

**THE MINISTRY OF HEALTH, KHARTOUM STATE
THE REPUBLIC OF THE SUDAN**

**PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR IMPROVEMENT OF HEALTH CARE
SERVICE IN SUBURBAN AREA OF KHARTOUM STATE
IN
THE REPUBLIC OF THE SUDAN**

APRIL 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

**SYSTEM SCIENCE CONSULTANTS INC.
BINKO INTERNATIONAL LTD.**

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the project for improvement of health care service in suburban area of Khartoum State in the Republic of the Sudan and entrust the survey to the consortium of System Science Consultants Inc. and Binko International Ltd.

The survey team held a series of discussions with the officials concerned of the Government of the Republic of the Sudan, and conducted field investigations from August 23 to September 16, 2014. As a result of further studies in Japan and the explanation of the draft survey report in the Republic of the Sudan from February 13 to February 20, 2015, the present report is finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Sudan for their close cooperation extended to the survey team.

April, 2015

Takao Toda
Director of Human Development Department
Japan International Cooperation Agency (JICA)

SUMMARY

1. Outline of the Republic of the Sudan

The Republic of the Sudan (hereafter referred as Sudan) is located at the north eastern part of the African continent, bordered by: Egypt to the north; Libya and Chad to the west; Central Africa and South Sudan to the south; and Ethiopia and Eritrea to the east. Sudan also faces to the Red Sea at its north eastern side. Its land area is approximately 1.88 million km² which is about 5 times bigger than that of Japan. Its population is approximately 379 million (World Bank, 2013). The majority of its terrain is vast flat plains and the River Nile runs across almost the middle of the nation through south to north. The northern part of the nation is occupied by the Nubian Desert and duneland spreads from the central to the southern part of the nation. The northern and the central areas of Sudan is a desert climate while the southern area is a savannah climate.

The capital city of Khartoum creates the biggest metropolitan area of Sudan as its centre located where the White Nile, running from south to north starting from the Lake Victoria via South Sudan, meets the Blue Nile, running from southeast with its origin at the Lake Tana in Ethiopia. The area of the Khartoum State is 220 thousand km². With a flow of internally displaced people (IDP) that exceeds over one million, its population has swollen from 5.27 million in 2008 to 6 to 7 million today. The hottest season at Khartoum is from April to July and the maximum temperature during said months exceeds 40 degrees Celsius. The annual rainfall does not reach 100mm. Sandstorms frequently develop from May to September.

While Sudan is a multiethnic, multicultural and multilingual country, its people are roughly divided into two ethnic groups: 'people with an Arabic origin who brought in Islamic culture' and 'people intermarried with indigenous blacks.' The current nation is composed of descendants of these two groups. The main language used is Sudanese Arabic. Concerning religions, Muslim, mainly Sunni Muslim, accounts 70% of all population. Others are: approximately 18% for traditional religions including Animism and approximately 5% for Christianity. Besides, there are about 0.2 million Coptic Christians among one of the northern ethnic groups.

GDP in Sudan accounts 66.7 billion USD which is the 7th in position among African nations (IMF). On the other hand, GDP per capita reaches 1,941 USD which accounts the 18th in entire Africa. GDP composition ratio for industries is: 39% for the service industry; 33.6% for the manufacturing industry; and 27.4% for the agriculture (Statistics 2013). As for the composition ratio of labour forces, people engaged in the agriculture accounts approximately 80% while 7% engages in the manufacturing industry and 13% in the service industry (CIA Fact book, 1998). However, the arable land accounts only about 6.7% of the entire land (CIA Fact book, 2013) allowing extremely limited area for the agricultural development. Thus, a half of farmers lives below the poverty line. Moreover, the economic condition of Sudan became worse due to an economic loss resulted from the independence of South Sudan, possessing 75% of oilfields, in September 2011. The national budget balance is in deficit as its income is 4.513 billion USD while its expenditure is 6.842 billion USD (estimated figures in 2013). In order to secure incomes that substitute oil, the government of Sudan (GOS) currently aims to develop mineral resources (iron ore, copper, chrome ore, zinc, tungsten, mica, silver, gold, etc.) with development potentials.

2. Background of the Project and its Outline

Due to an impact of the long lasting civil war, not enough health services are provided in Sudan. The national indexes in the health sector show: neonatal mortality rate 33/1,000 live births; infant mortality rate 57/1,000 live births; under-5 year mortality rate 78/1,000 live births; and maternal mortality ratio 216/100,000 live births (Sudan Household Survey 2010). There is also a wide regional difference.

Especially in Khartoum State, due to an inflow of people from war affected areas including Darfur, one million IDP (internally displaced people) were spawned during 3 years from 2008 to 2011. This resulted in increasing demands towards health services in suburbs of Khartoum State. The Ministry of Health, the Republic of the Sudan, began preparation of health centres (Family Health Centre and Family Health Unit), the primary health facilities, by the PHC Expansion Project based on The National Health Sector Strategic Plan (NHSSP II). However, as the secondary health facilities (including rural hospitals) which are the referral from the primary are not yet developed sufficiently, regional gaps in health service levels have been created. Out of 7 localities composing Khartoum state, a little less than 60% of its population is concentrated in 3 suburban localities (Umbaddah, Sharq Alneel, and Jabal Awilya). However, a number of the secondary health facilities is limited in these localities and a number of beds is 3.41 for every 10,000 people (2011) in average which is way below the standard (12 beds for every 10,000 people) (another standard is 1,460/bed that is indicated Sudan Health Map Khartoum) defined by the state. The health service in 3 localities is, therefore, behind. As for personnel in the health service sector, a number of village midwives (VMW), the major driving force for maternal and child healthcare remains 24 VMWs for every 100,000 people (2011). The figure is below the state standard of 100 VMWs for every 10,000 people and another 400 VMW need to be trained. Under these circumstances, the Sudanese government has requested assistance from the Japanese government in the form of grant-aid to expand the health services which to be provided for residents through the construction of midwifery school units and expansion of secondary healthcare facilities in Khartoum State.

The request was composed of six building components targeting three existing healthcare facilities located in suburbs of Khartoum State. Six components were constructions of healthcare facilities and the branches of midwifery schools, combined with procurement of equipment for each facility and school. Contents of the request is shown in the table below.

Table-1 Contents of the Request

	Requested Site	Component	Locality
1.	Umbaddah General Hospital	① Construction of a maternal and child health section and procurement of equipment ② Construction of a branch of midwifery school and procurement of equipment	Umbaddah
2.	Alban Jadid General Hospital	③ Construction of a maternal and child health section and procurement of equipment ④ Construction of a branch of midwifery school and procurement of equipment	Sharq Alneel
3.	Triaat Albija Health Centre	⑤ Construction for upgrading to rural hospital and procurement of equipment ⑥ Construction of a branch of midwifery school and procurement of equipment	Jabal Awilya

3. Outline of the Survey Result and the Project Content (Outline Design Drawing, and Construction Plan/ Equipment Plan)

Upon the request from the government of Sudan (GOS), the government of Japan (GOJ) decided an implementation of the preparatory survey which JICA dispatched a preparatory survey team and conducted a field survey from August 23 to September 16, 2014. Through summarising and analysing results of the survey, the team narrowed down requested contents to one site with one component, the construction of an additional facility for maternal and child health section and procurement of equipment in the Umbaddah General Hospital, Umbaddah locality (① in the above table) and developed a detailed plan. Subsequently, after explanation and discussion over the draft report of the preparatory survey in February 2015 in Sudan, the Sudanese side has agreed with the contents described in the report submitted by the Japanese side.

The Project shall establish a new health facility and procure necessary medical equipment for providing maternal and child health services targeting 5,000 annual deliveries within a compound of the existing Umbaddah General Hospital which is located approximately 20 km from the centre of Khartoum State. There is currently no health facility that can provide child delivering services within Umbaddah locality (the only hospital, the Umbaddah General Hospital, has stopped its function from 2012 due to its structural default and is currently under the major renovation work). Through this cooperation project, the Umbaddah General Hospital will recover its delivering capacity to the scale that of until the begging of 2012 by securing the environment that enables the provision of appropriate services. Moreover, the project enables the hospital to handle increasing number of deliveries by the target year of 2020 and therefore contributes to improve maternal and child health service in not only Umbaddah locality but also entire Khartoum State.

The outline of the cooperation project is shown in the table below.

Table-2 Outline of the Cooperation Project

Facility		
Facility component	Zone	Contents
Maternal and Child Health Section (total floor area: 4,653 m ²)		
Ground floor 2,720 m ²	Common Zone	Entrance, Waiting Area, Reception, Cashier, Medical Record, Toilet (Male/ Female), Slope, Stairs, Cafeteria, Kitchen, Electrical Panel Room
	Outpatient/ Laboratory/ Pharmacy Zone	General Outpatient Triage, Consultation Room (ANC/PNC, Immunization/ Growth Monitoring, Family Planning), Ultra Sound / ECG Room, Gynaecological Examination Room, Laboratory, Urinal Collection, Blood Collection, Blood Bank
	Delivery Zone	Nurse Station, Labour Room, Delivery Room, Post-Delivery Room, Nursery (un-septic), Nursery (septic), Medical Waste Stock, Storage, Linen Room, Ante Room, Inpatient Toilet, Staff Toilet (Male/ Female), Night Reception, Waiting Space of Night Visitor
	Operation Theatre (O/T) Zone	Ante Room, Changing Room (Male/ Female), Shower Room (Male/ Female), Equipment Storage, Recovery Room, Scrub/ Washing Room, Sterilization Room, Equipment Stock Room, Service Corridor, Changing Room for Staff

Facility		
Facility component	Zone	Contents
	Service zone	Laundry, Machine Room, Staff Office, Staff Room (Male/Female), Night Duty Room (Male/ Female), Workshop, Toilet (Male/ Female)
	First floor 1,867 m ²	Ward Zone
		Bed Room (5 beds), Private Room (with Shower & Toilet), HDU, Storage, Linen Room, Medical Waste Stock, Pantry, Nursing Room, Inpatient Shower, Inpatient Toilet
		Health Education Zone
		Health Education/ Seminar Room, Health Educator/ Staff Office, Storage
	Administration Zone	Director General's Room, Secretary Room. MCH Director's Room, Accountant Room, Storage, Meeting Room, Statistics Room, Resting Room, Office
Roof floor 66 m ²	-	Stairs
Annex Facilities 148 m ²	Electricity building	Transformer room, Main Distribution Panel Room, Generator Room
	Pump building	Pump Room
External Zone and other facilities	-	Parking, Car Entrance Area, Slope, Water Reservoir, Septic Tank, Treatment Tank, Elevated Water Tank
Total Floor Area including Annex Facilities 4,801 m ²		
Equipment		
Places to be installed	Contents	
Common Zone	Consultation Chair, Consultation Desk, Reception chair, Waiting Chair, etc.	
Outpatient/ Laboratory/ Pharmacy Zone	CTG, Ultrasound scanner type A, Gynaecology examination table with foot step, ECG machine, Medicine cabinet, Refrigerator, Coagulometer, Electrolyte (ISE) analyzer, Hematology Analyzer, Hot air oven, Platelets Incubator with Agitator, Spectrophotometer, etc.	
Delivery Zone	CTG, CPAP, Infant Incubator, Neonatal Monitor, Ultrasound scanner type B, etc.	
Operation Theatre (O/T) Zone	Anaesthesia machine with ventilator, Defibrillator, Electrosurgical unit, Hand Scrub station, High pressure steam sterilizer, Infant Incubator, Infant warmer, OT Lamp with battery, OT table (Hydraulic), Patient Monitor, etc.	
Service zone	Drying Machine, Press Machine, Washing Machine, etc.	
Ward Zone	HDU bed, Hospital bed with mattress, Infusion pump, Patient Monitor, Suction unit, Syringe pump, etc.	
Health Education Zone	LCD Monitor, Projector, Projector screen, Stacking Chair, etc.	
Administration Zone	Locker, Meeting table(M), Meeting table(L), Rack for storage, etc.	

4. Implementation Schedule and Cost Estimation of the Project

For the implementation of the project, 4 months are required for the detailed design; 3 months for the works related to tendering and 18 months for the construction work and procurement/ installation of equipment. The Cost to be borne by the Sudanese side is estimated to be 13.5 million yen to execute this Project.

5. Project Evaluation

(1) Relevance

This plan is relevant as for the project under the Japanese Grant Aid scheme due to reasons described below.

① Fair supply of maternal and child health services

Out of 7 localities in Khartoum State, Umbaddah locality has the second largest number of public healthcare facilities after Sharq Alneel locality. However, after the closure of the Umbaddah General Hospital in 2012, there is no public hospital at the secondary level within the locality which provides maternal and child health services for free of charge. The maternal and child health section of the Umbaddah General Hospital, the facility planned by the project plan, ensures fair access for maternal and child health services among women and children in the locality and contributes in building a better health service providing structure. For said reasons, its relevance is considered to be well recognized.

② Target beneficiaries of the Project

Umbaddah locality is the most populated (approx. 1.127 million) and has the biggest number of pregnancies (approx. 45 thousand cases) among localities within Khartoum State. Furthermore, Umbaddah locality accommodates many poor and the number of incoming IDP is the largest among all localities within Khartoum State. Considering said increasing number of direct beneficiaries (including pregnant women and children among IDP), the project relevancy is thought to be high.

③ Human security

Human security means focusing on individual people and building societies in which everyone can live with dignity by protecting and empowering individuals and communities that are exposed to actual or potential threats (Ministry of Foreign Affairs of Japan, 2014). There is no public general hospital in Umbaddah locality and its maternal mortality and neonatal mortality rates are high. In other words, many pregnant women and newborn babies are exposed to a threat of not being able to access appropriate treatment promptly. Introduction of facilities and equipment for the maternal and child health section through the implementation of the project will provide opportunities for receiving necessary treatment in a prompt manner for women and children within the locality. This matches with ‘an expansion of maternal and child health related services and training of human resources in nursing sector’ which is indicated in one of the Japanese priority policies for international cooperation, ‘supporting women’s empowerment and promoting gender equality.’

④ Contribution towards achieving the goal of mid/ long-term development plan in the recipient country

The implementation of this plan shall provide quality maternal and child health services at Umbaddah locality as well as obstetrical practical training opportunities for both medical students and students studying midwifery. It therefore contributes ‘reduction of maternal and child death rate,’ and ‘development of human resources in the health sector which satisfy the requirement of the health system’

in the Sudanese long-term health plan and ‘infrastructure development’ and ‘human resource development’ that are the priority items in the mid-term health plan.

⑤ Consistency with the Japanese country assistance policy

One of the priority areas (sub goals) in the Japanese country assistance policy for Sudan is assisting basic human needs (BHN). This project plan comes under the supply of appropriate services and infrastructure in the health sector which matches with the Japanese assistance policy.

(2) Effectiveness

1) Quantitative Effects

As the Umbaddah General Hospital at the target site has closed since 2012, the current achievement of each health service is null. However, in order to measure impacts of the Japanese grant aid cooperation quality expected by the implementation of the project, achievable target values for the project quantitative effect indicators will be set as figures from the last year operation of the Umbaddah General Hospital (2011) as baseline values. The target year will be 2020, 3 years after the completion of the project.

Table-3 Quantitative Effect Indicators and Target Values

Indicators	Baseline Value (actual figures in 2011)	Target Value (2020) (3 years after the project completion)
No. of child birth delivery at the target hospital	3,626 cases	5,000 cases
No. of patients for ANC/PNC at the target hospital (cumulative total No.)	14,504 person* *No. of delivery x 4 (3 ANC, 1 PNC)	30,000 person* * No. of delivery x 6 (4 ANC, 2 PNC)
No. of C/S conducted at the target hospital	703 cases	1,000 cases

2) Qualitative Effects

Through the implementation of the project and as the maternal and child health section of the Umbaddah General Hospital is being operated and maintained, following qualitative effects are expected.

- ① Patients with serious illness are transferred from health facilities with lower levels (health centres and health posts)
- ② The facility is used as an obstetrical practical training facility for both medical students and students studying midwifery.
- ③ Regional differences in deliveries at facilities within Khartoum State are mitigated.
- ④ Life insecurity of local women is reduced.
- ⑤ The satisfactory rate among facility users and motivation towards works among medical

personnel are increased by introducing new facility and equipment.

- ⑥ Costs for transportation and stays required for deliveries at hospitals in distance are to be reduced.

Considering above, the relevancy and effectiveness of implementing the project under the Japanese Grant Aid scheme is recognised as it provides an environment for safe deliveries among mothers and children in Umbaddah locality and contributes in the improvement of both quantity and quality of maternal and child health services.

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Site Location Map

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ABBREVIATIONS

Abbreviations	Description
AC	Air Conditioning
ANC	Antenatal Care
A/P	Authorization to Pay
B/A	Banking Arrangement
B-EmOC	Basic Emergency Obstetric Care
B.H.	Bore Hole
BS	British Standard
CMW	Community Midwife
CPAP	Continuous Positive Airway Pressure
C-EmOC	Comprehensive Emergency Obstetric Care
C/S	Caesarian Section
DG	Director General
E/N	Exchange of Notes
FHC	Family Health Centre
FHU	Family Health Unit
FMOH	Federal Ministry of Health
G/A	Grant Agreement
GDP	Gross Domestic Products
HIV	Human Immunodeficiency Virus
HDU	High Dependency Unit
ICU	Intensive Care Unit
IDP	Internal Displaced People
IMF	International Monetary Fund
KSWC	Khartoum State Water Corporation
LPG	Liquefied Petroleum Gas
MCH	Maternal & Child Health
MDGs	Millennium Development Goals
NEC	National Electricity Corporation of Sudan
NHSSP II	National Health Sector Strategic Plan II
NICU	Neonatal Intensive Care Unit
NST	Non-Stress Test
ODA	Official Development Assistance
OPD	Outpatient Department
PHC	Primary Health Care
PNC	Postnatal Care
RC	Reinforcement Concrete
SDG	Sudanese Pound
SMOH	State Ministry of Health
SPT	Standard Penetration Test
SSMO	Sudanese Standards & Metrology Organization
UAE	United Arab Emirates
VMW	Village Midwife
WHO	World Health Organization

CHAPTER 1 BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

1-1 Background of the Request for Japan's Grant Aid Assistance and its Outline

(1) Background of the Request

Due to an impact of the long lasting civil war, not enough health services are provided in the Republic of the Sudan. The national indexes in the health sector show: neonatal mortality rate 33/1,000 live births; infant mortality rate 57/1,000 live births; under-5 year mortality rate 78/1,000 live births; and maternal mortality ratio 216/100,000 live births (Sudan Household Health Survey 2010). There is also a wide regional difference.

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The request was composed of six components targeting three existing healthcare facilities located in suburbs of Khartoum State. Six components were constructions of healthcare facilities and the branches of midwifery schools, combined with procurement of equipment for each facility and school.

Table 1-1 Contents of the Request

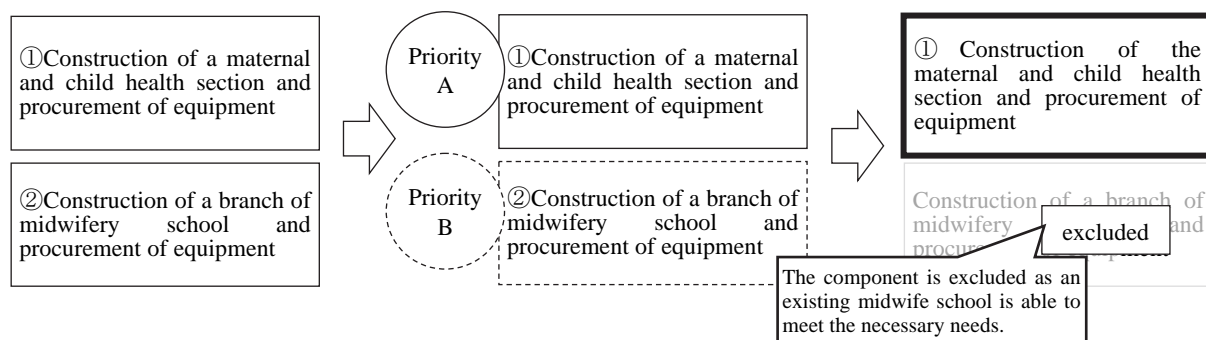
	Requested Site	Component	Locality
1.	Umbaddah General Hospital	① Construction of a maternal and child health section and procurement of equipment ② Construction of a branch of midwifery school and procurement of equipment	Umbaddah
2.	Alban Jadid General Hospital	③ Construction of a maternal and child health section and procurement of equipment ④ Construction of a branch of midwifery school and procurement of equipment	Sharq Alneel
3.	Triaat Albija Health Centre	⑤ Construction for upgrading to rural hospital and procurement of equipment ⑥ Construction of a branch of midwifery school and procurement of equipment	Jabal Awilya

(2) Changes in Requested Contents

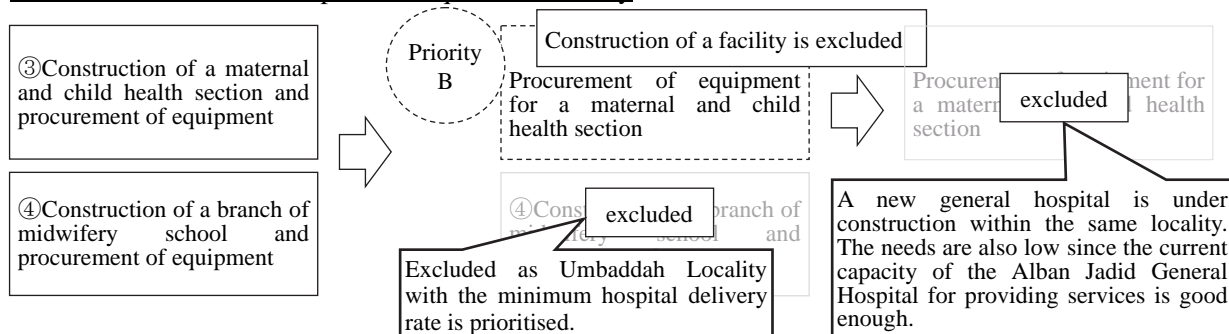
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Initial Contents of the Request	Changed Contents of the Request (at the field survey)	Target Components
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1. Umbaddah General Hospital, Umbaddah Locality



2. Alban Jadid General Hospital, Sharq Alneel Locality



Initial Contents of the Request	Changed Contents of the Request (at the field survey)	Target Components
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3. Triaat Albija Health Centre, Jabal Awlyaa Locality

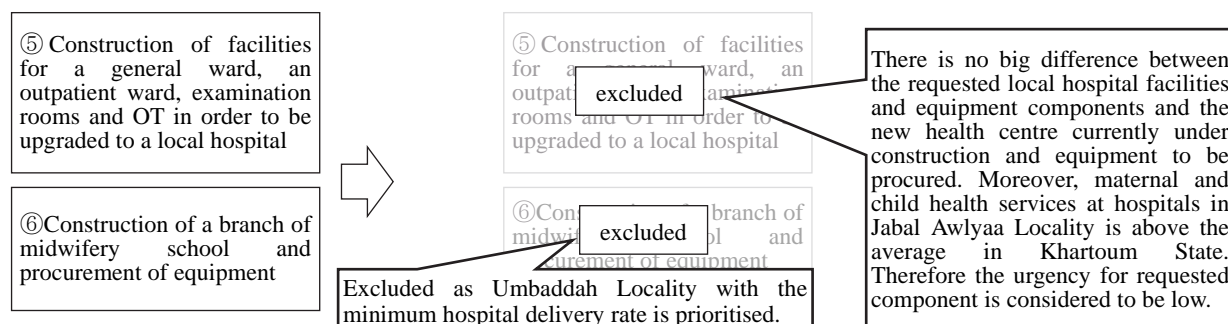


Fig. 1-1 Change in Requested Contents

The selection results based on reviews over their relevance for rejected components: Alban Jadid General Hospital; Triaat Albija Health Centre; and branches of midwifery schools are described below.

(Alban Jadid General Hospital, Sharq Alneel Locality)

There are 5 existing hospitals (3 general hospitals and 2 rural hospitals) in Sharq Alneel locality. In addition, SMOH is currently conducting construction of the New Sharq Alneel General Hospital (the construction started in 2013 and its work is on progress) and an additional building for the Om Dawang Ban Hospital. With these two hospitals, a maternal and child health service environment and accessibility to healthcare facilities will be further improved in Sharq Alneel Locality. The delivering rate in hospitals in Sharq Alneel Locality is 47.1% (2013) which is close to the State average of 51.9%. Once the New Sharq Alneel General Hospital is completed, the figure is estimated to exceed the State average. Looking into above mentioned situation, urgency in establishing a new hospital facility in Sharq Alneel Locality by the Japanese grant aid scheme is considered to be low.

On the other hand, situation of maternal and child health services in the existing facility at the Alban Jadid hospital is that delivery rooms and operation theatres are demarcated in appropriate lines of flow while necessary equipment for services are provided and maintained despite of some failures. Under the hospital head with strong leadership and experiences of handling over 3,000 deliveries, the hospital supplies services towards local demands. Considering above, urgency for an additional maternal and child health facility within the Alban Jadid Hospital is thought to be low and excluded from the project component.

(Triaat Albija Health Centre, Jabal Awlyaa Locality)

There is high contribution by the community towards the requested site in Jabal Awlyaa locality. The community repairs the existing health centre building that is damaged by cracks for its continuous usage. On the one hand, a new health centre building is under construction within its premises with the budget from SMOH. Simultaneously, operation theatres, x-ray diagnostic apparatus and ultrasound scanner will be equipped in the existing health centre. Though neither

vaginal delivery nor Caesarean section (C/S) will be handled, the new health centre will provide following services/ functions: a general outpatient practice; immunization; nutrition counselling; antenatal/ postnatal care (ANC/ PNC); family planning; inspection laboratory; pharmacy; administrative services beside others. Through the establishment of a new building and equipment, SMOH plans to upgrade the centre to a referral health centre. The centre then will be more or less at the same level as functions/ scales of rural hospitals except delivery services.

Alternatively, there are 3 secondary levelled general hospitals in Jabal Awlyaa locality that handle both vaginal delivery and C/S. Having these three hospitals, Jabal Awlyaa locality fulfils the standard for hospital allocation: one general hospital for every 500,000. A need for a new hospital is low from the view point of the hospital allocation standard as there exist two general hospitals in Kalakla health unit (one of two health units in Jabal Awlyaa locality) where the Triaat Albija Health Centre is located. In a case of emergency, one can travel from the centre to said two secondary levelled general hospitals, one in south and one in north, in 20 minutes by car using the arterial road in front of the centre respectively. In addition, a delivering rate in hospitals in Jabal Awlyaa locality is 60.9% (2013) which is higher than the average of Khartoum State by 9%, indicating low needs and urgency for a new maternal and child health facility. Considering above, urgency for a new local hospital in Jabal Awlyaa locality is thought to be low and the requested site is excluded from the Project.

(Branches of midwifery schools)

There are two standards for Community Midwife (hereafter referred as CMW) training needs. One is the allocation of one CMW in every village which is the goal of the PHC Expansion Project. Another standard is to allocate one CMW for every 2,000. Needs for CMW in each locality as of September 2014 is shown in the table below. Assuming the quota of the Bahry Midwife School, the only school for CMW in Khartoum State, as 90 students/ year, the number of required CMW as of 2014 based on either standard will be met within coming 10 years. However, the Bahry Midwife School plans to accept students from Darfur State until 2016 (the number is not decided), and it may influence a number of CMW to be trained within Khartoum State. Moreover, a number of applicants wishing to enter the school is less than its quota as the entrance qualification is the secondary school graduation certificate. Village leaders and staff of the Locality Health Office put efforts to recruit enrollees in order to fulfil the quota. The Ministry of Health and SMOH continue to review and frequently change the entrance qualification and curriculum of, and certificate to be obtained at CMW schools. At the time when the survey was conducted, VMW who has participated in a 15 month course and VMW who has participated in a 3 month course (bridge course) are all called under the same name of CMW. Whether to acknowledge CMW as a midwife specialised technician is not yet standardized and a clear position of CMW is still undefined. Thus, SMOH is not yet able to present a clear plan for training CMW for Khartoum State. The existing Bahry Midwife School is able to provide CMW training and fulfil a number of required CMW in coming 10 years. Moreover, a delivering rate in hospitals in Khartoum State is already high and is expected to further grow. In other words, the necessity for the expansion of a number of CMW in future is low. Therefore, the requests for branches of midwifery schools are excluded from the component of this grant aid project.

Table 1-2 Needs of CMW

Locality	No. of villages	Pop. not covered by CMW	Needs 1CMW/village	Needs 1CMW/2,000
Khartoum	40	30,097	4	15
Jabal Awlya	211	100,778	40	50
Omdurman	130	304,528	64	152
Kerrari	245	235,240	73	118
Umbaddah	214	889,283	98	445
Bahry	125	21,378	25	11
Sharq Alneel	387	25,620	68	13
Total	1,352	1,606,924	372	803

Sources) State Ministry of Health, Khartoum

1-2 Natural Condition

(1) Climate in Khartoum

An average temperature in Khartoum is approximately 25°C between December and February which is relatively mild while it goes up to 39°C or more from April to October being extremely hot. Moreover, there is a big difference of approx. 13°C between average maximum and minimum temperatures within a day. Rainfall is concentrated in July and August. The total annual precipitation is small which is approx. 88mm which is below 1/20 in Tokyo. The percentage of humidity during rainy season is about 38 to 52% otherwise it is dry with its figure being below 25%.

The wind tends to blow either from north or south-west. It is relatively mild throughout the year. However, sandstorms, composed of fine sand dust with its wind speed of 15m/sec. occur often from May to September.

Table 1-3 Climate Data of Khartoum (average between 2009 and 2013)

	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average.
Monthly Av. Temperature °C	24.7	28.0	28.8	33.1	35.3	35.6	33.2	31.6	33.6	33.4	29.0	25.2	31.0
Av. Highest Temperature °C	31.8	35.5	36.0	40.6	42.2	42.0	39.0	37.1	39.7	39.6	35.6	32.2	37.6
Av. Lowest Temperature °C	17.5	20.5	21.5	25.5	28.4	29.2	27.5	26.1	27.5	27.2	22.4	18.3	24.3
Av. Humidity %	23.6	19.0	14.0	10.6	14.2	22.2	38.4	51.8	37.2	24.4	22.0	26.2	25.3
Monthly Percolation mm	0.0	0.0	0.0	0.0	1.2	0.3	21.1	58.2	5.2	2.4	0.0	0.0	Total 88.4
Av. Wind Speed m/sec.	4.7	4.9	4.8	4.3	4.3	4.3	4.9	4.7	4.2	3.6	4.3	4.5	4.5
Wind Direction	N	N	N	N	NNW	SW	SW	SW	SW	NNW	NNW	N	NSW

Source: WEATHER- CLIMATE DATA (From 2009 to 2013), MINISTRY OF ENVIRONMENT, FORESTRY AND PHYSICAL DEVELOPMENT, METEOROLOGICAL AUTHORITY

Remarks: Maximum instantaneous wind speed 47.3m/s is the maximum recorded wind speed since 1964 in Khartoum.(Central Sudan surface wind data and climate characteristic, reports 88-01, 1988)

(2) Earthquakes

As Sudan is considered to be a nation with less-active seismic activity, there has been no directorate for earthquake records. However, considering a current increase of high storied buildings in and around Khartoum, the necessity for certain measures corresponding to risks of earthquakes began to be mentioned upon designing buildings in Sudan. However, there is no official design response spectral as of today.

① Recent earthquakes in and around Sudan

- Earthquake in South Sudan: 20 May 1999, Magnitude 7.4
- North Kurdufan State: 1 August 1993, Magnitude 4.3
- North Kurdufan State: 15 November 1993, Magnitude 5.5

② Earthquake research report

(13th World Conference on Earthquake Engineering, Vancouver, B.C., Canada, August 1-6, 2004, Paper No. 1508, DEVELOPMENT OF DESIGN RESPONSE SPECTRAL FOR CENTRAL KHARTOUM, SUDAN)

As there is no detailed record on the earthquakes listed in ①, this report studies by adapting other four earthquake data that detailed records are available to geologic strata in Central Khartoum. The outline of results from the earthquake study in Central Khartoum is described below.

