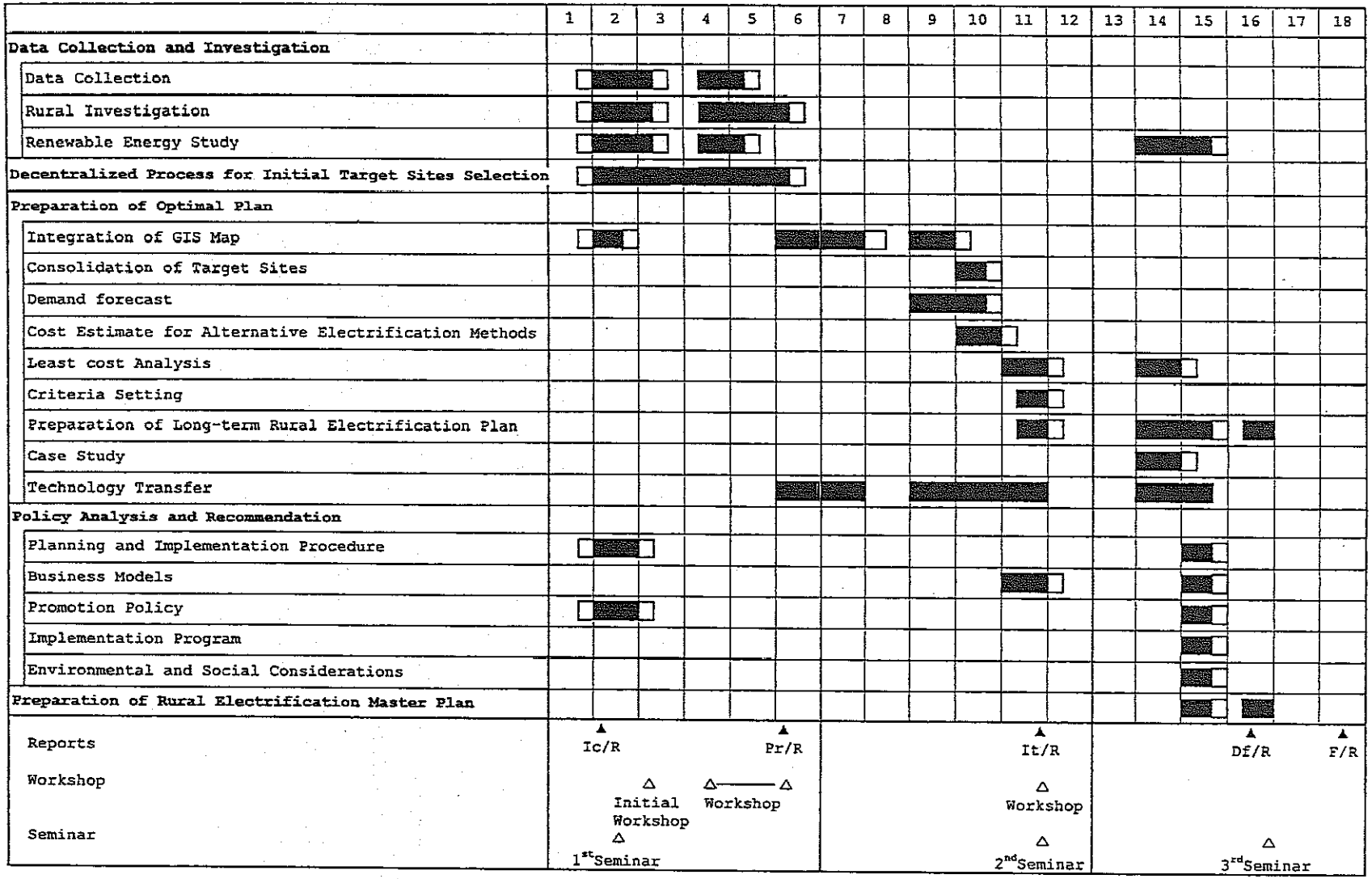
following measures:

(1) to dispatch, at its own expense, study team to Zambia.
(2) to pursue technology transfer to the Zambian counterpart personnel in the course of the Study.

10. OTHERS

JICA, MEWD and REA shall consult with each other in respect of any matter that may arise from or in connection with the Study.

The Study for Development of the Rural Electrification Master Plan in Zambia
Tentative Schedule



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The Study for Development of the Rural Electrification Master Plan in Zambia
Division of Technical Undertaking

	Undertaking of JICA	Undertaking of DOE	Undertaking of REA
Data Collection and Investigation			
Data Collection	Review	Coordinate and discuss	Collect data
Rural Investigation	Study	Coordinate and discuss	Study
Renewable Energy Study	Study	Coordinate and discuss	Study
Decentralized Process for Initial Target Sites Selection	Assist	Coordinate and Host	Host
Preparation of Optimal Plan			
Integration of GIS Map	Study	Discuss	Study
Consolidation of Target Sites	Study	Discuss	Study
Demand forecast	Study	Discuss	Study
Cost Estimate for Alternative Electrification Methods	Study	Discuss	Study
Least cost Analysis	Study	Discuss	Study
Criteria Setting	Study	Discuss	Study
Preparation of Long-term Rural Electrification Plan	Study	Discuss	Study
Case Study	Study	Discuss	Study
Policy Analysis and Recommendation			
Planning and Implementation Procedure	Study	Discuss	Discuss
Business Models	Study	Discuss	Discuss
Promotion Policy	Study	Discuss	Discuss
Implementation Program	Study	Discuss	Discuss
Environmental and Social Considerations	Study	Discuss	Discuss
Preparation of Rural Electrification Master Plan	Study	Discuss	Discuss

Attachment II

Counterpart List

Department of Energy

Mr.O. Kalumiana	Acting Director
Mr.G.Musonda	Assistant Director
Mr.C.Mulenga	Senior Electricity Officer
Mr.A.M.Simwaba	Senior Electrification Officer
Mr.P.Mubanga	Electricity Officer
Mr.Malama Chileshe	Energy Officer

Rural Electrification Authority

Mr.W.Serenje	Acting Chief Executive Officer
Mr.F.Mushimbwa	Acting Projects Engineer
Mr.W.Siwakwi	Acting Economic Specialist

List of Attendance

Department of Energy

Mr.G.Musonda	Assistant Director
Mr.A.M.Simwaba	Senior Electrification Officer
Mr.K.S.Zimba	Coordinator (IAES)
Mr.P.Mubanga	Electricity Officer
Mr.N.Silomba	Electrification Officer

Department of Planning and Information

Mr.G.Lintini	Director
Mr.Mundu Mwila	Planner

Rural Electrification Authority

Mr.W.Serenje	Acting Chief Executive Officer
Mr.F.Mushimbwa	Acting Project Engineer
Mr.W.Siwakwi	Acting Economic Specialist

ZESCO

Mr.A.S.Nyirenda	Senior Manager Generation
Mr.E.Kunda	Project Engineer
Mr.E.Sichande	Project Engineer

Energy Regulation Board

Mr.B.A.Sitali	Acting Executive Director
Mr.J.Manda	Head Engineer

JICA Project Formulation Study TEAM

Mr.T.Hayashi	Team Leader
Mr.M.Mayusumi	Study Planning
Mr.K.Asai	Electrification Planning
Mr.K.Otaki	Institutional Issues
Mr.K.Nishiwaki	Mini-hydro Power Planning

JICA Zambia Office

Mr.P.Chibbamulilo	Programme Officer

SCOPE OF WORK
FOR
THE STUDY FOR
DEVELOPMENT OF THE RURAL ELECTRIFICATION MASTER PLAN
IN ZAMBIA

AGREED UPON BETWEEN
MINISTRY OF ENERGY AND WATER DEVELOPMENT
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LUSAKA, 2nd Mar., 2006

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Acting Permanent Secretary
Ministry of Energy and Water Development

