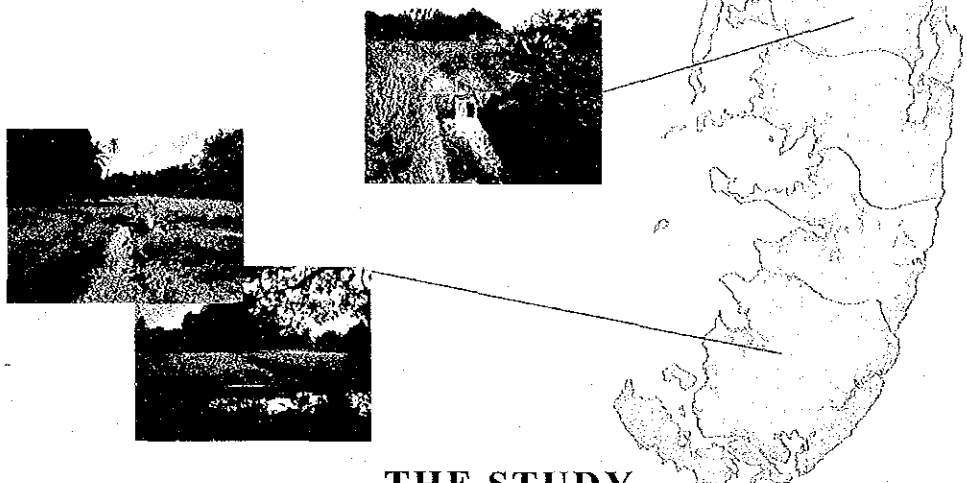


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF AGRICULTURE, NATURAL RESOURCES,
ENVIRONMENT AND COOPERATIVES (MANREC)



THE STUDY
ON
THE ZANZIBAR IRRIGATION MASTER PLAN
IN
THE UNITED REPUBLIC OF TANZANIA



NOVEMBER 2002

NIPPON KOEI CO., LTD.
NIPPON GIKEN INC.

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**MASTER PLAN
EXECUTIVE SUMMARY**

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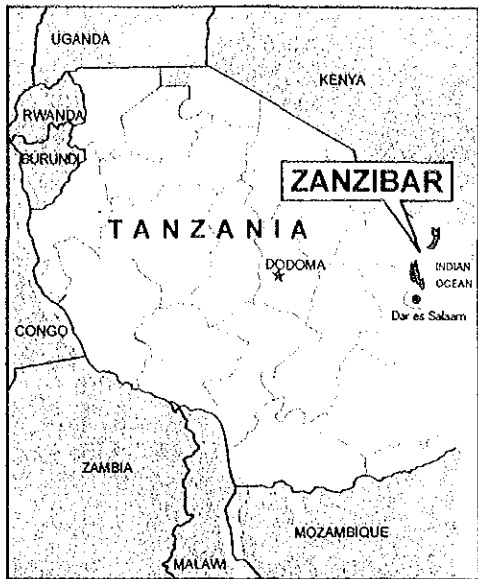
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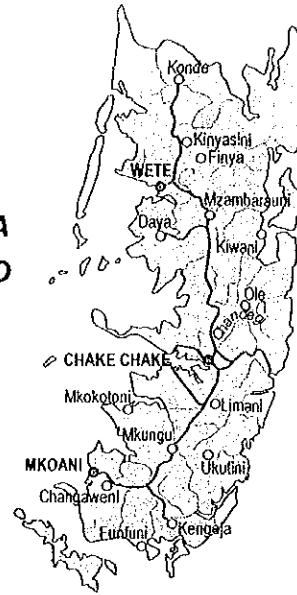
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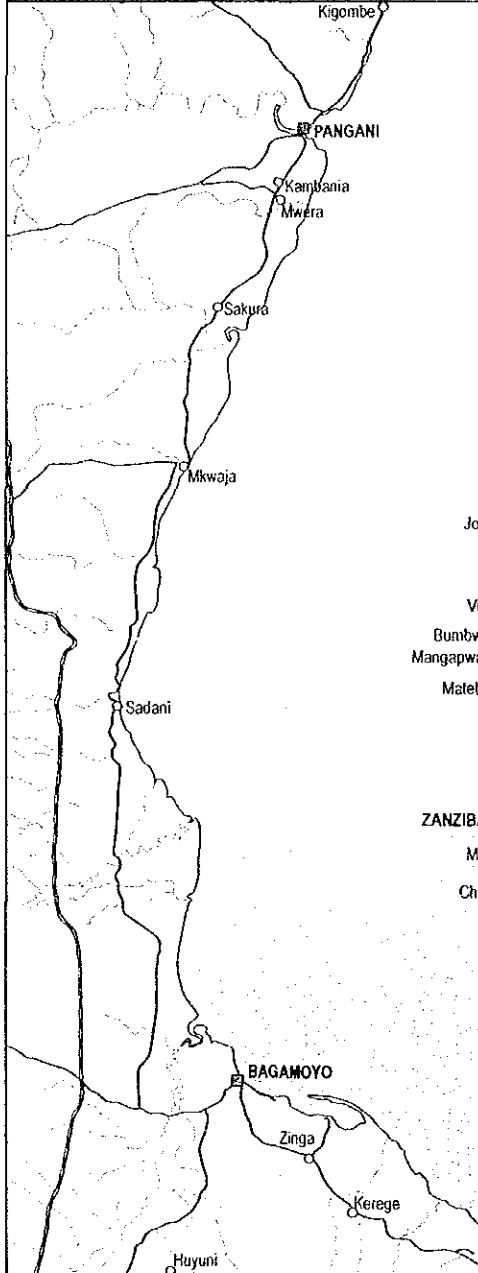
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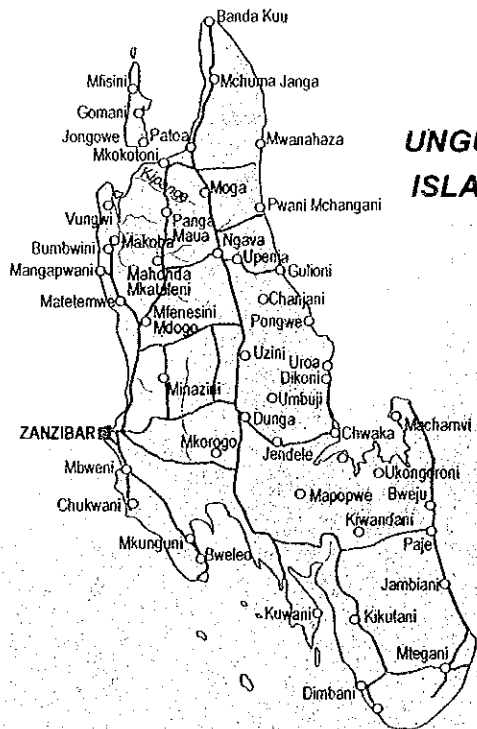
**PEMBA
ISLAND**