- Natural period of the ground: 0.5 seconds
- Maximum spectral acceleration: 0.76 – 0.95 gal

(3) Disasters

In Khartoum, the Nile overflowed due to seasonal heavy rain in August 2007 and 2009 which caused flooding of surrounding areas. Moreover, the northern region of Khartoum experienced flooding due to heavy rain and approximately 150 thousands of residents had suffered in August 2013. The area that the project site is located in Umbaddah locality was not affected by this flooding.

(4) Site Topography

The project site used to be a soil catchment place which was reclaimed as a site for the general hospital in the locality. Before being reclaimed, the ground surface was gently inclined from the front road at the eastern side towards the western side of the site. After the reclamation, the ground surface became flat in general with difference in elevation being 10 or more cm within the planned site. The size of the site is 180m x 180m, a square in shape. It is adjacent to the arterial road on its eastern side. There is an open ditch for rain water drainage at the western side of the road and there are bridges at the entrances to the site. Though there is almost no difference in elevation between the site and an adjacent land at the southern side, adjacent lands at the northern and western sides are lower than the site by 30-90cm.

The location of the existing facilities and obstacles are shown in Fig. 1-2.

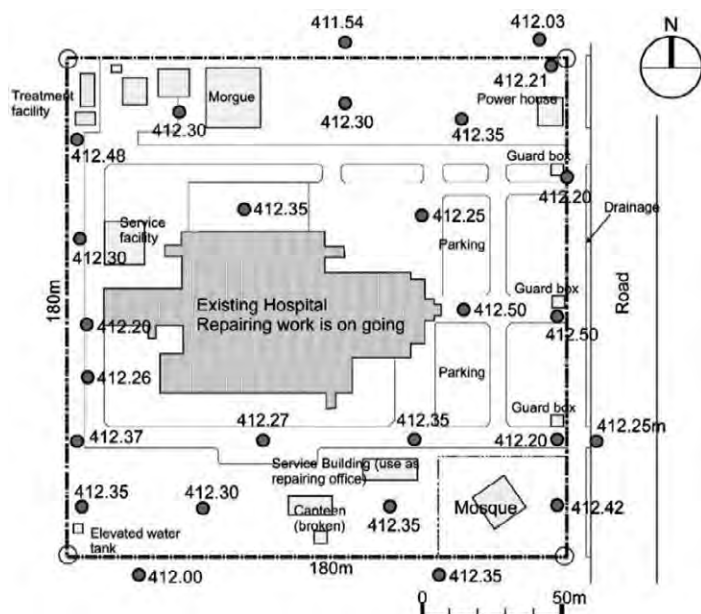


Fig. 1-2 Topographical map of Umbaddah General Hospital

(5) Geological features of the Site

Survey locations are determined based on a layout plan of planned facilities within the site. The survey conducted includes: the boring survey (20m in depth); SPT (Standard Penetration Test) (every 1m); and a soil sampling test.

Locations where the boring survey was conducted and the soil was sampled are shown in Fig. 1-3.

The outline of results for the geology survey is described as follows:

- Soils of the site are composed from geological layers of: silt-clay; silt-sand; clay-silt; and clay-sand. Thickness of each layer is unequal. These geological layers contain weak soil with decomposed sandstone and mudstone.
- There was no water in the borehole which indicates the water level of groundwater at the site is below 20m from the ground surface. However, it is necessary to note the possibility of surface water such as rain water causing an impact on the building foundation.
- PH of the soil at the site (2.0m in depth) is approximately 8.6 which incline to Alkaline.
- As for the test of soil bearing capacity, N value becomes approximately 20 at 2m below the ground surface. At 20m in depth, N values become 24 at BH.1, 34 at BH.2, and above 50 for other boreholes. However, there are places with weak soil with N value between 10 to 13 at the depth of 9-13 m.

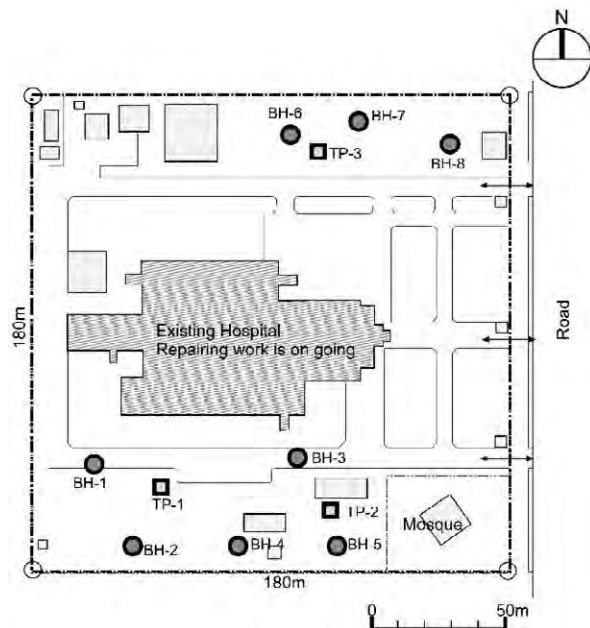


Fig. 1-3 Location of the boring survey

(6) Water Quality

The test results of water sampled from the existing well within the site confirm that water is appropriate for drinking in all tested items.

Table 1-4 Result of Water Quality Test

PARAMETER		UNIT	PARAMETER		UNIT
Appearance	Clear		Chloride	12	Mg/l
Turbidity	0.4	NTU	Fluoride	0.29	Mg/l
Colour	-	TCU	Sulphate	9	Mg/l
Odour	NIL		Ammonia	0.18	Mg/l
pH	7.5		Nitrite	0.022	Mg/l
Temperature	27.4	C°	Nitrite	NIL	Mg/l
E. Conductivity	461	LIS/CM	Iron	0.04	Mg/l
T.D.S	254	Mg/l	Calcium	40	Mg/l
T.S.S	-	Mg/l	Magnesium	20.4	Mg/l
Alkalinity	220	Mg/l	Sodium	29.1	Mg/l
pH Alkalinity	NIL	Mg/l	Potassium	5.74	Mg/l
T. Hardness	185	Mg/l	Manganese	0.02	Mg/l
Phosphate	0.39	Mg/l			

1-3 Environmental and Social Considerations

(1) Environmental Impact Assessment (EIA)

Environmental Impact Assessment (EIA) is required for a large scale development activity before its implementation. However, SMOH confirmed that EIA is not required for this project since the plan is to build a maternal and child health section building within the existing hospital site. Laws related to environmental and social considerations are listed below.

Table 1-5 Laws related to environmental and social considerations

Laws	Outline
Environmental Protection Act 2001	This law is the principles for environmental protection and appropriate use of natural resources. It regulates the establishment of the national committee for environmental authority.
Public Health Act 2008 (PHA) (revision of PHA 1975)	This law regulates the establishment of the national committee in the Ministry of Health, which has a responsibility to overall policies and plans related to environment and sanitation.
Environmental Health Act 2008 (EHA) (revision of EHA 1975)	This law regulates the establishment of the environmental committee for environmental and sanitary protection at the national level. Its purpose is, especially, to prevent air, water and soil pollution. This law established Environmental Health Committee (EHC) at the national and state levels. The state EHC has a responsibility to report the national EHC.
Industrial Waste Local for Khartoum North 1971	This law provides the qualitative regulations and conditions for the disposal of industrial wastes to the central sewerage treatment plant and others.
Environmental Protection Law 2008 by Khartoum State Ministry	This law is for the environmental protection at the state level. It is applied to implement the solid waste management at the state level.
National Plan for Environmental management in Post-Conflict Sudan (NPEM)	The plan is prepared through cooperation between Sudan and South Sudan supported by UNEP etc. However, it is not yet finalized as of 2014.

Source: Quoted from JICA Report 'Preparatory Survey on the Project for Improvement of Solid Waste Management in Khartoum State in the Republic of the Sudan,' February 2014

(2) Disposal of Medical Wastes

Regarding the disposal of medical wastes in Khartoum, each hospital keeps medical waste water into a tank and stores medical solid wastes into a container. They are periodically collected and sent to a processing plant. Medical waste water is heat-treated by steam and medical solid wastes are incinerated by a boiler. They are then buried at designated disposal sites in suburbs respectively. As the existing processing plant reached its processing capacity limit, a new processing plant is being built within the premises of the Al Saudi Maternal and Child Hospital (to be completed in January 2015). The building itself is almost completed and a boiler for generating steam and incineration

equipment are already installed. Medical wastes from the facility planned in this project will be carried and handled at the above mentioned new processing plant.

(3) Impact on the Surrounding Area during Construction Work

Though EIA is not required for the project, mitigation measures for minimizing the impacts during both construction and operation stages are summarised in the table below. Especially for the flows of movement of hospital users and construction vehicles need to be considered: they are to be demarcated by temporary fences and separate entrances will be introduced.

Table 1-6 Mitigation Measures that to be Considered

Items which may be impacted	Outline (Issues Concerned)	Possible Evasive Action/ Mitigation Measures
Land use	There is no extra space at the construction site for the planned building. Therefore, a temporary space for construction needs to be prepared in adjacent area. It is necessary to select an appropriate place for securing construction efficiency as well as safe movement of construction vehicles.	• An area at the south of the construction site is publicly owned that will be used for the temporary space for construction.
	It is necessary to demarcate a border between the construction site and traffic lines of renovation works on the existing hospital within the planned site.	• A construction supervisor and SMOH shall confirm on ensuring safe traffic lines.
	It is necessary to remove obstacles within the planned site and secure access for construction which minimise the impact on surrounding area.	• The removal of obstacles shall be completed before construction starts and the access paths for construction vehicles shall be secured by SMOH.
Existing social infrastructure and social service	There is possibility that the use of electricity and water for construction may cause impacts on surrounding infrastructure supply.	<ul style="list-style-type: none"> • Electricity for construction shall be provided by the generator for construction. • For minimising the impact, tap water that is stored during night or water from a well will be used for construction.
Sanitation	There will be some wastes to be produced during and after construction.	• The garbage space shall be introduced within the site in coordination with existing garbage collection system during the construction period. A worker in charge of waste management shall be posted.
Soil contamination	There may be a possibility of soil contamination by machinery oil, cement dust and rinsing liquid for paints during construction.	<ul style="list-style-type: none"> • A specific place for storing oil and toxic substances shall be designated. Their disposal methods will be coordinated with SMOH. • For waste oil and etc., storage tanks are set up for preventing soil contamination.
Noise and Vibration	Introduction of piles for supporting the foundation is included in construction works. As the construction site is located in some distance from the centre of the residential area, the impact on residents is expected to be	<ul style="list-style-type: none"> • Machines with low noise and less vibration will be used. • Construction areas and hours shall be adjusted during evening hours and

Items which may be impacted	Outline (Issues Concerned)	Possible Evasive Action/ Mitigation Measures
	minimal. However, noise need to be reduced during evening hours and holidays.	<p>holidays.</p> <ul style="list-style-type: none"> • Contents of construction works shall periodically be informed (e.g. explanation of construction works to SMOH, introduction of a notice board on construction works)
Damages on surrounding roads	The road in front of the site is a tarmac road and there are also bridges. Cautions need to be paid in order not to damage the road.	<ul style="list-style-type: none"> • Before starting the construction work, a survey on existing status of roads and bridges and loading capacity of vehicles shall be conducted. Travelling route of construction vehicles shall be explained to SMOH.
Accident	Prevention measures for disasters and accidents including traffic accidents during construction need to be thought through.	<ul style="list-style-type: none"> • Safe management of construction workers as well as construction vehicles shall be thoroughly enforced. At the same time, the construction site will be surrounded by temporary fences. • Safety confirmation and safe management of the construction site shall be thoroughly enforced.

CHAPTER 2 CONTENTS OF THE PROJECT

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2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Purpose

The Project shall establish a hospital for providing safe childbirth deliveries and maternal and child health services in Umbaddah locality, one of 7 localities of Khartoum State where there is no public hospital above the secondary level that is currently in operation for providing not only comprehensive emergency obstetric care but also childbirth delivery services. By doing so, the Project achieves levelling up overall situation for provision of maternal and child health services in Khartoum State. The Project purpose is therefore to ‘Expand supplies of maternal and child health service in Khartoum State’ and it will contribute to ‘Improve maternal and child health service in Khartoum State’ by mitigating regional gaps.

Overall Goal	To improve maternal and child health service in Khartoum State
Project Purpose	To expand supplies of maternal and child health service in Khartoum State

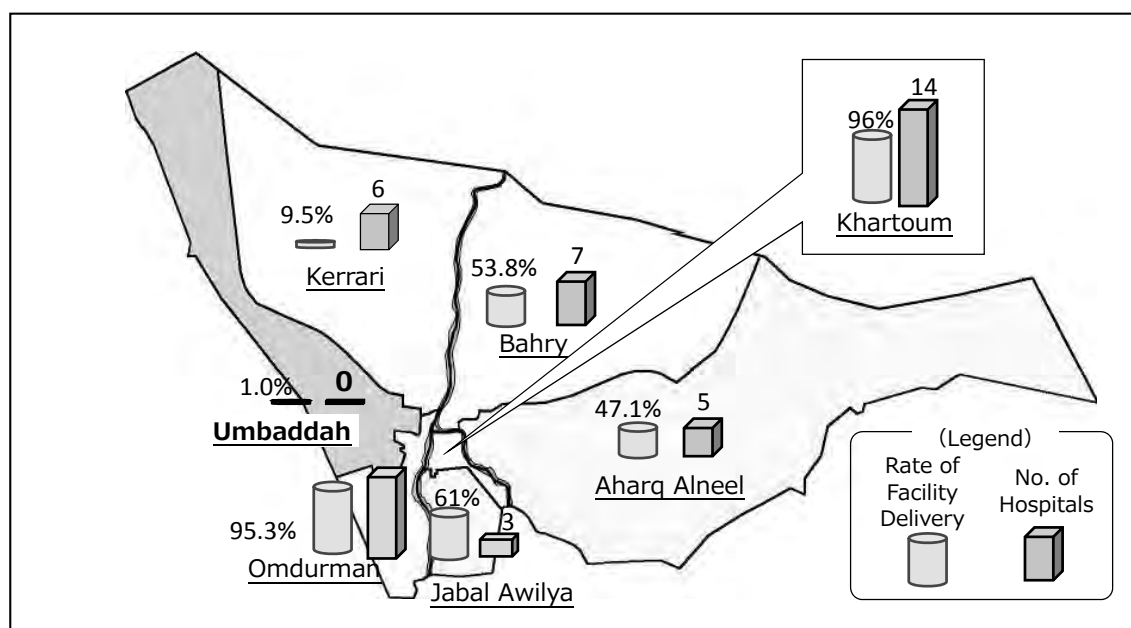


Fig. 2-1 Rate of Facility Delivery & No. of Hospitals in Khartoum (2013)

2-1-2 Project Outline

In order to achieve above mentioned goal, the Project plans to construct a medical facility and install necessary medical equipment for providing maternal and child health services. The facility will accommodate 5,000 annual childbirth deliveries and be established within the compound of the existing Umbaddah General Hospital that is located approximately 20km from the centre of Khartoum State.

The Umbaddah General Hospital, the only hospital that can accommodate deliveries in Umbaddah locality, stopped providing its services since 2012 due to structural defects and is under major renovation including its foundation structure. Therefore, there is currently no medical facility that one can deliver in Umbaddah locality. The Project will contribute in the improvement of maternal and child health services in Umbaddah locality and Khartoum State by recovering the services that the Umbaddah General Hospital had been providing until the beginning of 2012 as well as corresponding to an expanding number of childbirth deliveries by the target year of 2020.

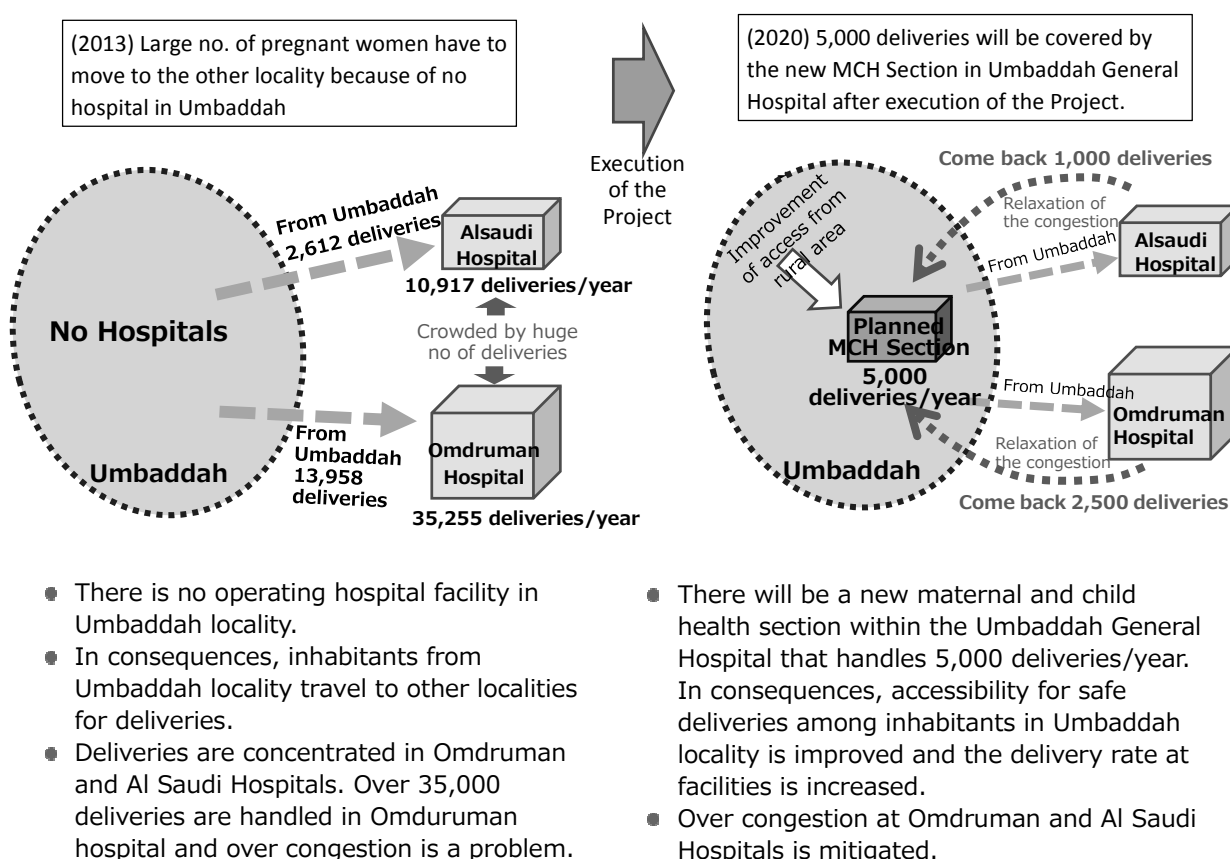


Fig. 2-2 Changes of the delivery situation in Umbaddah Locality by the Project

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

1) Basic Policy on the Establishment of a Maternal and Child Health Facility

A new maternal and child health section is planned based on the following policies:

- ① A maternal and child health section shall be planned that can provide safe childbirth deliveries and antenatal/ postnatal cares (ANC/PNC) for both mothers and newborn infants.
- ② The plan shall be in a scale that can operate and provide services independently so that it does not impact management of the existing general hospital within the compound.
- ③ Since it is a top referral hospital in the locality, specifications and designs of the plan shall be attractive and convenient to users especially for pregnant women, nursing mothers and handicapped individuals.
- ④ Structural specifications of the planned facility shall be strong enough so that it can be a base for reconstruction in emergency cases of disasters such as flooding.
- ⑤ Upon planning facilities and equipment, management capacities (allocation of personnel, technical level, financial capacity, and operation and maintenance skills) of the Sudanese side shall well be considered. The plan shall be designed as it can secure sustainability.
- ⑥ As the operation and maintenance cost is high, the plan does not include an elevator. Slopes will be used for transporting patients. However, the plan shall include elevator shafts for considering possible installation by the Sudanese side in future.

2) Basic Policy on Selection of the Project Facilities

A project site and components are selected based on the following policies.

- ① A site located in a region where the needs for improvement of health services are high as well as urgent necessity is recognized shall be prioritized.
- ② A facility and equipment shall be prioritized at a site where the needs for maternal and child health services are higher than that of the existing facility scale as well as their urgent necessity is recognized. On the other hand, necessity of the project is considered to be low for sites where sufficient maternal and child health services are provided.
- ③ A training facility shall be introduced at a site with medical facilities that have been providing childbirth deliveries and where stable practical opportunities can be expected.
- ④ Either a site or component with unclear future needs and/or mismatches situations in the region shall be excluded.
- ⑤ A site where either Sudan or other donors plan to introduce similar facilities within the same site or the same health unit shall be excluded in principle.
- ⑥ A site with unclear vision for securing new personnel and/or operational budget shall be excluded.

- ⑦ A site where the project is unable to secure enough space for introducing necessary facilities shall be excluded.

3) Basic Policy for Selection of Planned Equipment

Planned equipment under this project is selected based on following criteria:

- ① Equipment which contributes to safe delivery (both basic emergency obstetric care and comprehensive emergency obstetric care) and ANC/PNC is planned for the new maternal and child health section.
- ② Equipment which conforms to health services that to be provided by the planned maternal and child health section shall be installed.
- ③ Equipment which can well be operated and maintained by current medical personnel shall be installed. Equipment that requires new technical training will not be targeted under the project.
- ④ Planned equipment will be the same specification level with equipment that is commonly used at the secondary level health institutes under SMOH, Curative Medicine Directorate.
- ⑤ Equipment which contribute to decrease discharges of hazardous waste such as mercury will be selected.
- ⑥ Equipment which can easily be repaired and maintained by local agencies will be selected.
- ⑦ Equipment limited to specific manufacturers that a market competition principle is not applied is excluded.

(2) Policy for Natural Conditions

The facility plan puts emphasis on: keeping inside of the facility comfortable and hygienic; minimising energy consumption such as electricity; and protecting the facility from natural disasters. Especially for the soil condition which causes problems and severe natural conditions, following measures are to be taken:

- ① Considering severe damages on existing hospital buildings due to the problems caused by the soil condition within the compound, the plan shall introduce a foundation structure method that applies said soil condition.
- ② For common spaces such as a waiting hall where people gather, an increase of room temperature shall be prevented by enlarging room space within the facility. At the same time, natural ventilation and sunlight shall be secured by introducing necessary openings.
- ③ The temperature is high throughout the year. Except from November to March, an average temperature exceeds 40 degree Celsius. Air is extremely dry as annual rainfall does not exceed 100mm and there are sandstorms with fine sand dust. Considering these severe natural conditions, the plan shall secure ventilation as well as prevent entering sand dust.

(3) Policy for Socio-economic Conditions

An estimated population growth rate in 2014 for Sudan is 2.51% while it is expected to decrease in future. Yet, 3.49% of the annual population growth rate is applied for the population forecast in Khartoum State. This is because internally displaced people (IDP) are added to the number of current population (SMOH uses this figure for calculating a figure subjected to immunization). The facility plan needs to adopt such rapidly increasing future population.

In Sudan, mothers after giving births without troubles generally go home with their newborn infants after two hours of resting in case of vaginal deliveries. At the same time, a number of family members and relatives visit the hospital when a mother delivers. The plan shall take into consideration rules and local customs regarding childbirth deliveries.

(4) Policy for Construction/ Equipment Conditions

1) Policy for Construction Conditions

In Sudan, there are numbers of large-scale construction companies and technicians specialized in electronic/ machineries constructing oilfield bases and refinery plants that are developed by foreign oil companies and responding orders from international donor agencies. These companies undertake construction works based on international quality standards. There are also multi-storied buildings with quality materials imported from Europe, Saudi Arabia, Egypt, UAE, etc. being developed as well as hotels and commercial complexes equipped with modern facilities. However, majority of ordinary residences and small-medium scale buildings are constructed using cheap and low quality materials without an appropriate quality control. There are a number of buildings being under construction in Khartoum. However, much of said construction work is either stopped or conducted slowly due to financial difficulties. Reflecting such situation, current construction activities in Sudan is thought to be inactive. Therefore, many of technicians and skilled workers are seeking for jobs as there will most unlikely be a shortage of human resources for the project implementation.

Materials that can be procured in Sudan are limited to bricks, cement, sand, gravel, and reinforcing bars while other materials are imported. Though many of the products in the market are cheap and low quality, materials with international standards are also found. Except mentioned materials procured within Sudan, the project plans to use construction materials with international standards from abroad including Japan.

At the construction site, it is necessary to conduct employment contracts based on the Sudanese 'Labour Act, 1997.' The project shall review an overall project cost and construction plan through setting up the construction period and labour cost based on labour conditions and customs in the construction sector of Sudan.

For the construction component of the project, 'Building management and control of urban growth' set forth by the State Ministry of Physical Planning and Public Utilities and BS (British Standards) that is commonly followed in Sudan as well as Japanese construction standards will be applied.

2) Policy for Conditions on Equipment Procurement

Medical equipment that to be procured in this plan does not include anything special but equipment that is commonly used in general maternal and child hospitals. In Khartoum, there are many agencies including both major medical equipment agencies (legitimate agencies for major manufacturers) and small to medium scale agencies handling equipment based on customers' orders. While major agencies secure workers/ technicians for equipment installation, adjustment, repairing, after sales services and calibration; small to medium scale agencies provide neither such services nor follow-up after purchasing. The project therefore needs to be careful in selection of local agencies. Medical equipment is relatively easily imported in Sudan since there is no registration requirement. However, as there is a need for an in-advance application, prior request is necessary in order to avoid troubles upon importing equipment. To note, since procurement from US is difficult due to economic sanctions, the project shall avoid in selecting US made products.

(5) Policy for recruiting Local Constructors

There is a number of consultants and construction companies that have experiences in planning and implementing construction works based on international standards as well as high capacity in receiving contracts with healthy financial status. They are expected to be utilised in various works as subcontractors of a Japanese construction contractor whom to be a prime contractor of the project. However, for referring construction knowledge and techniques in severe weather conditions along the River Nile, it is effective to apply local contractor to the project. On the other hand, securing reliable quality of construction works, a package of both materials and constructors from Japan and/or third countries shall be considered for specialized construction works that are not commonly practiced in Sudan as the number of local contractors who can handle the work is limited. These works include: large-scale piling works; interior works of operation theatres with panels; and waterproofing of roofs. Moreover, compared with high technical skills, quality management and safety control that the Japanese Grant Aid Schemes are aiming at, what local consultants and contractors have is relatively low in standards. Therefore, technical transfer from Japanese constructors to local workers/ engineers is expected during implementation of the project.

(6) Policy for Operation and Maintenance of the Implementation Agency

1) Facility

Operation and maintenance of hospital facilities is conducted by electrician, machinery/plumbing engineers and workers stationed in each hospital through inspections and repairs. Due to the budget constrain, contents of general repair works are limited to minimum. For major failures caused to machineries including generators, pumps, air conditioners, and washing machines, repair services and change in spare parts are requested to manufacturers and agencies when failure occurs. Depending on the cost, hospitals request SMOH for an additional budget apart from its annual budget. The project also plans basic operation and maintenance of the new facility to be conducted through routine operation and checkups by hospital technicians and staff.

There are 24 engineers (of which 16 are women) being engaged in planning, supervision, and

accounting of medical facilities in the Development Directorate of SMOH. They consistently conduct works on medical facilities within their jurisdiction from planning to supervision/ inspection. On the other hand, SMOH requests the State Ministry of Physical Planning and Public Utilities for technical decision on continual usage of medical facilities with possible risks caused by failures from deterioration or/and building defects. The project shall inform work progress to and exchange technical information with the Development Directorate as their inspection/ supervision is expected for the planned facility.

Major expenditures for operation and maintenance (O&M) of the facility are: repairing cost (painting, plastering mortar walls, replacing tiles, plumbing, wiring, etc.); maintenance cost (cleaning septic tanks/ water tanks, changing air conditioning filters, etc.); and general O&M cost such as sweeping. The project shall try to design the facility so to minimize O&M cost.

2) Equipment

Basically, for the selection of medical equipment, equipment with a standard that can be operated with experiences and capacities of doctors, paramedics and nurses who used to work at the Umbaddah General Hospital is prioritised. Planned equipment is only for the maternal and child health section and used commonly in Sudan. However, some planned equipment such as ultrasound scanner with vaginal probe for diagnosis and CPAP unit for respiratory management requires clinical experiences. Since medical personnel who had worked at the same hospital is expected to be reassigned to the maternal and child health section, they already have some clinical experiences. Therefore, it is assumed that they can utilize planned equipment in terms of operation and daily maintenance. Even though planned medical equipment does not require any specific technique, there is a possibility that equipment supplied under the project may have different operational and maintenance methods due to renewal of the product or/and updating of a software. Thus, initial operational training will be conducted upon implementation of the plan.

(7) Policy regarding Facility/ Equipment Grade

1) Facility

GDP in Sudan accounts 66.748 billion USD which is the 7th in position among African nations. GDP per capita reaches 1,941.37 USD which is higher than that of Kenya (GDP: 54.99 billion USD; GDP per capita: 1,315.62 USD) (IMF World Economic Outlook Database, 2013). As Khartoum, the capital city of Sudan, being a centre of economy and industry, modern urban life styles are well adopted by inhabitants. Air conditioning system and clean toilets are now commonly required at working environment and industrial as well as public areas.

There is a number of relatively high levelled hospitals with modern facilities in the urban region of Khartoum State and required standards for medical facilities are therefore not low. Patients are able to choose hospitals for better services and environment. Considering above, the maternal and child health section that to be planned under the project needs to have specifications that are comfortable and attractive to users. The facility of the project therefore applies: (1) specification with strong, long durable and high quality that may hold down maintenance cost in future despite of a large initial

investment; (2) grades that are equivalent to existing public health facilities with good reputations in Khartoum (e.g. Omdruman and Al Saudi Maternal and Child Hospitals); (3) air conditioners in main rooms/area securing comfort for both workers and patients.

2) Equipment

Basic selection policy of equipment grade is to provide safe and precise medical services as a public health institute, and conforms to contents of health and medical services at similar health facilities in Sudan. In addition, grade is also fitted with technical capability of medical personnel and equipment end-user. Furthermore, it is noted that the level of planned equipment should not deviate from the one of maternal and child health services of health facilities at the secondary level.

(8) Policy for Construction/ Procurement Methods and Construction Period

1) Construction Method

In principle, a construction method which can be applied by local workers and technicians will be adopted. However, for particular works based on necessary specifications required for a hospital building planned in the project, a lump-sum contract for material procurement and construction works with a contractor from either Japan or the third country shall be considered. These works includes finishing of operation theatres and waterproofing of roofs. By doing so, the project shall secure quality works and prevent interruption in work progress caused by redoing works.

2) Procurement Method

Many of the medical equipment that can be purchased in local equipment companies are cheap and shoddy leaving questions in their quality and durability. In addition, their after-sale services are not satisfying as time is required for obtaining consumable supplies and spare parts. On the other hand, medical equipment made in Japan has good reputation among medical personnel as its function remains for a long period. The project recipients are requesting introduction of Japanese-made equipment. Therefore, considering quality assurance as for a grant aid project and reliability on product durability for operation and maintenance, equipment that to be procured under the project shall be Japanese-made in principle. However, when competitive tendering or a capable local agency is not secured upon restricting the project equipment to Japanese-made, procuring equipment from the third country shall also be considered.

3) Construction Period

Construction period needs to be developed considering not only local construction situation and natural conditions but also cultural and social backgrounds. For realizing high quality construction works in a developing country, enough time is required. In order to do so, following points are to be noted:

- ① The planned site is located approximately 20km away from the centre of Khartoum and

construction vehicles need to drive across the River Nile regularly. However, a number of bridges where large trucks can drive across is limited. Depending on hours of the day, transportation of construction materials may slow down due to traffic congestions. The plan therefore shall allow enough time for procurement of materials.