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Mrs. Petronela Mwaangala
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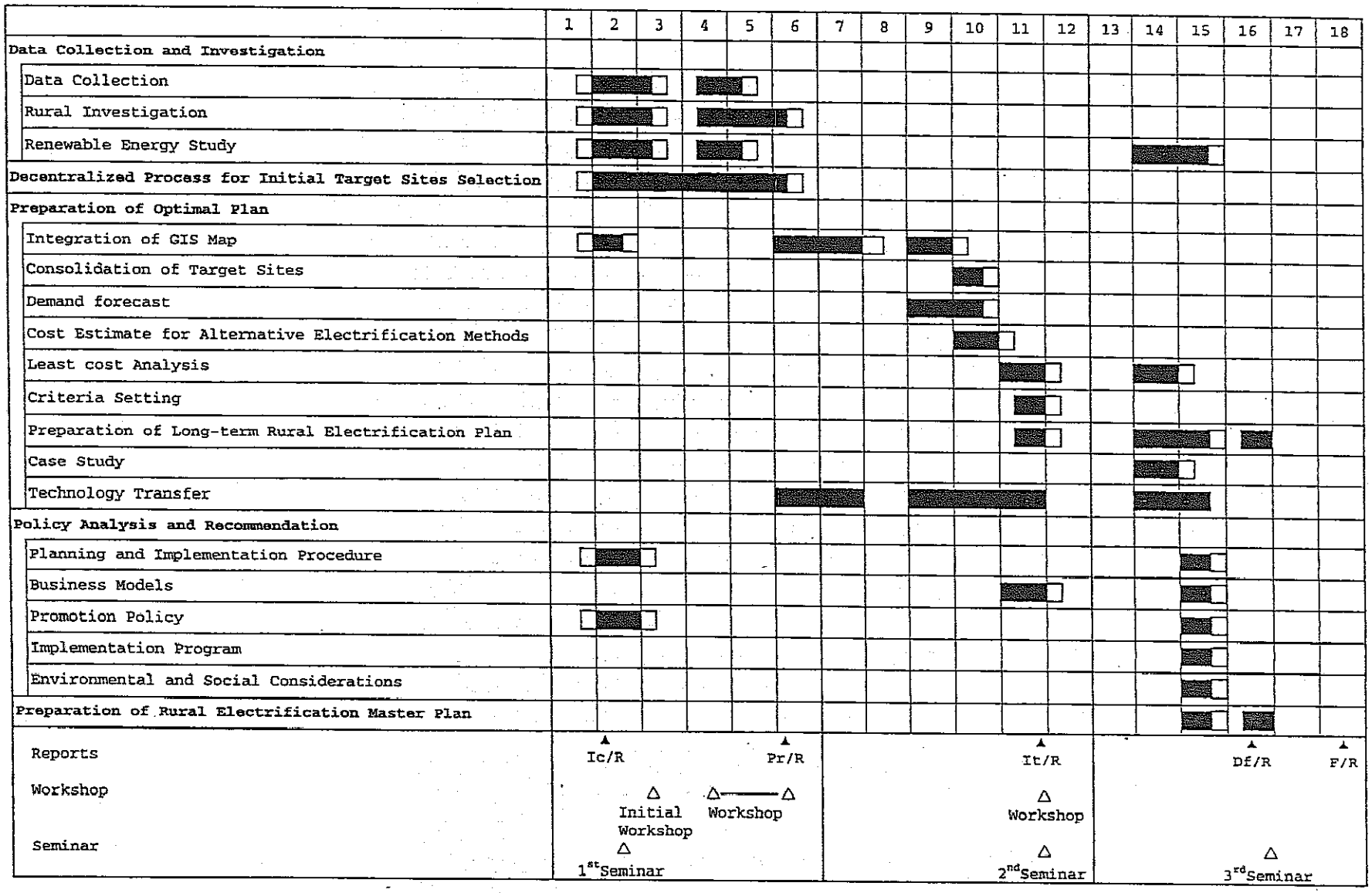
Tentative Schedule



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Promotion Policy	Study	Discuss	Discuss
Implementation Program	Study	Discuss	Discuss
Environmental and Social Considerations	Study	Discuss	Discuss
Preparation of Rural Electrification Master Plan	Study	Discuss	Discuss

事業事前評価表（開発調査）

作成日：平成　18年　2月　16日
担当グループ：経済開発部第二グループ

1．案件名
ザンビア地方電化マスタープラン開発調査
2．協力概要
（1）事業の目的 本事業は、地方電化を体系的に進めるための包括的なマスタープランを策定するとともに、相手国政府自らが、これを策定・改定することが出来るように技術移転を行うことを目的としている。 （2）調査期間 2006年5月から2007年9月 （3）総調査費用 1.9億円 （4）協力相手先機関 Department of Energy, Ministry of Energy and Water Development(DOE, MEWD) Rural Electrification Authority(REA) （5）計画の対象（対象分野、対象規模等） ・対象分野：電力（地方電化） ・対象地域：ザンビア国全土の未電化地方部 （ディーゼルにより電化されているDistrict centerを含む）
3．協力の必要性・位置付け
（1）現状及び問題点 ザンビア国は、地方電化を貧困削減のための地域経済活性化策と位置づけ、1994年に地方電化基金を設立するなど、これまでも地方電化の推進を図ってきた。しかしながら、未だに家屋電化率が20%程度（地方部では2%）に留まっていることから、2002年に策定された貧困削減戦略書（PRSP）において、2010年までに家屋電化率を35%（都市部で50%、地方部で15%）とする数値目標を掲げ、更なる地方電化政策の強化を図っている。その一環として、2003年には地方電化庁の設立及び地方電化基金の利用改善を目的とした地方電化法が制定されており、未だ整備途中ではあるものの地方電化を推進するための体制整備が進められている。 しかしながら、地方電化を体系的に進めるための包括的な地方電化マスタープランは、未だ策定されておらず、早急な策定が求められている。 （2）相手国政府国家政策上の位置づけ 現在策定中の第5次国家開発計画においても、地方電化を貧困削減のための地域経済活性化策のひとつと位置づけ、その推進を図る旨が述べられる予定である。また、政府は、本調査で策定したマスタープランを政府のマスタープランとして位置づけ、これに基づき地方電化を推進する意向であることから、国家政策と合致した支援であるといえる。

（３）他国機関の関連事業との整合性

SIDAは、エネルギー分野全体及びEnergy Service Company(ESCO)などの地方電化に対する技術支援を実施している。また、REAの能力向上のため専門家の派遣を実施する予定である。

WBは、電力設備の更新を実施中であるとともにマイクロ水力利用のミニグリッドによる地方電化パイロットプロジェクトを計画している。

Global Environmental Fund(GEF)は、再生可能エネルギー利用の地方電化を支援している。

これらの関係機関においても、地方電化マスタープランの必要性を認識しており、本マスタープランはこれら関連機関の事業を効果的に進めるための指針にもなるといえる。

（４）我が国援助政策との関連、JICA国別事業実施計画上の位置づけ

地方電化による裨益効果は、地域経済の活性化ひいては貧困削減にまで及ぶものであり、わが国のＯＤＡ中期政策における重点課題のうち持続的成長及び貧困削減に寄与するものである。また、国別援助計画においては、「貧困削減のための経済成長に資する産業開発」の一部として位置づけられる。

４．協力の枠組み

（１）調査項目

（ａ）データ収集及び基礎調査

・データ収集
・地方部調査
・再生可能エネルギー調査

（ｂ）地方分権手法による電化候補地点の選定

（ｃ）最適計画の策定

・ＧＩＳの構築
・電化候補地点の確定
・需要予測
・費用算出
・最小費用分析
・電化手法決定及び優先順位付けのための基準の整備
・長期地方電化計画の策定
・ケーススタディーの実施
・技術移転

（ｄ）政策分析及び提言

・計画・実施手続
・ビジネスモデル
・電化促進計画
・実施プログラム
・環境社会配慮

（ｅ）地方電化マスタープランの策定

（２）アウトプット（成果）

・地方電化マスタープランの策定
・上記マスタープランを共同で策定することによる策定手法の技術移転

（３）インプット（投入）：以下の投入による調査の実施

（ａ）コンサルタント（分野／人数）

・総括・地方電化計画／１人
・送配電計画／1人
・小水力発電地方電化計画／１人
・再生可能エネルギー地方電化計画／1人
・ＧＩＳ・データベース／1人
・環境社会影響調査／1人
・村落社会経済調査／1人
・電化政策・組織制度・経済財務分析／1人

（ｂ）その他　研修員受入れ

研修員：　５名

５．協力終了後に達成が期待される目標

（１）提案計画の活用目標

策定した計画に基づき政府の地方電化年度計画が策定される。

（２）活用による達成目標

策定した計画に基づき、地方電化の実施体制が整備され、地方電化基金を有効利用した効果的・効率的な地方電化が実施・促進される。

６．外部要因

（１）協力相手国内の事情

2006年9月又は10月頃に大統領選挙が実施されるので、調査工程に留意する。

（２）関連プロジェクトの遅れ

特になし。

７．貧困・ジェンダー・環境等への配慮（注）

地方電化が実施されると、その裨益効果は、地域経済の活性化ひいては貧困削減にまで及ぶものであるが、これには、地域内格差を助長することがないように社会面への十分な配慮を行うことが必要であり、このためには、マスタープラン段階から適切な配慮を行う必要がある。