ZANZIBAR



**UNGUJA
ISLAND**

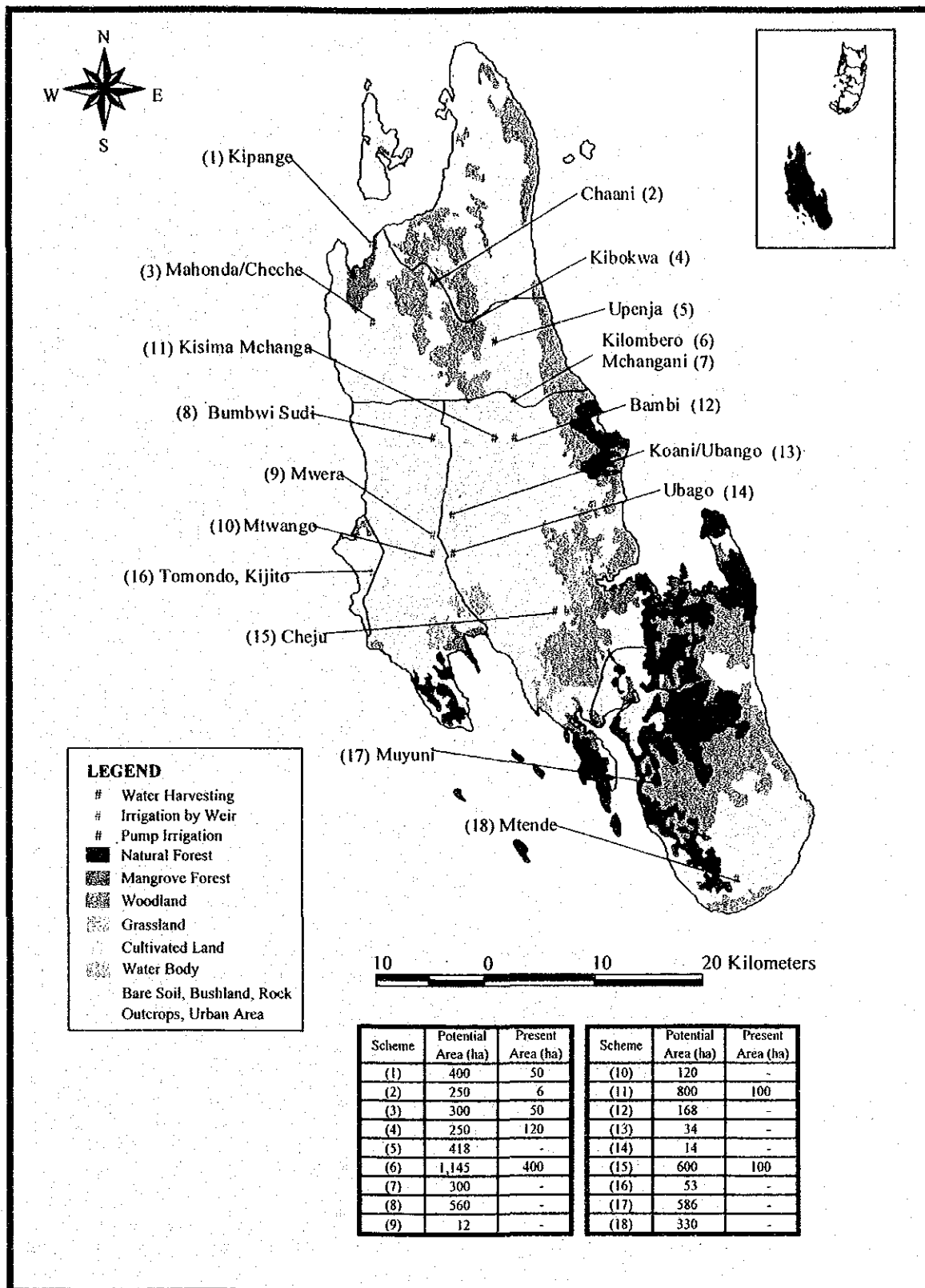


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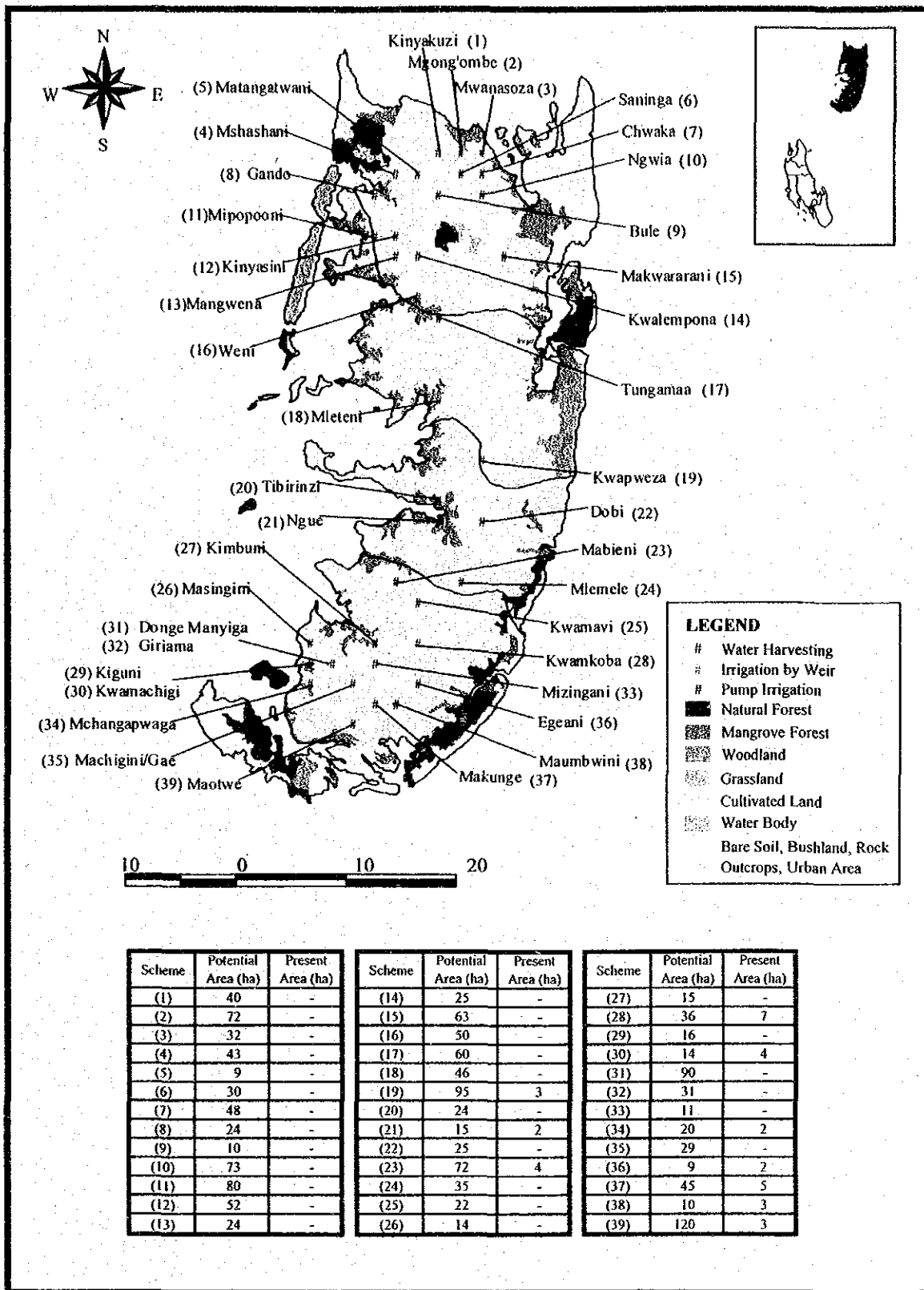
- Road
- +— Railroad
- River
- ☐ Capital
- ⊙ City
- Village

0 5 10 20 25 km

MAP OF ZANZIBAR



Potential Irrigation Schemes in Unguja Island



Potential Irrigation Schemes in Pemba Island

ISLAND PROFILE

SOCIO-ECONOMIC BACKGROUND

Administrative Profile¹

Region	Area (km ²)	Administrative Units		
		District	Wards	Villages
North	459	2	22	31
South	409	2	27	41
Others	120	-	-	-
TOTAL	988	4	49	72

LAND USE

Land Cover ¹	Area (1,000 ha)	%
Forest	19,392	17.4
Woodland	3,919	3.5
Bushland	2,088	1.9
Grassland	217	0.2
Cultivated Land	78,263	70.3
Open Land	7,051	6.3
Water Features	206	0.2
Others	266	0.2
Total	111,402	100.0

IRRIGATION

PRESENT CONDITION	North	South	Total
Water Harvesting			
Scheme Nos./Present Area (ha)	18/ 68	21/ 6	39/ 74
Potential Area (ha)	707	1,185	1,892
Irrigation by Weir			
Scheme Nos./Present Area (ha)	-/-	-/-	-/-
Potential Area (ha)	-	-	-
Pump Irrigation			
Scheme Nos./Present Area (ha)	-/-	-/-	-/-
Potential Area (ha)	-	-	-
Total			
Scheme Nos./Present Area (ha)	18/ 68	21/ 6	39/ 74
Potential Area (ha)	707	1,185	1,892

FEMBA

Population^{1,2}

Population (1988 Census)	267,039	persons
Population (2002 Projection)	375,000	persons*
Population (2020 Projection)	587,000	persons*
Population Density (2020 Proj.)	697.4	persons/km ²
Population Growth Rate	3.08	%
Nos of Farm Household (1990)	55,094	Nos

AGRICULTURE

Major Food Crops (2001)	Cultivated Area (ha)	Production (ton)	Unit Yield (ton/ha)
Crop			
Paddy	16,230	12,926	1.2
Cassava	10,042	80,344	8.0
Bananas	2,488	24,875	10.0
Yam	-	-	-
S. Potato	4,013	24,078	6.0
Maize	2,231	2,231	1.0
Total	27,624		

FUTURE PLAN

	North	South	Total
Group A			
Scheme Nos./Present Area (ha)	1/ 8	-/-	1/ 8
Potential Area (ha)	40	-	40
Group B			
Scheme Nos./Present Area (ha)	2/ 22	3/ -	8/ 22
Potential Area (ha)	114	151	365
Group C			
Scheme Nos./Present Area (ha)	11/ 37	12/ -	23/ 37
Potential Area (ha)	429	902	1,331
Group D			
Scheme Nos./Present Area (ha)	1/ -	6/ 6	7/ 6
Potential Area (ha)	24	132	156
Total			
Scheme Nos./Present Area (ha)	18/ 68	21/ 6	39/ 74
Potential Area (ha)	707	1,185	1,892

ISLAND PROFILE

SOCIO-ECONOMIC BACKGROUND

Administrative Profile¹

Region	Area (km ²)	Administrative Units		
		District	Wards	Villages
Town/West	234	2	35	69
North	423	2	22	51
South	873	2	21	56
Others	202	-	-	-
TOTAL	1,666	6	78	176

LAND USE

Land Cover ¹	Area (1,000 ha)	%
Forest	23,048	14.6
Woodland	34,652	21.3
Bushland	11,173	19.7
Grassland	3,115	2.0
Cultivated Land	62,634	39.7
Open Land	1,362	0.8
Water Features	2,177	1.3
Others	2,717	1.6
Total	156,272	100.0

IRRIGATION

PRESENT CONDITION	Town/West	North	South	Total
Water Harvesting				
Scheme Nos./Present Area (ha)	1/ 78	2/ -	-/-	3/ 78
Potential Area (ha)	120	650	-	770
Irrigation by Weir				
Scheme Nos./Present Area (ha)	2/ 78	1/ -	3/ 12	6/ 90
Potential Area (ha)	173	-	312	485
Pump Irrigation				
Scheme Nos./Present Area (ha)	1/ 136	2/ -	3/ 42	6/ 178
Potential Area (ha)	560	2,180	4,524	7,264
Total				
Scheme Nos./Present Area (ha)	3/ 214	6/ -	9/ 54	18/ 268
Potential Area (ha)	733	2,468	3,428	6,629

UNGUJA

Population^{1,2}

Population (1988 Census)	375,539	persons
Population (2002 Projection)	608,000	persons*
Population (2020 Projection)	1,159,000	persons*
Population Density (2020 Proj.)	672.3	persons/km ²
Population Growth Rate	3.08	%
Nos of Farm Household (1990)	52,363	Nos

AGRICULTURE

Major Food Crops (2001)	Cultivated Area (ha)	Production (ton)	Unit Yield (ton/ha)
Crop			
Paddy	4,547	5,456	1.2
Cassava	6,013	48,104	8.0
Bananas	2,246	22,455	10.0
Yam	392	3,916	10.0
S. Potato	942	5,651	6.0
Maize	1,297	1,297	1.0
Total	15,437		

FUTURE PLAN

	Town/West	North	South	Total
Group A				
Scheme Nos./Present Area (ha)	1/ 78	2/ -	-/-	3/ 78
Potential Area (ha)	120	650	-	770
Group B				
Scheme Nos./Present Area (ha)	1/ 136	-/-	2/ 12	3/ 148
Potential Area (ha)	560	-	312	872
Group C				
Scheme Nos./Present Area (ha)	1/ -	2/ -	3/ 42	6/ 42
Potential Area (ha)	53	550	1,386	1,989
Group D				
Scheme Nos./Present Area (ha)	-/-	2/ -	4/ -	6/ -
Potential Area (ha)	-	1,268	1,730	2,998
Total				
Scheme Nos./Present Area (ha)	3/ 214	6/ -	9/ 54	18/ 268
Potential Area (ha)	733	2,468	3,428	6,629

1: Zanzibar Statistical Abstract 1997

2: National Land Use Plan Planning Policies, October 1994, Dept. of Statistics

3: National Reconnaissance Level Land use and Natural Resources Mapping Project, Final Report 1997

*: Population Data are rounded by JICA Study Team.

**THE STUDY
ON
THE ZANZIBAR IRRIGATION MASTER PLAN
IN
THE UNITED REPUBLIC OF TANZANIA**

**MASTER PLAN
EXECUTIVE SUMMARY**

1 INTRODUCTION

(1) Authority

This Master Plan Report was prepared in accordance with the Minutes of a Meeting for the Study agreed between the Ministry of Agriculture, Natural Resources, Environment and Cooperatives, Zanzibar, the United Republic of Tanzania (MANREC) and the Japan International Cooperation Agency (JICA) on May 9, 2002.

(2) Background of the Study

The Zanzibar Irrigation Development Programme (ZIDP), prepared in 1997, requires revision due to the unexpected low progress of irrigation development, and the need for consistency with new policies formulated after the ZIDP such as the Zanzibar Vision 2020, Poverty Reduction Strategy Paper and Agricultural Sector Policy. The Government of Zanzibar (GOZ) thus requested the Japan International Cooperation Agency (JICA) through the Ministry of Agriculture and Food Security (MAFS), the Mainland, to formulate the Zanzibar Irrigation Master Plan (ZIMP) under the on-going Study on the National Irrigation Master Plan for the Mainland (NIMP) by the JICA. The JICA, with consent of the MAFS, agreed to this request, which is reported in the minutes of meeting and signed by JICA and the MANREC.

(3) Objectives of the Study

- Phase 1: Formulate the Master Plan on Irrigation Development for Unguja and Pemba Islands, using the NIMP as a guide.
- Phase 2: Prepare the Action Plan for priority irrigation schemes selected in the Master Plan.
- Phase 1 and 2: Conduct the technology transfer for counterpart personnel through field inspection and report explanation in the course of field works.

The Report presents the results of Phase 1 works only.

(4) Study Area

The Study Area for Phase 1 is Unguja and Pemba Islands.

(5) Steering Committee Meetings

The Steering Committee meeting was held for the Inception Report on May 15, 2002 and for the Draft Master Plan Report on August 26, 2002. The meetings were attended by staff of MANREC. The JICA Tanzania Office was represented by Dr. J. Nozaka, a JICA Expert, for the former meeting and Ms. K. Matsushita, Assistant Resident Representative, for the latter meeting. Eng. A.H. Simba, a Chief Counterpart of MAFS, attended both meetings. The contents of both Reports were fully discussed and finally agreed at the respective meetings.

2 PREVAILING GOVERNMENT POLICIES

(6) Zanzibar Vision 2020 and Zanzibar Poverty Reduction Plan

The current super-ordinate policies are the Zanzibar Vision 2020 and Zanzibar Poverty Reduction Plan (ZPRP). The Zanzibar Vision 2020 states the direction of economic policy objectives to boost economic growth and to eliminate the poverty trap in a setting of improved macro-economic stability. The ZPRP was prepared as an implementation plan of the Vision, and also as an operational plan for the country's financial resource as well as the provision of a climate to attract external resources.

(7) Agricultural Sector Policy

The Agricultural Sector Policy (ASP) is a direct super-ordinate policy regarding irrigation development. Its overall goal is to promote sustainable development of the agricultural sector for economic, social and environmental benefits for its people. For the irrigation development, the ASP indicates the need for a framework and strategies to enhance it in a cost-effective, efficient and sustainable manner, and issues the following policy strategies:

- Promote rehabilitate the existing irrigation schemes.
- Promote and strengthen Water Users Associations to ensure proper use of irrigation water.
- Develop and promote water harvesting techniques.
- Encourage the private sector to invest in irrigation farming.
- Create an efficient mechanism for collection of water fees from water users to cover the running and maintenance cost.

