JESS PRELIMINARY REPORT ON

AERIAL SURVEY OF THE JUBBA RIVER

JESS Report No. 14

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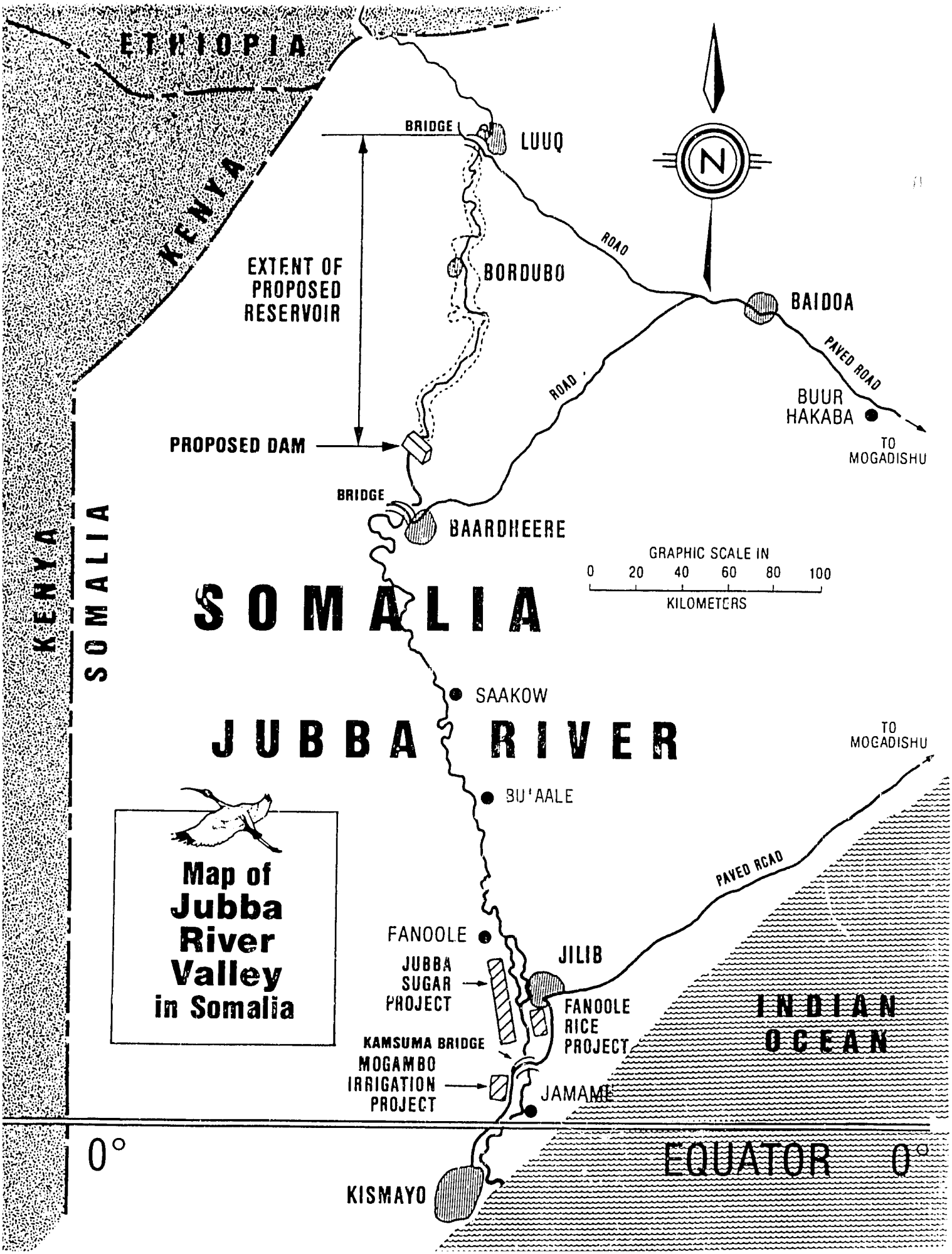
Under AID contract number AFR-0134-C-00-5047-00.