また、環境面への負の影響も想定されるため、環境面からもマスタープラン段階から適切な配慮が必要である。

よって、JICA環境社会配慮ガイドラインによる本調査のカテゴリ分類はＢとする。

８．過去の類似案件からの教訓の活用（注）

・実施可能な計画にするために必要となる能力と現状の能力とを比べ、どのような能力開発が求められるのかを明確にする。
・自ら計画策定・変更ができるよう十分な技術移転を行う。
・地方電化が実施されるためには、資金をどのように確保するかが最大の課題となる。このため、関連する他機関、他セクター及び他ドナーとの情報交換を積極的に行い、あらゆる方面から資金確保の可能性について検討を行いながら、現実的な計画を策定する。

９．今後の評価計画
（１）事後評価に用いる指標 （ａ）活用の進捗度 ・策定した計画に基づき、開発計画や資金計画などが具体化され、実行に移されているか。 ・策定した計画の必要な見直しが適切に行われているか。 （ｂ）活用による達成目標の指標 ・配電線の延伸距離 ・地方電化基金を利用した事業の内容 （２）上記（ａ）および（ｂ）を評価する方法および時期 フォローアップ調査によるモニタリング（調査終了から３年後以降）

（注）調査にあたっての配慮事項

4．現地踏査記録

1.現地踏査リスト

実施日	時間	サイト名	面談者
1/26(木)	11:00～12:30	SERENJE　Sub-station	ZESCO
1/26(木)	14:30～15:00	PENSULO　Sub-station	ZESCO
1/27(金)	12:00～14:30	Chishimba Power-station	ZESCO

2.現地踏査記録

(1)SERENJE Sub-station

日　　時	2006 年 1 月 26 日（木）及び 28（土）
場　　所	SERENJE　Sub-station
調　査　団	全員

調査内容

ザンビア政府が推進しているところの農場開発地点(全国に 9 箇所ある)の Nansanga　Firm Block への電力供給設備計画について説明を受けた。

電力供給は SERENJE　Sub-station から、66/33/11kV の送電線を延伸しており(ZESCO Nansanga　Project)、現在の進捗は 38km(計画延長は 97km)である(ZESCO は 11kV までであり、距離にもよるが ZESCO 送電線から分岐の 400V 配電線は基本的には消費者負担となっている)。

政府は Firm Block への送電線延伸計画に 42billKwacha の予算を計上しており、当地区には9billKwacha が割当てられている。つまり、送電線は政府が建設して運転維持管理を ZESCO が担当することになっている。

また、建設状況視察に合わせて、未電化地区(この送電線が建設されるまでの間)のタバコ工場、病院、学校を視察した。同地区の Kapengwe Middle Basic School の校長の話によると「電気がないため、先生の歩留まりが悪い」とのことであった。

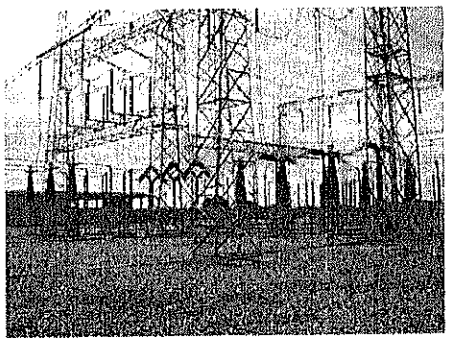
(2) PENSULO　Sub-station

日　　時	2006 年 1 月 26（木）　14 時 30 分~15 時 00 分
場　　所	PENSULO　Sub-station
調　査　団	全員

調査内容

PENSULO　Sub-station(1989 年完成)は、330/66kV で、4 箇所(LUSIWASI、GUES、SERENJE 及び CHIPATA)に電力を供給している。

Sub-station 所長の話によると、「今のところ，十分な供給力を確保している」とのことであったが、現実には、今回の現地踏査期間中に北部州の Kasama で経験した数時間に及ぶ停電(計画停電)や恒常的に起こる電圧変動などから、現状の供給体制が十分とは言いがたい。



PENSULO Sub-station 外観

(3) Chishimba Powerstation 設備見学

日　　時		2005 年 1 月 27 日（金）　12 時 00 分～14 時 30 分
場　　所		Chishimba Power-station （Northern Province）
面談者	相手機関	ZESCO
	調査団	全員

調査内容

同発電所は1959年に 1 期分(300kW@4=1.2MW)、1971年2期分新増設(1,200kW@4=4.8MW)の設備出力合計は 6 MWである。
概要は、以下のとおりである。

合計出力= 6 MW

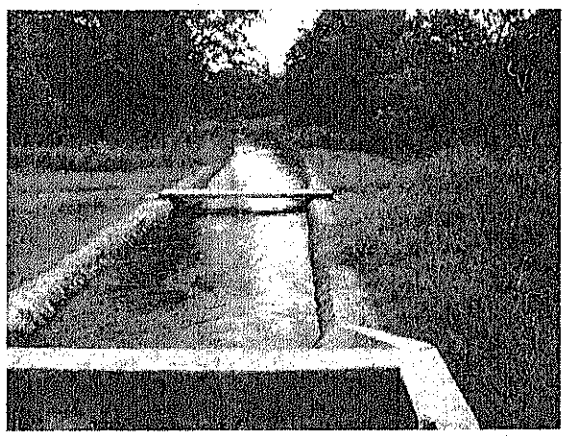
総落差=1 期分 73m、2 期分 79m

使用水量= 1 期分合計 2 m^3/sec、2 期分合計 7.8 m^3/sec

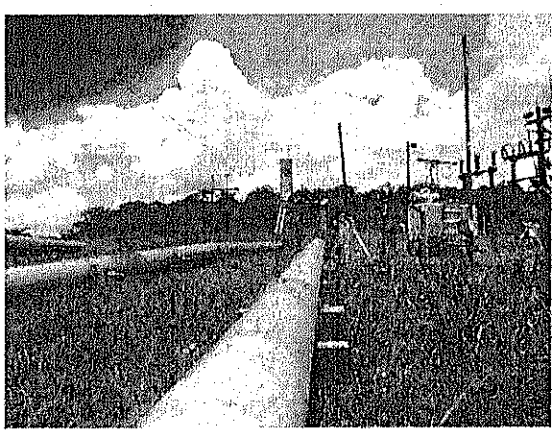
現在は予備品の欠如や機械の不具合から、1 期分、2 期分の其々 1 台が稼動しておらず、出力合計は 4.5MW となっている(なお、見学したときの発電出力は 1 号機 250kW、6,7 号機は其々500kW の合計 1,250kW であった)。

1 期分、2 期分其々の取水ダムを持つ流れ込み式の発電所である。年間を通じてほぼ一定の出力を確保しているとしており、使用水量は低水量あたりに設定されている模様である。発電所では、今後 20MW の新増設を既存発電所の脇に計画している。写真にも示すように取水地点の水量が多く増新設は可能と判断される。

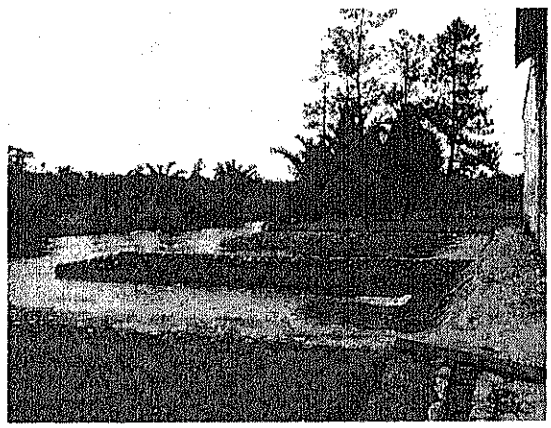
1 期分の取水ダム



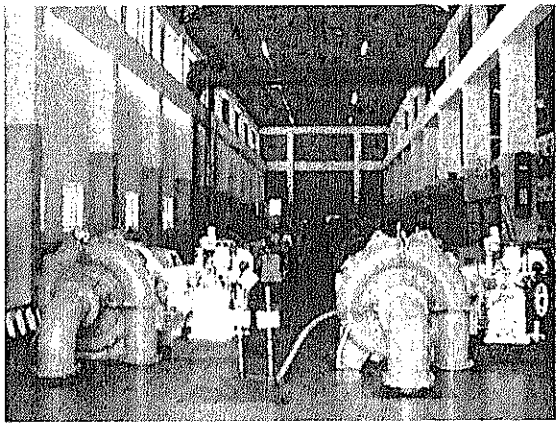
1 期分の導水路



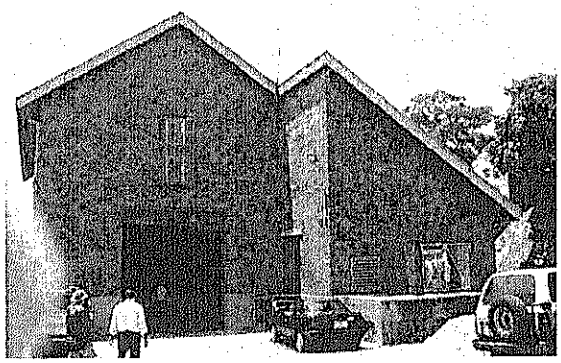
水圧管路（右が 1 期分、左が 2 期分(2 本)）



放水口(手前が 1 期工事分、奥が 2 期工事分)