(8) Zanzibar National Water Policy (ZNWP)

The objective of the ZNWP prepared in 1999, is to provide guidance on access to clean and safe water for all people and other water users to fulfill the needs of expanding social and economic activity. To achieve this objective, six goals were set. Five policy and strategy issues for future water resources management were elaborated in consideration of attainment of these goals. The responsibilities given to the MANREC for irrigation development in the ZNWP, were as follows:

- Develop water resources for irrigation.
- Control water use in all irrigation systems in accordance with the existing water rights and regulations as provided by the WRMB.
- Provide statistics on water requirements for all agricultural activities.
- Raise awareness of farmers on proper use of land, proper care of sources of water, forestry, and their environmental protection.
- Promote use of surface water for irrigation activities.
- Encourage private participation in harvesting and storage of rainwater for agricultural purposes.

(9) Environmental Policy

A comprehensive environmental study was conducted by the Zanzibar Integrated Lands and Environmental Management Project in 1990, the results of which were compiled into the report, An Environmental Policy and Programme for Zanzibar. The major points raised in the report are (i) the need of preparation of integrated land use plan to contribute to the protection of environment by elaborating a well-balanced zoning of land and resources for appropriate uses, focusing on the improvement of rural lands management, (ii) the need for control of environmental factors on public health problems to reduce health risks related to irrigation and stagnant water, and (iii) the promotion of legislation of lands to provide security of tenure, which could encourage farmers to control soil erosion. The Environmental Management for Sustainable Development Act was also prepared in 1996. Articles related to irrigation development in the Act, include action to maintain basic ecological process of land, water and air, and to promote the sustainable use of renewable natural resources. These articles should be reflected upon the planning and design of irrigation development.

3 SOCIO-ECONOMIC BACKGROUND

(10) Current Economic Performance and Agricultural Sector

The agriculture sector accounts for 36.4 % of GDP (in 2000), and employs more

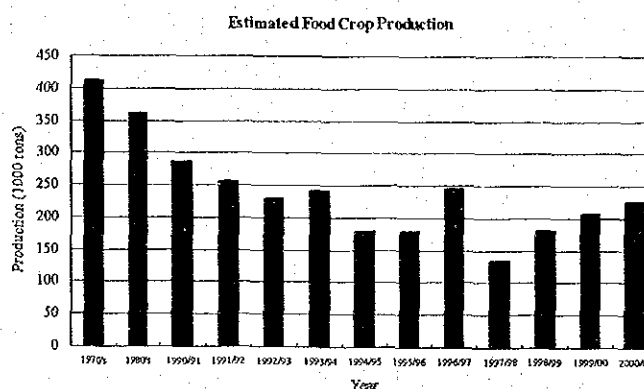
than 60% of the population, especially in rural areas. GDP growth rate increased by an average of 4.0% per annum between 1990 to 2000; and further moderate recoveries were achieved: 4.5% in 1999 and 4.2% in 2000. Inflation rate declined from 29.0% in 1995 to 6.5% by the end of 2000. This has been largely achieved through reduced domestic financing in pursuit of tight fiscal policy.

(11) **Fiscal Performance and Sector Budget Allocation**

Fiscal performance of the GOZ, once very weak, has improved in the past 3 years of 1998/99 to 2000/01, the cash budget system having minimized the deficit. Development expenditure, which suddenly dropped to 6.4 % of total expenditure in 1995/96 from 45.8 % in the previous year, is only a fraction of total expenditure since 1996/97. One reason for this may have been due a period of low aid assistance by many bilateral donors from 1995 to 2000. The GOZ increased the amount of development expenditures by 71% to Tsh 1.0 billion in 2000/01 from the previous year's Tsh 0.6 billion, but its share is still 2.4% of total government expenditure. Budget allocation to agricultural sector has remained relatively stable, but low, at only 5.2 % of the recurrent budget in 2001/02. The ZPRP suggests that more resource allocation to agricultural sector should be considered, particularly extension services including irrigation and research services.

(12) **Food Deficit**

The contribution ratio of food crop production to food supply has declined from 60% in 1970 to 42% in 1980 and to less than 35% in 1990 mainly due to decrease of farm land by population pressure. The table to the right shows the production (in tons) of food crops in Zanzibar from 1970s to 2000/01..



Source: *Food Self-sufficiency in Zanzibar 1996, Status of Irrigation Development in Zanzibar-2001, Statistic Bureau of Zanzibar*

Rice is major staple food crop in Zanzibar. The rice production has fluctuated over the past ten years with no significant increase being realized. According to the Agricultural Sector Review, June 1999, 15,600 ton of rice is produced, and 80,000 ton of rice is imported yearly to supplement the deficit.

(13) Poverty Status and Gender Issue

The poor in Zanzibar constitutes to 51 % of the population. Most of the poor live in the rural areas where agriculture is dominant. In general, Pemba is worse off than Unguja and is more dependent on agriculture than Unguja since nearly 60% of household in Pemba have farm land compared with just over 30% in Unguja.

(14) Gender Issue

Women in Zanzibar comprise 70 % of the agricultural labor force in food crop production but only 20 % of women own land. In addition, women are generally excluded from access to credit, information and extension services and appropriate farming technology. This hampers women's efforts to increase productivity, a situation which has remained unchanged due to the lack of social efforts to promote women.

4 BACKGROUND AND CONSTRAINTS IN IRRIGATION DEVELOPMENT

(15) Natural Conditions

Zanzibar has a territorial area of about 2,654 km² comprising Unguja 1,666 km² and Pemba 988 km². The Unguja has a topography forming a series of low flat corridors bounded by many parallel ridges running in a north-south direction. The Pemba is undulated due to numerous long and narrow valleys formed by perennial small streams originating in springs. Zanzibar has two distinct monsoon seasons: the North Monsoon from late March until June and the South Monsoon from late September until December. Annual rainfall averages 1,550 mm for Unguja and 1,830 mm for Pemba. Dry season is also divided into two patterns due to the sea influence. The short dry season occurs between August and September, and the long dry season between December and end of March. Zanzibar has a mean temperature of 27 °C with small seasonal fluctuations.

(16) Zanzibar Irrigation Development Programme (ZIDP)

The ZIDP was prepared to formulate a master plan of irrigation development based on the concept "transitioning to self-sustainability through proper institutional improvement". The ZIDP promoted a regional development, putting a high priority on surface fed gravity smallholder irrigation schemes in Pemba and extensive irrigation producing high value crops with private investor's enrolment in Unguja. However, the ZIDP did not present any concrete implementation plan. As a result, the ZIDP has faced no endorsement of financial resource and weak initiatives for its promotion in implementation, and thus little progress has been

made on the proposed 46 activities.

(17) Present Problems and Constraints in Irrigation Development

The present problems and constraints in irrigation development in Zanzibar are tabulated below:

Problems and Constraints in Irrigation Development in Zanzibar

Problems and Constraints	Content	Reasons
Institutional and economic issues	Implementation cost of irrigation schemes was high (In case of FAO project, it was reported at US\$23,000/ha.)	This is due to inexperience and institutional inadequacy of irrigation section. Although the complicated and small shape of schemes requires comparatively high cost, there is certain room to be devised.
Financial issue	In pump irrigation scheme, high pump operation cost is not affordable for the beneficiaries.	Groundwater is only reliable water resources in those areas. Proper subsidy is compulsory otherwise irrigation development is difficult in those areas.
Technical and sociological issues	Adequate irrigation efficiency is not attainable. Proper O & M is not executed.	It is caused by not only impervious material of the canal construction, but also weeds' deep roots and rats-roots. Farmers' neglectful water management is sometimes a significant cause for high water loss.
	Small dams do not function well.	Small dams in Zanzibar were constructed without rational planning and designing on the basis of sound estimation for the water requirement.

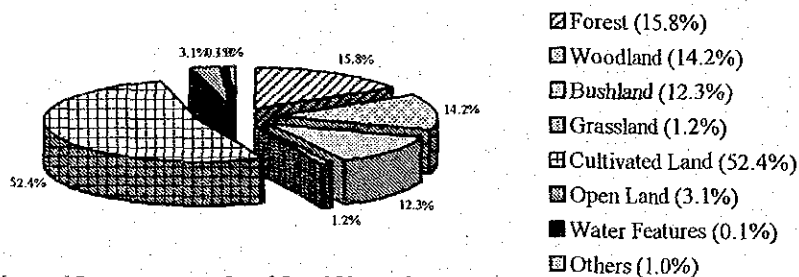
Source: Internal information in the DARI

(18) Land Use

The present land use in Zanzibar is shown in the figure below:

The cultivated land occupies more than 50 % of the total land area available (140,000 ha), with forestry the second largest land use.

Distribution of Land Cover in Zanzibar



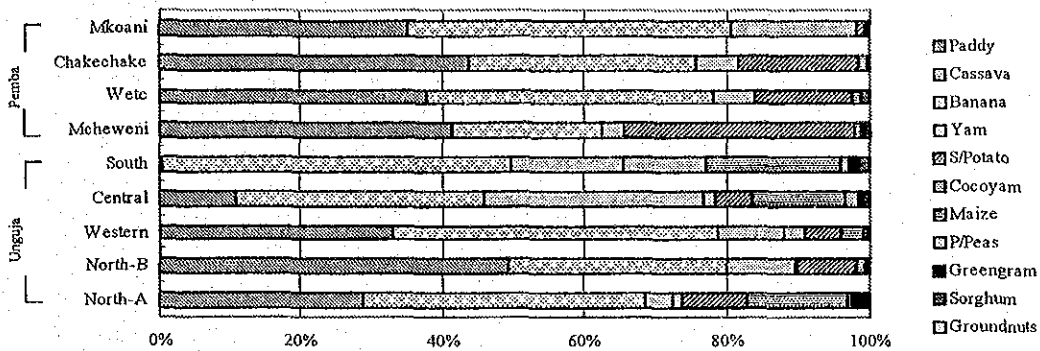
Source: National Reconnaissance Level Land Use and National Resources Mapping Project, Final Report 1997

(19) Crop Production

The cropping pattern varies considerably from district to district. Cassava dominates the cropping in many of the districts accounting for as much as 50% of

the food crop area in South of Unguja. Land allocated for rice is generally higher in Pemba. In Unguja, on the other hand, land for rice fluctuates from district to district. Land allocated for maize is generally higher in Unguja.

Crop Production by Region

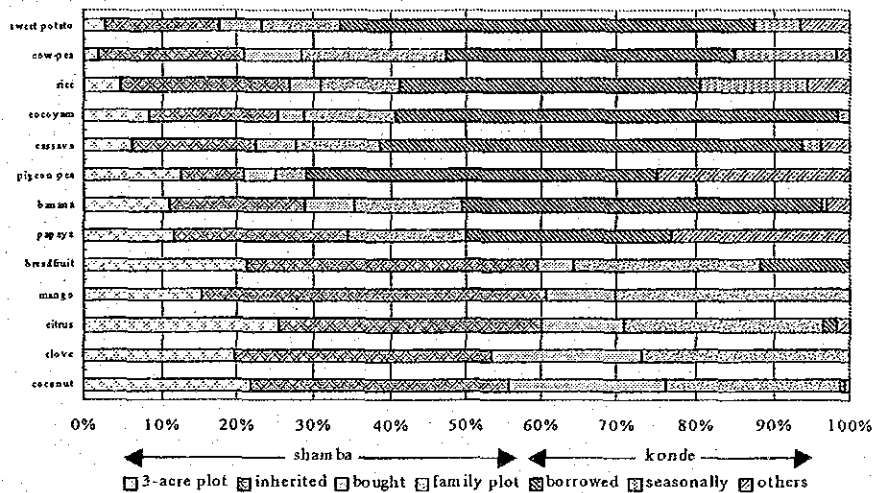


Source: Data obtained from Ministry of Agriculture

(20) Land Tenure and Farming System

The relationship between land tenure systems and cultivated crops show that tree crops including clove and coconut are almost exclusively cultivated by Shamba farms specifically in inherited land. Perennial and annual crops are mainly cultivated by Konde farms specifically in borrowed land. Seasonally allocated lands are mainly utilized for rice and cowpea cultivation. The figure below shows the distribution of land tenure system:

Relationship between Land Tenure Systems and Cultivated Crops

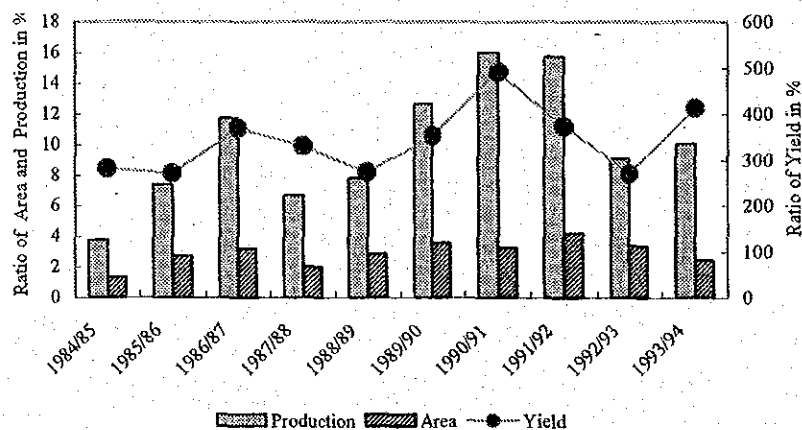


Source: A Baseline Survey for the Identification of Farming Systems in Zanzibar

(21) Irrigated Agriculture

Most activities are focused on irrigated rice development. According to the change of the ratio of irrigated paddy against total paddy for production, planted area and yield from 1984/85 to 1993/94, the irrigated area for rice production is only a few percent of the total planted area. Since the yield is 3 to 4 times higher than rainfed rice, the production of irrigated rice reaches more than 10% of the total production as shown below. This fact clearly shows the importance of irrigation for the future development of agriculture.