Date: 30 June 1987



Map of Jubba River Valley in Somalia

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ACRONYMS AND ABBREVIATIONS

AHT	Agrar und Hydrotechnik
AID	U.S. Agency for International Development
ARD	Associates in Rural Development, Inc.
BuRec	U.S. Bureau of Reclamation
GSDR	Government of the Somali Democratic Republic
JESS	Jubba Environmental and Socioeconomic Studies
JuDAS	Jubba Development Analytical Studies
kph	kilometers per hour
MJVD	Ministry of Jubba Valley Development
mph	miles per hour
NRA	National Range Agency
NRC	National Refugee Commission
NTTCP	National Tsetse and Trypanasomiasis Control Program
RMR	Resource Management and Research
USAID	U.S. Agency for International Development
UNHCR	United Nations High Commission for Refugees

PREFACE

The Jubba Environmental and Socioeconomic Studies (JESS) are jointly funded by the government of the Somali Democratic Republic (GSDR) and U.S. Agency for International Development (AID), and are part of a larger project, the Jubba Development Analytical Studies (JuDAS) project. Technical assistance and management for JESS are being provided to the Ministry of Jubba Valley Development (MJVD) by Associates in Rural Development, Inc. (ARD), of Burlington, Vermont, under AID contract number AFR-0134-C-00-5047-00.

This report describes the methods, results and issues arising from an aerial survey of the Jubba River carried out from 28 to 30 September 1986. This aerial survey was undertaken by Resource Management and Research (RMR) under the terms of a subcontract with ARD, titled "Subcontract RMR-A." The scope of work for this subcontract is presented in Appendix A.

This report was formatted by ARD home-office staff--no changes in its technical substance were made. Thus, principal responsibility for the technical content lies with RMR, ARD's subcontractor.

I. EXECUTIVE SUMMARY

As part of environmental and socioeconomic studies related to resource uses and the proposed Baardheere Dam, RMR conducted an aerial census of riverine features from 28 to 30 September 1986. This work was part of JESS Phase II activities, which focus on collecting environmental and socioeconomic data in the Jubba Valley prior to construction of a proposed dam near Baardheere. This riverine aerial census is the first of four seasonal aerial surveys to be conducted for JESS.

This report describes the methods used and results of a low-level aerial survey of the Jubba River, its banks and coastal waters affected by the river. The most important findings are that:

- crocodiles are very numerous, estimated between 6,000 and 20,000 individuals;
- hippopotamus are declining, and the population may possibly have been reduced to 400 to 800 specimens;
- general levels of economic activity in the valley are increasing rapidly with over 600 small, privately owned irrigation pumps in use, of which one-third are north of the proposed dam site;
- use of the river valley is dynamic with farms being abandoned and new ones created;
- interpretations based on 1:30,000-scale photography from 1983/1984 can be improved and brought up to date using new 1:10,000-scale photography of the riverbanks;
- a large unidentified species of turtle occurs in the river; and
- the gallery forest is rapidly being cleared, and the number of potential forest reserves has been reduced to a very few areas.

Important recommendations made by RMR include:

- a new round of photography at 1:10,000 scale of the riverine strip should be done;
- this 1:10,000 photography should be the basis for an amended stratification of the floodplain for the aerial census to be performed during Jilaal;

- JESS should put more emphasis on the riverine area in its work program;

- a sampling of the entire length of the river should be carried out using boats to examine a wide range of river-related phenomena;

- JESS should combine with all other agencies to ensure that a representative picture of the soils potential in the valley is developed;

- JESS should keep in touch with the United Nations High Commission for Refugees (UNHCR) and National Refugee Commission (NRC) to assure that the proposed socio-demographic surveys meet some of their more crucial needs;

- the National Range Agency (NRA) and other related agencies will have to act quickly if any Jubba Valley gallery forest relicts are to be saved;

- NRA should start a crocodile control and culling program;

- MJVD should start work on water-use analysis aimed at creating a water-use model and master plan for the valley; and

- MJVD should consider conducting feasibility studies to improve the physical infrastructure in the valley, particularly for the construction of two bridges at Jilib and Saakow.