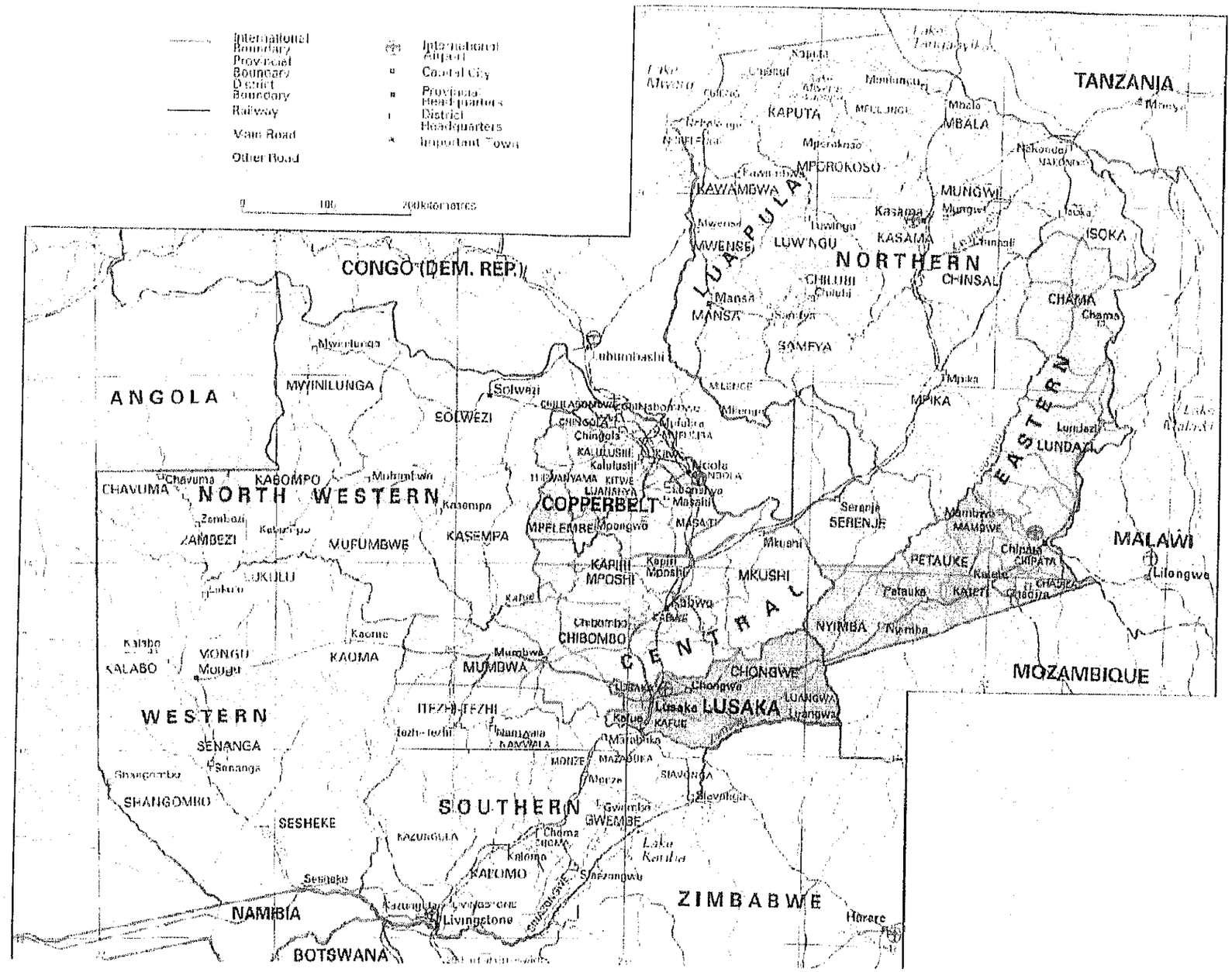


水車・発電機



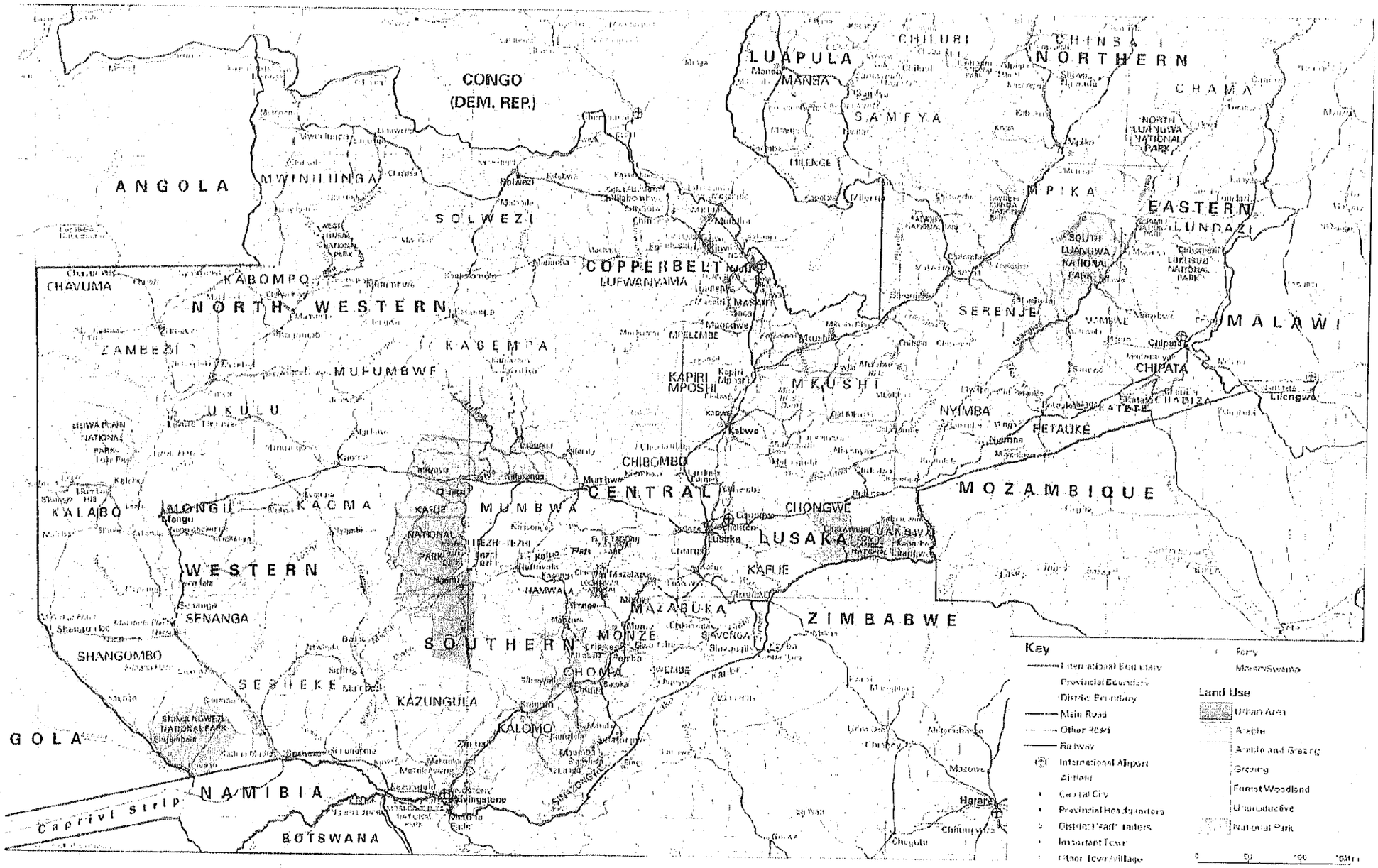
発電所概観

5．参考図

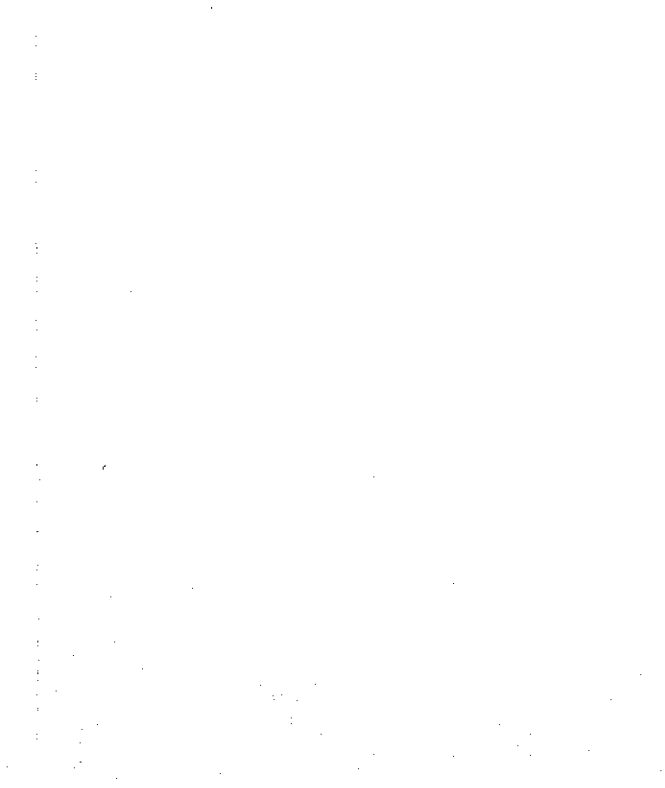


(出典：Basic Education Atlus of Zambia から作成)