Ratio of Irrigated Paddy against Total Paddy



Source: Status of Irrigation Development in Zanzibar, 2001 and Zanzibar Irrigation Development Programme

(22) Marketing

There are a variety of marketing systems for food products being operated in Zanzibar. The marketing system for locally produced cereals, imported cereals and pulses is different from that for cassava and bananas. The distribution systems are also different crops by crops. The major weaknesses of these current market and distribution systems are as follows:

- No regulations or guidelines for collection and distribution of agricultural produce.
- Many opportunities for intermediate middlemen to buy products at cheaper prices from producers and resell at exorbitant prices.
- No definition of role of wholesale markets.
- Lack of agricultural credit facilities, high interest rates and collateral.
- Low rate of loan repayments from farmers.
- No institution for control marketing of agricultural commodities.
- Infancy services and skills in marketing, particularly marketing information and marketing advice.

- Inadequate infrastructure, market information and quality control of agricultural commodities and agro-processed.
- Inadequate facilities for storage, packing and transport especially for perishable commodities.

(23) Institution

Institutional problems identified in the ZIDP and the ASP, are still applicable to the present institutional setting of the irrigation development. The ZIDP raised a fundamental issue regarding very little sense of ownership or responsibility of the beneficiaries in irrigation development and stated, "Successful transition to self-management and scheme sustainability will require more than just conscientious and well-organized water users associations. Changes will be required at National or policy level." "Thus, in terms of policy at least the following five changes have to be made:

- Markets for agricultural products should be totally liberalized,
- Farmers should be given more options as regards their cropping systems,
- More development activities and hence responsibility should be devolved to the communities,
- Reasonable charges should be levied through the WUAs for the use of irrigation water, and,
- Land tenure conditions should be redefined to increase a farmer's sense of security."

(24) Organization

The administrative organization structure for irrigation development in Zanzibar is divided into the national and local levels. The local level has a hierarchical three-tier structure: regional, district and village levels, whereas the Central Government functionally covers and supervises all of the levels, i.e. from the central to village levels. The Commission of Agriculture, Research and Extension (CARE), of the MANREC is now responsible for all matters pertaining to irrigation development, through the Division of Agriculture, Rice Cultivation and Inputs Supply (DARI). In terms of the present administrative performance of the relevant governmental agencies, only two roles deserve to be rated as "Good". One is the role of the MANREC to formulate and review policy, laws, procedures, regulations and guidelines on irrigation farming and the second is the role of the CARE to supervise in the preparation of irrigation farming projects before they are implemented. The remained majority of the roles and functions are rated as "Fair" or "Poor".

(25) Present Situations of Inventorized Schemes

The Inventorized schemes total 57, covering 342 ha of the existing irrigated area, and 8,521 ha of potential area in both Unguja and Pemba and are classified as follows:

Classification of Inventorized Schemes with Potential Area

Required Works	Type of Irrigation	Small-scale		Medium-scale		Large-scale		Total	
		Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)
Rehabilitation /Improvement of Existing Schemes	Dam	4	140	1	114	-	-	5	254
	Diversion weir	1	12	1	120	-	-	2	132
	Pump	-	-	-	-	2	1,758	2	1,758
	Sub-total	5	152	2	234	2	1,758	9	2,144
Restoration of Abandoned Schemes	Dam	2	46	3	180	3	1,197	8	1,423
	Diversion weir	-	-	-	-	-	-	-	-
	Pump	-	-	1	168	1	850	2	1,018
	Sub-total	2	46	4	348	4	2,047	10	2,441
Proposed New Schemes	Dam	23	518	5	347	2	550	30	1,415
	Diversion weir	1	20	1	53	1	300	3	373
	Pump	1	14	-	-	4	2,134	5	2,148
	Sub-total	25	552	6	400	7	2,984	38	3,936
Total	Dam	29	704	9	641	5	1,747	43	3,092
	Diversion weir	2	32	2	173	1	300	5	505
	Pump	1	14	1	168	7	4,742	9	4,924
	Total	32	750	12	982	13	6,789	57	8,521

Source: Inventory survey conducted by ZIMP

(26) Irrigation Development Level

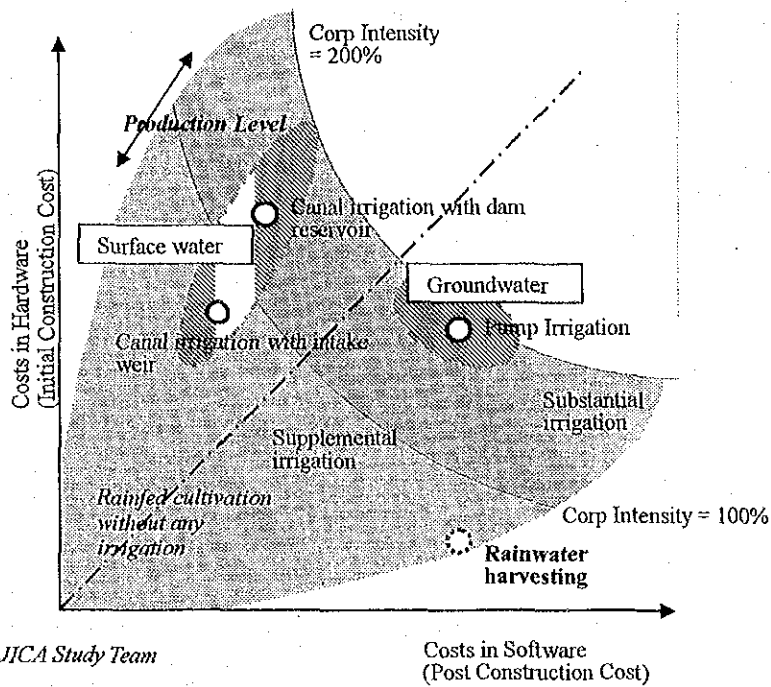
A wide variety of irrational irrigation development levels in different schemes' implementations, may bring about; (i) ineffective utilization of limited resources, (ii) complaints from farmers concerned to the irrigation schemes being inadequate, (iii) confusion in expansion of model effects to other areas, and (iv) complexity in supervising and monitoring irrigation schemes under different development levels. In Zanzibar, four irrigation types are allowable in general, namely, pump irrigation, canal irrigation with dam reservoir, canal irrigation with diversion weir, and watering. These irrigation types could be ranked in order of expectable benefits, required initial costs and post-construction cost as follows:

Relation of Three Factors by Irrigation Type

Irrigation Type	Expectable benefit	Required initial costs	Required post-construction cost
diversion weir	Low - Medium	Medium	Medium
dam reservoir	Medium - High	High	Medium
Pump irrigation	High	Medium	High
Watering	Low	Low	Medium - High

Source: JICA Study Team

These situations could be characteristically shown in the following two-axis graph of costs in hardware and in software aspects:



Source: JICA Study Team

Costs in Software
(Post Construction Cost)

Irrigation type is also selected depending upon scheme's site condition. For the case of canal irrigation utilizing surface water, several ranges of irrigation development level are selectable within the scope of canal irrigation system.

(27) Environment

Environmental problems identified in existing irrigation schemes are summarized as follows:

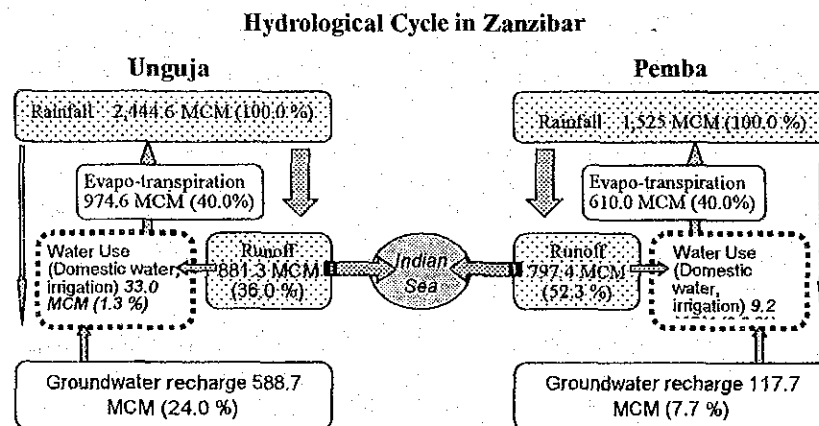
Negative and Positive Impacts

Negative Impacts	Positive Impacts
Overuse of water by upstream beneficiaries to detriment of downstream beneficiaries, leading to loss of income and quality of life for downstream beneficiaries and finally accelerating over grazing and wide spread land degradation.	Creation of cattle' grazing during periods when there are not many alternatives using end points of drains.
Overuse of water leading to falling replenishment of groundwater reserves.	Creation of an incentive for highly beneficial soil and water conservation practices through irrigation.
Local flooding due to poor water control /management.	Reduction of damage to downstream and upstream cultivation areas, health risks associated with flooding and soil erosion by flood alleviation.
Soil erosion leading to loss of soil cover.	
Water-born diseases such as Bilharzia and Malaria.	
Increased use of fertilizer and pesticides resulting in negative impact to environment.	
Deforestation for reclamation of new farming land.	

5 POTENTIAL AREA FOR IRRIGATION DEVELOPMENT

(28) Available Water Resources

Macroscopic water balance based upon annual hydrological cycles for Unguja, shows that around 307 MCM of groundwater would be exploitable and 70 MCM of stream discharge would be utilizable at maximum. For Pemba, around 43 MCM of groundwater would be exploitable and 717 MCM of flow discharge would be utilizable at maximum. The overall hydrological cycle of the both islands is schematically shown as follows: The figure presents the estimated water amount at the year 2002.



Source: JICA Study Team

(29) Land Resources

The Zanzibar Commission for Land and Environment produced the National Land Use Plan for Zanzibar based on various studies including "Soil Studies for Agricultural Development in Zanzibar", "Detailed Soil Survey for Irrigated Rice" and "Evaluation of Land Resources in Zanzibar". In this plan, the agricultural land was classified into three categories according to the suitability for cultivation. The suitable areas for sugar cane, rainfed rice, irrigated rice, tree crops & associations and ranch areas are also specified in this plan. Since most of the candidate schemes are located in suitable area of irrigated and/or rain-fed rice, there is correlation between the ZIMP and the land use plan.