- ② The ground of the planned site is weak that either introduction of a pile foundation or large scale foundation improvement is required. An extra period for said works shall be secured.
- ③ Since the most of workers are Muslims, Islamic customs shall well be considered. The construction period needs to be planned allowing enough time as construction works during Ramadan season can substantially slow down.
- ④ Climate condition needs to be taken into consideration when the construction period is decided. As it is hot and dry, work efficiency may drop during daytime. Concrete placement needs to be conducted during early morning and/or evening hours.
- ⑤ As the annual precipitation being below 100mm, Khartoum is an area with very little rain. Its rainfall is concentrated in July and August while there is almost no rain in other months. Moreover, since the infrastructure for draining rainwater is not well established in Khartoum, roads all over the city and suburbs are flooded and pose a problem for traffics every time it rains. Thus, in order to minimise the impact of delays in construction during the rainy season, the plan shall avoid ground and foundation works that can be influenced by rain to be conducted in July and August. The project shall also look for a route that workers and construction vehicles to be safely transported from suburbs to the site.

2-2-2 Basic Plan (Construction Plan/ Equipment Plan)

2-2-2-1 Overall Picture of Project

(1) Selection of the Project Coverage

As a result of a selection of the facility component of the project based on the '2-1-1 Design Policy 2) Basic Policy on Selection of the Project Facilities,' the project will target construction of a new maternal and child health section and procurement of its equipment at the Umbaddah General Hospital in Umbaddah locality.

Regarding the conditions described below, high needs and urgency for introducing a maternal and child health section at the Umbaddah General Hospital have been assessed.

① Needs for a maternal and child health facility in Umbaddah locality

Despite of being the most populated among seven localities in Khartoum State, there is currently no operating hospital in Umbaddah locality. Therefore, over 10 thousands of its inhabitants annually travel to the Omdurman Maternal and Child Hospital or/and Al Saudi Maternal and Child Hospital in neighbouring localities for childbirth deliveries. As a consequence, a delivering rate in hospitals is extremely low in Umbaddah locality compared to other localities which is almost zero percent.

Umbaddah locality is the only locality where there is no hospital above the secondary level. Its annual delivering number estimated by SMOH is 44,845 (2014) which accounts the highest among all localities. Being not able to provide delivering services for this big demand, urgency in needs for an appropriate maternal and child health facility in Umbaddah locality is considered to be high in comparison to other localities (see Table below). Thus, SMOH regards the introduction of a maternal and child health facility in Umbaddah locality as a top priority.

Table 2-1 Rate of Deliveries at Health Facility/at Home in Khartoum State (2013)

Locality	Estimated Delivery ¹⁾	Actual Delivery ²⁾	Institutional Delivery	% of Institutional Delivery	Home Delivery	% of Home Delivery	% of Unknown
Khartoum	18,830	34,628	33,206	95.9%	1,422	4.1%	0.0%
Jabal Awlya	43,870	27,005	16,437	60.9%	10,564	39.1%	0.0%
Omdurman	18,624	90,498	86,275	95.3%	4,223	4.7%	0.0%
Kerrari	25,453	11,174	1,065	9.5%	10,109	90.5%	0.0%
Umbaddah	45,317	11,572	111	1.0%	11,461	99.0%	0.0%
Bahry	21,520	41,203	22,186	53.8%	18,890	45.8%	0.3%
Sharq Alneel	33,316	30,508	14,367	47.1%	16,126	52.9%	0.0%
Total	206,930	246,588	173,647	70.4%	72,795	29.5%	0.1%

Sources) SMOH, Khartoum, Annual Statistics Report

1) Estimated delivery based on its population growth,

2) Delivery recorded by healthcare institutions or/and staff from the Ministry of Health

② Future plan for hospital allocation in Umbaddah locality

There are four Administrative Units in Umbaddah locality. SMOH classifies these four units into three health units (Al Amir and Western Rural Area as one health unit; Al Salam and Al Bagaa) and plans to allocate a general hospital in each health unit (Health Map Khartoum State, SMOH, Khartoum State, 2010). SMOH explains that the Umbaddah General Hospital covers Al Amir and Western Rural Area units while the Al Rajhi Hospital which is donated by Saudi Arabians will cover Al Salam unit. There is no plan for a hospital so far for Al Bagaa unit though minimum of three hospitals are requested within Umbaddah locality.

The Al Rajhi Hospital is located approximately 10km away from the Umbaddah General Hospital towards west. Its construction work has stopped since April 2014 and there are no construction workers at the site. Restarting date is not yet known. Referring to its drawing plan, all bedrooms are private rooms with its own toilets. It is assumed that the Al Rajhi Hospital targets patients with middle or above classes. Thus, needs of mothers and children who are the targets of this project will not be overlapped.

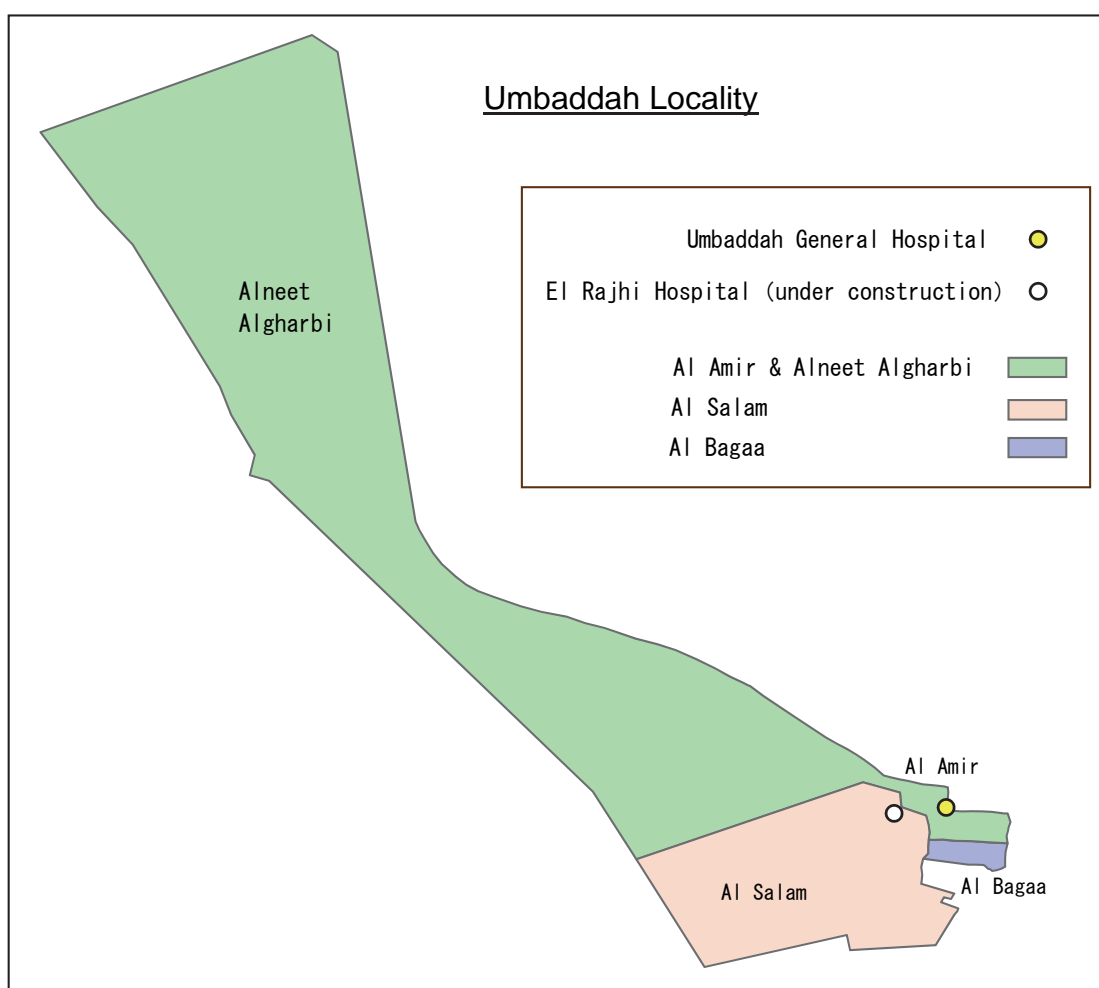


Fig. 2-3 Health Area and Location of Hospitals in Umbaddah Locality

③ Affirming hospital needs from a number of required beds in Umbaddah locality

The population of Al Amir and Western Rural Area units (hereafter referred as a 'target unit'), an area where the Umbaddah General Hospital covers, is expected to increase to 425,336 by 2020 (referred documents from SMOH). Based on a number of beds in the existing Umbaddah General Hospital which is currently under renovation and a number of required beds indicated in the 'Health Map Khartoum State 2010,' a shortage of beds in general hospitals at the target unit is estimated to be 131 by 2020. Of which, approximately half a number of beds is to be used for the maternal and child health sector (referring to interviews from SMOH). Considering a shortage of 66 beds for the sector, needs for a maternal and child health facility in the target unit is high.

(Calculation of a bed number required by 2020 for the target unit covered by the Umbaddah General Hospital)

(Calculation formula)

Bed number required by 2020 for the target unit

{ (A) Estimated population of the target unit by 2020 / (B) Standard for a required bed number in hospitals } - (C) Number of existing beds

= (A)425,336 / (B)1,460 - (C)160 = 131 beds

(A) Estimated population of the target unit by 2020

= Number of population in the target unit by 2010 x Yearly population growth rate

= 301,820 x 1.0349¹⁰ = 425,336

● Number of population in the target unit by 2010: 301,820 (Health Map Khartoum State, 2010)

● Yearly Population growth rate : 1.0349 (population growth rate adopted by SMOH)

(B) Standard for a required bed number in hospitals: 1 bed/ 1,460

(the figure calculated in the 'Health Map Khartoum State' is used in this project though SMOH sets a standard for a required bed number as 1 bed/ 1,000 persons)

(C) Number of existing beds: 160 (a number of beds in the Umbaddah General Hospital which is currently under renovation)

Table 2-2 No. of Required Beds in Umbaddah Locality

Health Unit	Population		No. of Required beds	No. of existing beds	No. of beds in shortage
	(Year 2010)	(Year 2020)			
Umbaddah Locality	1,041,432	1,467,623	1,005	360	645
Al Amir	188,491	265,628	182	160* ¹	
West rural area	113,329	159,707	109	0	
Total	301,820	425,336	291	160* ¹	131
Al Salam	386,093	544,096	373	70* ²	303
Al Bagaa	353,520	498,193	341	0	341

*1: 160 beds are counted from the drawing of Umbaddha General Hospital.

*2: 70 beds are counted from the drawing of El Raghy Hospital Project

④ Delivering at hospitals in other localities

Almost all childbirth deliveries in health facilities are accommodated at hospitals in Khartoum State. As there is no public hospitals one can give a birth for free of charge, inhabitants in Umbaddah locality travel to the Omdurman Maternal and Child Hospital or/and Al Saudi Maternal and Child Hospital where one can relatively easily be accessed for their deliveries. Of 35,306 childbirth deliveries at the Omdurman Maternal and Child Hospital in 2013, 13,958 deliveries, almost 30% of total deliveries, were given by inhabitants of Umbaddah locality. Similarly, of 10,917 deliveries at the Al Saudi Maternal and Child Hospital in 2013, 2,612 deliveries were given by inhabitants of Umbaddah locality. On the other hand, very few deliveries were given by inhabitants of Umbaddah locality in other hospitals neighbouring to Umbaddah locality.

In 2013, 16,600 deliveries given by inhabitants of Umbaddah locality were handled in hospitals in other localities. Concentration of deliveries at the Omdurman and Al Saudi Maternal and Child Hospitals prevents an appropriate supply of services as facilities and personnel are limited. Thus, some measures are required for mitigating congestion at specific hospitals.

Table 2-3 Change Number of Delivery at Hospital for Umbaddah Inhabitants

Name of Hospital	Year	2011	2012	2013
• Delivery no. in Umbaddah General Hospital		3,626	675	N/A
• Delivery no. in Omdurman Maternal Hospital		31,380	35,183	35,255
No. of inhabitants in Umbaddah Locality		11,918	14,242	13,958
Increased no. from last year			2,324	-284
• Delivery no. in Alsaudi Maternal Hospital		10,353	10,900	10,917
No. of inhabitants in Umbaddah Locality		992	1,940	2,612
Increased no. from last year			948	672
Increasing no. of delivery of Umbaddah inhabitants			3,272	

After the closure in 2012, patients receiving childbirth delivery services covered by the Umbaddah General Hospital are thought to have moved to above described hospitals in other localities. Comparing numbers of deliveries given by inhabitants of Umbaddah locality in 2011 and 2012 at hospitals in other localities, there are increases of 2,324 and 948 in the Omdurman Maternal and Child Hospital and the Al Saudi Maternal and Child Hospital respectively. A total of 3,272 added by 675, a number of childbirth given at the Umbaddah General Hospital before its closure in 2012, accounts 3,947 which becomes more or less the same with the figure of 3,626, the annual delivering number handled at the Umbaddah General Hospital in 2011. This explains that inhabitants travel to other localities for deliveries by necessity. It is assumed that expectant and nursing mothers who moved to other hospitals shall return once the project establishes a maternal and child health section at the Umbaddah General Hospital. In other words, congestion at the Omdurman and Al Saudi Maternal and Child Hospitals is expected to be mitigated.

⑤ Changing the use of the obstetric section in the existing Umbaddah General Hospital

As explained in ① to ④ above, the provision of the obstetric section is especially a pressing issue in Umbaddah locality. SMOH, therefore, requests Japan to introduce a maternal and child health section within the compound of the existing Umbaddah General Hospital as a top priority. Moreover, SMOH plans to change the obstetric section within the existing hospital into the gynaecological and surgical sections after the completion of the maternal and child health section by the Japanese assistance in order to respond local health needs as only one general hospital at the secondary level within the locality. In other words, division of roles between the existing hospital and the new maternal and child health section is clear as the new section is to provide delivering as well as maternal and child health services for people in the locality.

(3) Outline of Planned Facility

The target components of the project are: construction of a maternal and child health section (MCH section) and the annex facilities; and procurement of equipment within the compound of the Umbaddah

General Hospital in Umbaddah locality.

Upon planning a facility component of the maternal and child health section, the project shall include not only health service but also administrative and service sectors so that it can be operated independently. In other words, the planned section shall be operated without being influenced by the situation of the re-opening plan of the existing hospital (including its renovation works, procurement of equipment and reallocation of personnel) which has stopped its operation since February 2012. Therefore, the project component will be composed of: common zone; outpatient/ consulting zone; health education zone; delivery zone; operation theatre zone; ward zone; administrative zone; and service zones.

Being established in Umbaddah locality where there is no hospital that can either handle deliveries or emergency obstetric care, the new maternal and child health section will act as only maternal and child health facility at the secondary level in the region that provides safe delivery services. Functions expected to the new maternal and child health section are divided into 8 main categories listed below.

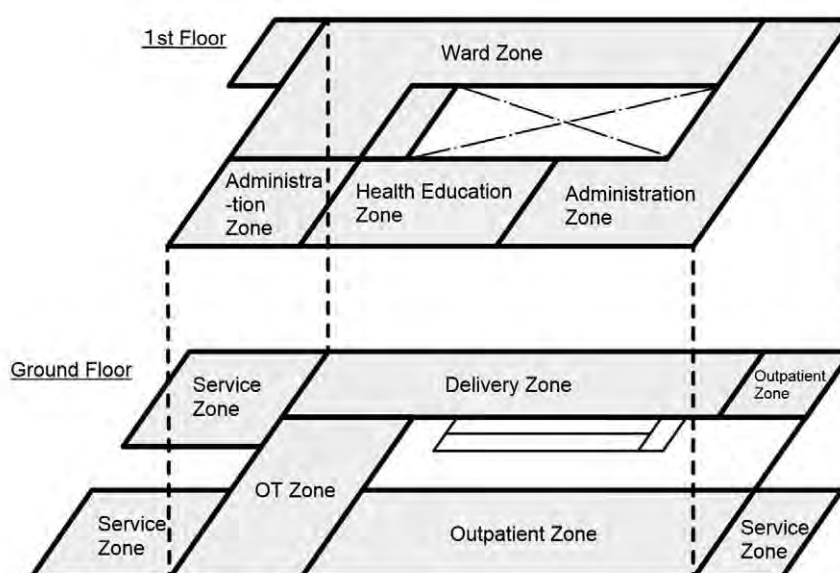


Fig. 2-4 Zoning of MCH Section Building

① Consulting Function

Following services are provided as outpatient consultation: ANC/PNC; immunization, growth monitoring; and gynaecological examination.

② Examination Function

Apart from urine and blood sampling, malaria and other infective diseases are tested. Simultaneously, pregnant women is checked by ultrasonic and electrocardiogram.

③ Delivery Function

In order to respond the huge demand for deliveries in the locality, enough number of delivery rooms, labour rooms, and post-delivery rooms are provided.

④ Operating Function

As to respond C-EmOC (Comprehensive Emergency Obstetric Care), mainly Caesarean section (C/S) operations are conducted.

⑤ Admission Function

Hospital admission is prepared for postoperative cares for patients whom have gone through C/S, premature birth, or/and threatened miscarriage and care for newborn infants.

⑥ Health Education Function

Places are provided for seminars for medical personnel and enlightenment activities among local residents on health education, family planning, adolescence counselling, public health, and others.

⑦ Service Function

Following services are provided: cleaning of linens used in bed rooms and operation theatres; O&M services including checkups of medical equipment; and food and drink services at cafeteria and kitchen.

⑧ Management Function

Spaces for management and operation are prepared. These include: office rooms for the hospital director, the head of maternal and child health, doctors and medical personnel; and meeting rooms.

Table 2-4 Outline of Facility/ Equipment Component

Facility		
Facility component	Zone	Contents
Maternal and Child Health Section (total floor area: 4,653 m ²)		
Ground floor 2,720 m ²	Common Zone	Entrance, Waiting Area, Reception, Cashier, Medical Record, Toilet (Male/ Female), Slope, Stairs, Cafeteria, Kitchen, Electrical Panel Room
	Outpatient/ Laboratory/ Pharmacy Zone	General Outpatient Triage, Consultation Room (ANC/PNC, Immunization/ Growth Monitoring, Family Planning), Ultra Sound / ECG Room, Gynaecological Examination Room, Laboratory, Urinal Collection, Blood Collection, Blood Bank
	Delivery Zone	Nurse Station, Labour Room, Delivery Room, Post-Delivery Room, Nursery (un-septic), Nursery (septic), Medical Waste Stock, Storage, Linen Room, Ante Room, Inpatient Toilet, Staff Toilet (Male/ Female), Night Reception, Waiting Space of Night Visitor
	Operation Theatre (O/T) Zone	Ante Room, Changing Room (Male/ Female), Shower Room (Male/ Female), Equipment Storage, Recovery Room, Scrub/ Washing Room, Sterilization Room, Equipment Stock Room, Service Corridor, Changing Room for Staff
	Service zone	Laundry, Machine Room, Staff Office, Staff Room (Male/Female), Night Duty Room (Male/ Female), Workshop, Toilet (Male/ Female)
First floor 1,867 m ²	Ward Zone	Bed Room (5 beds), Private Room (with Shower & Toilet), HDU, Storage, Linen Room, Medical Waste Stock, Pantry, Nursing Room, Inpatient Shower, Inpatient Toilet
	Health Education Zone	Health Education/ Seminar Room, Health Educator/ Staff Office, Storage
	Administration Zone	Director General's Room, Secretary Room, MCH Director's Room, Accountant Room, Storage, Meeting Room, Statistics Room, Resting Room, Office
Roof floor 66 m ²	-	Stairs
Annex Facilities 148 m ²	Electricity building	Transformer room, Main Distribution Panel Room, Generator Room
	Pump building	Pump Room
External Zone and other facilities	-	Parking, Car Entrance Area, Slope, Water Reservoir, Septic Tank, Treatment Tank, Elevated Water Tank
Total Floor Area including Annex Facilities 4,801 m ²		
Equipment		
Places to be installed	Contents	
Common Zone	Consultation Chair, Consultation Desk, Reception chair, Waiting Chair, etc.	
Outpatient/ Laboratory/ Pharmacy Zone	CTG, Ultrasound scanner type A, Gynaecology examination table with foot step, ECG machine, Medicine cabinet, Refrigerator, Coagulometer, Electrolyte (ISE) analyzer, Hematology Analyzer, Hot air oven, Platelets Incubator with Agitator, Spectrophotometer, etc.	
Delivery Zone	CTG, CPAP, Infant Incubator, Neonatal Monitor, Ultrasound scanner type B, etc.	
Operation Theatre (O/T) Zone	Anaesthesia machine with ventilator, Defibrillator, Electrosurgical unit, Hand Scrub station, High pressure steam sterilizer, Infant Incubator, Infant warmer, OT Lamp	

	with battery, OT table (Hydraulic), Patient Monitor, etc.
Service zone	Drying Machine, Press Machine, Washing Machine, etc.
Ward Zone	HCU bed, Hospital bed with mattress, Infusion pump, Patient Monitor, Suction unit, Syringe pump, etc.
Health Education Zone	LCD Monitor, Projector, Projector screen, Stacking Chair, etc.
Administration Zone	Locker, Meeting table(M), Meeting table(L), Rack for storage, etc.

2-2-2-2 Site and Facility Location Plan

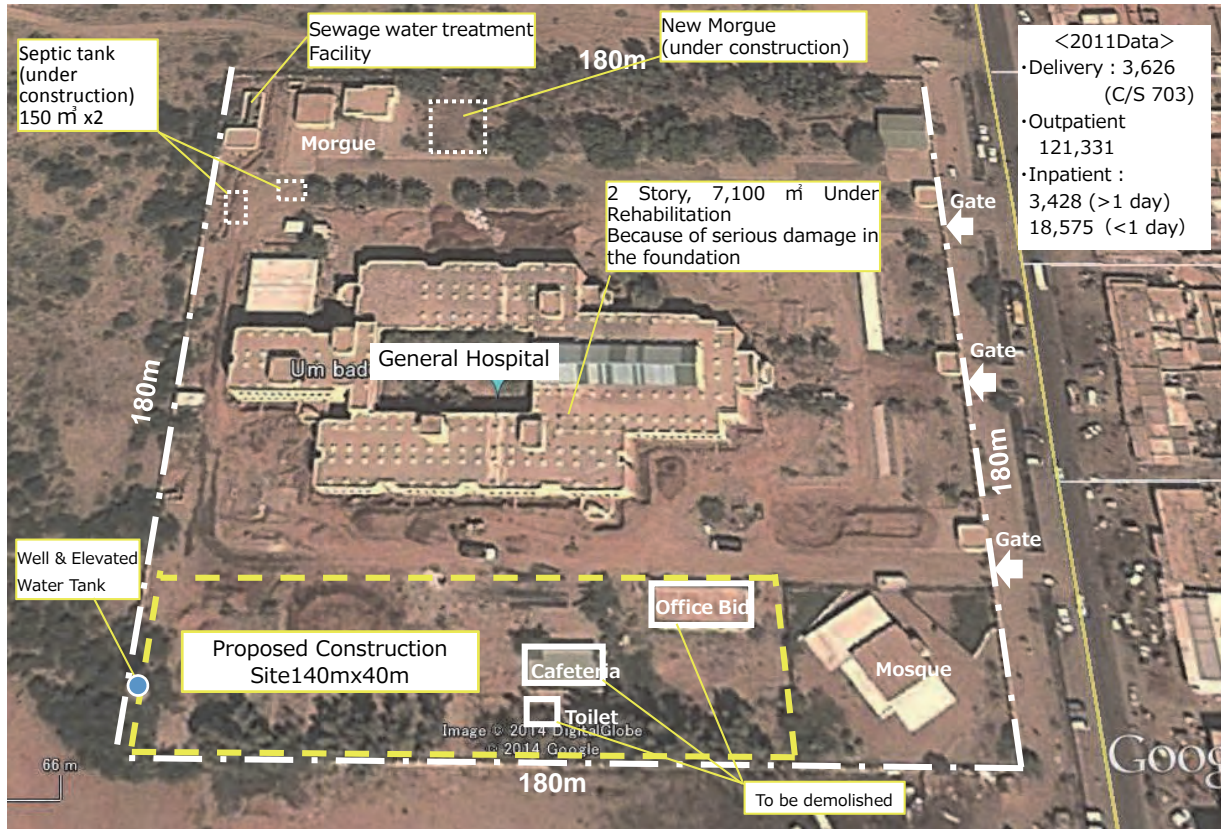
(1) Site Location and Surrounding Situation

The most urbanized area in Umbaddah locality lies in the south-east end of the locality and it extends to the western side of the urban area of Omdurman locality at the western bank where the Blue Nile meets the White Nile. The Umbaddah General Hospital is located at the western end of the urbanized area which continues to expand towards west and north.

Topography of the area where the hospital is located is flat and expanded without tall trees except a hill toward north-north west.

The eastern side of the hospital is adjacent to the arterial road that runs from south to north. Various shops are found in front of the road and the residential area is extended behind the shops. There is an open ditch most probably for rain water drainage between the arterial road and the hospital compound. Yet, the ditch is found only along the hospital compound, assumingly just to avoid flow of rain water from the road into the hospital compound. There is Leebee market (souk), the business centre of the area, approximately 1.5km along the road toward south. Except the surrounding area of the market, there is only one three or above storied building found in the south-eastern side of the hospital. Otherwise all buildings near the hospital are either one or two-storied.

A vacant space lies at the southern side of the hospital (45m from south to north). There is a road with stores which runs towards west at the southern side of the space. Both roads already accommodate urban infrastructures such as water supply and electricity. On the one hand, though a residential area at the western side of the hospital disappears once, another developed residential area is found in further west while the northern side remains undeveloped.



* The figure is downloaded from GoogleEarth with information from the survey added.

Fig.2-5 Present Situation of Umbaddah General Hospital

(2) Facility Location Plan

A rectangular construction site with 140m x 40m is arranged for the project at the south-western end of the existing hospital compound (180m x 180m). Northern side of the construction site lays the existing hospital building (currently under major renovation) across the road in the compound. There is a mosque at the eastern side. Western and southern sides are fenced as they border the compound.

The compound of the Umbaddah General Hospital is a square of 180m x 180m and a major hospital building is located in its western-leaning centre with the front yard in its eastern side. The hospital building is surrounded by: an electrical facility at its north-eastern corner; a sewage treatment facility and a morgue at the south-western side; a water supplying facility by a well at the south-western side; and a mosque at the south-eastern side. The area where the mosque is located is fenced (east to west: 44.5m; south to north: 39m) as it stands independently from other hospital buildings.

The new maternal and child health section of the project will occupy an area with 103m from east to west and 31m from south to north. The building is planned 10 and 8m away from the western border and southern border of the hospital compound respectively. In order to accommodate a facility with a necessary scale within a limited area, the plan maximizes the land usage by constructing the building adjacent to the road which borders the northern side of the project site. There will be an existing well, a high-level water tank, a new water receiving tank, and a new pumping room toward the western side of the new maternal and child health section building. With a certain distance between, there will be a

facility for water drainage at the northern side. A main entrance of the new building will be established facing towards east. Across the rotary for driveway apron, there will be an electrical room and a car parking space for 5 cars will be established in its front.

For approaching the planned facility, one shall enter from the arterial road that runs at the eastern side of the project site, transport approximately 70m straight along the road within the site and enter inside of the building from the main entrance. Vehicles shall approach the building from driveway apron of the rotary. During night hours, one shall enter the building from a night-time emergency entrance facing towards north along the road in the compound.

There are currently an existing cafeteria, its facilities, and a construction office for renovation works of the existing hospital within the project site. They are however to be removed by the Sudanese side.

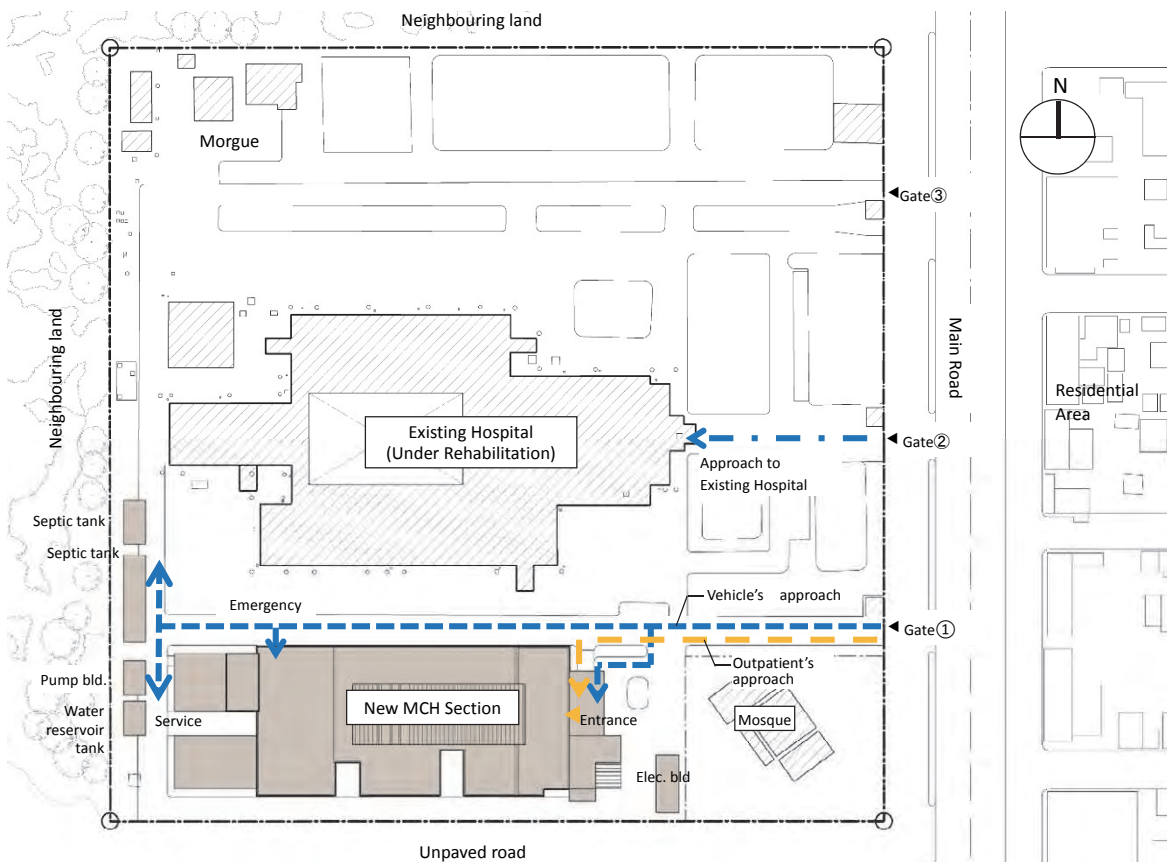


Fig. 2-6 Layout Plan of New MCH Section

2-2-2-3 Facility Plan

(1) Setting up a Facility Scale

1) Preconditions for the Plan

① Major Service to be Provided

Following services related to maternal and child health will be targeted: childbirth delivery; ANC/ PNC; C-EmOC (Comprehensive Emergency Obstetric Care); intensive mother and child care; family planning; immunization; growth monitoring; adolescence counselling; examination; health education and its enlightenment activities; seminars and others.

② Demarcation of roles related to maternal and child health sector between the new maternal and child health section and the existing hospital

The new maternal and child health section will handle deliveries and checkups (preventive measures) for healthy mothers and children while the existing hospital treats diseases and injuries. To note, the space used for the obstetrics section in the existing hospital will be altered to the extended gynaecology section after the renovation work.

New Maternal and Child Health Section

: counselling, prevention, delivery (C-EmOC), medical admission related to delivery (mainly for C/S), and health education

Existing Hospital

: examination, treatment, operation and medical admission for gynaecology and paediatrics

③ Other conditions for Hospital Operation

a. Hospital Operating hours

Obstetrics: 365 days/year, 24 hours

(Operation theatre: 07:30 - 19:30, 12 hours/day)

Outpatient: Sunday to Thursday (5 days/ week), 260 days/ year

07:30 - 15:30 (8 hours/day, 40 hours/week)

b. Time spent for outpatient examination:

15 min./ patient (4 examinations per hour/ room, 32 examinations/ room for a day, 8 hours)

c. Days/ hours spent at the hospital

Depending on types of deliveries, days/ hours required for preparation and recovery are summarised in the table below.