参考図－1　Zambia 行政区分図

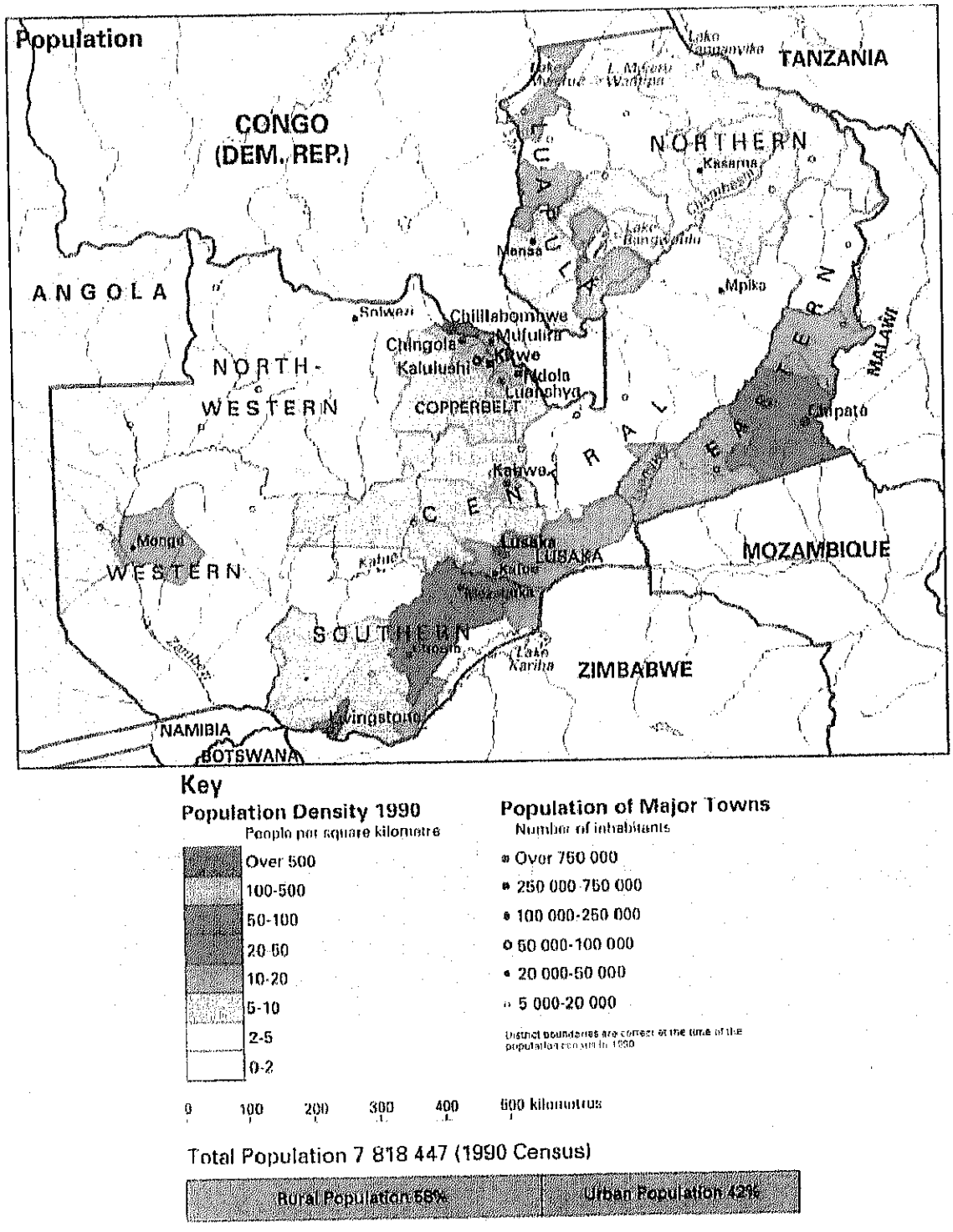


参考図－2　Zambia 国西部，北西部，中央部および東部



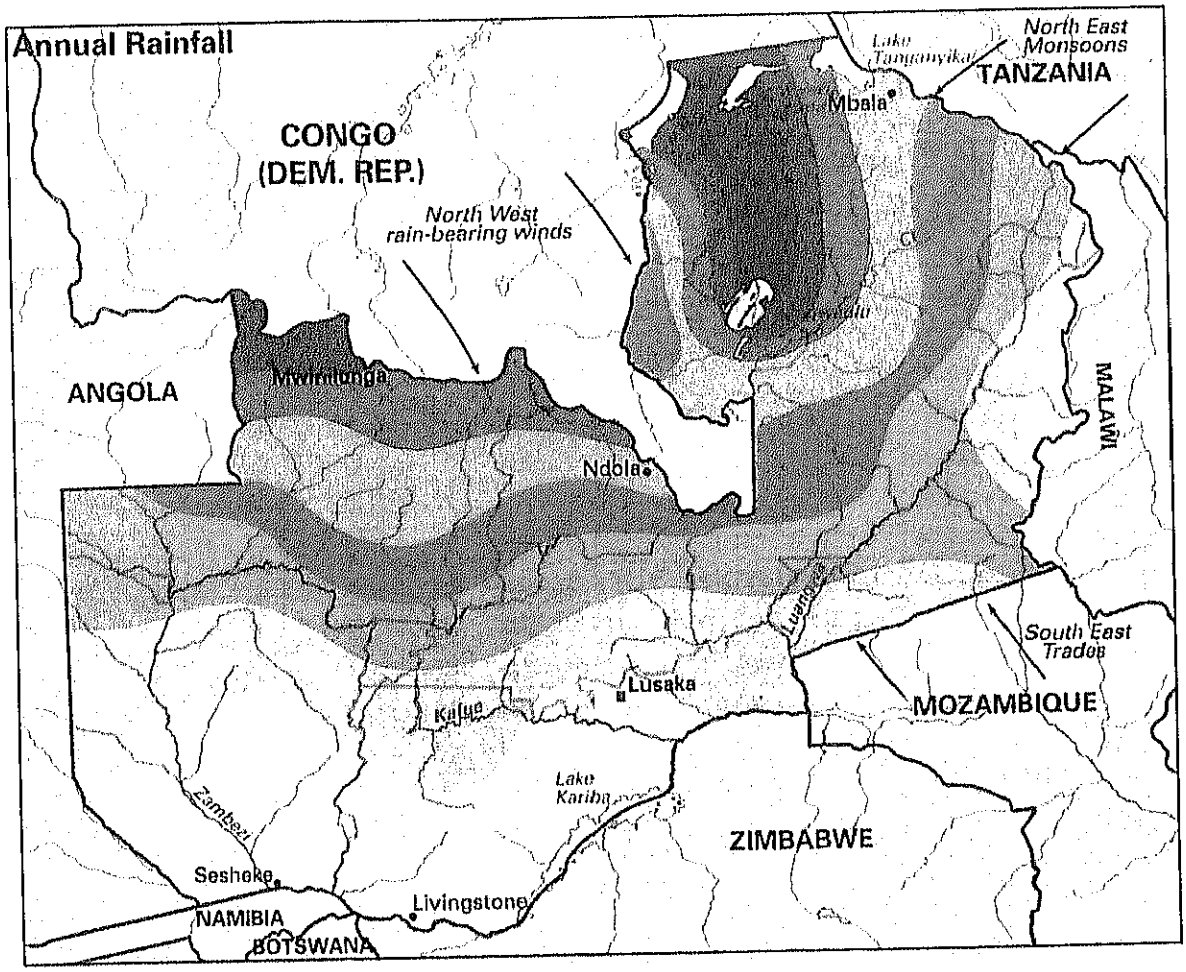
(出典：Basic Education Atlus of Zambia から作成)