(30) Potential Area for Irrigation Development

The Inventory Survey shows the 57 irrigation schemes consisting of 17 schemes for Unguja and 40 schemes for Pemba. Judging from the topographic conditions, usable water resources, potential land resources and other past study reports, these schemes, totaling 8,521 ha, are considered to show a maximum potential area for

irrigation development in Zanzibar. Features of the 57 irrigation schemes are summarized as follows:

Potential Area for Irrigation Development

Scheme Name	Water Resources	Potential Area (ha)		Scheme Name	Water Resources	Potential Area (ha)	
		Rainy	Dry			Rainy	Dry
Unguja							
Chaani	Surface Water	250	250	Koani	Surface Water	20	20
Kibokwa	Surface Water	250	250	Mchangani	Surface Water	300	200
Kilombero	Groundwater	850	373	Mwera	Surface Water	12	12
Kipange	Surface Water	400	400	Ubago	Groundwater	14	14
Mahonda	Surface Water	300	150	Mtende	Groundwater	330	165
Upinja	Groundwater	418	314	Muyuni	Groundwater	586	293
Bambi	Groundwater	168	168	Bumbwi sudi	Groundwater	560	450
Cheju	Groundwater	1,198	479	Mtwango	Surface Water	120	120
Ksima	Groundwater	800	560	Tomondo	Surface Water	53	27
Sub-total		4,634	2,944			1,995	1,301
Total of Unguja						6,629	4,244
Pemba							
Bule	Surface Water	12	12	Kwamavi	Surface Water	22	22
Chwaka	Surface Water	17	17	Kwapweza	Surface Water	62	27
Kinyakuzi	Surface Water	40	30	Mabieni	Surface Water	35	18
Kinyasini	Surface Water	23	9	Mfemele	Surface Water	73	68
Makwararani	Surface Water	114	31	Ngue	Surface Water	5	-
Matangatwani	Surface Water	19	7	Tibirinzi	Surface Water	25	7
Mgongombe	Surface Water	41	-	Donge Manyiga	Surface Water	19	7
Mshashani	Surface Water	25	15	Egeani	Surface Water	12	5
Mwanasoza	Surface Water	32	10	Giriama	Surface Water	33	14
Ngiwa	Surface Water	76	33	Kiguni	Surface Water	16	8
Saninga	Surface Water	38	21	Kimbuni	Surface Water	21	11
Gando	Surface Water	24	8	Kwamachigi	Surface Water	51	8
Kwalempona	Surface Water	53	14	Kwamkoba	Surface Water	93	42
Mangwena	Surface Water	29	6	Machigini	Surface Water	547	17
Mipopooni	Surface Water	65	20	Makunge	Surface Water	54	26
Mleteni	Surface Water	31	9	Maotwe	Surface Water	13	13
Tungamaa	Surface Water	33	20	Masingini	Surface Water	15	8
Weni	Surface Water	35	-	Masumbwini	Surface Water	29	7
Dobi	Surface Water	25	12	Machagapwaga	Surface Water	10	8
				Mizingani	Surface Water	25	6
Sub-total		732	409	Sub-total		1160	187
Total of Pemba						1,892	596
Grand Total of Zanzibar						8,521	4,840

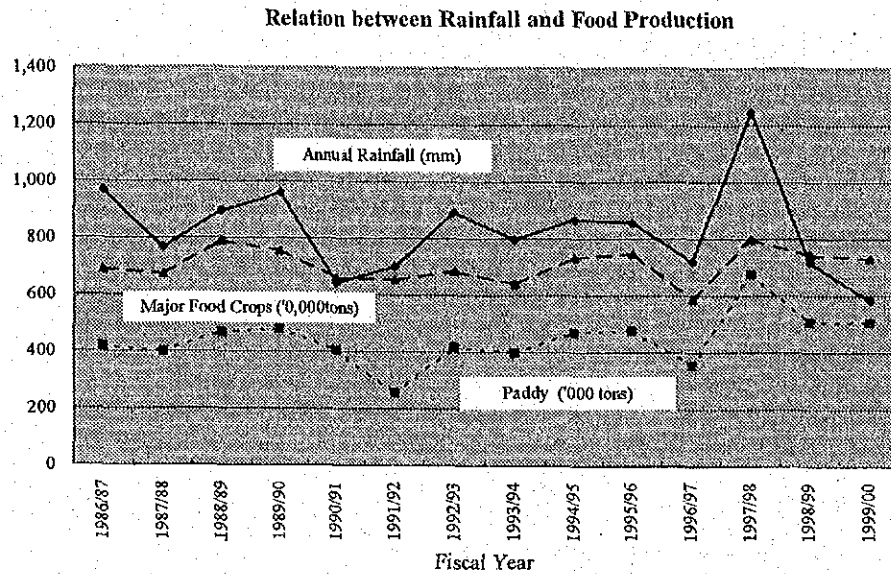
6 FRAMEWORK FOR IRRIGATION DEVELOPMENT PLAN

(31) Need of Irrigation Development

(a) Stabilization of Crop Production

Rainfed cultivation which is prevailing in Zanzibar, results in an unstable and low production due to erratic and unreliable rainfall. To improve this undesirable situation, irrigation is essential. The figure below, which was developed using

available data in the Mainland, shows the relation between annual rainfall and food production:



The figure shows a direct relationship between rainfall and crop production. From this, it can be said that irrigation development is a key activity to improve the productivity and also an important factor to improve the profitability in agriculture.

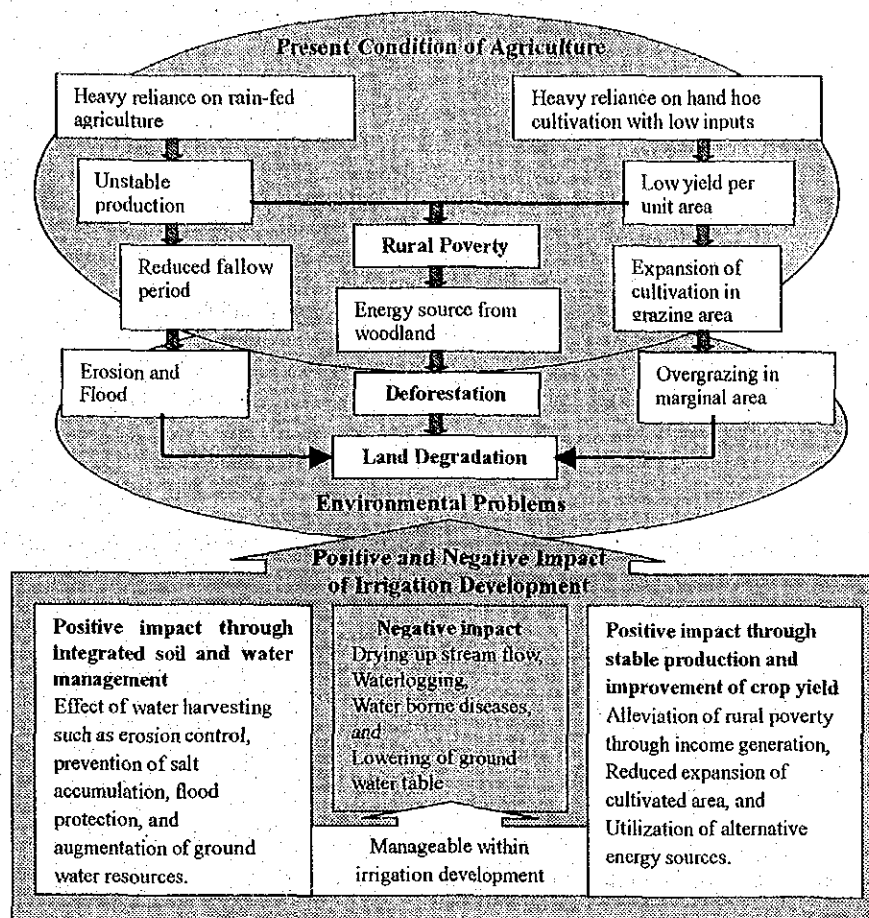
(b) Poverty Reduction of Smallholders due to Improvement of Farm Income

Zanzibar faces a poverty problem with about 51 % of the population in this category. Most are engaged in rainfed agriculture in rural area. Irrigation development results in stable and higher production and therefore irrigation development could be regarded as one of effective approaches to poverty alleviation in rural area.

(c) Environmental Conservation Effects of Irrigation Development

Inappropriate land husbandry practices accelerate the soil erosion and the consequent flood hazard. Irrigation development could greatly contribute to the environmental conservation.

Interrelation between Environmental Problems and Irrigation Development



Stable production and improvement of yield per unit area through irrigation development, could contribute to (i) the reduced expansion of cultivated area, (ii) the access to alternative energy sources and (iii) the creation of job opportunity. Furthermore, integrated soil and water management would be part of a properly designed irrigation scheme, to control erosion, prevent salt accumulation, manage flood protection and manage the augmentation of underground water resources.

(d) Effect of Irrigation Development

Based on the past trend of cropped area and production of paddy, the future production from 17,000 ha could be estimated at 13,000 tons maximum in the year 2020. However, the production under full development of irrigation, that is 8,521 ha out of 17,000 ha developed for irrigation and the remaining used for rainfed cultivation, would be estimated at more than 40,000 tons. It is thus obvious that a significant increase in rice production would be possible by the irrigation development. Production increase can contribute to the reduction of reliance on imported rice, and alleviate farmers poverty.

(32) Purpose of Zanzibar Irrigation Master Plan (ZIMP)

In consideration of the policies and strategies stipulated in the Vision and the ASP and also the study results, the “*Sustainable Irrigation Development*” was selected as a purpose of the ZIMP with emphasis on comprehensive measures through “*Effective Use of National Resources*”, to largely contribute to attainment of the overall goal of ASP. The “*Sustainable Irrigation Development*” means the establishment of technically and financially self-reliant irrigation schemes through institutional and organizational strengthening/reform.

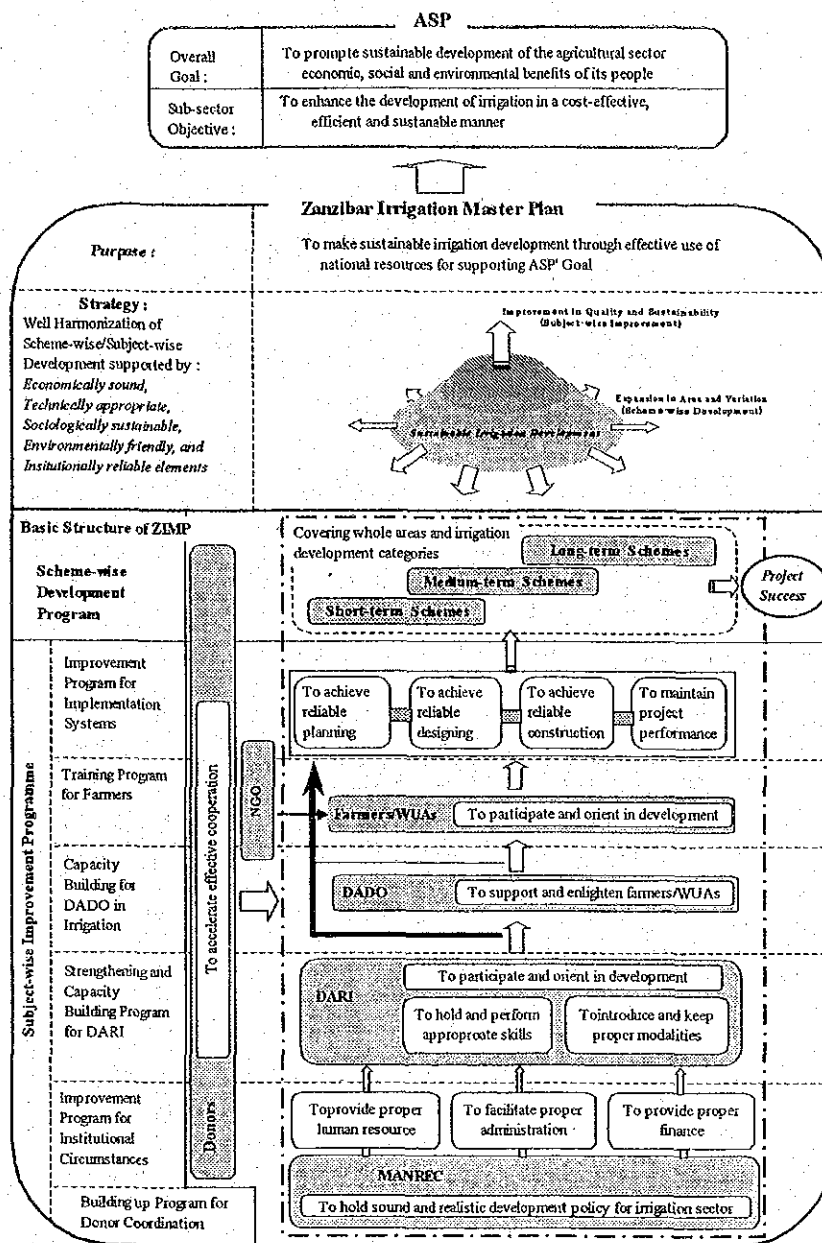
(33) Strategies of Zanzibar Irrigation Master Plan

(a) Lessons Learnt from ZIDP Implementation

The ZIDP could not have been implemented satisfactorily due to its incompleteness, lack of endorsement of financial requirement for its implementation, and weak initiatives for its promotion. The ZIMP shall be therefore prepared in view of these problems identified as lessons learnt from the *unsuccessful implementation of ZIDP*.