II. INTRODUCTION

This report is based on a consultancy from 28 to 30 September 1986 concerning an aerial census of features on the Jubba River, along its banks and the coastal shoreline affected by riverine flows in southern Somalia. It summarizes the study methods, data collected and conclusions reached from the aerial census. Recommendations are made based on these results.

It was originally intended that three distinct aerial surveys would be carried out under this subcontract--a survey of the inshore marine zone off the mouth of the Jubba River, a survey of Jubba River waters and immediate riverbanks, and a census of the floodplain and "river-dependent zone." However, several events caused postponement of a number of portions in this subcontract, and the postponed work will have to be performed at a later date. The most important events that created delays in subcontract implementation were that:

- delivery of a signed contract was delayed;
- the land-use classification units were possibly inappropriate, and the strip-sampling approach was modified;
- a radar altimeter had to be repaired, and the Deyr rains began; and
- coastal waters were turbid.

Although signed on 27 August and 1 September 1986 by RMR and ARD, respectively, the subcontract for this work did not arrive in Mogadishu at RMR's office until 25 September. RMR mobilized immediately and conducted the aerial river survey from 28 to 30 September.

During the river survey, observations were made of the floodplain. Some of the interpretations made by Agrar und Hydrotechnik (AHT) of the physiography and land use of the floodplain from aerial photography done for the National Tsetse and Trypanasomiasis Control Program (NTTCP) suggested either some errors in or important changes since the photographs were taken in 1983/1984. Moreover, the relevance of some of the aerial units determined by AHT was uncertain for an understanding of land use on the floodplain. For this reason, a decision was made to await the return of the JESS ecologist, Dr. Ian Deshmukh, from leave to discuss modifications of the strategy for efficiently stratifying the aerial census.

On 6 October, after meeting with Dr. Deshmukh, it was decided that some modifications of the AHT units in the

floodplain were necessary. Also, if the 1:10,000 aerial photography were carried out on the riverine strip (as RMR and ARD discussed on 10 September), these photographs would become the basis of an up-to-date description of physiography and land use, which would then be used to improve the AHT work. It was also decided that RMR would fly continuous strip samples from one side of the floodplain to the other and record the occurrence of livestock, land use, water sources and other characteristics along each strip. A suffix would indicate which of the land facets (uniform land-use types, such as abandoned rain-fed cultivation) best described each parcel of land at the time of the flight. This followed a modification of the aerial strip-sampling method first introduced in a National Census of Sierra Leone (Watson, 1979a).

Before the strip survey could begin, it was necessary to have the radar altimeter repaired which had become unserviceable during the river survey. Hence, the aircraft was flown to Nairobi on 9 October for repairs. Another difficulty was that the Deyr rains could very well start during the planned census, which would defeat most of its purpose. The rains were quite widespread in the valley by 19 October, with evidence of livestock moving onto wet areas before work on the aircraft could be completed. The JESS ecologist then requested that the Xagaa census be postponed until 1987 (Deshmukh, 25 October 1986). Some advantages can be gained from this delay, if the opportunity is taken to have 1:10,000 aerial photography carried out before the planned Jilaal census. This would enable an up-to-date stratification of the floodplain, which could then be used in the Jilaal census.

The floodwater discharge from the mouth of the Jubba River at the end of September extended north along the coast to Baraawe. It was impossible to see anything of the substrate in the inshore marine zone north of the Jubba's mouth, so this part of the marine survey will be carried out during the Jilaal census of 1987. A preliminary report about the inshore marine zone has been made, but most of the photography and a complete description must await better observation conditions.