Table 2-5 Days/hours and Locations spent at Hospital

	Vaginal Delivery	Caesarean Section (C/S)	Other cases except for C/S	Miscarriage (D&C)
Pre-Delivery /Pre- Operation (Location of Stay)	Less than 12 hours (Labour room)	1 day (Ward)	5days (Ward)	—
Post-Delivery /Post- Operation (Location of Stay)	2 hours* (Post delivery room)	3 days (Ward)		2 hours* (Post delivery room)

*Normal case only

The maximum hours to be spent at the labouring room will be 12 hours.

After a vaginal delivery, mothers and children go home in two hours if there is no problem in Sudan. It is very short, but all public hospitals in Sudan set a rule that mothers and children to leave the hospital normally two hours after the delivery.

For C/S, one will be admitted to the hospital one day before the operation for the preoperative treatment and stays 3 days after the operation. For cases of a complication or other troubles, one shall be admitted for 5 days which is referred to the practice at the Turkey General Hospital.

d. Contents of Pregnancies

Number of pregnancies and its contents are shown in the figure below.

No. of Pregnant 100%		
No. of Delivery 85%		No. of Miscarriage 15%
No. of Vaginal Delivery 68% (80%)	No. of C/S 17% (20%)	

% Number in () means percentage in total no. of delivery

Fig. 2-7 Contents of Pregnancies

(Miscarriage Rate)

As there is no reliable data in Sudan, the project will use the figure of 15% which is used by the Japan Society of Obstetrics and Gynaecology. Thus, the percentage of deliveries against the number of pregnancies is $100\% - 15\% = 85\%$.

(C/S Rate)

The rate is calculated based on the actual practices at the Umbaddah General Hospital in 2011 and the rate of 20% shall be adopted.

703 (Number of deliveries with C/S at the Umbaddah General Hospital in 2011) / $3,626$ (Number of total deliveries) = $19.39\% \rightarrow 20\%$

As being a top referral hospital in Sudan, deliveries with risks concentrate in the Omdurman Maternal and Child Hospital located in Omdurman locality. As a consequence, a number of C/S operations in the Omdurman Maternal and Child Hospital is especially high compared to other

hospitals which accounts 30.4% (2013). The rates are 24.64% at the Al Saudi Maternal and Child Hospital in Omdurman locality and 27.19% at the Turkey General Hospital in Jabal Awlyaa locality. These hospitals with relatively good facilities and staff have higher rates of C/S. This is because not only patients are transferred from other hospitals or/and lower referral medical facilities but also pregnant women with high risks choose reliable hospitals for better services.

Since the project site is relatively close to the Omdurman Maternal and Child Hospital and Al Saudi Maternal and Child Hospital that are highly specialized in maternal and child health and have bigger scales, pregnant women with delivery risks assumingly continue to visit these hospitals even after the completion of the project facility. Therefore, the rate for C/S is unchanged from the figure at the Umbaddah General Hospital in 2011.

e. Bed occupancy rate: 70%

Referring to 'Khartoum Public Health Standards for 100 to 500 Bedded Locality Hospitals' by Curative Medicine Directorate of SMOH, an ideal bed occupancy rate is above 80%. On the other hand, though there are a number of hospitals with their bed occupancy rates of 50% or below, good hospitals have their rates between 60 to 80% (data based on Annual Health Statistics 2013, Khartoum State). Therefore the target bed occupancy rate will be set for 70%.

f. Increasing rate of deliveries at the peak period: 1.1387

In general, a number of weddings increases after Ramadan that may result in an increase of deliveries in a certain period. Considering above, an increasing rate of deliveries at the peak period is calculated based on monthly delivery data (2013) of the Omdurman Maternal and Child Hospital which handles the biggest number of deliveries within the nation and has reliable statistic data. The increasing rate is calculated from a highest delivery number per month and a monthly average.

(Calculation formula)

Based on the monthly deliveries of the Omdurman Maternal and Child Hospital in 2013,

highest delivery number per month / number of monthly average deliveries

$$= 3,350 / (35,306/12) = 1.1387$$

Table 2-6 No. of Delivery in Omdurman Maternal Hospital (2013)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Delivery No.	2,943	2,540	2,838	2,590	2,750	2,675	2,951	3,350	3,301	3,222	3,038	3,107
Total	35,306											

Ref.) Data by Khartoum SMOH, 2013

2) Setting up a target number of deliveries at the new Maternal and Child Health Section at the Umbaddah General Hospital

The target year will be 2020, 3 years after the completion of the project facility.

The delivery service at the Umbaddah General Hospital has stopped since February 2012. From then onward, inhabitants of Umbaddah locality give births at two maternal and child hospitals in Omdurman locality. A target number of deliveries at the new maternal and child health section is calculated based on the actual delivery number in 2011 multiplied by the estimated population growth rate up to the target year of 2020.

(Calculation formula)

A target number of deliveries at the Umbaddah General Hospital in 2020

$$= (A) \text{ Annual delivery number in the Umbaddah General Hospital before its closure in 2011} \\ \times (B) \text{ population growth rate up to 2020} \\ = 3,626 \times 1.0349^9 = 4,938 \approx \mathbf{5,000}$$

Table 2-7 Estimated No. of Delivery in Umbaddah General Hospital from 2011 upto 2020

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
No. of Delivery	3,626	3,753	3,884	4,019	4,159	4,304	4,455	4,610	4,771	4,938

Ref.: Khartoum SMOH

(A): Annual delivery number in the Umbaddah General Hospital before its closure in 2011: 3,626

Table 2-8 Recorded Number of Delivery at Umbaddah General Hospital

Year	2009	2010	2011	2012	Hospital has closed since Feb. 2012
*No. of Delivery	3,972	3,701	3,626	675	

Ref.: Annual Statistical Data in Khartoum (SMOH)

Because there is no other hospital in Umbaddah locality, the number of institutional deliveries is considered to be conducted at the Umbaddah General Hospital.

(B): Population growth rate in Khartoum State from 2011 to 2020 = 1.0349⁹

(Annual population growth rate 1.0349: the annual population growth rate in Khartoum State used by SMOH)

3) Calculations of numbers of beds and major rooms

① Number of delivery tables: 3 units

Required delivery tables are calculated based on the number of vaginal deliveries per day and their rotation frequency.

As there is no hospital that can handle deliveries in Umbaddah locality, the new section will be required to respond a number of delivery needs. At the same time, the number of doctors and medical personnel is limited. Considering above, the rotation frequency of delivery tables shall be set at the higher side.

(Calculation formula)

$$\frac{\text{Target number of deliveries} \times (\text{rate of vaginal delivery } 0.8) / 365 \text{ days}}{(C) \text{ Rotation frequency of delivery tables} \times \text{Increasing rate of deliveries at the peak period}} \\ = 5,000 \times 0.8 / 365 / 5 \times 1.1387 = 2.496 \approx \mathbf{3 \text{ units}}$$

(C) Rotation frequency of delivery tables: 5 rotations/ table/ day

Assuming delivery rooms operate 24 hours for 365 days and doctors and midwives work for 8 hours in three shifts with maximum of two deliveries per shift, use of a delivery table will be 6 times/day (2 deliveries x 3 shifts, 1 delivery/ table in every 4 hours). It is a double in number to the standard of the general Japanese rotation frequency of delivery tables. However, bearing the situation of Sudan in mind, as the numbers of both hospital facilities and medical personnel are limited despite of its fertility, a burden for each hospital becomes bigger and even 6 rotations per day can be applicable.

On the one hand, the rotation frequency of delivery tables at the Turkey General Hospital that is similar to the new facilities planned by the Project in its scale, is 5.18 rotations/ day which is approximately 5. Reflecting this figure, the Project calculates the rotation frequency of delivery tables at the new facility as 5 times per day.

Reference

{ number of deliveries at the Turkey General Hospital in 2013 (5,190) – number of C/S (1,411) }

/ 365days / 2 delivery tables = 5.18

② A number of operation theatres: 2 rooms

In Sudan, C/S operation and miscarriage treatment are conducted in the operation theatre. Therefore, the required number of operation theatres is calculated based on numbers of C/S and miscarriages and the rotation frequency of an operation theatre.

(Calculation formula)

((D) Number of C/S + (E) Number of miscarriages) / 365 days /

(F) Rotation frequency of an operation theatre x Increasing rate of deliveries at the peak period

= (5,000 x 0.2 + 883) / 365 / 3 x 1.1387 = 1.958 → 2 rooms

(E) A number of miscarriages in a target year:

Target delivery number 5,000 = Number of pregnancies x 85%

Number of pregnancies = 5,000/ 0.85= 5,883

(G) Number of miscarriages = 5,883 x 15% = 882.3 → 883 cases

(F) Rotation frequency of an operation theatre: 3 rotations/day

Apart from C/S operations, Dilatation and Curettage (D&C) treatment is handled at the operation theatre. Rotation frequency of an operation theatre is calculated to be 3 rotations/day assuming time required for one C/S operation is 4 hours (preparation -> operation -> cleaning) and daily operation hours of the operation theatre are 12 hours.

Reference

Rotation frequency of an operation theatre at the Turkey General Hospital (C/S): 4 rotations/day

(Number of C/S in 2013 1,411 + number of D&C 1,186) / 365days / 2 operation theatres

= 3.56 → 4 rotations/day

③ A number of beds at labour rooms : 8 beds

The maximum hours to be spent at the labour room will be half a day (set a number of beds so that all patients are to be accommodated even if a half number of deliveries per day concentrates at the same time).

(Calculation formula)

Daily delivery number =

Annual vaginal delivery number x increasing rate of deliveries at the peak period / 365 days

$$= (5,000 \times 0.8) \times 1.1387 / 365 = 12.48 \rightarrow 13 \text{ deliveries/day}$$

A half of daily delivery number = 13 deliveries x 0.5 day = 6.5 → 7 beds

A spare bed is added which becomes 8 beds in total.

④ Number of beds at the post-delivery room A: 8 beds

A same number of beds is prepared as beds for labouring.

⑤ Number of beds at the post-delivery room B (in case of miscarriages and stillbirths): 2 beds

It is half a number of daily miscarriages which is calculated based on the number of annual miscarriages in the target year. To note, the post-delivery room B shall be located in some distance from the post-delivery room A and nurseries. Lines of flow for these rooms shall not be overlapped.

(Calculation formula)

Number of annual miscarriages x increasing rate of deliveries at the peak period / 365

$$= 883 \times 1.1387 / 365 = 2.75 \rightarrow 3 \text{ cases/day}$$

Thus, a half of a number for daily miscarriages is 3 cases/day x 0.5 = 1.5 → 2 beds

⑥ Number of beds in the ward: 24 beds (20 public and 4 private beds)

A required number of beds as a public hospital is calculated based on: a number of C/S operations per day bearing the condition at the peak period in mind; a number of annual hospital admissions due to other causes (e.g. a complication); days spent at the hospital; and bed occupancy rate. Private bed rooms are also to be introduced responding to the needs for private rooms and as a source of income for the hospital.

(Number of public beds)

a. Number of general beds (before C/S operations): 4 beds

(Calculation formula)

Number of C/S in target year x days of hospital admission 1 day / 365 days

/ bed occupancy rate 70%

$$= (5,000 \times 20\%) \times 1 / 365 / 0.7 = 3.91 \rightarrow 4 \text{ beds}$$

b. Number of general beds (after C/S operations): 12 beds

(Calculation formula)

$$\frac{\text{Number of C/S in target year} \times \text{days of hospital admission 3 days} / 365 \text{ days}}{\text{bed occupancy rate 70\%}}$$

$$= (5,000 \times 20\%) \times 3 / 365 / 0.7 = 11.74 \rightarrow 12 \text{ beds}$$

c. Number of general beds (hospital admission apart from C/S): 4 beds

Patients admitted to the hospital except those for C/S operations were 101 at the gynaecologic sector of the public Turkey General Hospital that handled 5,190 deliveries in 2013. The number of beds for non C/S patients for the project facility will be calculated based on this given ratio.

(Calculation formula)

$$\frac{\text{Number of non C/S patients admitted to the hospital in target year}}{\text{x days of hospital admission 5 days} / 365 \text{ days} / \text{bed occupancy rate 70\%}}$$

$$= 98 \times 5 / 365 / 0.7 = 1.917 \rightarrow 2 \text{ beds}$$

$$\frac{\text{Number of non C/S patients admitted to the hospital in target year}}{(\text{Number of non C/S patients admitted to the hospital at the Turkey General Hospital} / \text{annual delivery number}) \times \text{delivery number of target year}}$$

$$= (101 / 5,190) \times 5,000 = 97.3 \rightarrow 98 \text{ cases /year}$$

The maternal and child health section of the project will be the only gynaecologic medical facility at the secondary level in Umbaddah locality. In comparison to the Turkey General Hospital that is located in Jabal Awilya locality where three hospitals are present, it is assumed that this new maternal and child health section will be referred by a number of medical facilities with lower levels. Thus, two more beds will be added.

Table 2-9 Comparison of Health Facilities between Jabal Awilya and Umbaddah

Locality	No. of Hospital	No. of Health Centre	No. of Health Unit	Total no. of Primary level Health Facility	Population
Jabal Awilya	3	62	5	67	1,074,620
Umbaddah	1*	89	11	100	1,126,769

* : No. of Hospital '1' means the Umbaddah MCH Section by this project.

(Number of private beds)

A standard of SMOH for the number of private beds is a minimum of 10% to the number of public beds. However, since the scale of the planned facility is small with only 20 public beds, the number of private beds will be doubled from the standard (20%) considering an expectation for the income as well as a staff number and their capacities.

$$= (14 + 3 + 3) \times 20\% = 4.0 \rightarrow 4 \text{ beds}$$

⑦ HDU (High Dependency Unit): 2 beds

The number of beds in HDU will be the same as the one of the Turkey General Hospital. No treatment for respiratory problems will be provided so that patients who need respiratory supports are to be transported to other hospitals specialised in maternal and child health with higher levels (thus, there will be no respiratory apparatus).

⑧ ICU (Intensive Care Unit): 0 bed

The project targets maternal and child examinations and safe delivery services. Treatments and severe operations for gynaecology and paediatrics will be handled at the existing General Hospital. For said reason, there will be no ICU in the new facility.

⑨ NICU (Neonatal Intensive Care Unit): 10 beds

In-hospital delivery (un-septic): 4 beds

Transferred from outside (septic): 6 beds

As there is no clear standard in Sudan, the number of NICU will be same as that of the Turkey General Hospital which is equivalent in scale with the new facility.

Though there is no specific criterion for entering NICU, newborn infants above 24th week (weight of 500g or above) are mainly treated. The most commonly treated are newborns with weight of 1,000g. After being treated for 28 days in NICU, some will continue to stay while others are transferred to the other ward depending on their weight and conditions. They are then discharged. Newborns at NICU are accommodated in incubators with oxygen, infusion (antibiotics) and aspiration. Respiratory control is not provided (thus, there is no respiratory apparatus).

⑩ Outpatient examination rooms: 8 rooms

The new maternal and child health section of the project mainly targets prevention of diseases and risky deliveries through maternal and inborn checkups and delivery measures (mainly C/S operations). Outpatient examination rooms therefore provide four services: ANC/PNC; family planning; immunization and growth monitoring as well as services for diagnosing miscarriage/ abortions (gynaecology) and ultrasonic/ electrocardiogram examinations.

a. Consultation room (ANC/PNC) : 4 rooms

(Calculation formula)

$$\frac{\text{Total number of deliveries} \times 6 (\text{ANC 4 times} + \text{PNC 2 times}) / 8 \text{ hours} \times 4 \text{ cases (minutes spent for one examination 15 min.)} / 260 \text{ days}}{= 5,000 \times 6 / 32 / 260 = 3.6 \rightarrow 4 \text{ rooms}}$$

ANC and PNC are normally conducted in a same room with a same doctor. Therefore the project also uses same rooms for ANC and PNC.

In Sudan, a standard number of ANC during pregnancy is three and PNC within 40 days after the

delivery is one. Examination items for ANC are: blood pressure; uterus/ foetus/ oedema/ urine (sugar and protein) examination; and blood sampling (blood type, HIV and hepatitis B for the first time only, haemoglobin for every checkup). They are conducted in all three checkups. Examination items for the PNC are: blood pressure; breast/ uterus/ urine examination; and blood sampling.

On the other hand, the benchmark number of times for receiving ANC indexed by WHO is four times. The project therefore uses 4 for the number of ANC in its calculation formula.

Though WHO formerly sets a number of times for receiving PNC as 2, it recommends mothers to be checked three times after their childbirths (within 24 hours, between 7-14 days, and within 6 weeks) since 2013. However, the figure is unrealistic in Sudan as many mothers are currently unable to be checked even once. Therefore, the project facility will be designed so to be able to handle 2 times of PNC for all mothers who deliver at the new facility.

b. Consultation room (Family planning): 1 room

The number of family planning services, 977 cases at the Turkey General Hospital is referred.

(Calculation formula)

$$977 / (260 \text{ days/year}) = 3.76 \rightarrow \text{approximately 4 cases/day}$$

Thus, one room will be provided for its specific use.

c. Consultation room (immunization/ growth monitoring): 1 room

1 room is to be provided as immunization does not require long time that many cases can be handled in a same room for ANC/PNC. Simultaneously, the existing large-scale hospital handles immunization in a single room similar in size.

d. Ultrasonic and electrocardiogram examination room: 1 room

1 room specialized for both ultrasonic and electrocardiogram is prepared.

e. Gynaecological examination room: 1 room

A number of miscarriages, 883 cases/ year, is used for calculation.

(Calculation formula)

$$883 / 260 \text{ days} = 3.4 \rightarrow \text{approximately 4 cases/day}$$

Considering the contents of examination, the room will be differentiated from ANC/PNC and a specific room for gynaecological examination will be provided. One room is enough to handle 4 cases/day.

(2) Required Floor Area

Gross floor space and floor spaces of each room for the new maternal and child health section is summarized in the table below.

Table 2-10 Floor Area of Planned MCH Section Building

Ground Floor				
Common Zone		Room Size A x B (m)		Floor Area (m ²)
Common Zone	Entrance	6	6	36
	Hall (Waiting Area)	12	13	156
	General Outpatient Triage	3	4	12
	Waiting Space (Passage)	30	4.25	127.5
	Stairs-1	2.4	12	28.8
	Stairs-2	3	6	18
	Stairs-3	3	6	18
	Slope	30	4.8	144
	Toilet Female	3	6	18
	Toilet Male	3	6	18
	Disabled Person's Toilet	3	3	9
	Electrical Room (EPS)	3	6	18
	Cafeteria	12	6	72
	Kitchen			46.5
	Food Storage	2.5	3	7.5
	Common Zone Total (m ²)			729.3
Outpatient/Pharmacy/Laboratory Zone		Room Size A x B (m)		Floor Area (m ²)
Outpatient/Pharmacy/Laboratory Zone	Reception	6	3	18
	Medical Record	6	3	18
	Casher	3	6	18
	Storage	3	3	9
	Pharmacy	6	6.5	39
	Medicine Store	2.5	6	15
	Laboratory	6	9	54
	Blood Collection	3	3	9
	Blood Bank	3	6	18
	Urinal Collection	3	3	9
	Consultation Room (ANC/PNC)-1	6	3	18
	Consultation Room (ANC/PNC)-2	6	3	18
	Consultation Room (ANC/PNC)-3	6	3	18
	Consultation Room (ANC/PNC)-4	6	3	18
	Consultation Room (Immunization/ Growth Monitoring)	6	3	18
	Consultation Room (Family Planning)	6	3	18
	Examination Room (Gynecology)	6	3	18
	Ultra Sound / ECG	6	3	18
	Waiting Space (OPD)	6	12	72
	Outpatient Zone Total (m ²)			423

Delivery Zone		Room Size A x B (m)		Floor Area (m ²)
Delivery Zone	Corridor	42	3	126
	Nurse Station	6	6	36
	Delivery Room 1	3	6	18
	Delivery Room-2	3	6	18
	Delivery Room-3	3	6	18
	Labour Room	9	6	54
	Ante Room-3	3	3	9
	Nursery (un-septic)	6	6	36
	Linen-1	3	1.5	4.5
	Nursery (septic)	9	6	54
	Post-Delivery Room-1	9	6	54
	Toilet (female)	3	6	18
	Hall	9	7	63
	Ante Room-1	6	4	24
	Ante Room-2	4	4	16
	Medical Waste	2	2	4
	Emergency Entrance	3	6	18
	Night Reception	3	4.5	13.5
	Waiting Space for Attendants	3	6	18
	Post-Delivery Room-2	3	6	18
	Gas Cylinder Storage	2	7.5	15
	Stairs-4	4	6	24
	Delivery Zone Total (m ²)			659
OT Zone		Room Size A x B (m)		Floor Area (m ²)
OT Zone	Ante Room-4	4.5	6	27
	Changing Room (Male)	6	3	18
	Changing Room (Female)	6	3	18
	Linen-2	2	2	4
	Equipment Storage	4	2	8
	Preparation Hall	4.5	9	40.5
	Operation Theater-1	6	6	36
	Operation Theater-2	6	6	36
	Recovery Room	5.5	2.5	13.75
	Resting Room (Male)	4	2.75	11
	Resting Room (Female)	4	2.75	11
	Cleaning Tool Storage	1.5	1.5	2.25
	Washing Room	7.5	3	22.5
	Sterilization Room	6	3	18
	Equipment Stock Room	3.75	3	11.25
	Ante Room-4	2.25	3	6.75
	Corridor	2	8	16
	Service Staff's Changing Room	4	3.75	15
	OT Zone Total (m ²)			315

Service Zone		Room Size A x B (m)		Floor Area (m ²)
Service Zone	Laundry	6	9	54
	Laundry Staff's Office	3	3	9
	Linen	3	3	9
	Service Staff's Office	6	4	24
	Service Staff Room (Male)	3	4	12
	Service Staff Room (Female)	3	4	12
	Night Duty Room (Male)	2	4	8
	Night Duty Room (Female)	2	4	8
	Storage	4	2	8
	Workshop	6	6	36
	Machine Room	7	12	84
	Toilet (male)	6	3	18
	Toilet (female)	6	3	18
	Service Zone Total (m ²)			300
Other spaces, corridor and etc.				294
Total floor area of Ground floor (m²)				2,720

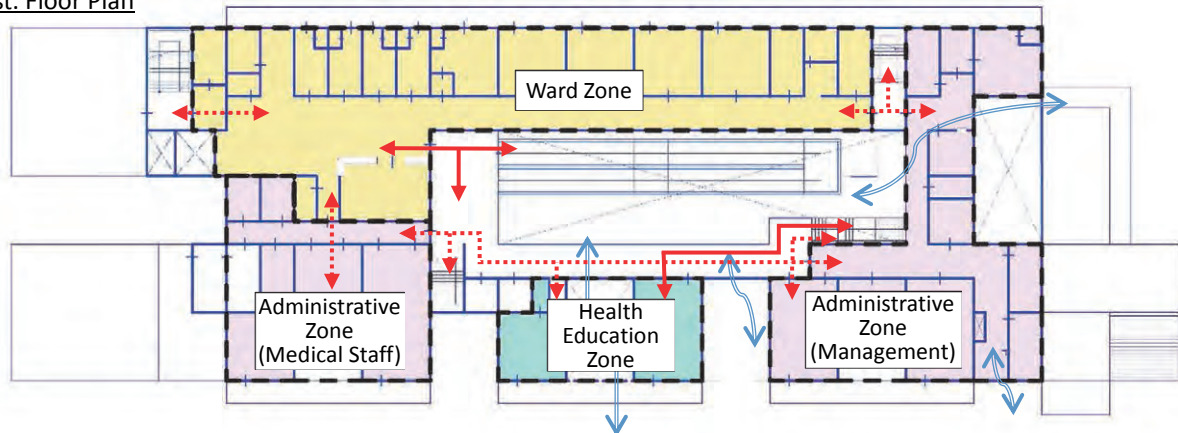
First Floor				
Common Zone		Room Size A x B (m)		Floor Area (m ²)
Common Zone	Corridor	30	3	90
	Toilet Male	3	3	9
	Toilet Female	3	3	9
	Common Zone Total (m ²)			108
Word Zone		Room Size A x B (m)		Floor Area (m ²)
Word Zone	Hall	18	6	108
	Corridor	27	3	81
	Nurse Station-2	8	5.25	42
	Linen-3	2	4	8
	Pantry	3	6	18
	Nursing Room	3	4	12
	Medical Waste	3	2	6
	Ante Room	3	3.75	11.25
	Toilet (Male)	3	5	15
	Bed Room (5 beds)	6	6	36
	x 4rooms			144
	Bed Room (1 bed)	3	6	18
	x 4rooms			72
	HDU (2 bed)	6	6	36
	Storage	3	6	18
	Shower-(Female)	3	3	9
	Toilet – (Female)	3	6	18
	Washing	3	3	9
	AC Ducting Room	3	6	18
	Word Zone Total (m ²)			625.25

Health Education Zone		Room Size A x B (m)		Floor Area (m ²)
Health Education Zone	Health Educator's Office	6	6	36
	Storage	1.75	3	5.25
	Health Education /Seminar Room	6	9	54
	Health Education Zone Total (m ²)			95.25
common Zone		Room Size A x B (m)		Floor Area (m ²)
Administration Zone	Ante Room-5	3	3	9
	Corridor1	2	13	26
	MCH Medical Director's Room	3	6	18
	Secretary Room	3	4	12
	DG's Room	6	6	36
	Accountant Room	4	4	16
	Storage	4	2	8
	Meeting Room	4	4	16
	Statistics Room	6	9	54
	Office	6	9	54
	Resting Room	6	3	18
	Corridor2	3	27	81
	Staff Toilet (male) -east	3	6	18
	Staff Toilet (female) -east	3	6	18
	Kitchenette	3	3	9
	Doctor's/Staff's Room (male)	6	9	54
	Doctor's/Staff's Room (female)	6	12	72
	Conference Room (Medical staff meeting room)	6	6	36
	Staff Toilet (male) -west	3	4	12
	Staff Toilet (female) -west	3	4	12
	Corridor3	18	2	36
	Administration Zone Total (m ²)			615
Other spaces, corridor and etc.				424
Total Floor Area of 1st Floor (m ²)				1,867
Total Floor Area of Roof Floor (m ²)				66
Grand Total Floor Area (m ²)				4,653
Annex Buildings		Building Size A x B (m)		Floor Area (m ²)
Electrical Building		6	18	108
Pump Room Building		8	5	40
Water Reservoir Tank, Elevated Water Tank, Septic Tank				-
Total Annex Buildings (m ²)				148

(3) Floor Plan

The new maternal and child health section building will be two storied in order to maximize the land usage. The entrance hall continuing into the open ceiling space with slopes at the centre will be the axial structure of the building. It is composed of eight zones classified by their functions. There are: common zone, outpatient/ consulting zone; delivery zone; OT zone; and service zone on the ground floor. In the first floor, there are: common zone, ward zone; health education zone; and administrative zone. Related zones are located closely aiming at the smooth flow. Especially for delivery and OT zones, they are connected at the hall in front of the nurse station so that one can be immediately transferred in a linear manner for a case of emergency. OT and bed rooms are connected by slops enabling an access using stretchers. These two zones and slops are closely located with an anteroom in between so to minimize the transportation distance. Though elevators are convenient for transferring stretchers between the ground and first floors, the project only plans elevator shafts since the O&M cost of elevators is high. Elevators can be independently installed and managed by the implementation agency of Sudan in future. Outpatient/ consulting and health education zones are accessed by stairs facing to the entrance hall as people from outside can easily approach. They are also located facing to an open ceiling space with good ventilation and light as many patients and their attendant families visit these zones. Alternatively, all bed rooms are located in the northern side of the building. As they are places for rest, it is planned so to avoid strong sunlight and heat of radiation. In addition, balconies are introduced in order to prevent direct sunlight.

1st. Floor Plan



Ground Floor Plan

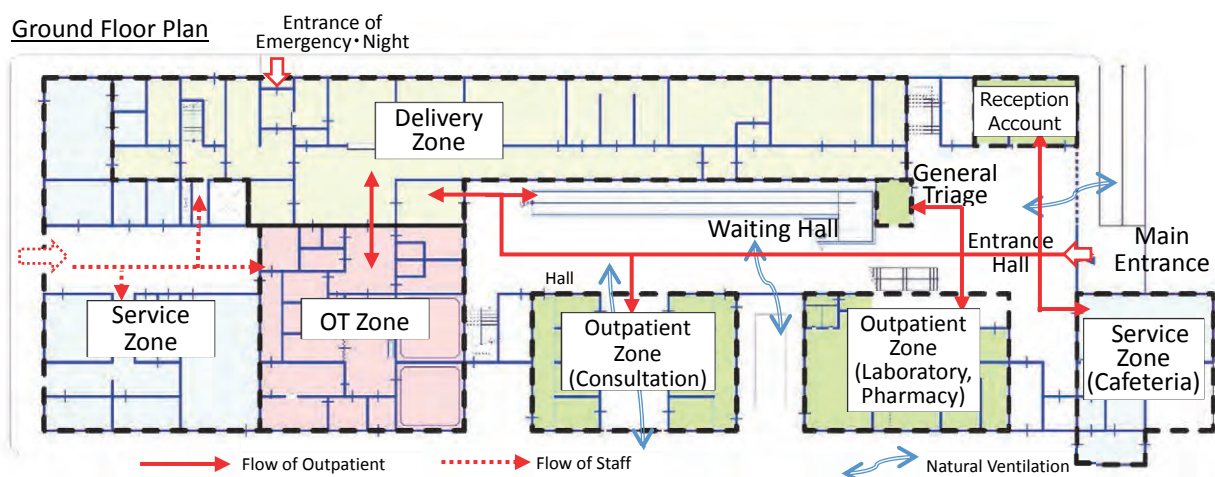


Fig.2-8 Zoning Plan of MCH Section Building

1) Outpatient/ consulting Zone (Ground Floor)

Outpatients are guided to consultation rooms, examination rooms, or/and pharmacy via general outpatient triage in front of the entrance hall. The reception, pharmacy, examination rooms and consultation rooms are located as they encircle the entrance hall which also functions as waiting spaces. For consultation rooms, 4 ANC/PNC rooms, and other 4 rooms (an immunization/ growth monitoring room, a family planning room, a gynaecological examination room and an ultrasonic/ electrocardiogram examination room) are located opposite to each other with a waiting space in between.

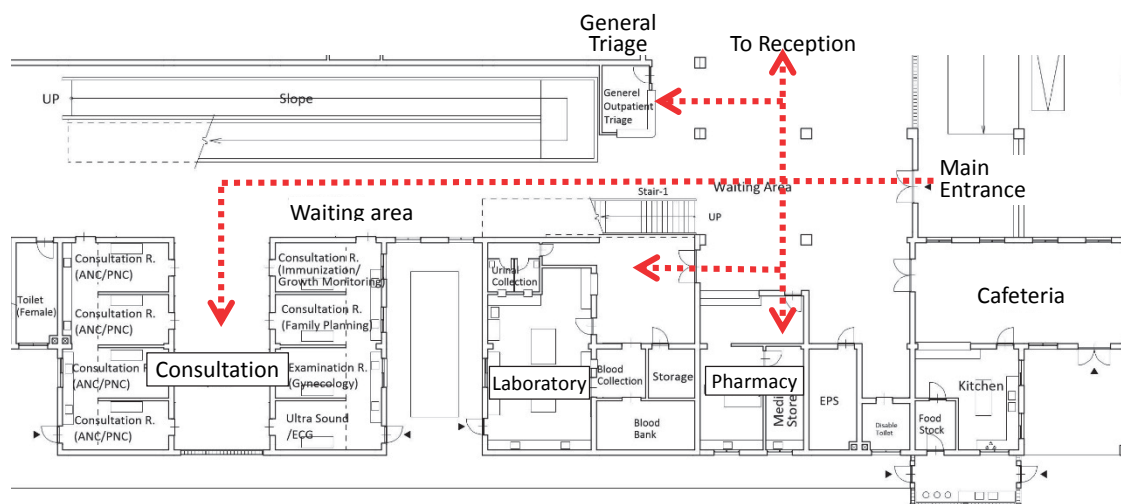


Fig. 2-9 Floor Plan of Outpatient/ Consulting Zone

2) Delivery Zone (Ground Floor)

Rooms related to deliveries are located in line at the northern side of the building and zoned together with a side corridor. One shall enter the zone through an anteroom and find a nurse station in front of the hall. Then there are a nursery (un-septic), a labour room, delivery rooms, another nursery (septic) and post delivery rooms next to each other. The nursery (septic) and the post delivery room are separated from other rooms as a non-cleanliness area. There is a night reception desk next to the nurse station which performs as a main entrance during nights and emergencies. The delivery and OT zones are located side by side with a hall in between so that measures such as emergency operations can be promptly handled.