(b) Irrigation Development by Well Harmonization of Subject-wise Improvement and Scheme-wise Development

The ZIMP proposes the two concepts of Subject-wise Improvement and Scheme-wise Development, and the integration of them as a strategic approach to the sustainable irrigation development. The Subject-wise Improvement aims at the creation of an appropriate environment for sustainable irrigation development, mainly from a viewpoint of enhancing quality. The Scheme-wise Development aims at expansion of irrigation areas and variation using effective use of national resources. The Subject-wise Improvement and Scheme-wise Development Programmes shall be prepared considering five elements; “*Economically Sound*”, “*Technical Appropriate*”, “*Socio-logically Sustainable*”, “*Institutionally Reliable*” and “*Environmentally Friendly*”. The following figure shows the concept of the NIMP.



(34) Framework for ZAMP

(a) Policy Framework

The sustainable irrigation development in Zanzibar, namely self-reliant irrigation development could not be realized without strong support by the government. Until now, the ZOT has made some effort for reform by create the enabling environment for involvement of private sector including farmers. However, the progress has not been steady. Further efforts should be given the strengthening of the policy framework for reform focusing on the following issues:

Recommended Issues on Policy Framework

Policy Framework	Recommended Issues
- Legal Access to Land	Modification/Strengthening of Land Acts for easy access by private sector.
- Establishment of Water Right Act	Preparation of water act for prevention of any water conflict among users.
- Legal Framework for Irrigators' Groups	Establishment of optimum organizational framework for securing farmers' ownership and self-reliable irrigation development.
- Favorable Taxes and Tariff for Irrigation Development	Set of sound taxes and energy tariff for growing and profitable agriculture
- Close Communication with International Community	Strengthening of close communication with multi- and bi-donors for receiving technical and financial assistance.

(b) Macro-economic Framework

Through the analysis on actual allocated development expenditures and recurrent expenditures on irrigation development from 1992/93 to 2002/03, expected financial resource is projected for three cases: High Case, Base Case and Low Case:

Indices for Each Scenario

Variable	Base Case	High Case	Low Case
GDP Growth Rate	2003/04-2005/06: 5.0%; 2006/07-2010/11: 7.0%; 2011/12-2020/21: 9.0%	1.0% p.a. above Base Case	4.5% p.a. for the entire ZIMP period
Irrigation Development Budget (Local Fund portion)	2.0% (of GOZ Development Budget)	3.0%	2.0% (No increase)
Foreign Donors Contribution to Irrigation Projects (Fund portion)	6 times (of Local Funds)	9 times	3 times (Current situation)

The results of the sensitivity analysis are summarized in the table and figure below:

Results of Sensitive Analysis

Scenario	Financial Resources Envelope (million Tsh.)	Equivalent USS (million USS)
Base Case	4,164	4.4
High Case	6,203	6.5
Low Case	2,746	2.9

(c) Demand Projection in Crops

A demand estimate for staple food products was made using the current pattern of food intake of 2,160 kcal, to clarify the positioning of the irrigation sector in the overall agricultural development, and to examine the relevance of the reinforcement and promotion of irrigation sector from the point of view of food supply.

Staple Foods Demand Forecast

(Unit: ton)

Crops	Year			
	2005	2010	2015	2020
Maize	25,927	30,371	35,652	41,939
Rice	97,226	113,695	133,695	157,270
Wheat	39,971	46,822	54,964	64,656
Pulses	28,088	32,902	38,623	45,434
Cassava	96,146	112,626	132,210	155,523
Bananas	117,752	137,935	161,920	190,472
Potatoes	60,496	70,866	83,188	97,857

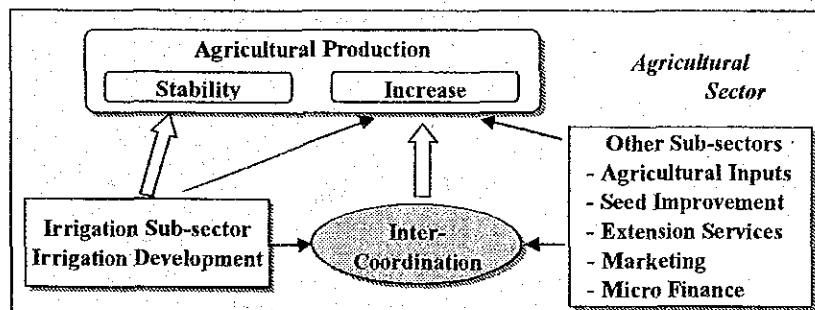
Source: JICA Study Team estimated based on the population forecast and per Consumption in Zanzibar.

Demand of rice which is a target crop for irrigation development, is projected at 157,270 ton in 2020, which become 8.5 times the production of 18,500 ton in 2000/01.

(35) Need of Inter-sectoral Coordination in Agricultural Sector

Irrigation is an essential tool for improving the stability of agricultural production and becomes a major factor for creating the physiological suitable environment for enhancing and increasing agricultural production. However, irrigation by itself could not realize the remarkable increase of agricultural production without interventions from other sub-sectors such as agricultural inputs and extension services. These other sub-sectors therefore require to be developed under close inter-coordination with the irrigation sub-sector, to make the most effective contribution toward an increase of agricultural production.

Need of Inter-coordination in Agricultural Sector



(36) Irrigation Development Level

(a) Concept of Guideline

The function of the guideline for irrigation development level is to provide an outline of technical principles and assist with decision making for irrigation scheme implementation. It is not a procedural manual to be obeyed formally. Sometimes, it may provide a broad interpretation with flexibility depending upon

the peculiarity of the scheme.

(b) Guideline

Guideline of irrigation development level shall be in a form of giving information relating to selected indicators by irrigation development type: (i) Project scale, (ii) Water resources availability, (iii) Satisfying site condition, (iv) Type of irrigation facilities, (v) Requirement for land development works, (vi) Allowable costs, and (vii) Project life. Applicable indications in these indicators are outlined as follows:

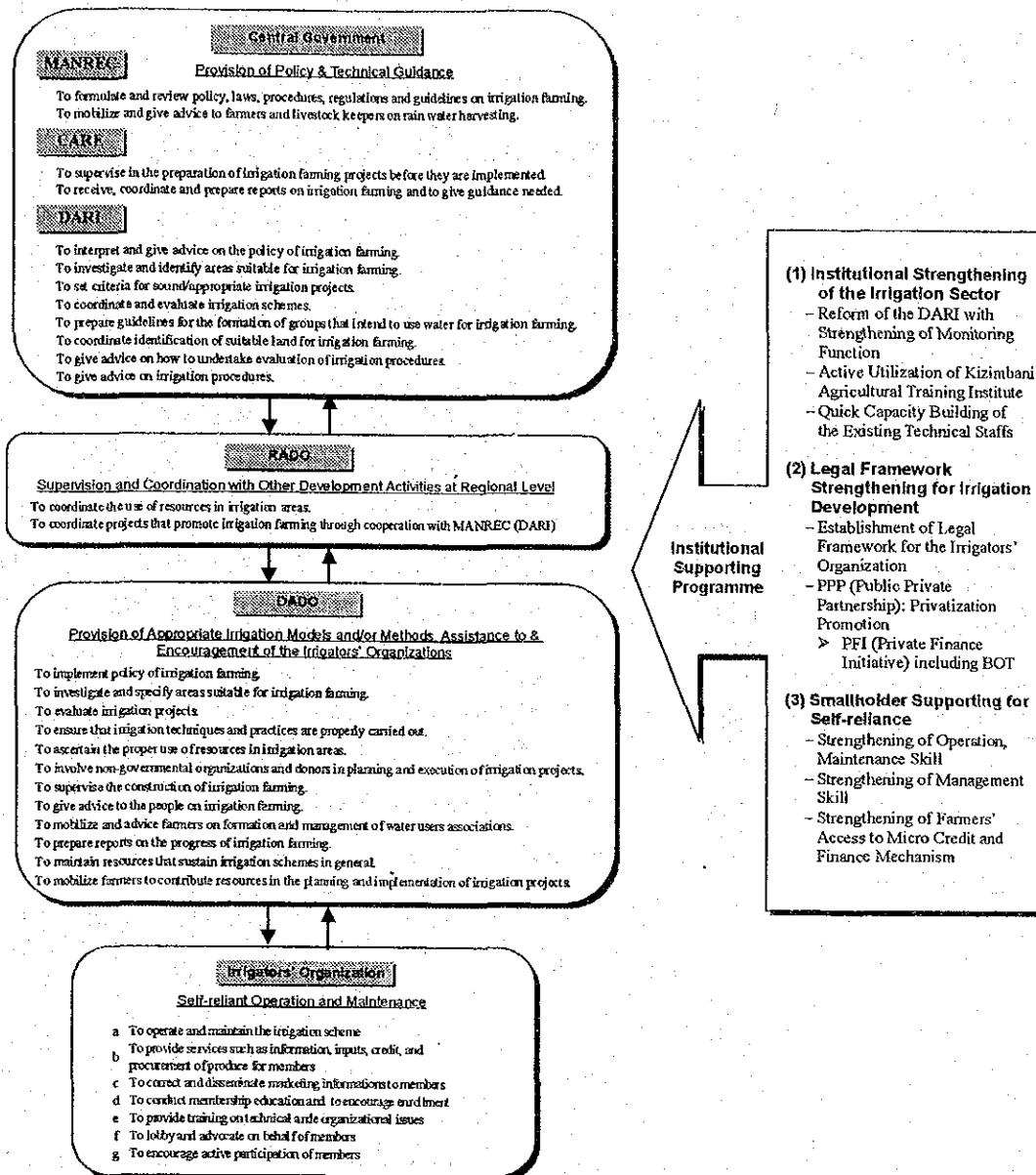
Guidelines of Irrigation Schemes Implementation by Irrigation Type

Items	Irrigation Type			
	Pump Irrigation	Canal Irrigation with Dam Reservoir	Canal Irrigation with Diversion Weir	Watering
Irrigated area (Dry season)	X ₁	X ₁	X ₁	X
Irrigated area (Rainy season)	X ₂	X ₂	X ₂	-
Water Resources	Groundwater: discharge > 2.0xX ₂ /sec Lifting head < 30 m.	Stream flow:	Stream flow: low flow discharge or spring yield > 3.0xX ₂ /sec	Individual impounding, spring or well
Site conditions	Site having exploitable groundwater yield more than the above	Proper dam site having storage capacity of more than 11,000x X ₂ m ³	Proper weir site for construction	-
Proposed modality of water resources development facilities	Appropriate and manageable pumping set with high efficiency	Concrete (or fill) dam with proper spillway (silt excluder if necessary)	Concrete (or gabion) weir	-
Type of canal	Conduit or lined canal	Lined canal	Earth or partly lined canal	-
Land Development	As required	As required	Not required in general	-
Allowable costs	~US\$8,000xX ₂	~US\$8,500xX ₂	~(US\$3,000xX ₁ + US\$5,000xX ₂)	~US\$2,000xX
Project life	~25 years	30~50 years	~30 years	-
Remarks	Proper subsidizing for operation costs is required for sound farm financial viability	Perimeter drainage and side slope protection is required	Perimeter drainage and side slope protection is required	Farmers can do individually depending on its possibility

(37) Basic Plan for Institutional Development

The basic concept of the institutional development for the ZIMP is to realize a practical and reliable institutional setting for the sustainable and self-reliant irrigation development. The following three groups of the institutional development components are identified: (i) Institutional Strengthening of the Irrigation Sector including the DARI, the RADOs and the DADOs, (ii) Legal Framework Strengthening for Irrigation Development, and (iii) Smallholder Support for Self-reliance

Institutional Development Components and Demarcated Roles of the Central Government, the RADOs, the DADOs, and Irrigators' Groups



(38) Basic Plan for Agricultural Development

(a) Target Crops for Irrigation Development

In order to increase the export earnings through the development of alternative export crops to the clove mono-crop economy, the GOZ launched "Zanzibar Cash Crops Farming Systems Project (ZCCFSP)" in 1991. No single export crop was, however, found capable of replacing clove as the main cash crop. The ZIDP concluded that the food security crops to be included for planning purposes should

be rice, banana and sweet potato and the additional options for a second crop should be pulses and vegetables. Among those candidate crops, emphasis should be given to rice because most of the past irrigation development study was focusing on rice cultivation. Since water resources are mainly surface flow in Pemba, rice cultivation under gravity condition seems most appropriate with financial and economical viability. In Unguja, on the other hand, water resources are mainly groundwater and irrigated rice is rarely financially viable due to high pumping and equipment cost. Pulses and vegetables are therefore recommended as target crop options for the local market. Various high value crops should also be introduced in a small proportion responding to the local food requirement for tourist hotels and restaurants.