参考図－3　Zambia 国北部



(出典：Basic Education Atlus of Zambia から作成)

参考図－4　Zambia 国の人口分布図



Key

Average Annual Rainfall

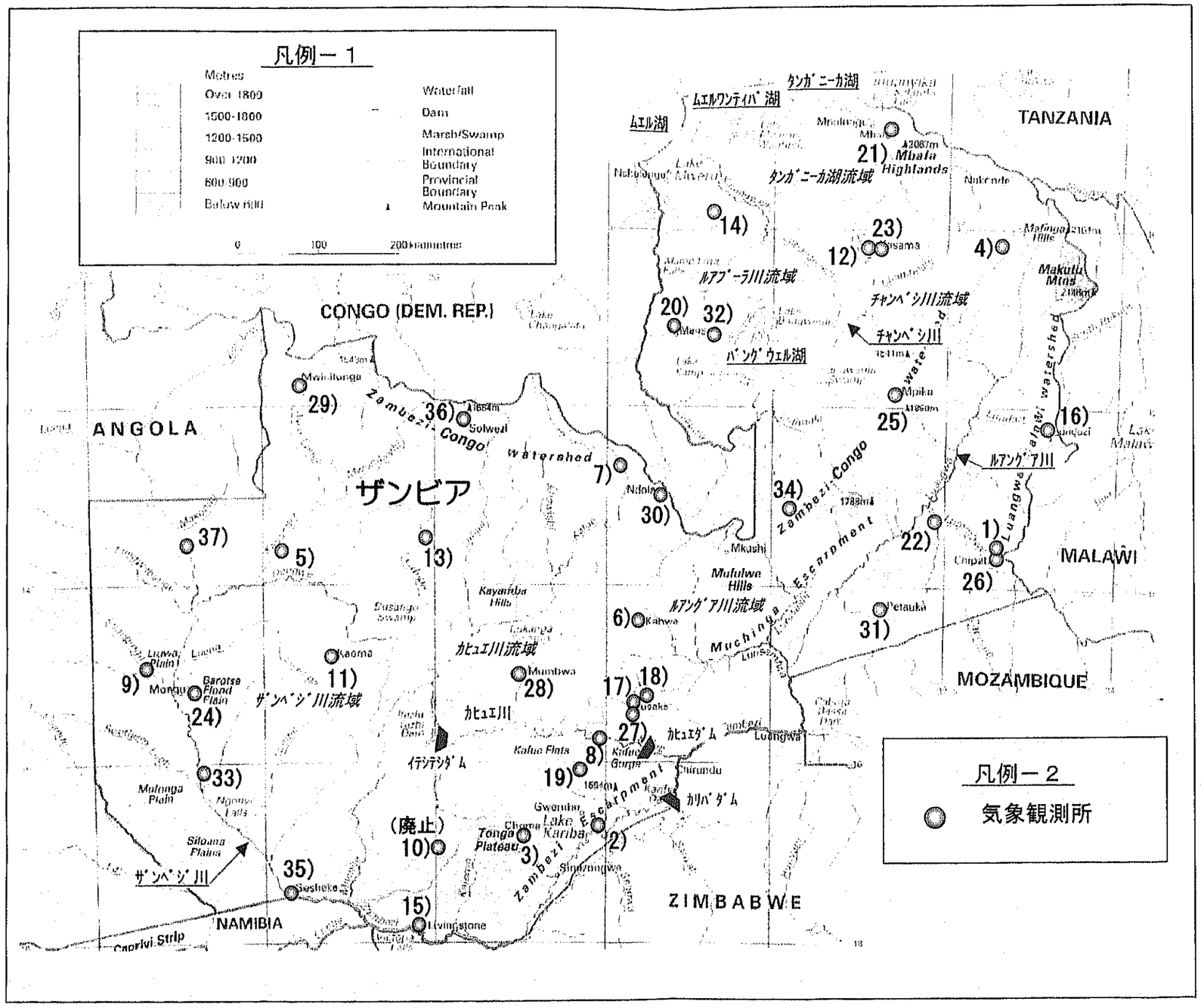
Millimetres

- Over 1500
- 1400-1500
- 1300-1400
- 1200-1300
- 1100-1200
- 1000-1100
- 900-1000
- 800-900
- 700-800

→ Winds

(出典：Basic Education Atlus of Zambia から作成)

参考図ー5　等雨量曲線図

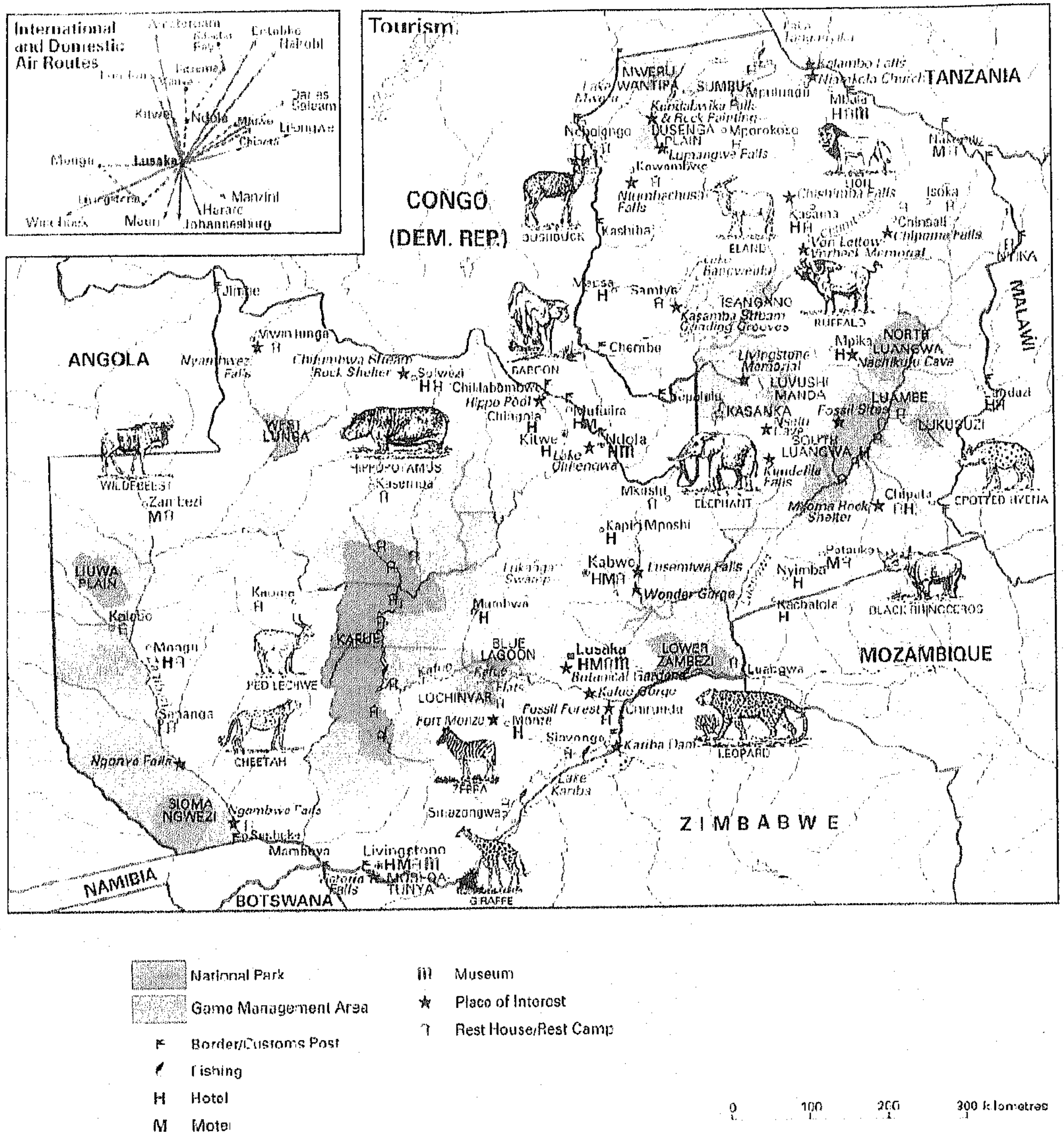


(出典：Basic Education Atlus of Zambia から作成)