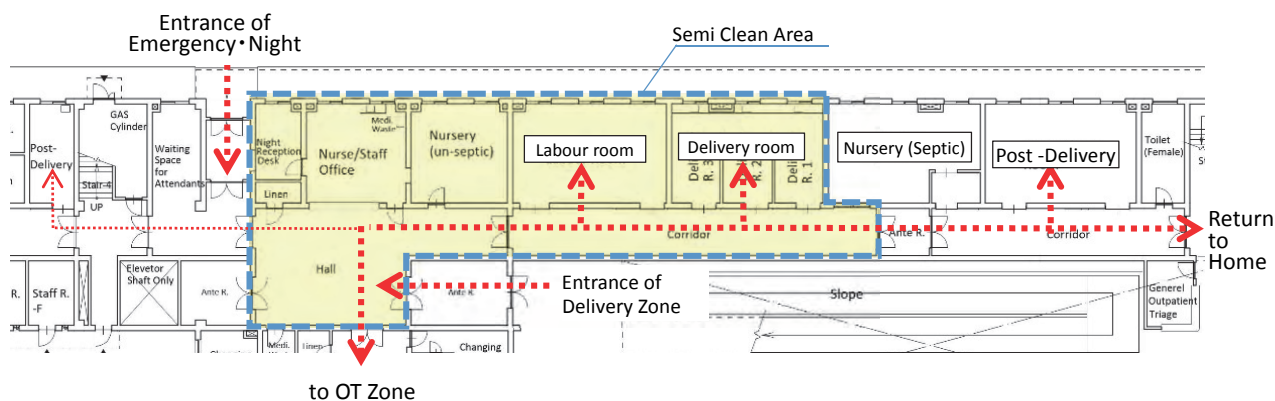


Fig. 2-10 Floor Plan of Delivery Zone

3) OT zone (Ground Floor)

The OT zone is entered through changing rooms facing to the anteroom. It is further divided into a hygienic area from the delivery zone and composed of two operation theatres, resting rooms, a recovery room and a sterilization unit with a preparation hall in the centre. The sterilization unit is composed of a washing room facing to the preparation hall, a sterilization room and a stock room. Cleaning staff use a different entrance that is situated at the western side of the zone across the corridor so that they are unable to enter directly into the designated hygienic area.

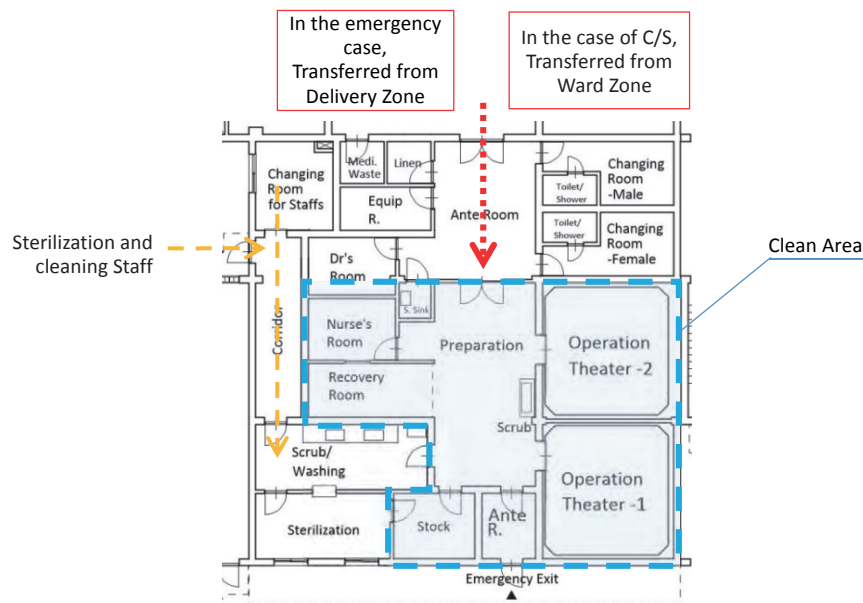


Fig. 2-11 Floor Plan of Operation Zone

4) Service Zone (Ground Floor)

As for the service zone, there are a laundry, a staff office, resting rooms, workshops, a machine room, and external toilets at the western side of the building. They are located out of the movement flow of outpatients and patients. A kitchen and cafeteria are located in the south of the main entrance considering the use of outpatients and others.

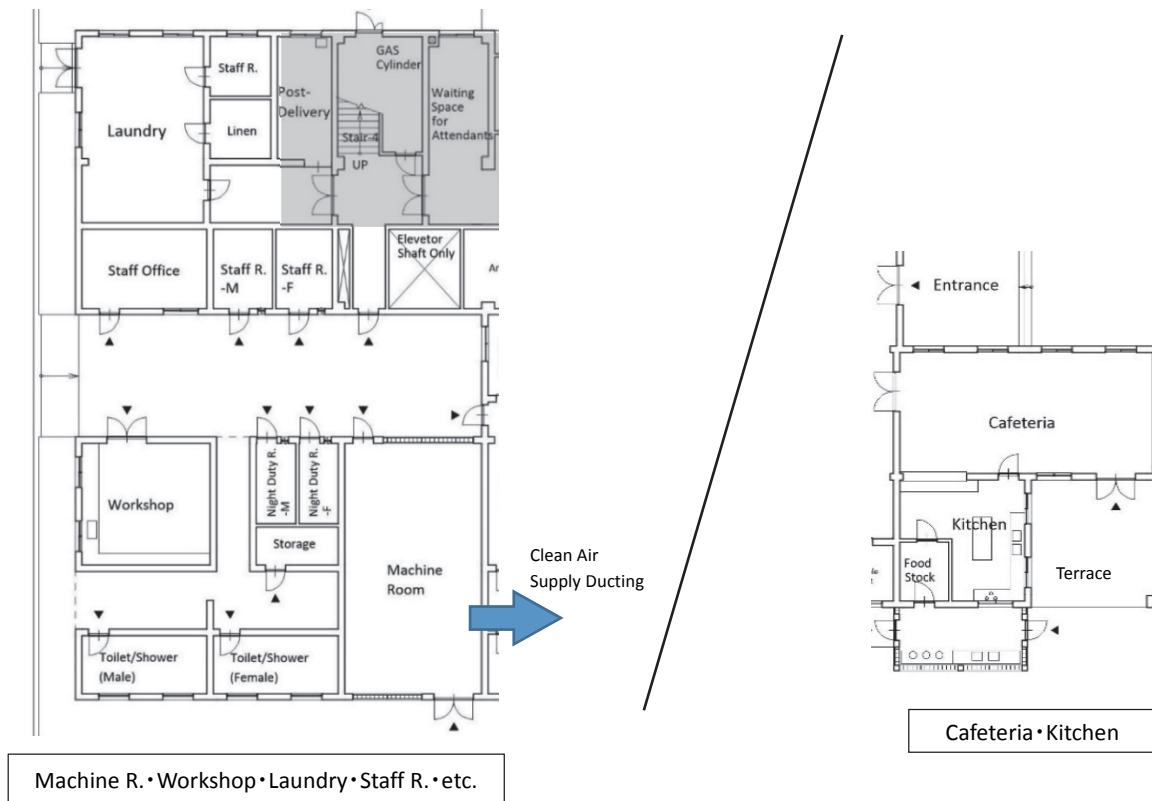


Fig. 2-12 Floor Plan of Service Zone

5) Ward Zone (First Floor)

For the ward zone, targeting patients with C/S operations, premature births and miscarriages, public bed rooms (5 beds/room), private rooms, and HDU for patients with severe conditions are located along the northern side of the first floor of the building avoiding strong sunlight. In line with these bed rooms, there are a storage, toilets for patients, shower rooms, a pantry and a nursing room. Entering the zone is controlled as its entrance is seen by the nurse station facing to the hall.

After the operation, patients are carried on stretchers to the ward zone by slops located in the centre of the building. Staff including nurses and doctors use stairs at the north western side of the building linked with the delivery and OT zones. Otherwise, they enter through staff exchange rooms/ resting rooms at the southern side of the ward zone.

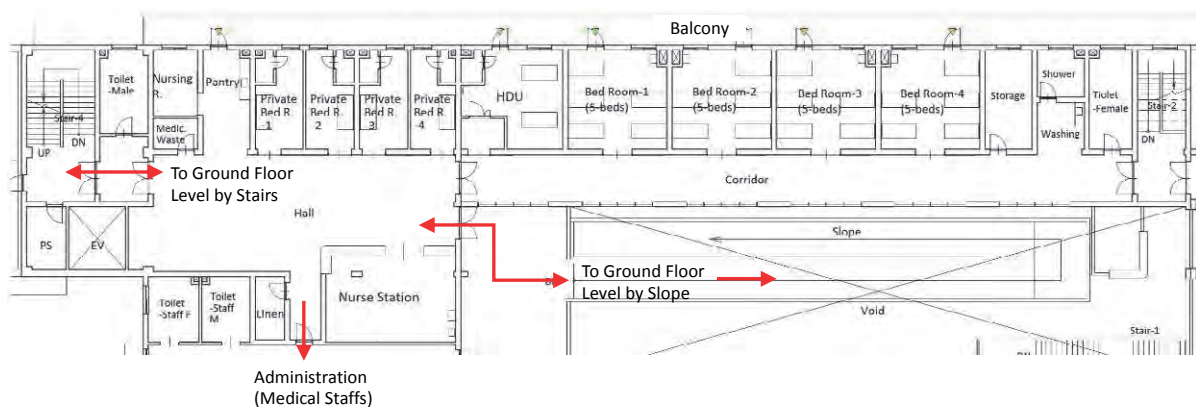


Fig. 2-13 Floor Plan of Ward Zone

6) Health Education Zone (First Floor)

The health education zone is composed of a seminar room and a preparatory room connected by corridor with an open ceiling space in middle. The seminar room will be the size which can accommodate 40 people in maximum. The room is accessed by the main stairs at the entrance hall. It can also be approached from the administrative side. The corridor, facing to the open ceiling space with slops for stretchers and wheels chairs in middle, also plays a role as a foyer.

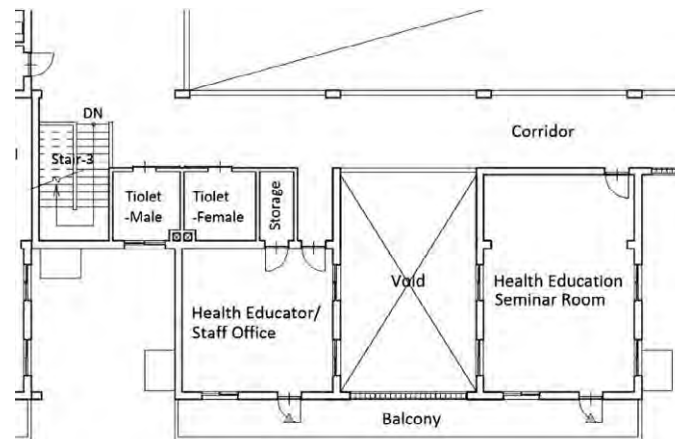


Fig. 2-14 Floor Plan of Health Educational Zone

7) Administration Zone (First Floor)

The administration zone will be divided into two blocks: the eastern block and the western block. The eastern block is composed of rooms for officials and administrative offices while the western block is composed of changing and resting rooms for medical staff including nurses and doctors. The eastern administration block is connected in sight with the outpatient zone on the ground floor via corridor facing to the open ceiling space. The size of the office at the south side of the zone is 6m x 9m so to accommodate enough desks and storing cabinets. There are two doors for the office considering future changes in its usage or/and staff increase.

Male and female changing and resting rooms for doctors and paramedics are located at the western administration block. Rooms are designed in an integrated fashion so to be rearranged with partitions and lockers enabling to respond future changes in staff reallocation which may happen after the completion of renovation works for the existing hospital.

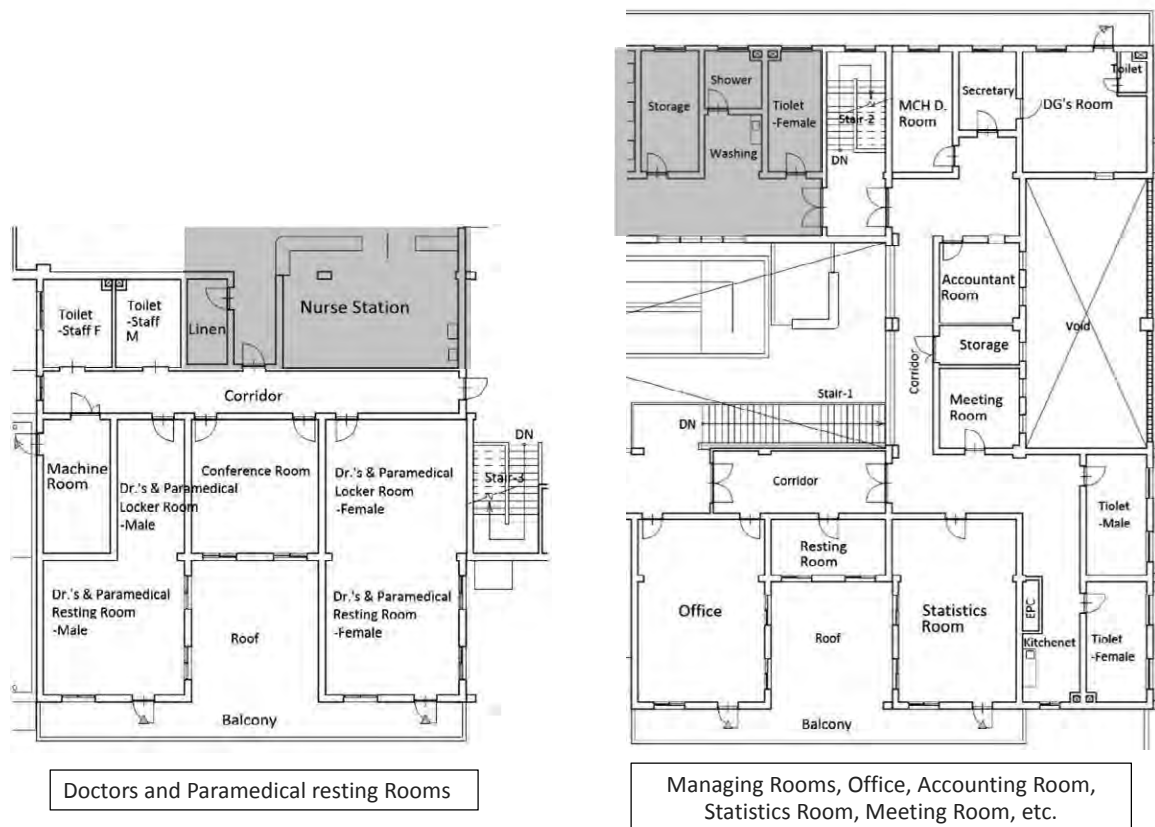


Fig. 2-15 Floor Plan of Administration Zone

(4) Section Plan

The building will be two storied above the ground. The height of each floor shall be 4m in order to secure enough spaces for ventilation pipes; those also to be used for the air conditioning system. Moreover, for installation of ceiling fans, the general ceiling height for habitable rooms will basically be 3m.

The waiting hall, a common space, will be a large open space equipped with slops in the middle of its north-south section. The upper part is designed open as a semi-outdoor space which creates air convection. By introducing such design moderate ventilation and lightning will be provided.

Balconies established on northern and southern walls act as eaves that prevent direct sunlight entering into the inside of the building. Alternatively, the outer wall will be composed of one layered bricks which air layers between bricks prevent outer air and heat. There will be no open end at the western side.

The ground floor is levelled 500mm above the ground in order to prevent entering of sand dust and rainwater. Therefore, slops will be introduced for approaches by stretchers and wheelchairs. Considering barrier-free environment, each floor is designed so to have no uneven levels.

The water proofing layer of slab roof is insulated by Styrofoam in order to minimize radiant heat inside of the building and reduce a burden on air conditioners.

(5) Plan for Outdoor Facilities

Outdoor facilities are composed of: a car parking space for facility users; service roads within the site near the planned facility; roads connecting the main and side entrances to the road in front; rain water ditches; planting spaces; a plate with the project title; flag poles; a guide panel for the site and others.

Service roads within the site and the car parking will be paved with interlocking blocks with the objective of securing cleanness within the site and easiness of O&M. The Sudanese side will bear the works including: planting, renovation of the existing building; and walls and doors for surrounding the compound.

To be noted, the soil called ‘black cotton’ is found near the surface ground of the project site which expands with moisture. It is therefore, when a drainage system within the site is planned, an attention needs to be paid in both facility planning and daily O&M so that water to be pooled neither within the building nor its surroundings.

2-2-2-4 Structural Design

(1) Ground Condition and Type of Foundation Form

As described in ‘1.2 Natural Condition (5) Geological features of the Site,’ the result of the geology survey which was locally subcontracted shows places with soft soil with N value between 10 to 13 at the depth of 9-13 m. As this soil can seriously influence the upper structure of the building, a type of foundation form that eliminates the impact of the soil needs to be applied.

Considering above, following two construction methods are reviewed based on their applicability at the site, economical and safeness aspects.

- a) Pile Foundation Method: RC cast-in-place piles with the diameter of 0.8-1.2m are introduced into the ground with depth of 15m from the pile head. Independent RC foundation is constructed with its pile heads 1.5m above the ground surface. It is a method that piles support the building weight.
- b) Direct Foundation Method: Direct foundation with its batholith at 2.5m of depth from the surface level is introduced. The soil layer below the direct foundation is replaced with quality macadam. It is a combination method of direct foundation and soil replacement.

For the pile foundation method a), the soil layer that lays 17m below the surface ground will be the supporting layer. Its N-value is above 35. As the problematic soil layer is found between 9 to 13m in depth, stable bearing capacity is secured. On the other hand, the direct foundation method b) secures its basic bearing capacity by replacing soil of 1.5 to 2m below the batholith of RC independent foundation with quality macadam. However, in order to avoid influences caused by the problematic soil found between 9 to 13m in depth, soil improving measures such as cement grouting to problematic areas need to be conducted in addition to the replacement of soil below the batholiths. What is more, it is difficult to specify the area of the problematic soil as it is not found at the same level. Therefore, in order to

secure the long term safeness of the building, entire soil layers below the foundation need to be improved.

Despite of using piles with the diameter of 0.6m, the structure of the existing hospital is seriously damaged by irregular subsidence. Considering such situation, a basic foundation which is not affected by the problematic soil need to be introduced.

The pile foundation method a) is therefore selected.

(2) Type of Construction Structure

Following a commonly used construction structure in Sudan, RC rahmen frame structure is used for main building frames including its foundation, poles and beams. RC beams and RC slab structure will also be used for roofs. However, since the span is big, steel framework is used for the roof of an open ceiling space with metal roofing material.

As it is most commonly practiced in the area, brick lying is applied for the outer walls and major partitions. Bearing the high outside temperature in mind, thickness of the outer wall shall be secured for improving heat prevention.

(3) Design Standards

Appling the following Japanese standards, structural design will be undertaken by introducing the allowable stress design.

- The Building Standards Act, the Enforcement Order
- Technical Standards related to building structures
- Calculation Standard for reinforced-concrete structures, and its interpretation

(4) Design Stress

1) Earthquakes

There is no specific official design standard against earthquakes in Sudan. However, architects themselves introduce a horizontal seismic coefficient for important buildings in the urban area. As the project plans to build a hospital which has high public importance, the Japanese earthquake resistant design code, the design horizontal seismic coefficient of 0.05, shall be applied (note: 1/4 of the design horizontal seismic coefficient in Japan).

2) Wind pressure

Considering the maximum instantaneous wind speed of 47.3m/second recorded in Khartoum in the past, the maximum design wind speed of 30m/second applied in the project will be the wind speed for the design basis.

(5) Materials and their Strengths

1) Concrete

The specified concrete strengths for the concrete used for the building frame and levelling concrete are 25N/mm² and 15N/mm² respectively. Concrete used for piling will be 25N/mm².

2) Reinforcing bar/ steel frame

Locally available reinforcing bar/ steel frame that are commonly used in Sudan shall be applied. Yet, they need to meet BS standards. The Standards are Grade 460/425 of BS4461 and BS4449 (otherwise equivalent to JIS G3112 SD390).

2-2-2-5 Utility Plan

The existing hospital facilities currently under renovation within the project site include utility facilities for electrical and water supply, sewage system, septic tank, and others required for the hospital operation. Almost all facilities are targeted for renovation. Yet, neither the completion date for renovation nor their contents/capacities are unclear. At the same time, sharing these utility facilities is difficult as specifications and the level of durability for the project facility differ from the existing ones. Therefore, the project separately designs the contents of electricity, city water and sewage system for the use of the project facility.

(1) Applicable Standard

Considering O&M aspects, the local standard will be applied for those with Sudanese specifications that are widely available locally. For those that are locally unavailable and those that need to meet Japanese standards are to be procured from Japan or neighbouring countries.

(2) Electrical Planning

1) Power system

① Power Receiving and Transforming System

There is a transformer with 1,000KVA within the site. However, as the reopening of the existing hospital is not known, and to differentiate managerial responsibilities of facility management, a new transformer with 1,000KVA is to be installed for the use of the new project facility. The power receiving and transforming room is located at the south-eastern corner of the project site.

② Emergency power system

Though power supply at the project area is relatively stable, power failure is not uncommon. There will be a power generator (300KVA) that supplies the minimum power necessary for avoiding

stoppage of hospital functions. Switching power system will be manually handled by the utility management engineer.

2) Main line and power supply system

Electrical wiring from the power room to each facility will be a cable buried under the ground. Power will be supplied to each zone with 50hz, 415V for three-phase and 220-240V for single-phase.

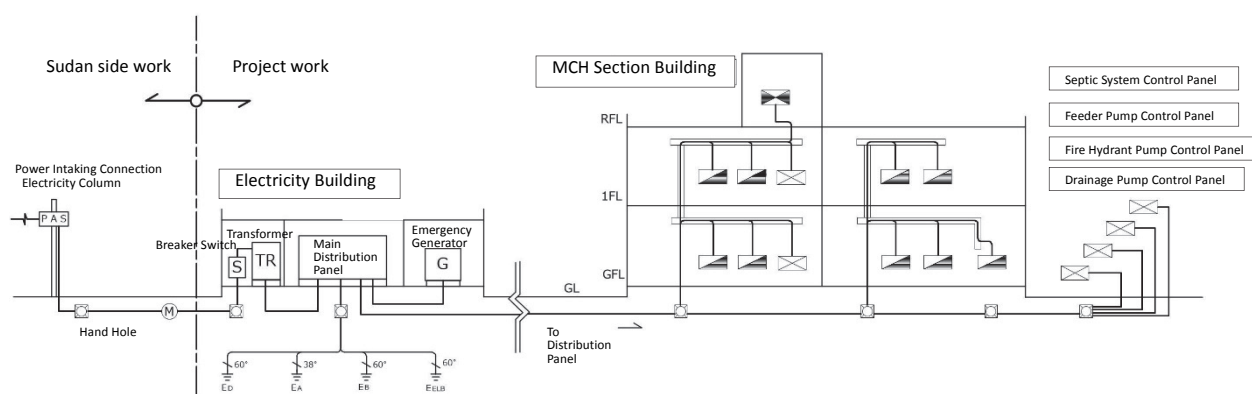


Fig. 2-16 Main Electricity Circuit Plan

3) Lighting system

Considering O&M, lighting fixtures generally available in Sudan will be selected. The light source will be either LED or fluorescent. Encapsulated types are used for consultation/ examination rooms and OT. Lighting intensities of major areas are planned as described in the following table.

Table 2-11 Lighting Plan of Main Rooms

Major Rooms	Lux
Entrance Hall	150
Waiting Area	150
Corridor	100
Office	300
Meeting Room	300
Consulting Room	300
OT/ Delivery Room	500
Bed Room	200
Nurse Station	300
Labour room, Post delivery room	200
Storage	150

4) Electric outlet system

Items that are commonly available in Sudan shall be selected. Either a single outlet or a grounded outlet shall be installed for places where equipment requiring big electric capacity are used.

5) Switch system

Items that are commonly available in Sudan shall be selected. A three-way switch is planned at where it is necessary, e.g. corridors.

6) Telephone system

A space for a telephone switchboard will be secured in a main office. Ducting for telephone lines to offices and nurse stations are provided (for 3 lines including sockets). Cable racks are used for installation of telephone lines which to be connected to empty ducts in each room.

7) Nurse call system

A base unit is installed at the nurse station and wall units are provided at each bed (call button, lamp, and reset button), toilet (call button and lamp), and corridor of each room (lamp showing calls).

8) Interphone system

A base unit equipped with a lamp and alarm interlocked with the nurse call system is installed at the nurse station. Speakers and microphones will be introduced at the ceiling of the rooms in needs.

9) Internet system

One line out of three telephone lines will be used considering a use of cables. Ducting for lines to offices and nurse stations are provided for future use.

10) Central monitoring system

Alarms for each system are transferred to and indicated on the alarm panel which will be installed in the office. There will be no central monitoring system for equipment control.

11) Public Address (PA) system

PA system will be set at the main office and nurse stations linked with speakers installed on walls/ceilings where necessary.

12) TV, receiving antenna, and outlet system

Empty ducts are planned at waiting rooms and offices for future installation. Cable racks will be used for setting cables.

13) Electrical clock system

Electrical clocks will be provided in main rooms. A clock for measuring time will be installed at OT

(3) Water/ Sanitation/ Gas Systems

1) Water supply system

As the situation of water supply at the existing hospital is not clear, a complete water supply system will be newly established. The amount of service water is estimated to be approximately 50m³/day considering numbers of beds, staff and attendant families. Based on this figure, the capacities of the water receiving tank and high-level water tank will be 40m³ and 10m³ respectively. A filtering method and filtering capacity are calculated based on the planned facility. A high-level water tank will be introduced at a place where required as it supplies water by gravity. A high-level water tank for fire, which is commonly found in Sudan is not planned under the project Water for such purpose will be supplied not from a receiving tank but from another tank with its size of 10m³ using a pump. The plumbing material will basically be either the white gas pipe (galvanised steel pipe) or the rigid vinyl chloride lining steel pipe.

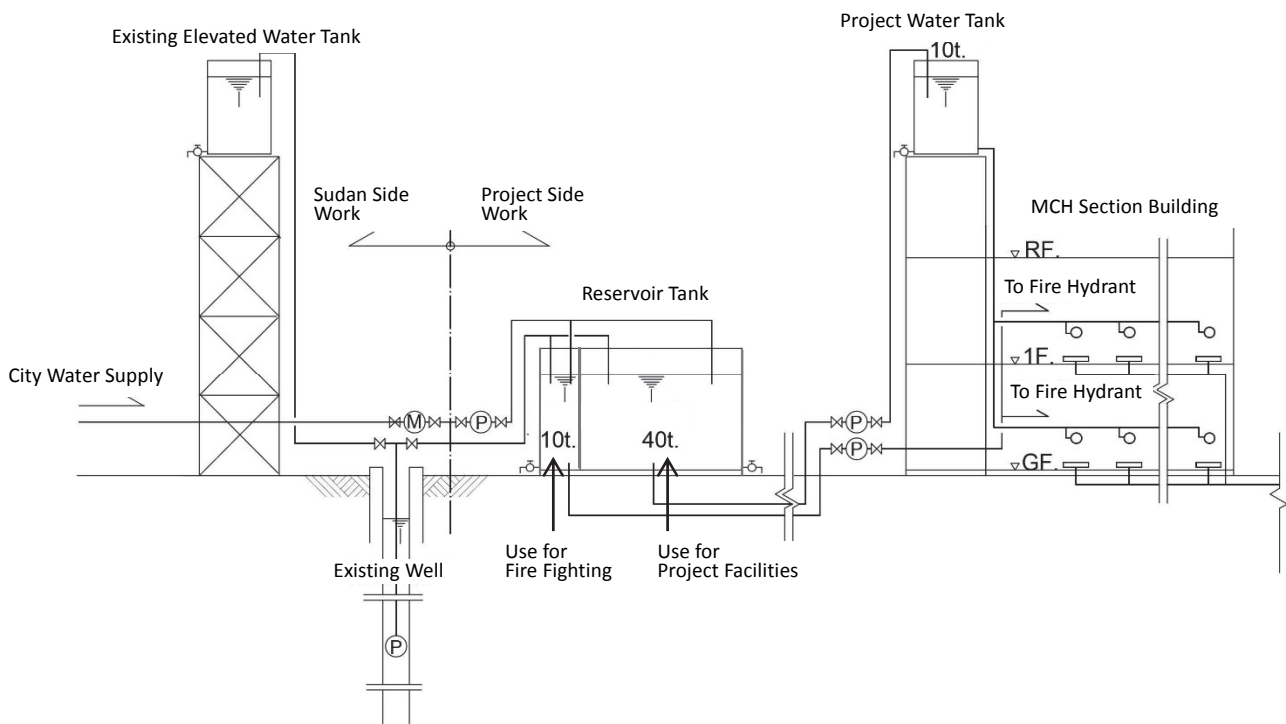


Fig. 2-17 Water Supply System Outline

2) Hot water supply system

Based on the calculation of the necessary amount at each facility, a hot-water heater with electricity as a heat source is to be planned. The heater will provide hot water to places including medical equipment, kitchen equipment, laundry system and others. The basic plumbing will be using the M-

type deoxidized copper pipe.

3) High pressure steam system

A heat source of a boiler will basically be electricity and it will be introduced separately. Planned steam pressure is 7kg/cm^3 and piped to places required after controlling the pressure.

4) Sanitary apparatus

① Wash-basin/ lavatory basin

Items that can be procured locally are selected for future O&M.

② Changing rooms/ shower rooms

Specifications that are suitable to local customs will be applied.

5) Sewage system

① Non-faecal wastewater

A sewage treatment method commonly applied by hospitals in Sudan is to be followed. Public power and city water supply services are carried out under the jurisdiction of the local government. The infrastructure services at urban area including the project site are relatively good. However, there is no sewage infrastructure that the site can drain wastewater. In addition, it is difficult for wastewater to percolate through the soil layer at the site due to its structure. Therefore, drained wastewater of the project facility will be treated in the septic tank. Treated water is tanked and stored which is then used for watering plants within the site. Excessive water is connected to the percolation well which is handled by the on-a-premise percolation method as a backup measure.

② Kitchen wastewater

A sewage treatment method commonly applied by hospitals in Sudan is to be followed. However, a trap will be introduced in order to avoid oil contamination.