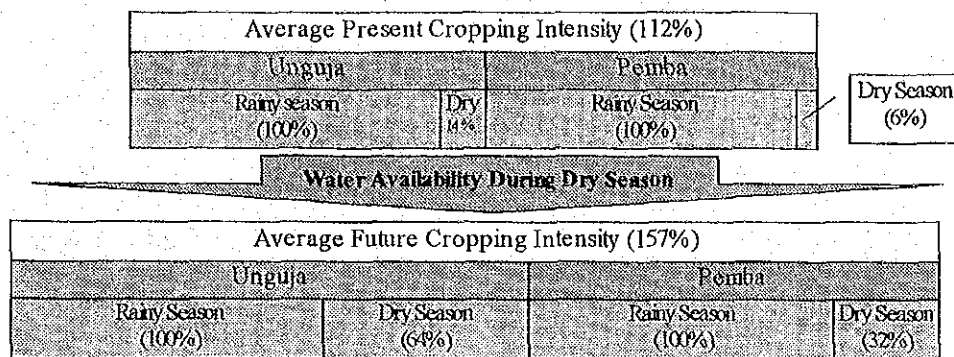
(b) Land Use Plan

Thorough study based on the agro-ecological zoning for the irrigation development had already been already carried out and most of the suitable areas for the irrigation development were selected and inventoried as candidate schemes. It was therefore considered that the land use plan for irrigated agriculture was almost covered under the proposed schemes.

(c) Cropping Pattern

The present and future cropping pattern for each candidate scheme was presented as a result obtained through inventory survey under the current master plan study. Out of 57 candidate schemes, 11 schemes are already irrigated and the present cropping intensity ranged from 107% to 200% with the average of 118%. The present cropping intensity in the non-irrigated schemes, ranged from 100% to 148% with the average of 110%. Although double cropping can be introduced with an irrigation system, the future cropping intensity is largely affected by the water availability during dry season. The cropping intensity for each scheme was therefore assessed through the water availability mainly from reservoir capacity. The results showed that more than 150% of average cropping intensity can be anticipated in general. The overall alteration of cropping intensity for both islands is shown in the next page. In this cropping intensity, paddy is mostly cultivated for all seasons in both present and future cases, and beans are planted for small areas in dry season in the present case at Unguja.

Present and Future Cropping Intensities under Irrigation



Source: JICA Study Team

(39) Priority Grouping of Inventorized Irrigation Schemes

(a) Prioritization Criteria of Inventorized Schemes

Fifty seven Inventorized schemes were prioritized based on criteria prepared in consideration of technical, economical, social, environmental and institutional aspects as follows:

- Technical factors (20 points)
- Economic factors (40 points)
- Environmental factors (10 points)
- Ease of implementation (5 points)
- Social factors (25 points)

(b) Results of Priority Grouping

The results of priority grouping are tabulated below:

Summary of Priority Grouping

Group	Nos.	Potential Area (ha)
(1) "A" Group (Points: over 70)	4	810
(2) "B" Group (Points: 61 - 70)	11	1,237
(3) "C" Group (Points: 51 - 60)	29	3,320
(4) "D" Group (Points: below 50)	6	3,154
Total	57	8,521

(40) Alternative Study for Development Target

The maximum farming area for paddy cultivation in Zanzibar is estimated at 17,000 ha. Of this, the irrigation development potential area is estimated at 8,521 ha, with the balance (8,479 ha) used for rainfed paddy cultivation. Financial resources for implementation of the ZIMP are examined for the three different cases by referring to the past expenditures, namely the High Case, Base Case and

Low Case. Based on these data, possible paddy production is calculated for comparison with projected demand of 157,270 tons (paddy base) as follows:

Comparison of Projected Demand of Paddy with Each Case

Case	Cost *	Irrigated Area	Rainfed Area	Total Production (ton)	Balance with Demand
Full Development	20.3	8,521 ha	8,479 ha	40,854	- 116,416
High Case	4.8	2,383 ha	14,617 ha	23,118	- 134,152
Base Case	3.2	1,953 ha	15,047 ha	22,186	- 135,084
Low Case	1.5	1,066 ha	15,934 ha	21,248	- 136,022

* : required development cost of schemes in Million US\$

As can be seen in the above table, even the case of "full development" could not achieve the projected demand of paddy in 2020. In addition, this case would require the extremely high budget of US\$ 20.3 million by 2020 as compared with the required development cost of irrigation schemes for the High Case of US\$ 4.8 million. From this analysis, and also in consideration of the available budget and with an aim to decrease the quantity of imported rice as much as possible, the High Case which would bring about the irrigation development area of 2,383 ha, has been selected for preparation of development programme for the year 2020. If current budget to irrigation development continues in the future, namely the Low Case, the country will face the so severe deficit of paddy. It is therefore expected that the GOZ will allocate the sufficient budget to irrigation development, at least that for the High Case.

7. IRRIGATION DEVELOPMENT PROGRAMME

(41) Development Scenario for the Year 2020

The ZIMP aims to achieve sustainable irrigation development through the effective use of national resources for contributing to an increase of agricultural productivity. The development programme which implement the ZIMP, targets the establishment of sustainable irrigation development system by 2020 in a stage-wise development: Short Term (2003 – 2007), Medium Term (2003 – 2012) and Long Term (2003 – 2020).

In considering of needs of structural reform of the agricultural sector, further strengthening of government's and farmers' ownership, and self-reliant irrigation development, the JICA Study Team elaborates the stage-wise development scenario for Subject-wise Improvement and Scheme-wise Development focusing on improvement in quality and expansion in area respectively.

Stage-wise Irrigation Development Scenario			
	Short Term (2003-2007)	Medium Term (by 2012)	Long Term (by 2020)
Development Target	To Establish Sustainable Irrigation Development System by 2020		
Key Issue for each Term	Reform	Ownership	Self-reliance
Subject-wise Improvement			
Strategic Approach	<ul style="list-style-type: none"> - Reform of environment for creation of government's ownership and involvement of private sector - Establishment of appropriate technologies on irrigation development in cost-effective concept - Arrangement of environmental issues on irrigation development 	<ul style="list-style-type: none"> - Establishment of irrigation development system under government's ownership - Application of appropriate technologies on irrigation development in cost-effective concept - Establishment of environmental protection method on irrigation 	<ul style="list-style-type: none"> - Establishment of self-reliant irrigation development by private sector and public sector partnership - Establishment of easy access system from farmers on technical support - Spread of environmental protection method established
Activities	Prepare and apply tailor-made improvement programme for project sustainability		
Scheme-wise Development			
Strategic Approach	Expand the irrigated area through development of irrigation schemes in effective use of national resources		
Activities	Give priority to construction of small-scale irrigation and water harvesting schemes		
Expected Annual Growth Rate of GDP	5.0 %	7.0 %	9.0 %

(42) Institutional Supporting Programme

(a) Stage-wise Development

The institutional development will be executed in the following stage-wise programme:

- Short term (2003-2007) : To reform the existing institutional setting for better performance of participatory irrigation.
- Medium Term (by 2012): To undertake farmer-oriented irrigation development under the government ownership.
- Long Term (by 2020) : To support realizing self-reliant irrigation development through the PPP (Public Private Partnership).

(b) Strengthening of Irrigation Sector

The Institutional Strengthening of the DARI has the following three sub-components:

- Reform of the DARI with Strengthening of Monitoring Function
- Active Utilization of Kizimbani Agricultural Training Institute (KATI)
- Quick Capacity Building of the Existing Technical Staffs

A task force of the experts should be organized to prepare a strengthening plan of the Irrigation Sector (DARI and DADO) focusing on the three sub-components. The plan for the first and second sub-components should be a stage-wise program responding to the Short Term (2003-2007), the Medium Term (by 2012) and the Long Term (by 2020). The promotion of the DARI to Department status should be undertaken in the short term, because it is an important first step toward sustainable and self-reliant irrigation development and a trigger of other institutional developments.

(b) Strengthening of Legal Framework for Irrigation Development

A reliable legal framework is a prerequisite for successful farmers-oriented irrigation development. It should provide a secure legal environment for farmers and other private stakeholders to participate and invest in irrigation development. Legal status of irrigators' group, land tenure and water right, as well as ownership of and responsibility for irrigation infrastructure should be clearly defined for irrigation development. A consultancy work for establishment of the legal framework, possibly a new Act, Ordinance or Regulations, should be undertaken through the initiative of the DARI in cooperation with the relevant governmental agencies, lawyers and technical specialists.

(c) Smallholder Supporting for Self-reliance

Extension services for the irrigators' groups through the DADO should be given a high priority, with emphasis put on in the training programs for the following sub-components.

- Strengthening of Operation and Maintenance Skills
- Strengthening of Administrative, Financial and Technical Management Skills

(d) Monitoring and Evaluation of ZIMP

The performance of the ZIMP itself should be carefully monitored and evaluated at each development stage, in the same way as an irrigation development scheme, needs good operation and maintenance for satisfactory performance. Necessary feedback through a reliable monitoring and evaluation mechanism should be provided so that the ZIMP can be revised for the future. The role of monitoring and evaluation of the ZIMP should be assigned to the DARI.

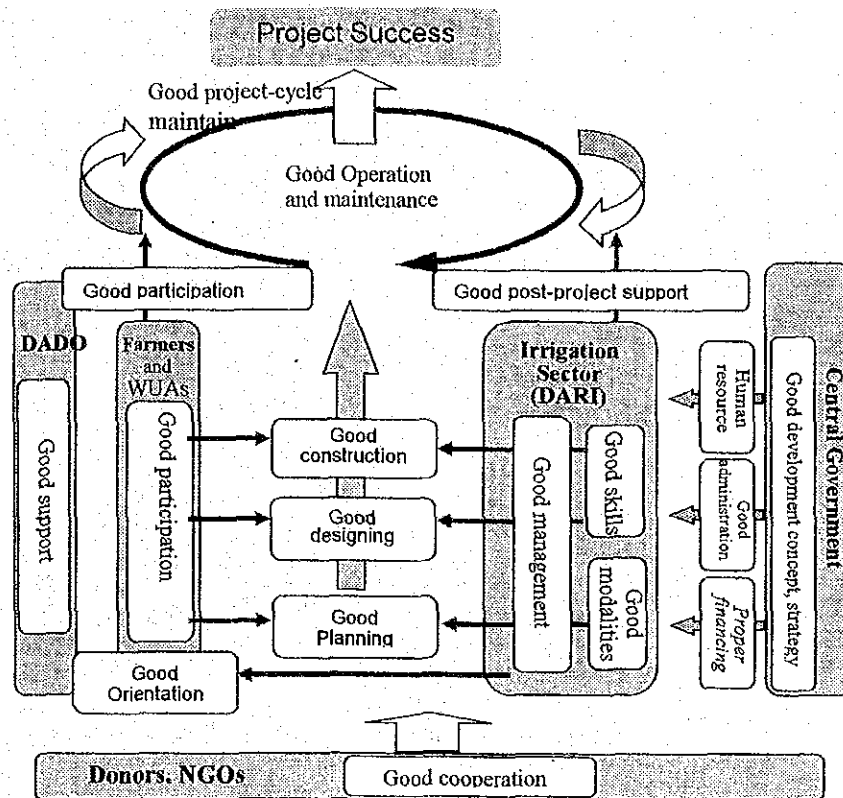
(43) Subject-wise Improvement Programme

(a) Outline of Subject-wise Improvement Programme

The Subject-wise Improvement Programme is a series of arrangements to improve the management system, necessary for successful scheme implementation and

operation. The Subject-wise Improvement Programme will be formulated at a conservative level to meet most insistent requirements taking the development scope into consideration.