参考図－6　ザンビア国の気象観測所位置

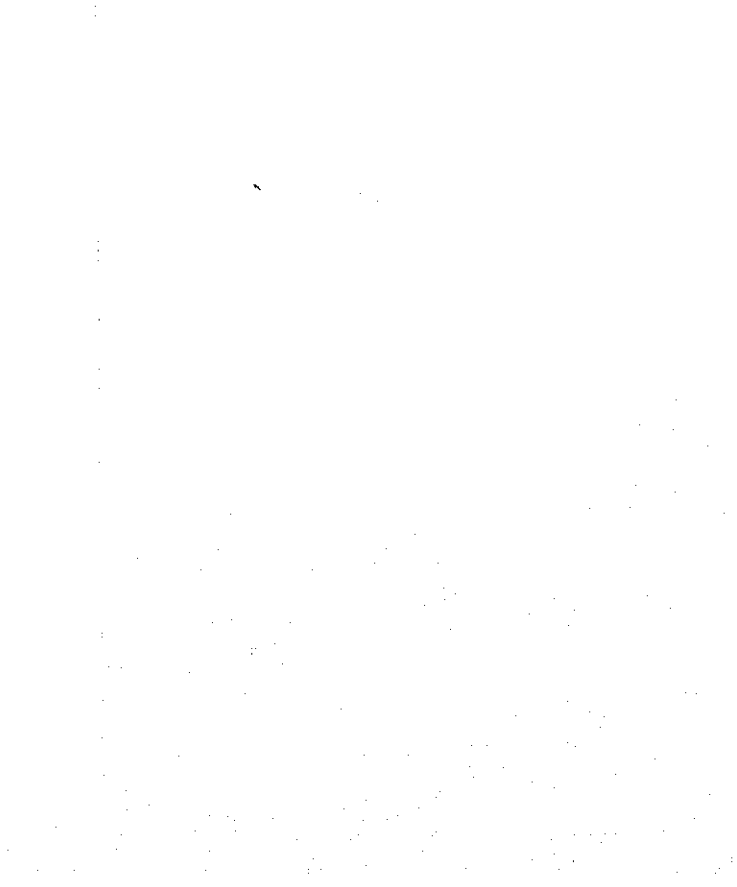
気象観測所一覧表

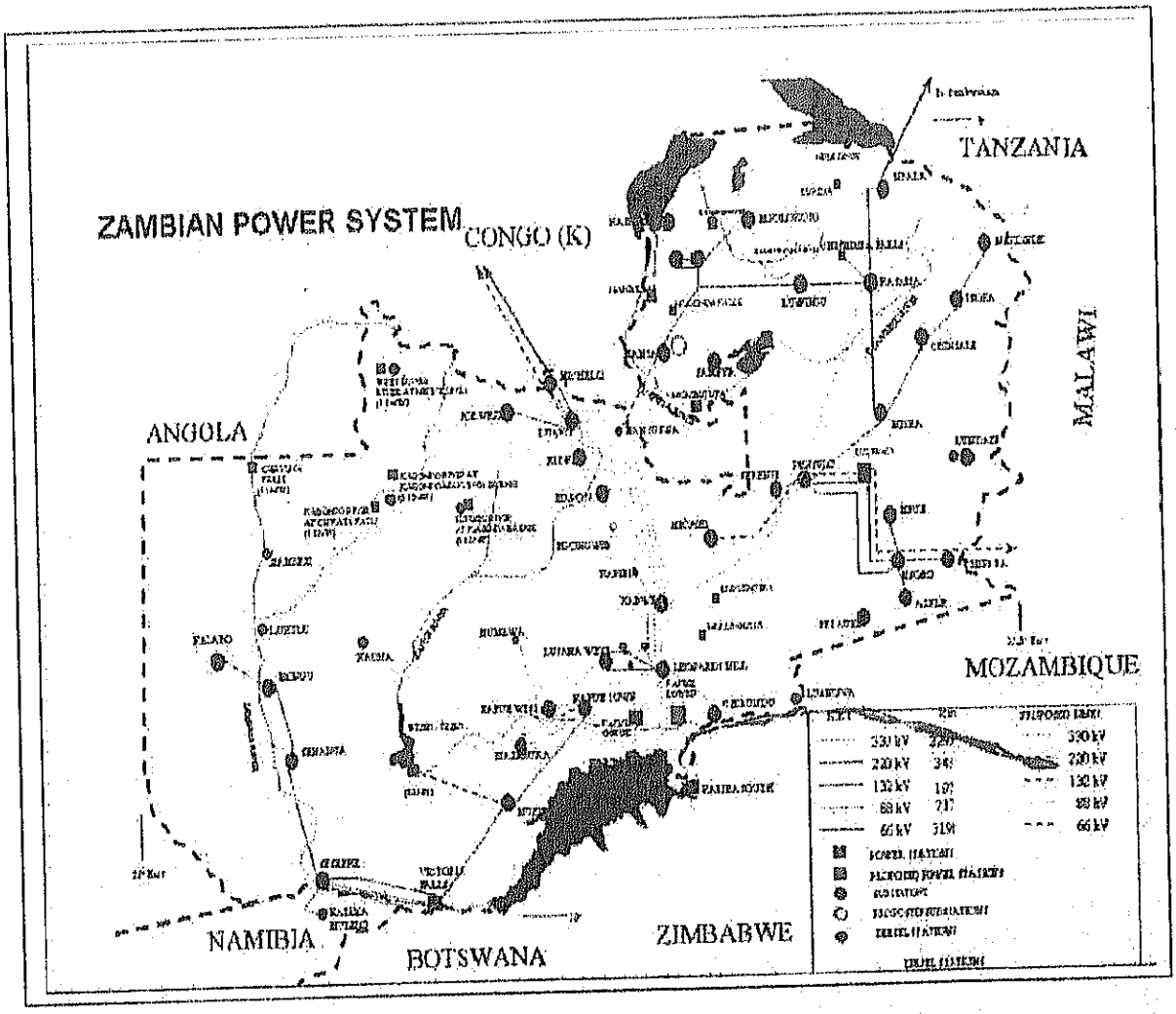
番号	観測所記号	位置 (deg)		観測所名
		東経	南緯	
1)	CHIPAT01	32.58	13.57	Chipata
2)	CHIPEPO	27.88	16.80	Chipepo
3)	CHOMA	27.07	16.85	Choma
4)	ISOKA	32.63	10.17	Isoka
5)	KABOMPO	24.20	13.60	Kabompo
6)	KABWE01	28.48	14.42	Kabwe
7)	KAFIRONDA	28.17	12.63	Kafironda
8)	KAFUE	27.92	15.77	Kafue
9)	KALABO01	22.70	14.95	Kalabo
10)	KALOMO09	26.00	17.00	Kalomo（廃止）
11)	KAOMA	24.80	14.80	Kaoma
12)	KASAMA01	31.13	10.22	Kasama
13)	KASEMP01	25.83	13.47	Kasempa
14)	KAWAMBWA	29.25	9.80	Kawambwa
15)	LIVING	25.82	17.82	L/stone
16)	LUNDAZI	33.20	12.28	Lundazi
17)	LUSAKA01	28.32	15.42	Lusaka Cit
18)	LUSAKA02	28.43	15.32	Lusaka Int
19)	MAGOYE	27.63	16.13	Magoye
20)	MANSA01	28.85	11.10	Mansa
21)	MBALA	31.33	8.85	Mbala
22)	MFUWE	31.93	13.27	Mfuwe
23)	MISAMF01	31.22	10.18	Misamfu
24)	MONGU	23.17	15.25	Mongu
25)	MPIKA	31.43	11.90	Mpika
26)	MSEKERA	32.57	13.65	Msekera
27)	MTMAKULU	28.32	15.55	Mt. Makulu
28)	MUMBWA	27.07	14.98	Mumbwa
29)	MWINIL	24.43	11.75	M/lunga
30)	NDOLA	28.66	13.00	Ndola
31)	PETAUK01	31.28	14.25	Petauke
32)	SAMFYA	29.32	11.21	Samfya
33)	SENANGA	23.27	16.12	Senanga
34)	SERENJE	30.22	13.23	Serenje
35)	SESHEKE	24.30	17.47	Sesheke
36)	SOLWEZ01	26.38	12.18	Solwezi
37)	ZAMBEZI	23.12	13.53	Zambezi