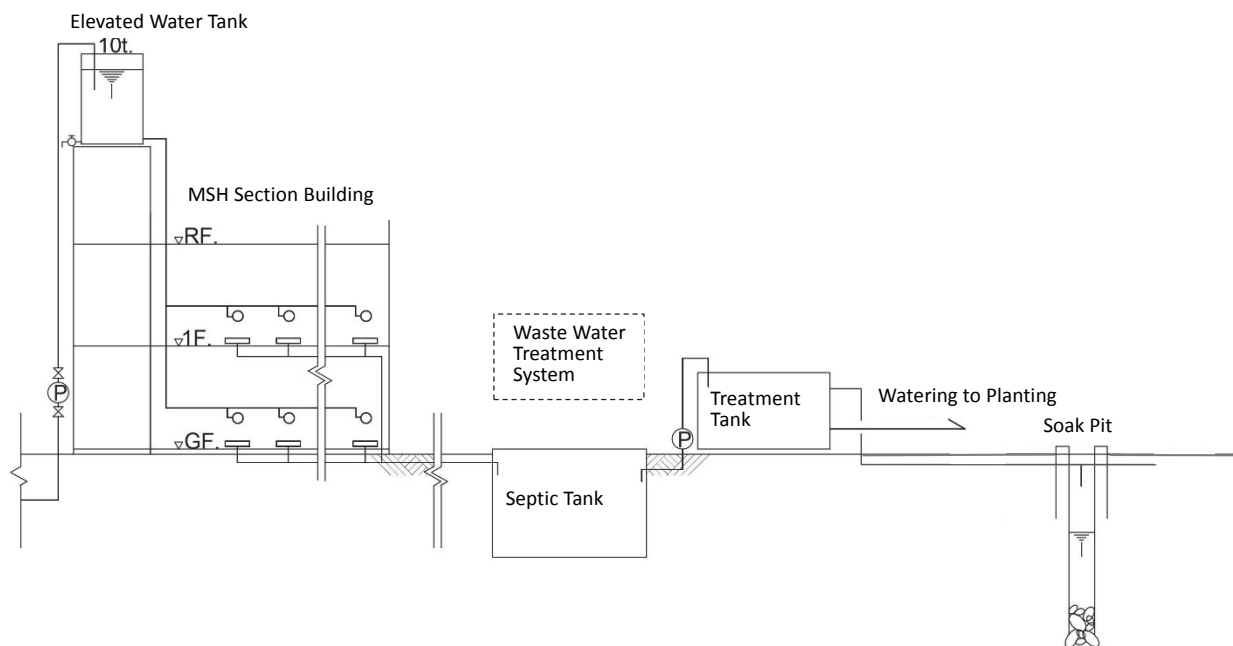


Fig. 2-18 Drainage System Outline

6) LP Gas system

There is no city gas. LPG (approximately 12,000kcal/kg of heating value) is partially introduced at the kitchen only. The piping material will be either the one locally available or the GS pipes.

7) Kitchen system

Based on the design plan, kitchen equipment are planned that match with local dietary habits. Standard equipment include: a cooking stove, sink, cooking table, refrigerator, and food storage.

8) Laundry system

Based on the design plan, machines that match with local customs are planned.

9) Incineration system

There will be no incineration facility.

(4) Disaster Prevention System

1) Lighting protection system

As the building area is large, a roof-ridge conductor is to be planned. Its specification will be the one which is commonly available in Sudan.

2) Automatic fire alarming system

The Japanese or BS standard is applied for smoke as well as heat detecting devices. There will be

an inspection by the fire authorities before the use of a new building. If inconvenience is indicated, the system needs to be improved.

3) Emergency light

Taking account of the Japanese domestic law, emergency lights are installed in every 20m for the ground floor (evaluation floor) and 10m for the first floor or above.

4) Guide light

Taking account of the Japanese domestic law, guide lights are installed in every 40m for the corridor of the ground floor (evaluation floor) and 30m for the first floor or above.

5) Fire prevention system

① Fire extinguisher

Taking account of the Japanese domestic law, fire extinguishers are installed in every 20m.

② Fire hydrant

Fire hydrants are installed based on the local specification. The minimum necessary level of the hydrant hose reel is planned based on the local fire service act and their rules.

(5) Ventilation and Air Conditioning System

1) Ventilation system

① Central ventilation system

The central ventilation system is introduced for the area such as OT and delivery rooms that requires cleaning. Air is blown in after being cleaned.

② Individual ventilation system

- Wall ventilation and Ceiling ventilation

Based on the facility plan, devices that suit to customs of local hospitals are planned.

2) Air conditioning system

Based on the design plan, devices that suit to customs of local hospitals are planned for the central and the individual air conditioning systems respectively. An appropriate air conditioner is selected based on the required cleanness, pressure, temperature and humidity for each room.

① Central air conditioning system

The central air conditioning system is also introduced for the area that requires cleaning and air is sent to each room. Air cooling package-type air conditioners will be introduced.

② Individual air conditioning system

Separate types are applied to all rooms except rooms indicated in ①. Simultaneously, ceiling fans are also installed. Depending on the time of the day and outside temperature, air conditioners and

fans are used alternatively in order to save the electricity bill.

2-2-2-6 Construction Material Plan

It is necessary to select materials that suit with the local climate which is dry and high in temperature. Both aggregates and cements, materials for concrete, are produced locally. They are to be used for this project as they are used by other Japanese grant aid projects and large scale works in Sudan. Bricks made out of clays obtained from the Nile River. The project plans to apply these bricks for wall materials as they are good in adiathermancy, weather resistance, and durability. These major construction materials and materials produced in neighbouring countries and traded within Sudan as main construction materials, construction materials to be used for the project will be planned.




2-2-2-7 Equipment Plan

(1) Review on Necessary Equipment

1) Equipment Selection Method

As there is no concrete list for requested equipment for the requested facility, the equipment lists related to the project are referred from the Standard list of medical equipment and furniture for general hospital prepared by the Curative Medicine Directorate, SMOH. They are the equipment lists for Obstetrics/Gynaecology, laboratory and administrative rooms and used as a source for reviewing equipment for the project.

Selection of planned equipment has following steps:

- ① Selection of related equipment for the requested facility among the Standard list of medical equipment and furniture for general hospital.

- ② Narrowing down the list by selection criteria such as: equipment being possessed by the hospital; level of end-users; operational and maintenance system; capability of local agencies; and sustainability of equipment maintenance management.

- ③ Verification of necessary equipment for the targeted facility in terms of specification and quantity.

- ④ Selection of planned equipment.

2) Selection Criteria

Necessity for the installation shall be reviewed based on the following 7 selection criteria.

- ① Purpose of use
 - : Equipment suitable for maternal and child health services at secondary level
 - ×: Equipment not suitable for maternal and child health services at secondary level
- ② Necessity
 - : Equipment necessary for maternal and child health services at secondary level
 - ×: Equipment not necessary for maternal and child health services at secondary level, or benefits are limited.
- ③ Technical level
 - : Equipment compatible with the current technical level
 - ×: Equipment which requires higher technical skills
- ④ Operational System
 - : Equipment for which medical staff are properly allocated or expected
 - ×: Equipment for which medical staff are not expected to be allocated

- ⑤ Maintenance and Management System

- : Equipment which can be regularly inspected and repaired by the local agency and its spare parts and consumables can easily be procured by the same agency.
- ×: Equipment which has difficulty of being regularly inspected and repaired by the local agency and its spare parts and consumables are difficult to be procured by the same agency.

- ⑥ Operation and Maintenance Cost

- : Equipment for which operation and maintenance cost is low or affordable
- ×: Equipment for which operation and maintenance cost is high or not affordable

- ⑦ Overall Evaluation

- : Equipment which its procurement is considered to be appropriate and thus, targeted by the Project
- ×: Equipment which its procurement is considered to be inappropriate and thus, not targeted by the Project

3) Justification of Purpose of Use, Grade and Quantity of Major Selected Equipment

The standard list of medical equipment and furniture for general hospital prepared by SMOH contains equipment which is not adequate for medical and counselling services required under this project and the level of medical personnel. Therefore, the list for the requested equipment has been narrowed down after the result of the site survey and discussion with SMOH (above procedure ① and ②). Examination List of Requested Equipment based on the equipment selection criteria is as per attached Appendices 6..

Through domestic analysis, quantity and specification of planned equipment for the new Umbaddah maternal and child health section was examined. The result is then selected as a planned equipment list (above procedure ③ and ④);

Justification of specification and quantity of planned equipment is shown in the table below:

Table 2-12 Quantity and justification of specification for major equipment

Room	Quantity and justification of specification for major equipment																
Nursery	<p>Nursery consists of two rooms, one of which is for septic (4 beds) and another is for un-septic (6 beds). Following equipment will be installed for each room.</p> <ul style="list-style-type: none">• An infant height & weight scale is to be equipped for neonates who are delivered from delivery rooms and in-septic neonates.• A IV stand is to be equipped to one per two infant incubators.• An O₂ regular, a humidifier and a flowmeter are to be equipped for an oxygen bottle which is provided to each infant incubator.• Infant warmers and baby cots are to be equipped for neonate with mild symptoms.• A phototherapy unit and a syringe pump are to be equipped to half the number of total beds. A neonatal monitor and a portable suction unit are to be equipped to each infant incubator.• A resuscitation set for neonatal, a bilirubin meter with centrifuge, a infusion pump, a pulse oximeter and a diagnostic set for neonate are to be equipped for each room.• CPAP and an oxygen concentrator are to be equipped for patients who require respiratory control or high concentration oxygen filling. <table><tr><th>NO</th><th>Planned Equipment</th><th>Qty</th><th>Purpose of Use, Justification of Equipment Grade</th></tr><tr><td>46</td><td>Infant incubator</td><td>10</td><td>Used for keeping temperature of premature babies. 4 for septic and 6 for in-septic. Its grade shall be equivalent to the one used in local health facilities.</td></tr><tr><td>49</td><td>Neonatal monitor</td><td>10</td><td>To monitor vital sign of neonates. Its grade shall be equivalent to the one used in local health facilities.</td></tr><tr><td>55</td><td>CPAP</td><td>2</td><td>To assist ventilation for neonates with respiratory diseases, such as acute respiratory syndrome. Its grade shall be equivalent to the one used in local health facilities.</td></tr></table>	NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade	46	Infant incubator	10	Used for keeping temperature of premature babies. 4 for septic and 6 for in-septic. Its grade shall be equivalent to the one used in local health facilities.	49	Neonatal monitor	10	To monitor vital sign of neonates. Its grade shall be equivalent to the one used in local health facilities.	55	CPAP	2	To assist ventilation for neonates with respiratory diseases, such as acute respiratory syndrome. Its grade shall be equivalent to the one used in local health facilities.
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Delivery Room	<p>In three delivery rooms, an IV stand, a delivery table, two sets of delivery instrument, a mobile OT lamp with battery, an infant warmer, a baby cot, a resuscitation set for neonates, a forceps delivery set, and a suction unit are to be equipped for each room. An electric water heater is to be equipped for neonatal bathing. Two sets of delivery instrument are to be equipped considering time required for its sterilization. In Delivery room-2, located in the middle of three delivery rooms, an hot air oven is to be equipped to sterilize used equipment in three delivery rooms.</p>																
Operation Theatre	<p>Following equipment is to be installed in each OT.</p> <ul style="list-style-type: none">• OT Table (hydraulic) and IV stand are to be equipped.• Since C/S often requires cervical anaesthesia. Yet, there are cases that used anaesthesia gas, an anaesthesia machine with ventilator is to be equipped.• OT Lamp (ceiling type) is to be equipped for illuminating hands of a surgeon.• To treat neonates, an infant warmer, a resuscitation set for neonates and a baby cot are to be equipped.• For transferring neonates to the nursery, an infant incubator is to be equipped.• For blood aspiration during surgeries, a suction unit is to be equipped.• Two O₂ regulars/ humidifiers/ flowmeters, and one N₂O regulator/ humidifier/ flowmeter, are to be equipped for O₂ and N₂O bottles.• An electric surgical unit is to be equipped for incision and solidification.• One patient monitor, an instrument trolley, an instrument cabinet, one D&C set (abortion), and two C/S instrument sets are to be equipped. A number of instrument is considered based on the sterilization turnover rate.• One unit of a defibrillator is to be equipped for two O/T preparing for cases when the patient status suddenly changes.																

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NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade																																					
46	Infant incubator	2	Used for keeping temperature of premature babies. Its grade shall be equivalent to the one used in local health facilities.																																					
87	Hand scrub station for 3 persons	1	To clean and sterilize hands and fingers of surgeon and their assistants before operation. Its grade shall be equivalent to the one used in local health facilities.																																					
88	OT table (hydraulic)	2	To keep a patient in an appropriate position for operation by adjustment of height and angle. Its grade shall be the one applicable for general operations.																																					
89	Anaesthesia machine with ventilator	2	To apply gaseous anaesthesia for patients, and manage patient respiration during anaesthesia. Its grade shall be equivalent to the one used in local health facilities.																																					
90	Electrosurgical unit	2	To cut and coagulate biological tissue by high frequency current for operation. Its grade shall be equivalent to the one used in local health facilities.																																					
93	Defibrillator	1	To improve hemodynamics and bring back the heart contraction to the normal status by passing a direct current to ventricular fibrillation or atrial fibrillation. It shall be used for emergency cases and its grade is to be the level of a general standard.																																					
104	Patient monitor	2	It is an apparatus that monitors circulation status of a patient by monitoring ECG, Resp., and SpO ₂ and other biological information through showing figures and waveforms on the screen. Its grade shall be a general standard as for an apparatus that to be used for managing vital signs of a patient.																																					
113	OT Lamp (ceiling type)	2	To light surgical areas during operation. Its grade shall be equivalent to the one used in local health facilities.																																					
Sterilization Room	A high pressure steam sterilizer and a hot air oven are to be equipped for sterilize used surgical instruments and supply sterilized ones.																																							
	<table><tr><th>NO</th><th>Planned Equipment</th><th>Qty</th><th>Purpose of Use, Justification of Equipment Grade</th></tr><tr><td>95</td><td>High pressure steam sterilizer</td><td>1</td><td>To sterilize surgical instruments and surgical gown by high pressure steam. Its grade shall be equivalent to the one used in local health facilities.</td></tr></table>				NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade	95	High pressure steam sterilizer	1	To sterilize surgical instruments and surgical gown by high pressure steam. Its grade shall be equivalent to the one used in local health facilities.																												
NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade																																					
95	High pressure steam sterilizer	1	To sterilize surgical instruments and surgical gown by high pressure steam. Its grade shall be equivalent to the one used in local health facilities.																																					

Room	Quantity and justification of specification for major equipment			
Laboratory	<ul style="list-style-type: none"> • A haematology analyzer (automated) and a coagulometer are to be equipped for blood examinations. • A spectrophotometer is to be equipped for biomedical examinations. • An electrolyte (ISE) analyzer is to be equipped to measure electrolyte of neonates. • A sample shaker and a microscope are to be equipped for other examinations. 			
	NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade
	60	Haematology analyzer (automated)	1	To measure number and haemoglobin contents of RBC, WBC and platelets for pregnant and post pregnant women when they visit at antenatal and postnatal check-up. Grade is general for secondary medical facility.
	61	Coagulometer	1	To measure blood coagulation time. Grade is general for secondary medical facility.
	65	Electrolyte (ISE) analyzer	1	To measure electrolyte of neonates such as Na, K, Cl. Grade is general for secondary medical facility.
Blood Bank	<ul style="list-style-type: none"> • A blood bank refrigerator (L) is to be equipped to store blood bags. • Two freezers (before and after screening) are to be equipped to store blood products at low temperature. • A platelets incubator with agitator, a thawing water bath and a sphygmomanometer are to be equipped. 			
	NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade
	74	Platelets incubator with agitator	1	To stir blood bags at an appropriate temperature. Its grade shall be equivalent to the one commonly used for the secondary levelled blood bank.
Labour Room	CTG and a faetal doppler are to be equipped to antenatal and post natal examinations.			
	NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade
	18	CTG	3	Used for NST (Non-Stress Test*) of late pregnancy by continuous monitoring of uterine contraction strength, and faetal heart beats. Its grade shall be a general standard for health facilities at the secondary level.
	23	Ultrasound scanner type B	1	To diagnose pregnancy progress for early gestation, faetal growth monitoring for second pregnancy trimester and late pregnancy. Its grade shall be equivalent to the one used in local health facilities.

Room	Quantity and justification of specification for major equipment			
Ultra sound/ ECG	An ultrasound scanner type A and ECG machine are to be equipped for antenatal and post natal examinations.			
	NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade
	20	Ultrasound scanner type A	1	To diagnose pregnancy progress for early gestation, faetal growth monitoring for second pregnancy trimester and late pregnancy. Its grade shall be equivalent to the one used in local health facilities.
	21	ECG machine	1	To record the heart movement of patients for C/S in order to find abnormalities such as arrhythmias. Its grade shall be equivalent to the one used in local health facilities.
Laundry Room	Two washing machines, two drying machines, a press machine, two laundry carts, a meeting table (L), 6 meeting chairs, a water heater, and steam boilers are to be equipped. The capacity of washing machines is planned to be 25L. The amount of washing is assumed to be a total of 141kg per day: 117 kg of surgery gowns and 24kg of sheets from patient ward, total 141 kg. Washing machines are therefore to be used for 3 turns per day per machine.			
	NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade
	78	Washing machine	2	To wash linen from patient ward and delivery rooms. Its grade shall be equivalent to the one used in local health facilities.
	79	Drying machine	2	To dry linen from patient ward and delivery rooms. Its grade shall be equivalent to the one used in local health facilities.
HDU	80	Press machine	1	To press linen, by steam or oil in order to keep them clean. Its grade shall be equivalent to the one used in local health facilities.
	A bedside cabinet, an O ₂ regulator, a humidifier, a syringe pump, an infusion pump and a patient monitor are to be equipped for each bed in order to monitor pregnant women who are seriously ill. An instrument cabinet is to be equipped for storage.			
	NO	Planned Equipment	Qty	Purpose of Use, Justification of Equipment Grade
	104	Patient monitor	2	It is an apparatus that monitors circulation status of a patient by monitoring ECG, Resp., and SpO ₂ and other biological information through showing figures and waveforms on the screen. Its grade shall be a general standard as for an apparatus that to be used for managing vital signs of a patient at HDU.
Bed Room (general patient)	A suction unit is to be equipped per room for patients who need suction of blood or body fluids. An IV stand, a bedside cabinet and an overbed table are to be equipped to each bed.			
Bed Room (private room)	An IV stand, a suction unit, a bedside cabinet, an overbed table and a sofa for patient attendants are to be equipped to each bed/ room.			

*Non-Stress Test : This is one of the tests to find out whether a baby without labour is fine or not in order to test stress resistance of the baby for uterine contraction.

(2) List of Planned Equipment (after the review)

Selected equipment for the planned facility is summarized in the following equipment list.

Table 2-13 List of Planned Equipment

NO	Planned Equipment	Qty
1	Reception chair	6
2	Waiting chair (for 3 persons)	34
3	TV monitor	1
4	Consultation desk	26
5	Consultation chair	40
6	Projector	1
7	Projector screen	1
8	Diagnostic set	10
9	Faetal doppler	7
10	Adult weighing scale	2
11	Adult height scale	2
12	Neonatal height & weight scale	4
13	Vaccine refrigerator	2
14	Examination table	4
15	Gynaecology examination table	5
16	Examination instrument set	5
17	Examination light	5
18	CTG	3
19	Partition	4
20	Ultrasound scanner type A	1
21	ECG machine	1
22	Examination table with foot step	1
23	Ultrasound scanner type B	1
24	Labour bed	8
25	IV stand	48
26	Refrigerator	3
27	Delivery table	3
28	Delivery instrument set	6
29	Mobile OT Lamp with battery	3
30	Instrument trolley	8
31	Instrument cabinet	6
32	Stretcher	4
33	Wheel chair	2
34	Infant warmer	7
35	Baby cot	18

NO	Planned Equipment	Qty
36	Resuscitation set for neonate	7
37	Forceps delivery set	3
38	Vacuum extractor	1
39	Suction unit	15
40	Recovery bed	10
41	Hot air oven	4
42	Chair(for laboratory)	10
43	Desk(for laboratory)	2
44	Duty bed (double ducker)	2
45	Bedside cabinet	26
46	Infant incubator	12
47	O2 regulator, humidifier and flowmeter	16
48	Phototherapy unit	7
49	Neonatal monitor	10
50	Portable suction unit	10
51	Bilirubin meter with centrifuge	2
52	Syringe pump	9
53	Infusion pump	5
54	Pulse oximeter	3
55	CPAP	2
56	Oxygen concentrator	2
57	Diagnostic set for neonate	2
58	Medicine cabinet	6
59	Rack for storage	25
60	Haematology analyzer (automated)	1
61	Coagulometer	1
62	Spectrophotometer	1
63	Centrifuge	1
64	Table top autoclave	1
65	Electrolyte (ISE) analyzer	1
66	Microscope	3
67	Micro pipette set	2
68	Sample shaker	1
69	Water bath	1
70	Water distiller	1
71	Blood donor beds	1
72	Bag shaker	1
73	Sphygmomanometer	2
74	Platelets incubator with agitator	1
75	Blood bank refrigerator	2

NO	Planned Equipment	Qty
76	Freezer	1
77	Thawing water bath	1
78	Washing machine	2
79	Drying machine	2
80	Press machine	1
81	Laundry cart	6
82	Cooking equipment as a set	1
83	Dining table	5
84	Dining chair	25
85	Garbage box	6
86	Locker (for 9 persons)	12
87	Hand scrub station for 3 persons	1
88	OT table (hydraulic)	2
89	Anaesthesia machine with ventilator	2
90	Electrosurgical unit	2
91	D&C set (abortion)	4
92	Caesarean instrument set	8
93	Defibrillator	1
94	N2O regulator, humidifier and flowmeter	2
95	High pressure steam sterilizer	1
96	Dressing drum set (L,M,S)	8
97	Hospital bed with mattress	25
98	Overbed table	24
99	White board	3
100	HDU bed	2
101	File rack for medical records	3
102	Meeting table(L)	10
103	Meeting chairs	90
104	Patient monitor	5
105	Refrigerator & freezer	1
106	Locker (for 4 persons)	10
107	Sofa	4
108	Stacking chair	40
109	Hand truck	1
110	Book self	17
111	Cylinder cart	4
112	Couch	3
113	OT Lamp(ceiling type)	2
114	Meeting table(S)	2
115	Meeting table(M)	6

(3) Installation Plan

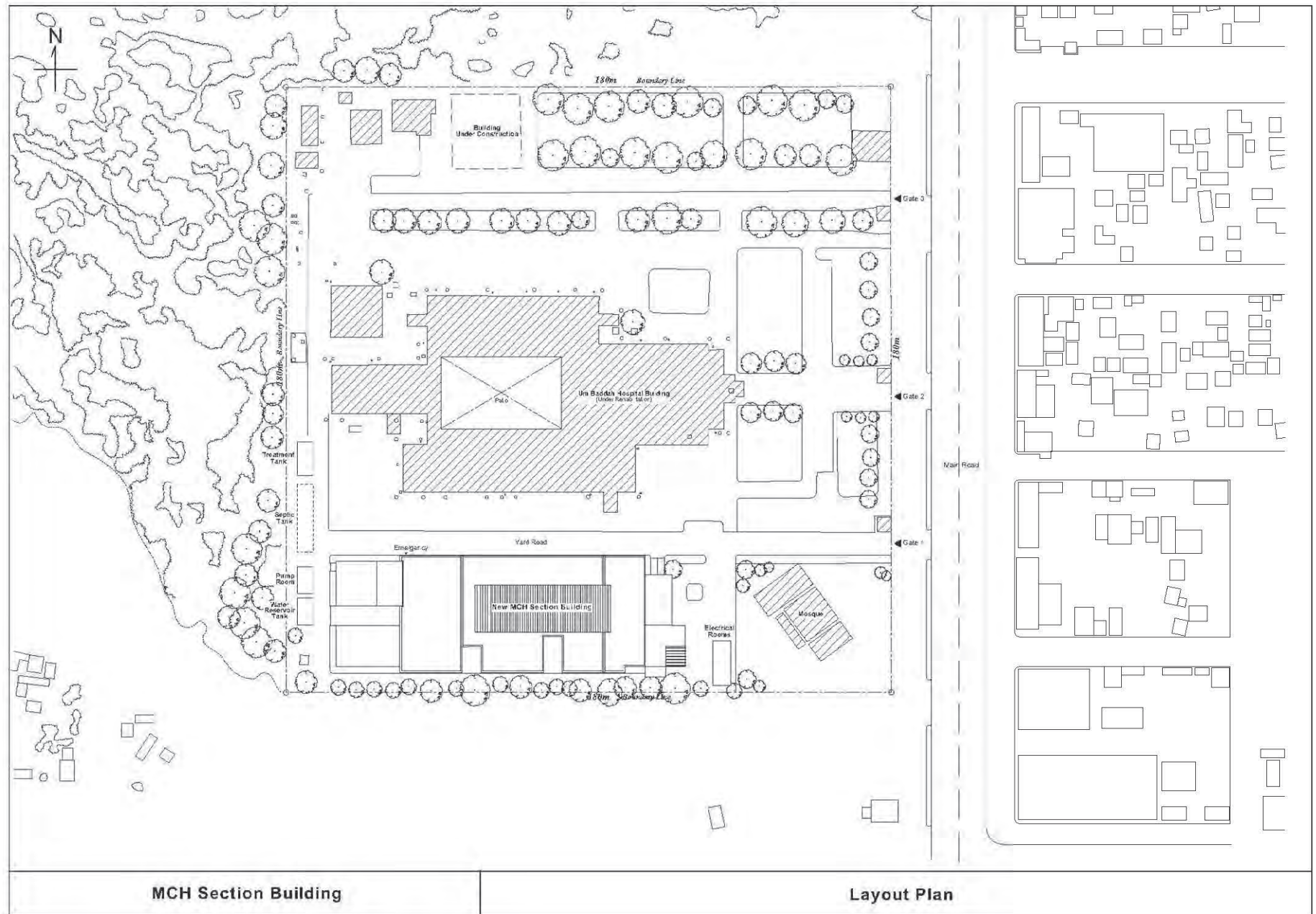
Equipment which requires coordination with the construction work for adjusting the locations for connecting electricity and water pipes (both supply and drain) is washing machines, a drying machine and a sterilizer besides others. Those equipment requires three phased electricity power supply and is bolted to the floor when installed. Therefore appropriate positioning considering the convenience of users is necessary. From the planning stage of the construction work, the utility conditions such as the maximum volumes of electricity power, water supply and drainage necessary for each equipment shall be shared with the construction side. By confirming and coordinating the location for electrical wiring and water pipes as well as specifications of equipment with the construction side, an appropriate operation of planned equipment is to be secured.

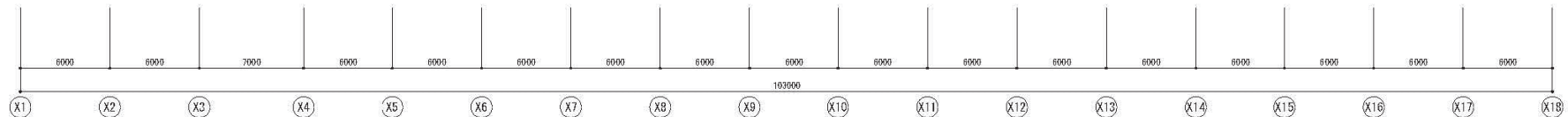
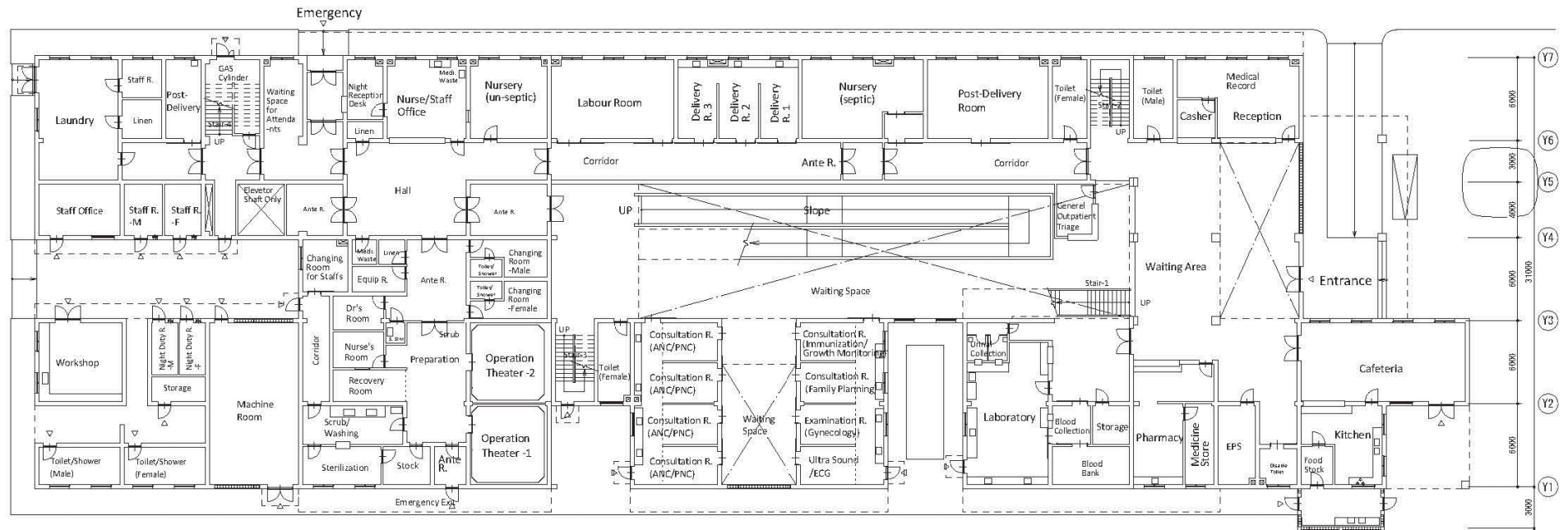
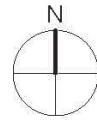
2-2-3 Outline Design Drawings

(1) Layout Plan

(2) Drawings of MCH Section Building

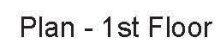
- Plan -Ground Floor
- Plan –First Floor
- Plan –Roof Floor
- Elevation (Eastern Side, Southern Side)
- Elevation (Western Side, Northern Side)
- Section