III. METHODS AND SCHEDULE

A. Aircraft

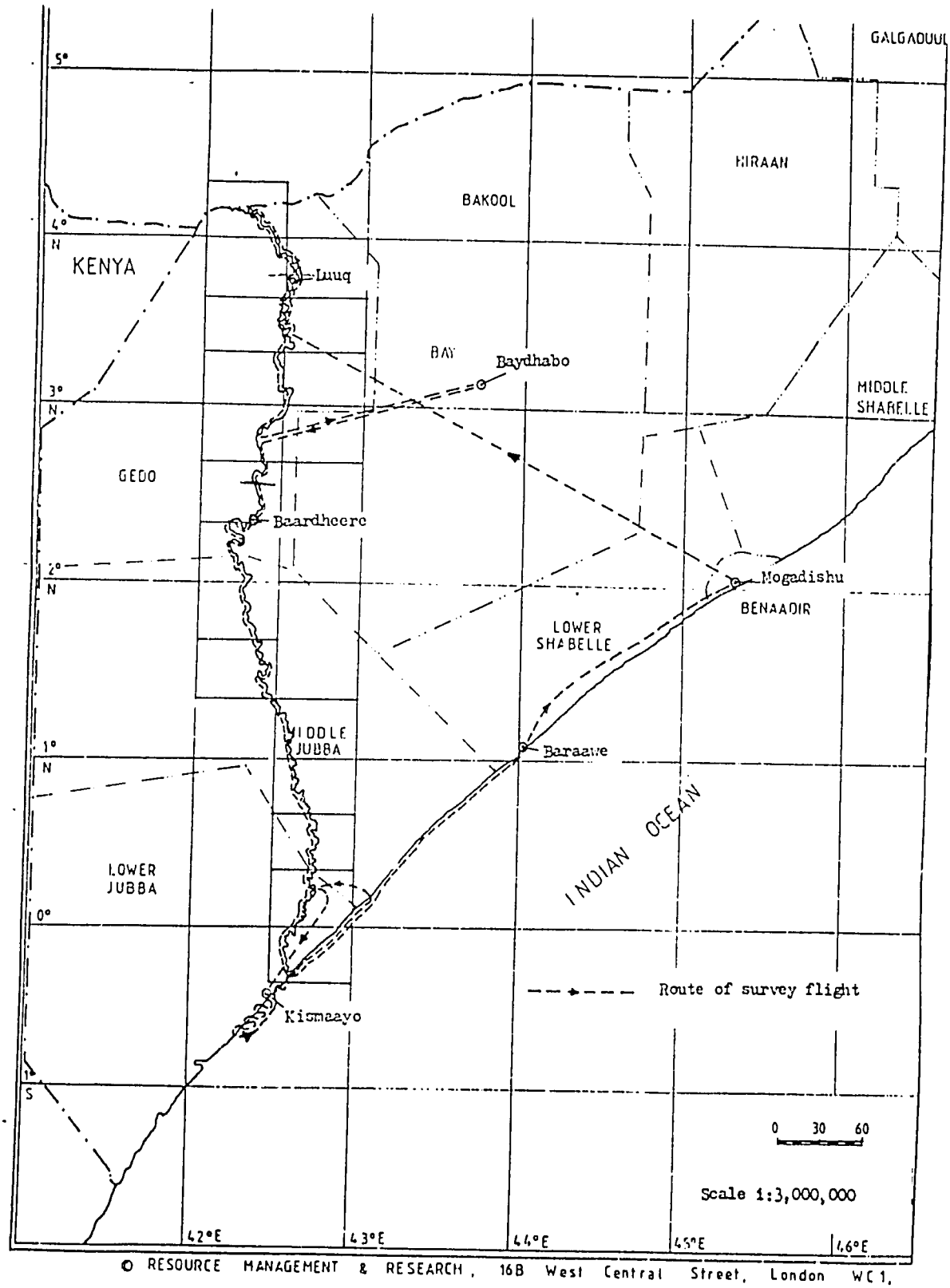
The aircraft used was a PA18 (Super Cub), modified for aerial surveillance work and equipped with long-range tanks, recorders and a radar altimeter. The aircraft panels were open, allowing the pilot/observer unobstructed views on both sides as well as below the aircraft. The open panels also permitted photography to be performed with a maximum of flexibility.