（出典：Basic Education Atlus of Zambia から作成）

参考図－7　Zambia 国立公園位置図





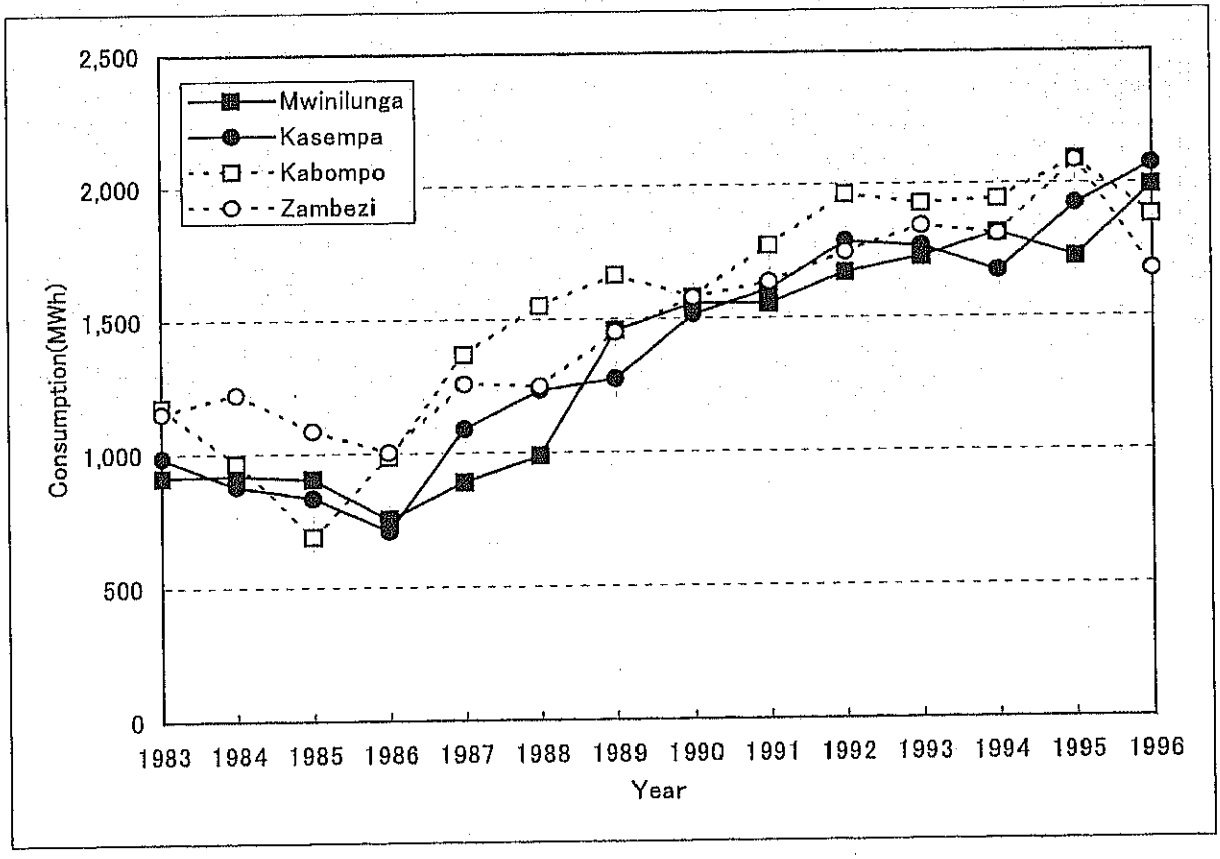
(既設送電線の状況)

記号	電圧（ｋＶ）	送電線亘長（km）
A	３３０	２，０４１
B	２２０	３４８
C	１３２	２０２
D	８８	５５７
E	６６	２，８２３
計		５，９７１

(出典：ZESCO)

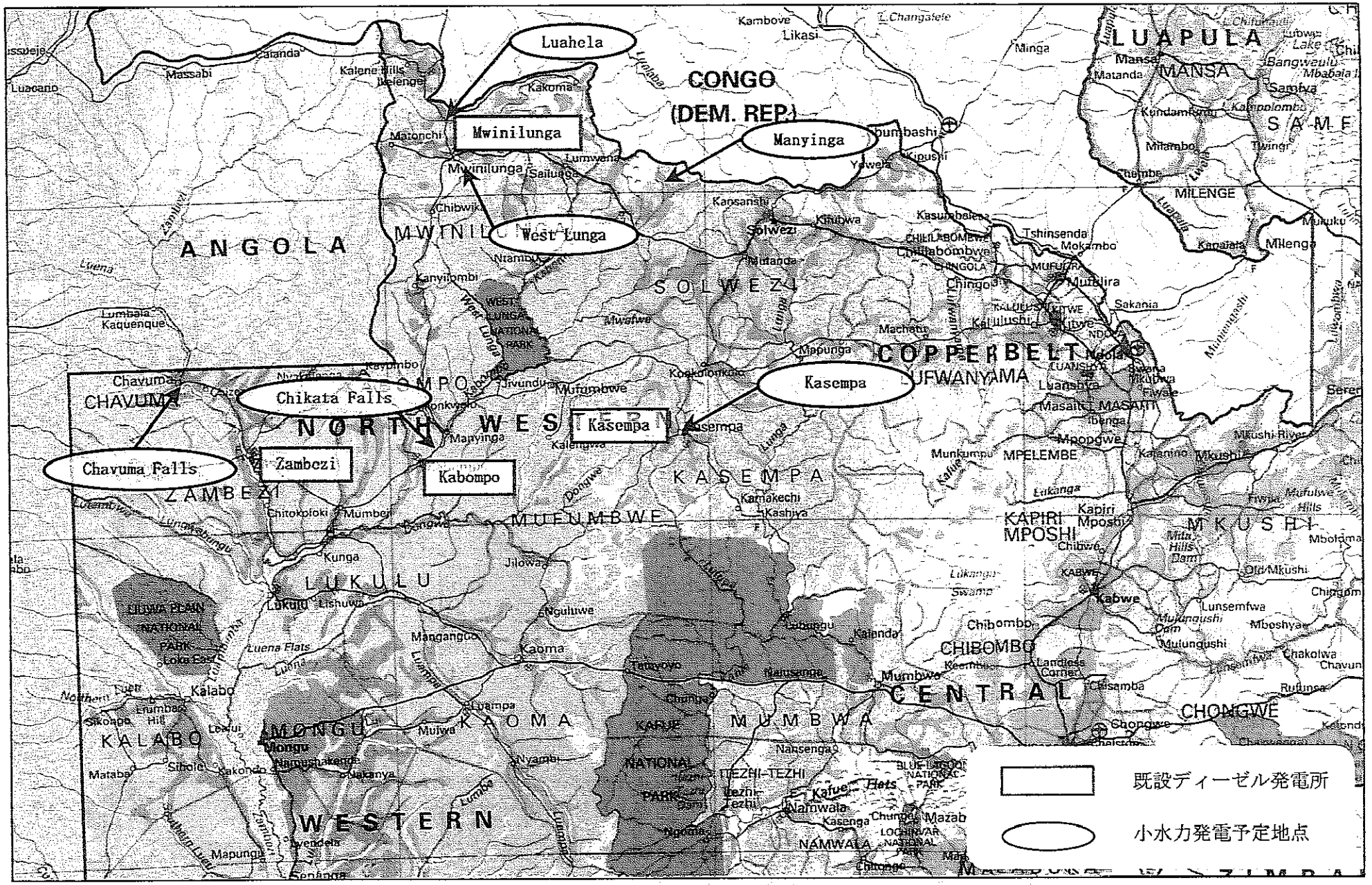
参考図－8　ザンビア国の電力系統図

District	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Mwinilunga	914	920	905	754	892	990	1,458	1,559	1,555	1,670	1,728	1,817	1,725	1,991
Kasempa	987	879	835	710	1,092	1,234	1,276	1,515	1,608	1,787	1,768	1,674	1,924	2,072
Kabompo	1,177	965	690	987	1,370	1,552	1,664	1,582	1,774	1,962	1,926	1,943	2,089	1,880
Zambezi	1,154	1,224	1,086	1,004	1,260	1,250	1,450	1,578	1,636	1,746	1,842	1,812	2,085	1,677



(出典：ZESCO)

参考図－9　ザンビア国北西部４郡の電力消費量の推移



参考図－10　小水力発電候補地点位置図

6．収集資料リスト

No	資料名	備考
1	Proposed Guidelines on Selection of Rural Electrification Projects for Funding by the Authority	
2	Proposed Terms of Reference for the Preparation of a Rural Electrification Master Plan	
3	Small Hydropower Pre-investment Study North-Western Province, Zambia	
4	The Air Pollution Control (Licencing and Emissions Standards) Regulations, 1996.	環境/規則
5	The Hazardous Waste Management Regulations, 2001	環境/規則
6	Environmental Protection and Pollution Control (Ozone Depleting Substances) Regulations, 2000	環境/規則
7	Pollution Control (Pesticides And Toxic Substances) Regulations, 1994	環境/規則
8	The Water Pollution Control (Effluent and Waste Water) Regulations, 1993	環境/規則
9	The Water Act	
10	List of Publication(Geological Survey of Zambia)	図面
11	Temparature Map	図面
12	Soil Map	図面
13	Educational Facilities Map	図面
14	Electricity Generation and Transmission Map	図面
15	Population Growth Map	図面
16	Medical Facilities Map	図面
17	Sunshine Map	図面
18	Vagetation Reference Map	図面
19	GIS Data	REA収集データ
20	他ドナーの関連資料	
21	その他	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