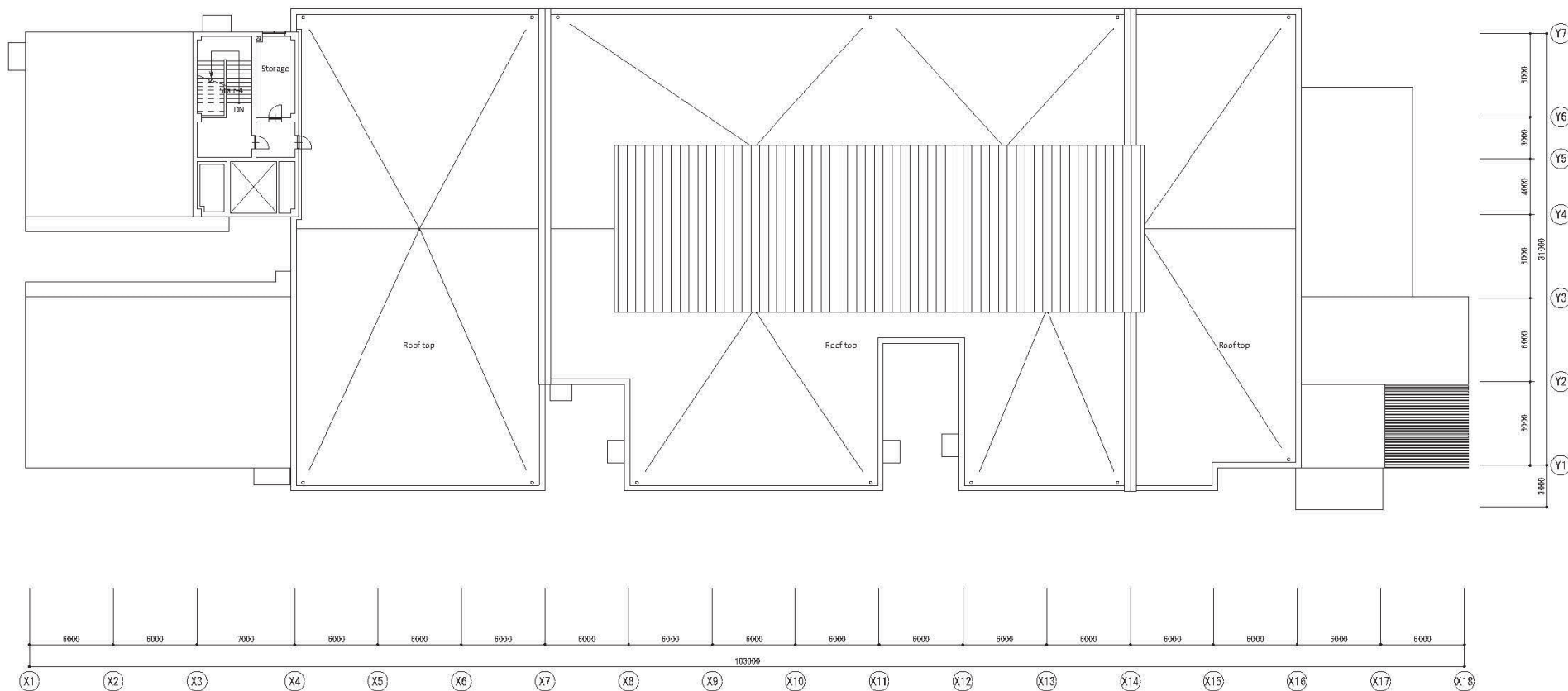




MCH Section Building

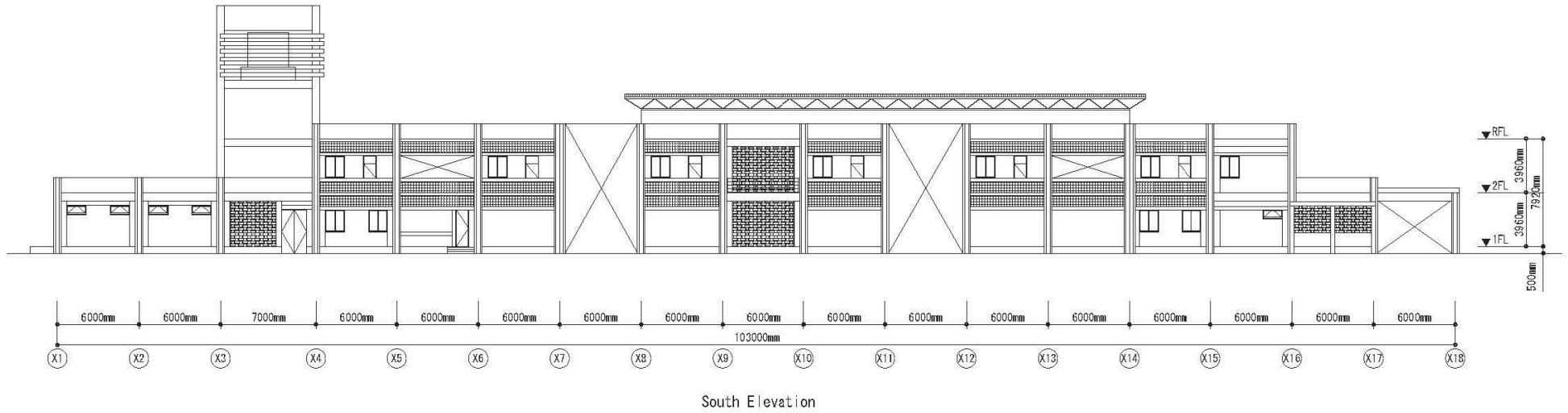
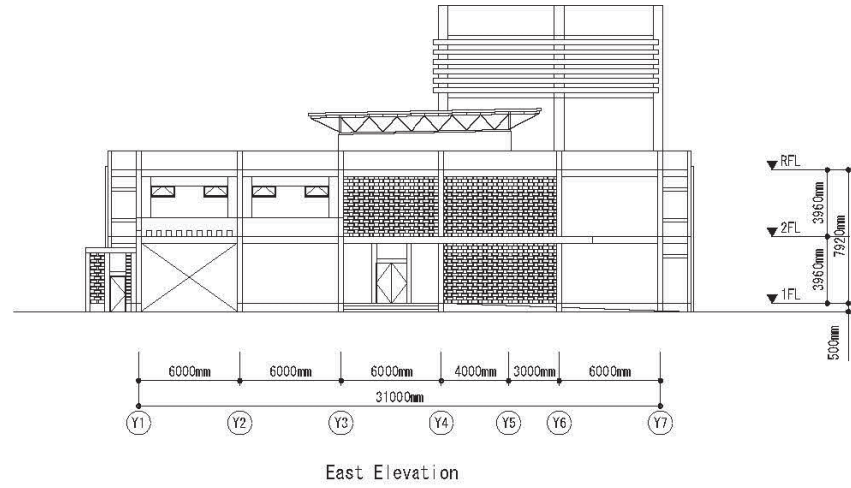
Plan - Ground Floor



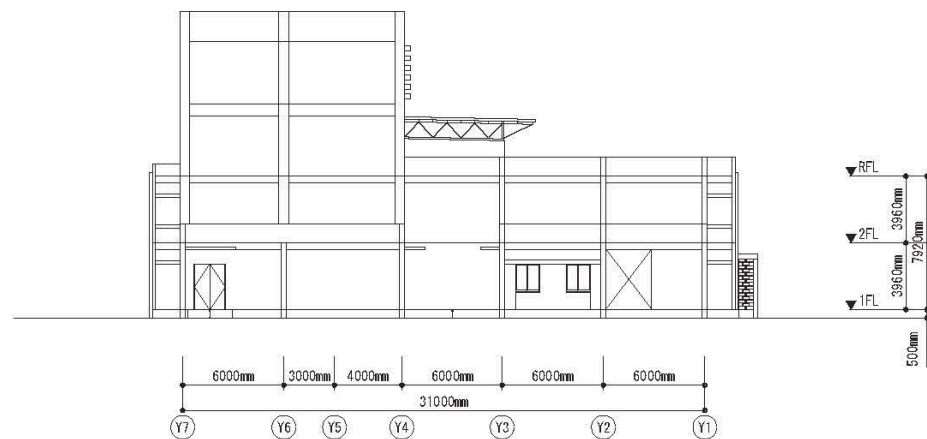


MCH Section Building

Plan - Roof Floor



MCH Section Building	Elevation East and South Side
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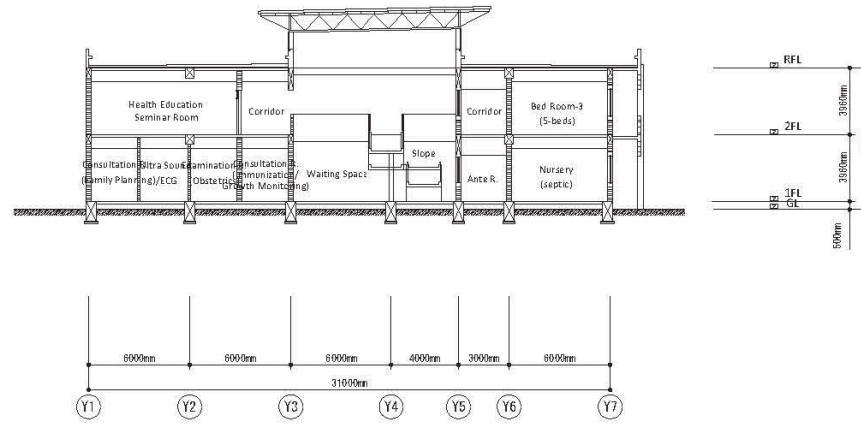


West Elevation

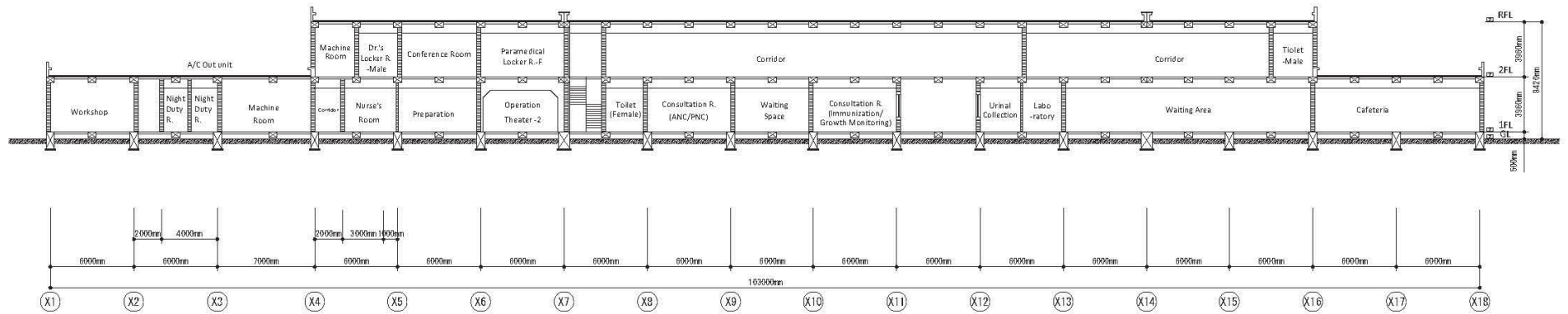


North Elevation

MCH Section Building	Elevation West and North Side
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B-B (X10-X11)



A-A (Y2-Y3)

MCH Section Building

Section

2-2-4 Implementation/ Procurement Plan

2-2-4-1 Implementation/ Procurement Policy

(1) Project Implementation Structure

The project is implemented within the framework of the Japanese Grant Aid scheme. The project implementation will therefore be conducted smoothly through close communication among stakeholders from Sudanese related agencies and personnel, consultant, construction contractor and equipment supplier.

(2) Consultant

The Sudanese implementation agency will conclude a consulting service agreement with the Japanese consultant and entrust supportive works on tendering and supervision of construction works based on this preparatory survey report.

(3) Construction contractor and equipment supplier

With supports from the Japanese consultant, the Sudanese implementation agency will conduct competitive tenders for construction work and equipment supply. The tender for construction work accompanies prequalification. A Japanese firm will be selected and a lump-sum contract is to be signed.

(4) Use of local consultant and local construction contractor

Procedures such as application for building confirmation are to be handled by the Ministry of Health. Yet, advices from a local consultant who is well acquainted with the soil and geological condition of the site especially for the foundation work are necessary as a serious trouble has occurred to the framing structure of the existing building. At the same time, for construction works under the hot and dry climate, the use of a local construction contractor who is well aware of local climates becomes essential.

(5) Dispatch of a Japanese expert

Several works for the project facility require concrete knowledge and good construction skills. These works include: introduction of cast-in-place piles; finishing works for walls and floors of OT and waterproofing of the roofs; installation of an aerated septic tank and air conditioners; electrical wiring and other utility works. However, since there are local experts with past performances in each specialty, a Japanese expert will not be dispatched.

2-2-4-2 Implementation/ Procurement Conditions

(1) Points to be noted upon construction

Setting the construction method shall be based on the collected information during the field survey that its contents suit with local construction and site conditions. It will be a plan that considers capacity and skill levels of local engineers.

The project pays special attention to following points for designing a safe and efficient construction plan:

① Securing heavy machines for introduction of cast-in-place piles

Cast-in-place piles have locally been introduced and a local construction contractor possesses the earth drills necessary for excavation. The maximum diameter of the pile required for the project building is 1.2m and the depth of excavation will be 17m from the ground surface. The machine shall therefore need to be the one that can meet these demands. At the same time, the number of piles exceeds 100. Procurement of a machine with good O&M condition and power that is able to perform well until the completion of the work is necessary so to avoid delays in the construction schedule due to the machine failures.

② Demarcation on line of flow from the existing hospital

During the construction work, a fence will be established at the border of the temporary yard at the southern side of the compound so that construction vehicles are controlled at the gate for their safeness. Within the compound, the construction area and the existing hospital will be clearly demarcated by a temporary fence. For differentiating lines of flow for pedestrians and construction vehicles, they will be using different gates for accessing the compound.

(2) Points to be considered on Procurement of Equipment

Local engineers will be dispatched for equipment assembling and installation work in order to utilize local general manpower for unpacking and delivery of medical equipment. In addition, planned equipment includes a sterilizer, washing machines, a drying machine and a press machine which require coordination with construction works at the time of installation. Therefore, it is necessary to control the schedule of procurement and installation in close coordination between the consultant and the construction contractor through dispatchment of a management engineer from Japan.

2-2-4-3 Scope of Works

The Project will be implemented through mutual cooperation between Japan and Sudan. The works borne by each country for the smooth implementation of the project under the Grant Aid scheme of GOJ are as follows:

(1) Works borne by the Japanese side

The Japanese side shall bear consulting services (including preparation of detail design; selection of a contractor and equipment supplier; supervision of construction works; etc.), and the implementation responsibility for construction of facilities and procurement and installation of equipment as listed below:

- ① Construction of facilities targeted under the project
- ② Procurement and installation of equipment targeted under the project
- ③ Test operation of the facilities and equipment; explanation/ guidance for maintenance and inspection and management methods

(2) Works borne by the Sudanese side

The Sudanese side, mainly SMOH, the Ministry of Health, and the Ministry of Finance, shall bear the implementation responsibility of following works:

- ① To secure the construction and temporary construction sites
- ② To level the construction site/ demolish and clear existing buildings and other unnecessary materials within the target site
- ③ To draw infrastructures (electricity, city water, telephone line, etc.) into the construction site
- ④ To conduct outdoor works including gates, planting, etc.
- ⑤ To exempt custom duties and internal taxes over materials/ equipment as well as services and to conduct their procedures
- ⑥ To ensure smooth custom clearance and procedures for inland transport of materials/ equipment
- ⑦ To accord Japanese nationals for their entry into the country and stay therein for the performance of their works
- ⑧ To conduct procedures for necessary approvals and authorization for the project implementation
- ⑨ To bear all necessary expenses, other than those to be borne by the Japanese side

Table 2-14 Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure the construction site and the temporary site during construction works		●
2	To construct following facilities		
	1) The building	●	
	2) Gates and fences in and around the site		●
	3) Parking lots (for the project building)	●	
	4) The road within the site	●	
	5) The road outside the site		●
	6) To demolish and clear existing buildings and other unnecessary materials from the construction site		●
	7) Planting		●
3	To draw necessary infrastructures for the operation of the planned facility into the construction site from outside		
	1) Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer (installation work by the Sudanese side)	●	(●)
	2) Water Supply		
	a. The main city water distribution to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The main city drainage (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The main city gas to the site		—
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt customs clearance of the products and to assist internal transportation of the products in the recipient country.		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	(●)	(●)
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted.(According to the approval of the concerned authorities)		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that the facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
	1) Advising commission of A/P		●
	2) Payment commission		●
10	Environmental and social considerations that may impact on the project implementation		●

(B/A : Banking Arrangement, A/P : Authorization to pay)

2-2-4-4 Consultant Supervision

(1) Construction Supervision Plan

Basic policy and points to be noted for the construction supervision plan are listed below.

- 1) The consultant shall coordinate closely with the implementation agency for the smooth construction work. Especially for drawing infrastructures into the site, the work borne by the Sudanese side, the work timing is important as it is related to works borne by the Japanese side. Therefore, the work schedule and specifications need to be well discussed and coordinated prior to the work.
- 2) Prior to the work, the construction work plan and drawings submitted by the construction contractor need to be scrutinized and appropriateness of a temporary building plan, work schedule, quality of planned materials and construction methods are examined.
- 3) Upon the work completion and handing over, an inspection is to be conducted for checking whether completed work contents meet design specification. If there is any revision to be made, appropriate advices shall be given.
- 4) A construction engineer shall be stationed at the construction site. An engineer for utility facilities shall be dispatched and engage in the work supervision when needed.

(2) Procurement Supervision Plan

Basic policy and points to be noted for the procurement supervision are listed below.

- 1) The consultant in charge of equipment shall dispatch a spot supervisor who shall engage in the work coordination, equipment handover inspection, operation guidance supervision for the smooth supply and installation of equipment.
- 2) Upon loading equipment into a ship, a pre-shipping collation inspection is conducted by the third-party organization for the confirmation of contracted equipment.
- 3) After the equipment arrival at the site, the consultant shall conduct a receiving inspection. Contents of the receiving inspection are: checking the quantity of equipment, their external appearances and attachment/ spare parts; and conducting test operations. For equipment that requires installation, the consultant shall monitor installation works conducted by the supplier. The consultant also supervises the initial operation guidance conducted by the supplier for personnel who will be in charge of equipment operation in Sudan.

2-2-4-5 Quality Control Plan

(1) Construction

Though BS is applied for the standard for quality control in Sudan, it is not fully practiced. Therefore, for those to be quality-controlled by the standard of developed countries, the standard of each country is generally respected. As for the project, the quality control plan shall be prepared and conducted along the Japanese Construction Standard after satisfying the local standard.

(2) Procurement

In order to secure and check the quality of equipment procured by the contracted supplier, a factory pre-shipment inspection is conducted for major equipment. At the same time, a temporary storing place at the site before equipment distribution is to be confirmed and a place that is not affected by either rain or sunlight is determined. Deterioration caused by the air within the container during storage is to be avoided.

2-2-4-6 Procurement Plan for Materials/ Equipment

(1) Construction Materials

Reinforcing bar, cement, and aggregates are locally produced. These materials are inspected along BS and their usage is to be reviewed. There are several ready mixed concrete plants in the urban area of Khartoum and a number of pump vehicles and concrete trucks is available. As the project site is within one hour distance from the existing plant by vehicle, usage of ready-mixed concrete is actively considered. Bricks, tiles and FRP products are also locally produced and possibility for procuring these locally made products is studied. The most of other materials and equipment are imported and there are many local agencies that handle high quality products including those made in Japan so that almost all construction materials are procured locally.

For imported materials and equipment, a collation inspection by SSMO for their specifications upon customs clearance is necessary. SSMO, the Sudanese Standards and Metrology Organization, controls specification standards in Sudan. A pre-importation inspection is required for some products including reinforcing bars and cements, thus they need to be examined by a contractor whom SSMO entrusts the work. In order to avoid any influence on the work schedule, an appropriate measure for dealing with the inspection need to be taken.

Major construction machines are possessed by the local constructors and able to be procured locally.

(2) Medical Equipment

Among equipment that to be procured under the project, only few equipment requires continuous maintenance. Those that require maintenance are an ultrasound scanner and laboratory equipment.

However, aiming at a sustainable use, the project shall procure equipment that is easily operated and maintained and has its spare parts etc. available in local agencies.

In Khartoum State, there are several local agencies and dealers of medical equipment which could provide spare parts and after sales services. Thus, the equipment shall be procured from Japan based on the Japanese ODA procurement policy.

(3) Transportation Plan

① Ocean Transport

Equipment procured from Japan is unloaded at port of Sudan in Sudan. Then, customs clearance will be conducted. Customs clearance is available at port of Sudan and within Khartoum state (Soba).

② Inland Transport

Equipment procured from Japan is unloaded at port of Sudan after ocean transportation from Japan, and is transported approximately 840 km by heavy-duty truck to Khartoum state which would take around 3 days.

2-2-4-7 Initial Operation Guidance/ Application Guidance Plan

Contents of equipment for the project are based on equipment distributed at local existing hospitals and being handled by doctors and paramedics whom to be assigned to the new facility. Therefore, equipment that are targets for the initial operation guidance and application guidance are limited. Image diagnostic equipment that has high updating frequency for its types and functions is thought to be the first priority for the guidance. The supplier shall conduct the initial operation guidance and application guidance for other medical equipment upon their delivery as to confirm the right usage and maintenance.

Table 2-15 Initiated Operational and Management Instruction

Trainer	Description	Contents of Instruction
① Image Diagnostic Equipment Engineers belong to the manufacturer	Ultrasound scanner 2 kinds	Operational method Usage of application Daily check method
② General medical equipment Medical equipment engineers belonging to local agencies in Khartoum	Other medical equipment (patient monitor, OT lamp(ceiling type), examination lamp, ECG machine, vacuum extractor, infant warmer, infant incubator, etc.)	Operational method Daily check method Trouble shooting

2-2-4-8 Soft Component Plan

A request for soft component was made by the Sudanese side for the improvement of medical equipment maintenance. Contents of the request were to improve repairing capability at the hospital level. However, due to the Product Liability Law, repairing works can only be carried out by certified engineers whom belong to local agencies so that it is not possible to conduct the soft component requested by the Sudanese side. The soft component which can be conducted as a part of the Japanese Grant Aid scheme for improvement of maintenance of medical equipment is mainly for the following 5 items: 1) Daily check-up method, 2) Periodical check-up method, 3) Repair route management by equipment wise, 4) Life cycle management based on equipment inventory list and 5) Establishment of repair route to outside local agencies.

Each medical facility in Sudan has its own inventory list, and a list of local agencies, so that there is no need to conduct above-mentioned 5 soft components for improvement of medical equipment maintenance system. Therefore, the soft component is not planned in this Project.

2-2-4-9 Implementation Schedule

After signing of EN and GA between GOJ and GOS, the detailed design is prepared by the consultant, and tendering and contract agreement on construction works and procurement of equipment are carried out. Followed by the verification of the contract with a contractor by GOJ, the selected Japanese contractor begins construction works and procurement/ installation of equipment. Simultaneously, the consultant starts construction supervision work. A period for construction works is estimated to be 18 months.

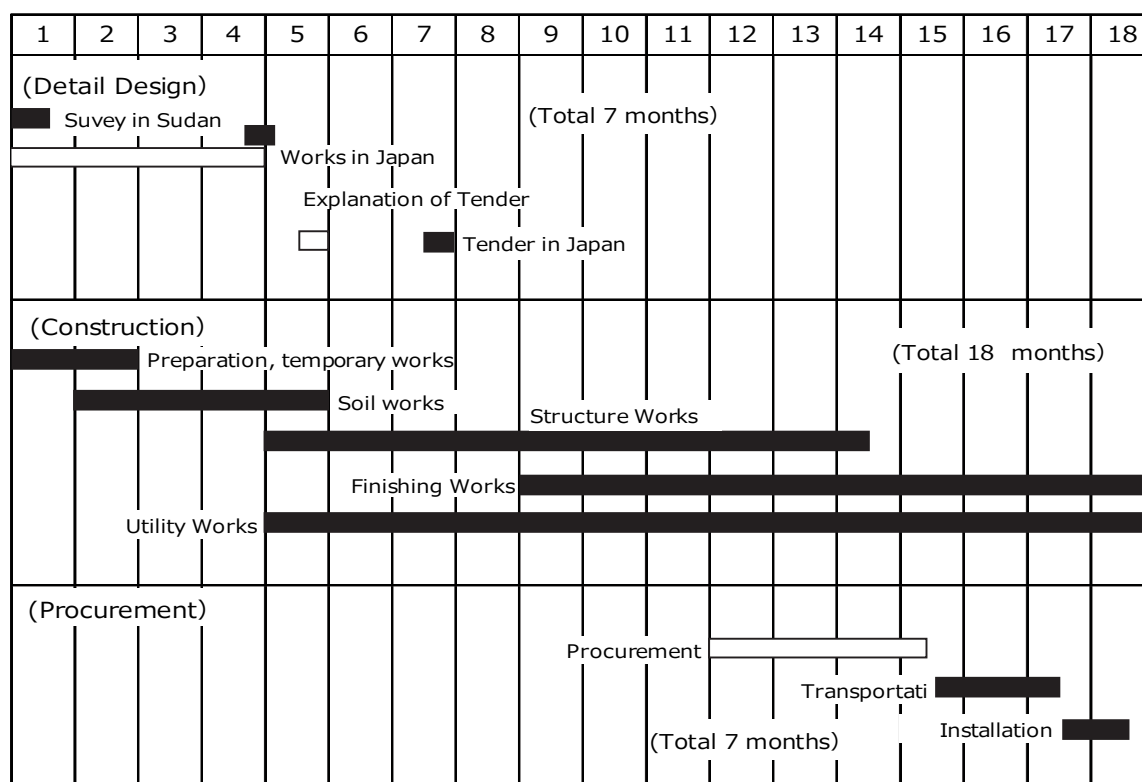


Fig. 2-19 Implementation Schedule

2-3 Obligation of Recipient Country

For the implementation of the project, the implementation agencies, SMOH and the Ministry of Health, need to complete following tasks within the restricted period:

(1) To secure the construction site

The construction site for the planned facilities, the maternal and child health section and attached facilities, has already been secured within the compound of the existing Umbaddah General Hospital.

(2) To demolish and clear existing buildings and other unnecessary materials

Following buildings and unnecessary materials including plants are to be demolished and cleared before the construction work starts:

- Office: $19.4\text{m} \times 8.4\text{m} = 163\text{m}^2$
- Cafeteria: $14\text{m} \times 8\text{m} = 112\text{ m}^2$
- Toilet: $5\text{m} \times 6\text{m} = 30\text{ m}^2$
- Others: tile pavement, curb stones, and plants

(3) To clear the construction site

After the removal of the existing buildings, the site shall be cleared. The target site is located within the compound of the existing hospital and is a prepared land that used to be a catchment place. It is therefore, almost flat and there is need for neither filling nor cutting.

(4) To secure a temporary site for construction works

A temporary site of a necessary size for construction works is required by the southern border of the compound of the Umbaddah General Hospital. The site is used for collecting materials for the construction, processing yard, and a temporary field office.

(5) To draw infrastructures into the construction site

Works for the following infrastructures need to be completed just before the completion of utility works and finishing works of the planned facility as well as installation of equipment.

1) Electricity

There is already a transformer with 1,000KVA within the compound of the existing General Hospital and a high voltage line is drawn into the compound from the road in front. Yet, another transformer with 1,000KVA will be installed for the maternal and child health section building. The Sudanese side shall draw in an overhead line from the road at the eastern side of the compound via 2-3 newly established electric poles. The transformer is purchased by the Japanese side while its installation and connection shall be undertaken by the Sudanese side.

2) City water

Though there is an existing well and a high level water tank by the western border of the construction site, the Sudanese side shall pipe in city water from the opposite side of the road along the southern side of the construction site in order to secure stable water supply required for health facilities.

3) Telephone

The Sudanese side shall extend an existing main telephone line to be connected to the telephone switchboard inside of the planned facility. 3 telephone lines are to be drawn in (emergency, normal, and internet).

(6) To conduct procedures for necessary approvals and authorization

A construction permit needs to be applied and approved without delay before the construction work for the project facility starts.

Since the project is to improve a public health facility, all application forms shall be handed in to the Development Directorate, SMOH. Then the forms are submitted to the Development Directorate, the Ministry of Physical Planning and Public Utilities for authorization procedures. No cost is required and the procedures normally take approximately two weeks. Following documents are necessary for a permit.

Registration of Architect Office (not necessary for assistance projects)/ site map/ design drawings (floor plan/ vertical plan/cross-section plan, electricity, machine, AC, fire prevention, etc.)/ Consultant Contract Agreement/ Geological Survey Report

(7) To engage in management, operation and maintenance (O&M)

The implementation agency shall secure necessary personnel and the budget for its management and O&M for the project implementation in order to engage in appropriate and effective operation and management of constructed facilities and procured equipment by the Grant Aid scheme.

(8) To exempt custom duties

Following the E/N between two countries, a smooth procedure for disembarkation, custom clearance and internal transport of materials/ equipment procured under the Grant Aid scheme is necessary. At the same time, based on the approved contract, custom duties over materials/ equipment as well as services, VAT, and other taxes for banking transfer and transaction shall be exempted and refunded.

(9) To enter into a B/A with a Japanese bank

Based on the consultant and contractor contract agreements, GOS needs to enter into a Banking Arrangement (B/A) with a Japanese bank that includes opening a bank account.

(10) To execute A/P and pay commission

The implementing agency will have to pay an A/P notification commission as well as a payment commission to the bank with which it has entered into a B/A.

(11) To accord Japanese nationals for their entry into the country and stay therein

Following the E/N between two countries, GOS shall accord Japanese nationals for their entry into the country and stay therein for the performance of their works based on the approved contract agreement.

2-4 Project Operation

2-4-1 Management Structure/ Personnel Plan

The new maternal and child health section is a medical section of the existing hospital that is currently under renovation. Until the restart of the main hospital, its operation will be undertaken by the head of obstetrician-gynaecologist as a director. An estimated number of personnel to be assigned at the new section will be 174 and details are shown in the table below. A three rotating shift system (8 hours x 3) is generally practiced by staff engaged in childbirth deliveries: doctors, nurses and midwives. The same system is also applied by personnel engaged in works related to hospital admission, inspection and pharmacy in order to provide 24 hour services. Non-permanent staff needs to be recruited by the own income of the hospital (payment for medical services). It is assumed that the income of the new section to be unstable when it starts its operation. Therefore, all staff will be permanent staff and the SMOH secures the personnel cost. Staff whom had been working at the hospital before its closure is currently assigned to a number of other medical facilities. They will be reallocated to the hospital once it reopens. Medical personnel or/and staff whom to be newly recruited for the section are: a family doctor; a data processing specialist; a health education specialist; a public health specialist; and a biomedical technician. Aiming at smooth hospital operation, experienced personnel will be hired and assigned.

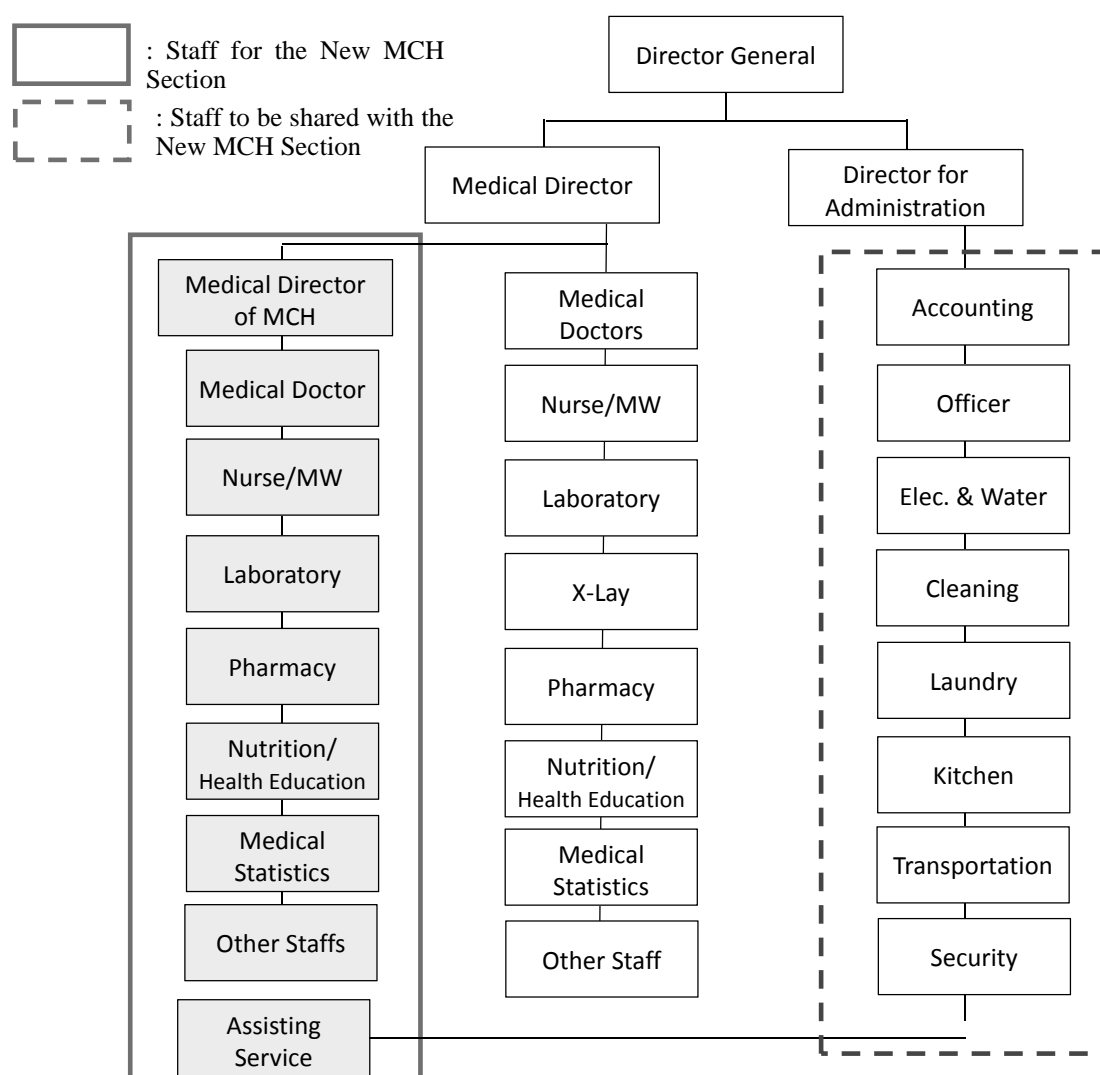


Fig. 2-20 Organization Structure of the Umbaddah General Hospital

Table 2-16 Staff List for New MCH Section of the Umbaddah General Hospital

	Doctor	No.	Paramedical /Med. Engineer /Technician	No.	Management	No.
1	Obstetric & Gynaecological doctor	6	Nurse technicians	38	Medical director of MCH	1
2	Paediatrician	3	Certified nurses	6	Secretary	1
3	Medical doctors	10	Midwife	10	Data input	3
4	Family medicine consultant	2	Lab technicians	6	Human resource	1
5	Pharmacists	4	Lab assistant	8	Internal auditor	1
6	Anaesthetist	2	Public Health officer	1	Accountant	2
7			Health educator	4	Cashier	4
8			Medical assistant pharmacist	3	Biomedical engineer	1
9			Anaesthesia technician	8	Store keeper	1
10			Theatre attendant	8	Electrical technician	1
11			Immunization technicians	2	AC and Mechanical engineer	1
12			Statistic technician	3	Plumber	1
13			Data clerk	6	Worker	2
14					Driver	3
15					Cleaner	15
16					Security	6
	Total	27	Total	103	Total	44
Grand Total 174						

Sources) SMOH, Khartoum

2-4-2 Operation and Maintenance (O&M) Plan

(1) Facility O&M

Operation and maintenance of the facility shall be undertaken by service staff including: an electrician; an AC/machinery engineer; a plumber; and other workers. An engineer will be assigned for each specialized area: electricity, air conditioning system and plumbing respectively. There is a system to respond a trouble during night hours or holidays, which either makes an emergency call to engineers or contracts out services to outside specialists depending on the situation. To note, these O&M staff will also work for the existing Umbaddah General Hospital and as a part of overall O&M section of the entire hospital.