**Required Good performances
in Whole Circumstances Surrounding Irrigation Project Success**



(b) Stage-wise Development

Thirty one components are proposed for the Subject-wise Improvement Programme. These components will be stage-wise implemented by dividing them into the Short Term group and Medium Term group in view of the following aspects:

- Common components for all irrigation schemes,
- Fundamental issues for irrigation schemes,
- Integration with the Stage-wise Development Scenario,
- Sound linkage with future transition of the scheme implementation types, and
- Orderly relationship of each component in consideration of the whole context of the Subject-wise Improvement Programme

As a result, 27 components will be executed or started in the Short Term, and the remaining 4 components in the Medium Term. Of these, eight components (shown

in bold in the below table), will be independently conducted in Zanzibar and the remaining 23 components will be carried out together with Mainland.

List of Subject-wise Improvement Programme in Short Term

No.	Ref.	Components
1	I-1	DARLRADO and DADO Institutional Improvement Programme
2	II-1	DARI Working Mandate Formulation Programme
3	II-2	Regulatory Networking System Establishment between RADO/DAD and DARI
4	II-3	NGO's Intervention in Irrigation Development Encourage Programme
5	II-4	Cooperation Channeling within Irrigation-Sector Establishment Programme
6	II-5	Sub-sectors Coordination System Establishment
7	III-1	Survey and Investigation Guideline Establishment Programme
8	III-2(1)	Planning Guideline Establishment Programme
9	III-2(2)	Designing Guideline Establishment Programme
10	III-3(1)	O&M Guideline Establishment Programme
11	III-3(2)	Monitoring & Evaluation Guideline Establishment Programme
12	III-4	Farmers' Participation in Irrigation Development Programme
13	III-5	Village Irrigation Development Guideline Establishment Programme
14	III-6	Farmers' O&M Manual Establishment Programme
15	III-7	Establishment of DADP Formulation Guideline for Irrigated Agriculture Development
16	IV-1	Technical Manuals Handling Guideline Establishment Programme
17	IV-2	Information and Database Improvement Programme
18	IV-3	Irrigation Development Contractors and Consultants' Listing Programme
19	IV-5	Existing-scheme Monitoring System Establishment Programme
20	V-1(1)	Irrigation Technology Research Center Establishment Programme
21	V-1(2)	Perennial Irrigation Method Improvement Programme
22	V-1(4)	Small Dam Technology for Irrigation Development Establishment Programme
23	V-1(5)	Environmental Assessment Study for Irrigation Practice in Tanzania
24	V-1(6)	Study of River-Basin Approach in Irrigation Development
25	V-3	Farmers' Participation Training Programme
26	V-4(1)	Irrigated Agriculture Training Programme for Rice Production Increase
27	V-4(2)	Irrigated Agriculture Training Programme for Cash Crops Production Increase

List of Subject-wise Improvement Programme in Medium Term

No.	Ref.	Components
1	IV-4	LGA Networking System Establishment Programme
2	V-1(3)	Flood Irrigation Development Programme
3	V-2	Hydraulic Experimental Center Establishment Programme
4	V-5	Integrated Irrigation Development Model establishment Programme

(44) Scheme-wise Improvement Programme

(a) Selection of Schemes to be Developed

The possible irrigation development areas by 2020 are estimated at 2,383 ha under the "High Case" of financial resource. These areas are included in the 16 irrigation schemes which are selected from the "A", "B" Groups and parts of "C" group. The breakdown of 16 irrigation schemes is as follows:

Irrigation Development Areas by 2020

Type of Development	No(s)	Total Potential Area
Surface by dam reservoir	12	1,349 ha
Surface by diversion weir	3	432 ha
Groundwater by pump	1	602 ha
Total	16	2,383 ha

Source: JICA Study Team

(b) Development Programme for the Year 2020

The development programme for the year 2020, which is prepared based on the financial resource allocated annually under the "High Case", is shown below.

Accumulated Irrigation Development Area in the Unguja Island

Development Target at each Term	Short Term	Medium Term	Long Term
	2003 - 2007	by 2012	by 2020
(a) Surface by dam reservoir	250 ha	650 ha	900 ha
(b) Surface by diversion weir	90 ha	132 ha	432 ha
(c) Groundwater by pump	178 ha	178 ha	602 ha
Total	518 ha	960 ha	1,934 ha

Source: JICA Study Team

Accumulated Irrigation Development Area in the Pemba Island

Development Target at each Term	Short Term	Medium Term	Long Term
	2003 - 2007	by 2012	by 2020
(a) Surface by dam reservoir	106 ha	106 ha	449 ha
(b) Surface by diversion weir	-	-	-
(c) Groundwater by pump	-	-	-
Total	106 ha	106 ha	449 ha

Source: JICA Study Team

By the year 2020, seven schemes will be developed in the Unguja Island and nine schemes in the Pemba.

(45) Cost Estimate for ZIMP Implementation

Based on the possibly available budget for the ZIMP implementation (High Case), the cost estimate was made for the Subject-wise Improvement Programme and Scheme-wise Development Programme.

The total cost for implementation of the ZIMP including operation and maintenance amounts to US\$ 7.59 million (including farmers' contribution of US\$ 1.29 million), and consisting of US\$ 0.46 million for Subject-wise Improvement, US\$ 4.77 million for Scheme-wise Improvement, and US\$ 1.07 million for operation and maintenance cost. The breakdown is tabulated below:

Breakdown of Project Cost

Year	Government				Total	Balance	Farmers' Contribution
	Budget	Subject	Scheme	O & M			
'03	166	48	10	57	115	51	6
'04	176	63	19	57	139	37	9
'05	187	63	69	57	189	-2	21
'06	202	66	119	57	242	-40	34
'07	218	74	119	57	250	-32	34
'08	235	74	110	57	241	-6	32
'09	254	49	110	57	216	38	32
'10	275	23	129	57	209	66	37
'11	302		209	57	266	36	57
'12	332		289	57	346	-14	77
'13	366		297	57	354	12	79
'14	402		350	57	407	-5	92
'15	442		401	58	459	-17	107
'16	487		401	58	459	28	108
'17	535		451	58	509	26	121
'18	589		492	67	559	30	131
'19	648		557	74	631	17	148
'20	712		642	74	716	-4	169
Total	6,529	460	4,774	1,073	6,307	222	1,294

Unit : Thousand US\$

(46) Appropriateness of Investment to Irrigation Development

The implementation of the ZIMP consisting of 31 components of Subject-wise Improvement Programme and 16 irrigation schemes of Scheme-wise Development Programme, will require about US\$ 6.3 million for 18 years (government portion only). The ZIMP implementation would produce at full development of 2020, (i) creation of job opportunity (222,000 man-day), (ii) poverty reduction of smallholder by increase of farm income (US\$ 143/ha to US\$ 450 per one crop season), and (iii) saving of foreign currency necessary for rice import (US\$ 2 million for importation of rice at 2002 current price). On this basis, it is judged that investment of US\$ 6.3 million to the ZIMP implementation would be appropriate from a national viewpoint.

8 CONCLUSIONS AND RECOMMENDATIONS

(47) Conclusions

The Study presents the framework and strategies for sustainable irrigation development for Zanzibar with the target year of 2020, aiming to contribute to creation of an enabling and conducive environment for improving productivity and profitability of agricultural sector.

In order to achieve this target, the Study prepared a development programme

toward the year 2020 considering five elements: Economically Sound, Technically Appropriate, Sociologically Sustainable, Environmentally Friendly and Institutionally Reliable. The Study selected 31 components of Subject-wise Improvement Programme and 16 irrigation schemes of Scheme-wise Development Programme as follows:

Components and Schemes to be Developed by 2020

Components and Schemes Developed	Short Term	Medium Term	Long Term
	2003 - 2007	by 2012	by 2020
(a) Subject-wise Improvement Programme			
- Components	27 nos.	4 nos.	-
(b) Scheme-wise Development Programme			
- Surface by dam reservoir	356 ha	756 ha	1,349 ha
- Surface by diversion weir	90 ha	132 ha	432 ha
- Groundwater by pump	178 ha	178 ha	602 ha
Total of (b)	624 ha	1,066 ha	2,383ha

In preparation of the development programme, the Study established a prioritization system for the implementation of many irrigation schemes, and then priority ranked them for implementation using the data and information obtained through the inventory survey. The availability of data and information on the schemes largely affected the priority ranking and therefore, it is essential to check the availability of data at any time, and if necessary review and modify the selected schemes for early implementation using this updated data and information.

(48) Recommendations

(a) Urgent Commencement of ZIMP Implementation

The food shortage poses a serious problem in Zanzibar. The increasing population pressure will further aggravate the situation if appropriate countermeasure are not taken in time. Irrigation Development is a key factor to improve the agricultural productivity, and therefore it is recommended that the ZIMP be implemented as early as possible.

(b) Urgent Need of Strengthening the DARI

The DARI of MANREC as a coordination agency with the different organizations involved, shall be responsible for the smooth implementation of the 31 components as the Subject-wise Improvement Programme and 16 irrigation schemes as the Scheme-wise Development Programme. It consequently requires a stronger institutional and organizational position of the DARI in MANREC. The Institutional Strengthening of the DARI has the following three sub-components:

- Reform of DARI with strengthening of monitoring section
- Active utilization of Kizimbani Agricultural Training Institute(KATI)

- Quick capacity building of existing technical staff

The plan should be a stage-wise program responding to the Short Term (2003-2007), the Medium Term (by 2012) and the Long Term (by 2020). In order to smoothly implement this stage-wise program on a reform plan of the DARI, it is essential to organize a task force of experts.

(c) Legal Framework Strengthening for Irrigation Development

A sound legal framework is a prerequisite for successful farmers-oriented irrigation development, empowering farmers and the other private sectors to enable them to secure their ownership, i.e. to take full responsibility for all decisions and matters involved in development, operation and management of the irrigation schemes. Legal status of irrigators' group, land tenure and water right, as well as ownership of and responsibility for irrigation infrastructure should be clearly defined for irrigation development. Presently these items are defined disconnectedly by a number of separate laws.

A consultancy work for establishment of the legal framework, possibly a new Act, Ordinance or Regulations, should be undertaken through the initiative of the DARI in cooperation with the relevant governmental agencies, lawyers and technical specialists.

(d) Arrangement of Development and Recurrent Expenditures for Irrigation Development

The inadequate financial resource is one of major constraints to irrigation development. The required cost for implementation of 31 components of Subject-wise Improvement Programme and 16 Scheme-wise Development Programme, is estimated at US\$ 6.3 million. It is deemed that this required cost would be still a procurable amount. It is thus expected that the government will arrange at least this amount.

(e) Urgent Need of Preparation of Water Right Act

At present, Zanzibar has no act stipulating water right. It is indispensable for ensuring irrigation development and also for avoiding any water conflict among related stakeholders. Zanzibar has significant water resource as a whole, however topographic conditions restrict usable water amount for irrigation. In addition, the increasing population pressure would create the competitive situation between irrigation water and domestic water. In order to avoid any water conflict, and from viewpoint of social environment, a Water Right Act should be prepared urgently.

(f) Need of Inter-sectoral coordination

Irrigation provides an effective environment for stabilization and increase of agricultural production. There is no doubt that irrigation itself directly links with the stabilization of agricultural production, but in improvement of agricultural production, irrigation becomes only one of the factors for creating the physiologically suitable environment for enhancing the agricultural production. Irrigation by itself could not realize the remarkable increase of agricultural production without interventions from other sub-sectors such as agricultural inputs and extension services. It is therefore recommended that other sub-sectors such as agricultural inputs and agricultural extension services should be developed with close coordination with the irrigation sub-sector, to enhance respective effects toward increase of agricultural production. In order to create sound watershed condition required for stable water resource, which is required for irrigation, it is important to keep close communication with other sectors such as the forestry sector.

(g) Updating of ZIMP

The ZIMP provides the overall framework and strategies for irrigation development toward the year 2020, and is generally consistent with the ASP. The ZIMP was formulated using the currently available data and information obtained through the inventory survey. Therefore, when additional and/or updated data become available, the ZIMP, should be reviewed and modified, especially the priority ranking of schemes using the established prioritization system stipulated in the ZIMP.

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