Main items for O&M of the building and utility are listed as follows:

Table 2-17 Facility Maintenance Plan

Part of Facility and Utility	Frequency			Activities of Maintenance	Person in charge
	Ordinary	Regularly	Agency		
(Building)					
Roofing				Check and cleaning	Worker
Drain, Dawn Spout		6 months		Check and cleaning	Worker
Wall	○	1 year		Cleaning, painting	Worker
Floor	○	1 year		Cleaning, repairing clacks	Worker
Door & Window	○			Check, adjustment of lock, moving	Worker
(Electrical Utility)					
Main distribution Board	○		1 year	daily check	Elec. Engineer
Generator	○		1 year	Daily check, exchange filters and oil	Elec. Engineer
Lighting	○			Daily check, exchange tube	Elec. Engineer
Nurse call		1 month		Operation check	Elec. Engineer
Emergency utilities		1 month		Operation check	Elec. Engineer
(AC, Ventilation)					
AC		3 months	1 year	Cleaning and exchange filter	Mechanical engineer
Ventilator		3 months	1 year	Adjustment, cleaning	Mechanical engineer
Ceiling fan		3 months	1 year	Cleaning, adjustment	Mechanical engineer
(Mechanical utility)					
Water reservoir tank, Elevated water tank		1 year		Check, cleaning, overhaul	Plumber, Mechanical engineer
Water supply pump	○	1 year		Daily maintenance	Mechanical engineer
Fire hydrant pump	○	6 months	1 year	Check and test	Mechanical engineer
Sanitary unit	○			Check and cleaning	Plumber
Septic Tank	○		1 month	Check and cleaning, vacuuming	Plumber
Aeration system	○	1 year		Check	Mechanical engineer
Drainage pump	○	1 year		Check	Plumber
Manhole	○	3 months		Check and cleaning	Plumber
Sewage inlet	○		1week	Check and cleaning	Plumber

(2) Equipment O&M

At the Curative Medicine Directorate, SMOH, there is a biomedical engineering unit for management of medical equipment installed at hospitals. At this unit, there are a total of 5 biomedical engineers for monitoring and supervision: 2 persons are allocated to SMOH, one in Oumdurman, one in Khartoum, and one in Bahari. Furthermore, there is biomedical engineer(s) assigned to each hospital. According to the SMOH, an exclusive biomedical engineer is expected to be assigned to the Umbaddah MCH

section. Biomedical engineers working at each hospital engage in maintenance works such as: fixing of minor defects of medical equipment; periodical check-up and exchanging of spare parts. For the defect that the repairing cost exceeds 5,000SDG, a request is sent to a regional levelled biomedical engineer or SMOH, and the repairing work is then requested to the agency. The biomedical engineering unit at SMOH engages annual maintenance contracts with respective agencies for the large-scale medical equipment such as CT scanner and X-ray unit. However, for the most of the equipment, on-call maintenance is asked by SMOH to local agencies when problems occur. Therefore, the cost for maintenance contracts is borne by the state government budget instead of the hospital budget. After the opening of the maternal and child health section, O&M shall be conducted including a periodical checkups by the biomedical engineer of the state. In addition, planed equipment listed in Table 2-23 requires maintenance services so that it is recommended to engage a maintenance contract with a local agency in Khartoum after 1 year warranty-guarantee period is over.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Costs to be borne by the Sudanese side

Project cost estimation (borne by the Sudanese side) : 744.9 thousand SDG (13.5 million yen)

Table 2-18 Initial Cost Estimation for the Project by the Sudanese Side

Item	Expenses (Thousand SDG)	Note
1. Construction works		
A: Demolition the existing facilities located in the proposed construction site	152.5	Existing cafeteria, an office building, an old toilet are to be demolished and removed from the site.
B: Removing existing obstacles	90.0	Existing pavement, trees and obstacles are to be demolished and removed from the site.
C: Site clearance	86.4	Proposed lands for the project are to be cleared.
D: Distribution and installation of the power line and transformer to the site	226.0	The installation work of the transformer and its connecting cables from the main line at outside of the site. The introduction of new electrical poles.
E: Distribution of telephone line to the site	30.0	Three telephone lines (1 for emergency, 1 for general, 1 for internet) to the main distribution frame/panel (MDF) are to be distributed to the building.
F: Distribution the city water to the site	60.0	City water pipe from main line is to be connected to the site.
G: Planting around the new building	50.0	
Sub-total	694.9	
2. Banking Fees	50.0	Banking Arrangement (B/A) establishment expenses and Authorization to Pay (A/P) issuance charges
Total	744.9	

(2) Cost estimation conditions

Cost Estimation Conditions

- i) Time of estimation: September, 2014
- ii) Exchange rate: 1 USD = 103.25 yen
1 SDG = 18.08 yen
1 USD = 5.71 SDG (Central Bank of Sudan TTB rate)
(an average of three months from 1 June to 31 August 2014)
- iii) Construction period: The period of detailed design, tenders and building construction

work and equipment procurement are as shown in the project implementation schedule.

- iv) Other: The Project shall be implemented in accordance with the Japanese Government's Grant Aid Scheme.

2-5-2 Operation and Maintenance Cost

The planned facility is designed and will additionally be constructed to be one of the sections that belongs to the existing general hospital and specialized in providing maternal and child health services. The existing general hospital is under major renovation works including its foundation structure due to a threat of collapse caused by the failure in its building structure. However, due to the shortage of budgets and the work with low quality, its completion is expected to be delayed. In addition, there need to be re-procurement of equipment after the renovation and reallocation of personnel, the re-opening of the existing hospital is not yet known. Considering such situation, the new section is composed of components so to be independent as one hospital facility. Therefore, O&M cost and income generating plan of the project facility is calculated based on operation and maintenance of the maternal and child health section only.

- (1) Annual management, operation and maintenance (O&M) cost for the planned maternal and child health section

A necessary annual budget for management, O&M of the planned maternal and child health section is summarised in the table below.

As a result of the calculation, an annual management, O&M cost is estimated to be SDG 3,425,648.

Table 2-19 Annual Management, O&M Cost for the Maternal and Child Health Section

Items	O&M cost (SDG)	Contents/ Remarks
① Personnel cost	1,908,900	Refer to following '1) Personnel Cost'
② Office supply cost	147,752	SDG17.39 (office supply cost per m ² at the Umbaddah General Hospital in 2012)× 182.6% (inflation rate of SDG between 2012 and 2014) × 4,653m ² (gross floor area of the new maternal and child health section)
③Medicine and Consumable Cost	109,144	Consumable cost only. Refer to following '2) Medicine and Consumable Cost'
④ Electricity bill		
Electricity	490,918	5,173KW/day (electricity use per day) × SDG0.26 × 365days
Fuel	95,352	2 hours of generator use per day × 42ℓ/h (fuel cost) × SDG3.11 (diesel price/ℓ) × 365days
⑤ City water bill	13,509	SDG1.59 (city water bill per m ² at the Umbaddah General Hospital in 2012)× 182.6% (inflation rate of SDG between 2012 and 2014) × 4,653m ² (gross floor

Items	O&M cost (SDG)	Contents/ Remarks
		area of the new maternal and child health section)
⑥ Gas bill	30,672	SDG3.61 (gas bill per m ² at the Umbaddah General Hospital in 2012) × 182.6% (inflation rate of SDG between 2012 and 2014) × 4,653m ² (gross floor area of the new maternal and child health section)
⑦ Telephone bill	12,000	SDG1,000/month × 12 months
⑧ Facility O&M cost	304,680	SDG35.86 (facility O&M cost per m ² at the Umbaddah General Hospital in 2012) × 182.6% (inflation rate of SDG between 2012 and 2014) × 4,653m ² (gross floor area of the new maternal and child health section)
⑨ Equipment O&M cost	—	Not budgeted as SMOH signs contracts with agencies in principle. SDG8,958. Refer to following '3) Equipment O&M Cost'
⑩ Medical gas charges (O ² only)	159,870	Estimated use of oxygen cylinders (mainly at 2 OT, 10beds at NICU, 12 in total/ half a cylinder is used for a day of operation) 6 cylinders/day (use per day) × 365days × 73 SDG (cost per cylinder)
⑪ Medical waste disposal cost	152,851	SDG3.0/kg × 30kg/day (amount of medical waste per 1,000m ² of hospital) × 4.653 × 365days
Total	3,425,648	

1) Personnel Cost

The personnel cost was 4,303,341SDG for 2012, the year the Umbaddah General Hospital had closed. The number of staff in the entire hospital is 467 while the number of the maternal and child health section is estimated to be 174 that its personnel cost is calculated to be 1,603,386SDG based on its staff ratio.

The following table shows an estimated personnel cost for the maternal and child health section calculated based on the table of wages (wages in range) for SMOH in 2014. Since it is not realistic to consider all personnel are either fresh graduates (minimum side of the wage range) or staff near the retirement age (maximum side of the wage range), the average wages are used which its total personnel cost is estimated to be approximately 1,908,900SDG. There is an increase of approximately 19.05% from an estimated personnel cost as of 2012. The personnel cost of the Umbaddah General Hospital had increased by 18.45% in two years from 2010 to 2012 (refer to Table 2-26). Moreover, the personnel cost at the Alban Jadid General Hospital, the same public hospital, had increased by 19.47% between 2011 and 2013 (data from SMOH). Looking at these increasing rates of personnel costs, the calculated figure is considered to be payable enough.

Non-permanent staff needs to be recruited by the own income of the hospital (payment for medical services). It is assumed that the income of the new section to be unstable when it starts its operation. Therefore, all staff will be permanent staff and SMOH secures the personnel cost.

Table 2-20 Estimated annual personnel expenses for MCH Section

(Unit : SDG)

	Doctor	Number	Salary/month/person	Salary/year		
				Minimum salary	Medium salary	Maximum salary
1	Obstetric & Gynaecological doctor	6	1,500-2,000	108,000	126,000	144,000
2	Paediatrician	3	1,500-2,000	54,000	63,000	72,000
3	Medical doctors	10	750-950	90,000	102,000	114,000
4	Family medicine consultant	2	1,500-2,000	36,000	42,000	48,000
5	Pharmacists	4	750-1,700	36,000	58,800	81,600
6	Anaesthetist	2	1,500-2,000	36,000	42,000	48,000
Sub Total		27		360,000	433,800	507,600
	Paramedical/Med. Engineer/Technician	Number	Salary/month/person	Minimum salary	Medium salary	Maximum salary
1	Nurse technicians	38	600-1,000	273,600	364,800	456,000
2	Certified nurses	6	700-1,500	50,400	79,200	108,000
3	Midwife	10	700-1,500	84,000	132,000	180,000
4	Lab technicians	6	700-1,500	50,400	79,200	108,000
5	Lab assistant	8	600-1,000	57,600	76,800	96,000
6	Public Health officer	1	700-1,500	8,400	13,200	18,000
7	Health educator	4	600-1,000	28,800	38,400	48,000
8	Medical assistant pharmacist	3	600-1,000	21,600	28,800	36,000
9	Anaesthesia technician	8	600-1,000	57,600	76,800	96,000
10	Theatre attendant	8	600-1,000	57,600	76,800	96,000
11	Immunization technicians	2	600-1,000	14,400	19,200	24,000
12	Statistic technician	3	600-1,000	21,600	28,800	36,000
13	Data clerk	6	600-1,000	43,200	57,600	72,000
Sub Total		103		769,200	1,071,600	1,374,000
	Management/Administration	Number	Salary/month/person	Minimum salary	Medium salary	Maximum salary
1	Medical director of MCH	1	950-1,800	11,400	16,500	21,600
2	Secretary	1	750-1,500	9,000	13,500	18,000
3	Data input	3	600-1,000	21,600	28,800	36,000
4	Human resource	1	700-1,700	8,400	14,400	20,400
5	Internal auditor	1	750-1,500	9,000	13,500	18,000
6	Accountant	2	700-1,700	16,800	28,800	40,800
7	Cashier	4	700-1,700	33,600	57,600	81,600
8	Biomedical engineer	1	750-1,500	9,000	13,500	18,000
9	Store keeper	1	600-1,300	7,200	11,400	15,600
10	Electrical technician	1	500-650	6,000	6,900	7,800
11	AC and Mechanical engineer	1	500-650	6,000	6,900	7,800
12	Plumber	1	500-650	6,000	6,900	7,800
13	Worker	2	500-650	12,000	13,800	15,600
14	Driver	3	500-650	18,000	20,700	23,400
15	Cleaner	15	450-600	81,000	94,500	108,000
16	Security	6	550-1,000	39,600	55,800	72,000
Sub Total		44		294,600	403,500	512,400
Ground Total		174		1,423,800	1,908,900	2,394,000

Ref.) Interview from SMOH

2) Medicine and Consumable Cost

The costs for medicine/ medical materials required for examinations at the hospital, and reagents used for laboratory tests are divided into ones borne by each hospital and ones borne by SMOH. Cost sharing of medicine and consumables is listed below.

Table 2-21 Cost Sharing of Medicine and Consumables

Item	Borne by
Medicine	SMOH
Medical material	each hospital
Reagent	each hospital

On the other hand, procurement and delivery of medicine/ medical materials is conducted by the Drug Revolving Fund (DRF), an independent organisation while reagents are procured and delivered by the Laboratory directorate, Curative Medicine General Directorate of SMOH.

At the Umbadda General Hospital before its closing, medical equipment maintenance budget of SDG 115,000 allocated in 2012 was used for procurement of reagents and medical materials for medical equipment (including spare parts) and it does not include costs for medicine. Therefore, an annual consumable fee which is necessary for operation and maintenance of medical equipment for the Umbaddah MCH section expects to be a sum of SDG 109,144 shown in the table below.

Table 2-22 Medical Consumable Cost for Planned Equipment

No	Equipment	Consumables	Quantity/ Unit		Total (SDG)
18	CTG	Belts for Doppler transducer	1	pc	88
		Gel 12tube./box	1	box	351
		Recording paper	1	set	993
20	Ultrasound scanner type A	Recording paper 10rolls/set	3	set	3,651
		Gel 300g 12pcs./box	3	box	3,651
21	ECG machine	Recording paper 210mx30m 10rolls/set	5	set	2,366
		Electrode cream 100g x 2pcs./box	10	box	321
		Electrode set 100pcs.x5/set	20	set	5,141
23	Ultrasound scanner type B	Recording paper 10rolls/set	3	set	3,651
		Gel 300g 12tubes ./box	3	box	3,651
26	Refrigerator	Recording paper 12 books/box	1	box	228
34	Infant warmer	Skin temperature probe	1	set	803
		Probe pad 30pcs./set	9	set	1,104
		Micro filter 5pcs./box	2	box	672
		Access port cover 6pcs./set	4	set	351
38	Vacuum extractor	Cannula set	1	pc	1,509
39	Suction unit	Suction bottle with Cup	1	pc	672
		Cannula connection hose	1	pc	613
41	Hot air oven	Heater	1	pc	730
46	Infant incubator	Thermistor probe	1	pc	964

No	Equipment	Consumables	Quantity/ Unit		Total (SDG)
		Temperature fixed pad 30pcs./box	12	box	1,472
49	Neonatal monitor	Disposable Spo2 probe 24pcs./box	1	box	1,870
		Disposable ECG electrode set for neonate 150pcs./box	2	box	789
50	Portable suction unit	Suction bottle	1	pc	146
51	Bilirubin meter with centrifuge	Capillary tube 100pcs./set	1	set	234
52	Syringe pump	Needle (10ml) 50pcs./set	2	set	150
		Needle (20ml) 50pcs./set	2	set	100
		Needle (30ml) 50pcs./set	1	set	58
		Needle (50ml) 50pcs./set	1	set	36
		Extension tube	1	pc	294
53	Infusion pump	Infusion tube 20set/pack	3	pack	161
55	CPAP	Face mask 10pcs./set	3	set	964
60	Hematology analyzer(Automated)	Reagent kit 800tests/set	1	set	6,039
		Calibrator 3months	1	set	857
		Control 3months	1	set	8,408
61	Coagulometer	PT reagent 1,000tests/set	1	set	2,434
		APTT reagent 1,000tests/set	1	set	852
		fbg reagent 400tests/set	1	set	4,625
		TT reagent 4,500tests/set	1	set	9,737
		Factor 8 deficient plasma 500tests/set	1	set	2,921
		Control 3months	1	set	2,337
		Calibrator 3monrhs	1	set	609
62	Spectrophotometer	Reagent kit 500tests/set	1	set	4,990
63	Centrifuge	Rotor or conical tube 50ml	200	pc	10,516
		Glass tube 15ml	200	pc	1,168
65	Electrolyte (ISE) analyzer	Control 3 level each 10pcs./set	2	set	1,344
		Cleaning solution 1month	3	set	789
		Solution pack 1month	3	set	6,134
		Recording paper 100tests(5rolls)/set	5	set	584
75	Blood bank refrigerator (L)	Recording paper 12 books /box	1	box	228
87	Hand scrub station for 3 persons	UV lamp 6pcs./set	1	set	613
89	Anaesthesia machine with ventilator	Mask set 5pcs./set	5	set	2,001
		CO2 absorber tablets	1	box	225
90	Electrosurgical unit	Electrode holder	1	pc	876
		Electrode set	1	set	58
94	Defibrillator	ECG electrode	1	set	320
		Recording paper(210mm x 30m 10 rolls/set)	5	sets	504
		Gel (100g x 2pcs/box)	10	boxes	730

No	Equipment	Consumables	Quantity/ Unit		Total (SDG)
95	High pressure steam sterilizer (approx.150L)	Door gasket	1	set	672
104	Patient monitor	Disposable ECG electrode set for adult 150pcs./box	2	box	789
Total					109,144

3) Equipment Maintenance Cost

Medical equipment which is necessary for engagement of a maintenance contract with a local agency is limited to 3 items. These equipment requires to engage maintenance contracts which include annual check-ups and calibration between the local agency and SMOH. The amount of the maintenance contract is expected to be a sum of SGD 8,958 borne by SMOH. On the other hand, equipment such as infant incubators, infusion pumps, syringe pumps, ECG machines, anaesthesia machines with ventilators, high pressure steam sterilizers, washing machines requires maintenance services from outside at the time of defects. Thus, these equipment needs to be checked periodically by hospital maintenance staff according to the user manual, and ask local agencies for repair as on call basis at the time of defects.

Table 2-23 Maintenance Management Fee for Major Equipment

Dept.	Description	Contents	Contract	Contract price In SDG
Image diagnostics	Ultrasound scanner	Annual maintenance	Annual maintenance contract	4,868.55
Clinical laboratory	Coagulometer	Annual maintenance and calibration		2,629.02
	Hematology analyzer(Automated)	Annual maintenance and calibration		1,460.56
Total				8,958.13

(2) Prospect for payment for medical services at the planned maternal and child health section

5,000 as the target number of deliveries, an estimated income from the payment for medical services for the planned maternal and child health section is calculated in the table below.

Table 2-24 Estimated amount of the Payment for Medical Services

Services	Qty.	Fee for Service (SDG)	Amount (SDG)
Vaginal (normal) Delivery	4,000	100	400,000
Caesarean Section	700	350	245,000
Caesarean Section(Private ward)	300	1,500	450,000
Urine examination*	30,000	5	150,000
Blood Test*	30,000	5	150,000

Services	Qty.	Fee for Service (SDG)	Amount (SDG)
Ultrasound**	20,000	3	60,000
D & C	937	200	187,400
Hospitalization in Nursery	313	100	31,300
Total Amount			1,673,700
×0.8(80%)			1,338,960

*) Same number as a total number of ANC/PNC: 5,000 x 6 times = 30,000

**) Same number as a total number of ANC: 5,000 x 4 times = 20,000

The whole amount of the payment for medical services is once allocated to SMOH and 80% of the amount is refunded to the hospital as a hospital budget. In Sudan, delivery and medical services are provided free to patients. However, the cost of services provided by the hospital is calculated by SMOH based on the unit price for medical services and 80% of the service cost is refunded to the hospital as the hospital budget.

(3) Income and expenditure of the maternal and child health hospital

The income of the hospital is divided into the budget from SMOH and the payment for medical services. In case of the Umbaddah General Hospital in 2012, the total income of the hospital was SDG10,620,435 of which SDG 7,860,435 was from SMOH and SDG 2,760,000 was from the payment for medical services. For the expenditure, the personnel cost was SDG 4,303,341 that accounts 40% of all. Remaining SDG 6,317,096 was spent for the use of utilities, O&M, etc. (refer to the Table 2-26)

An annual budget for O&M of the planned maternal and child health section is estimated to be SDG 3,425,648 as shown in the Table 2-19. Referring to other state hospitals, the budget disbursement from SMOH for personnel costs, electricity and water bills is stable. Thus, securing the budget for said purposes at the new maternal and child health section is also thought to be no problem (personnel cost: SDG 1,908,900; electricity bill: SDG 490,918, water bill: SDG 13,509). On the one hand, the income from the payment for medical services is estimated to be SDG1,338,960 as calculated in the Table 2. Together with the budget from SMOH, an annual income of SDG3,752,287 is expected.

Table 2-25 Annual Income and Expenditure for the Maternal and Child Health Section

Item	Amount
1) Annual management and O&M cost for MCHS (necessary budget)	SDG 3,425,648
2) Prospected annual income for MCHS (①+②)	SDG 3,752,287
⊖ Budget from SMOH (assuming to be restricted to personnel cost, and electricity/ water bills)	SDG 2,413,327
⊕ Income from the payment for medical services	SDG 1,338,960

As calculated above, if the disbursement of the budget for personnel cost, and electricity/ water bills by SMOH is assured, the enough budget for the maternal and child health section will be secured as the

prospect for the income is expected to be higher than the necessary budget. Furthermore, an additional income of SDG100,000 is anticipated from contracts with private medical universities (provision of practical opportunities).

Table 2-26 Budget of Umbaddah General Hospital (2009~2012)

	2009	2010	2011	2012
Income:				
SMOH	5,842,771	6,023,475	6,340,500	7,860,435
Medical fee	2,289,006	2,359,800	2,484,000	2,760,000
Total	8,131,777	8,383,275	8,824,500	10,620,435
Expense :				
Personnel Salary**	3,523,807	3,632,791	3,823,990	4,303,341
Office supplies	99,702	102,785	108,195	120,300
Electricity	87,082	89,775	94,500	105,000
Water	9,123	9,405	9,900	11,000
Gas	20,734	21,375	22,500	25,000
Fuel	221,142	227,981	239,980	266,644
Medical gas	348,327	359,100	378,000	420,000
Medical equipment maintenance	98,601	101,650	107,000	115,000
Facility maintenance	205,679	212,040	223,200	248,000
Other	3,517,580	3,626,373	3,817,235	5,006,150
Total	8,131,777	8,383,275	8,824,500	10,620,435

CHAPTER 3 PROJECT EVALUATION

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3-1 Preconditions

3-1-1 Preconditions for the Project Implementation

In order to complete the overall plan of the project, appropriate implementation and procedure of the following actions from the Sudanese side are necessary.

- ① Implementation of tasks borne by the Sudanese side which are described in Chapter 2 ‘2-3 Obligations of Recipient Country’.
Clearing the construction site and exemption of custom duties prior to the implementation of the construction work is especially important.
- ② Securing allocation of personnel described in Chapter 2 ‘2-4 Project Operation Plan’.
- ③ Securing operation, maintenance and management budgets for running the maternal and child health section described in Chapter 2 ‘2-5 Project Cost Estimation’.

3-1-2 External Conditions for achieving the Project Plan

Following external conditions are assumed to be necessary for effective as well as sustainable project implementation.

① Securing Health Budget

The Sudanese government currently spends 10.6% of the national expenditure in the health sector and plans to increase its share up to 15% by 2015. It is important that the share of the national expenditure for the health sector not to be drastically reduced and the basic budget for hospital operation needs to be stably disbursed for sustainable operation and management of the plan. The basic budget includes personnel cost, utility charges, medical supplies, and contracts over equipment maintenance and management.

② Safeness of the Existing Hospital Building .

Renovation works for the existing Umbaddah General Hospital which its foundation and upper building frameworks are seriously damaged by uneven settlement are underway and the hospital is expected to restart its operation. However, if the building is again seriously damaged and negative influence is caused on its operation, safeness of the facility of this project will also be questioned by both citizens and staff as it is one section of the Umbaddah General Hospital. Reputation of the general hospital as a whole may drop and users may possibly be distanced. However, the project designs the maternal and child health section to function as a single-department hospital even if the existing General Hospital does not operate.

3-2 Project Evaluation

3-2-1 Relevance

This plan is relevant as for the project under the Japanese Grant Aid scheme due to reasons described below.

(1) Fair supply of maternal and child health services

Out of 7 localities in Khartoum State, Umbaddah locality has the second largest number of public healthcare facilities after Sharq Alneel locality. However, after the closure of the Umbaddah General Hospital in 2012, there is no public hospital at the secondary level within the locality which provides maternal and child health services for free of charge. The maternal and child health section of the Umbaddah General Hospital, the facility planned by the project plan, ensures fair access for maternal and child health services among women and children in the locality and contributes in building a better health service providing structure. For said reasons, its relevance is considered to be well recognized.

(2) Target beneficiaries of the Project

Umbaddah locality is the most populated (approx. 1.127 million) and has the biggest number of pregnancies (approx. 45 thousand cases) among localities within Khartoum State. Furthermore, Umbaddah locality accommodates many poor and the number of incoming IDP is the largest among all localities within Khartoum State. Considering said increasing number of direct beneficiaries (including pregnant women and children among IDP), the project relevancy is thought to be high.

(3) Human security

Human security means focusing on individual people and building societies in which everyone can live with dignity by protecting and empowering individuals and communities that are exposed to actual or potential threats (Ministry of Foreign Affairs of Japan, 2014). There is no public general hospital in Umbaddah locality and its maternal mortality and neonatal mortality rates are high. In other words, many pregnant women and newborn babies are exposed to a threat of not being able to access appropriate treatment promptly. Introduction of facilities and equipment for the maternal and child health section through the implementation of the project will provide opportunities for receiving necessary treatment in a prompt manner for women and children within the locality. This matches with ‘an expansion of maternal and child health related services and training of human resources in nursing sector’ which is indicated in one of the Japanese priority policies for international cooperation, ‘supporting women’s empowerment and promoting gender equality.’

(4) Contribution towards achieving the goal of mid/ long-term development plan in the recipient country

The implementation of this plan shall provide quality maternal and child health services at Umbaddah locality as well as obstetrical practical training opportunities for both medical students and students studying midwifery. It therefore contributes ‘reduction of maternal and child death rate,’ and ‘development of human resources in the health sector which satisfy the requirement of the health system’

in the Sudanese long-term health plan and ‘infrastructure development’ and ‘human resource development’ that are the priority items in the mid-term health plan.

(5) Consistency with the Japanese country assistance policy

One of the priority areas (sub goals) in the Japanese country assistance policy for Sudan is assisting BHN. This project plan comes under the supply of appropriate services and infrastructure in the health sector which matches with the Japanese assistance policy.

3-2-2 Effectiveness

Expected target levels of implementing this project are described below.

(1) Quantitative Effects

As the Umbaddah General Hospital at the target site has closed since 2012, the current achievement of each health service is null. However, in order to measure impacts of the Japanese grant aid cooperation quality expected by the implementation of the project, achievable target values for the project quantitative effect indicators will be set as figures from the last year operation of the Umbaddah General Hospital (2011) as baseline values. The target year will be 2020, 3 years after the completion of the facility.

Table 3-1 Quantitative Effect Indicators and Target Values

Indicators	Baseline Value (actual figures in 2011)	Target Value (2020) (3 years after the project completion)
No. of child birth delivery at the target hospital	3,626 cases	5,000 cases
No. of patients for ANC/PNC at the target hospital (cumulative total No.)	14,504 person* *No. of delivery x 4 (3 ANC, 1 PNC)	30,000 person* * No. of delivery x 6 (4 ANC, 2 PNC)
No. of C/S conducted at the target hospital	703 cases	1,000 cases

Basis for calculation for above values are explained below.

① Number of child birth delivery

Based on the actual number at the target site in 2011, the expected number of annual deliveries by the target year of 2011 is set as 5,000 taking the population growth rate into account. For the population growth rate, the rate that is calculated by SMOH is used.

The value is referred to ‘3.2.2.3 Facility Plan, (1) Setting up a Facility Scale, 2) Umbaddah General Hospital Setting up a target number of deliveries at the new Maternal and Child Health Section.’

② Number of patients for ANC/ PNC.

In Sudan, a standard number of visits for ANC during pregnancy is three times and PNC within 40 days after the delivery is once. However, the benchmark number for receiving ANC indexed by WHO is four and PNC is three for developing countries. The project therefore uses 4 for the number of ANC following WHO indexes. However, for PNC, the figure is unrealistic in Sudan as many mothers are currently unable to be checked even once. Therefore, the project shall adopt the figure, 2, for the number of expected PNC to be received.

③ Number of C/S conducted

As the rate of C/S exceeds over 30% in some reliable maternal and child hospitals in Khartoum State, there is possibility that many pregnant women with risks may visit the maternal and child health section of this project. However, it is anticipated that pregnant women with risks continue to concentrate at the Omdurman Maternal and Child Hospital, the top referral hospital for the maternal and child healthcare of the nation located in Omdurman locality, and Al Saudi Maternal and Child Hospital, the second top. For said reasons, the C/S rate of 20% based on the actual figure of the target site in 2011 is adopted and the number of annual C/S is set as 1,000 as the annual target delivery number being 5,000.

(2) Qualitative Effects

Through the implementation of the project and as the maternal and child health section of the Umbaddah General Hospital is being operated and maintained, following qualitative effects are expected.

- ① Patients with serious illness are transferred from health facilities with lower levels (health centres and health posts)
- ② The facility is used as an obstetrical practical training facility for both medical students and students studying midwifery.
- ③ Regional differences in deliveries at facilities within Khartoum State are mitigated.
- ④ Life insecurity of local women is reduced.
- ⑤ The satisfactory rate among facility users and motivation towards works among medical personnel are increased by introducing new facility and equipment.
- ⑥ Costs for transportation and stays required for deliveries at hospitals in distance are to be reduced.