B. Route of Survey Flight

The survey flight started from Mogadishu at 0830 hours on 28 September, at which point, a direct line was flown to the river at latitude 3°29'N, the point where the river cuts through the Buuraha Waxab. At this position, the river course was followed north to an intersection with latitude 4°10'N. This is less than five kilometers from the disputed Somali-Ethiopian border. There are an estimated additional 26 kilometers of river within Somalia as the river runs parallel to the boundary) but previous experience has shown that aircraft are liable to be shot at in this area. From this point, the aircraft returned down the river as far as latitude 2°48'N, where the Togga Dhuurta joins the Jubba, and from there, the pilot flew to Baydhabo, landing at 1755 hours.

The next day, the pilot resumed flying from Baydhabo at 1005 hours and flew directly to the intersection of the Jubba River at latitude 2°48'N. The survey continued south down the river as far as latitude 0°13'N at Sabatuuni. Because of failing light, the survey was broken off and the aircraft flown to Kismaayo for the night, landing at 1800 hours. On 30 September, the flying began at 0935 hours, and the first part of the marine inshore environments were surveyed beginning at 0°27'S (Raas Ogaden) and continuing southwest down the coast to 0°40'S (the southern end of Koyaama island). From here, the aircraft was flown northeast back along the coast past Kismaayo to the intersection with latitude 0°10'N, at which point the marine offshore survey was terminated for the day. The aircraft was then flown west to Sabatuuni for resumption of the Jubba River survey. From Sabatuuni, the river survey was continued to the sea, where the aircraft was flown northeast once again, up the coast to resume the offshore survey, which was then continued as far as Baraawe at latitude 1°07'N. The track of the survey flight is shown on the following page.

Route of RMR Survey Flight



C. Sections of Jubba River in the Aerial Enumeration

1. Zone I

This zone extends from the Jubba River at the Ethiopian border to a point due north of Luuq, in the circular loop of river flowing around the town, being about 3°49'45"N. At present, this is the point to which water in the Baardheere reservoir will back up at the highest water level. This section of the river is characterized by numerous islands. The bed is slightly incised, and floodplain terraces are well developed.

2. Zone II

Zone II encompasses the Jubba from the endpoint of Zone I to the planned site of the Baardheere Dam. In this section, the river starts to cut a significant gorge through the suites of Cretaceous and Jurassic limestones and sandstones that constrict its course. In the southernmost part of this reach, the gorge is a narrow and spectacular gash, 50 meters deep and 500 meters wide. The present dam site is located where the river cuts at latitude 2°37'N.

3. Zone III

From the dam site, the gorge continues southward for about 18 kilometers, gradually widening to allow river terraces to extend several hundred meters from the Jubba, which has nevertheless incised weakly in the limestone plains for another 170 kilometers. Along this stretch, the river winds through eroding limestone plateau remnants, now reduced to low hills. At latitude 1°44'N, the river starts to meander in its own floodplain and enters Zone IV.

4. Zone IV

This zone marks the part of the river where erosion and deposition processes are approximately in balance for the long term. Dhesheegs and levees make their first appearance, and the valley lies in a shallow trough cut through the marine plain. The zone continues as far south as latitude intersect 1°10'30"N.

5. Zone V

In this zone, deposition processes predominate over erosion, and no trace of the incised trough remains. The river meanders extensively in its own floodplain, and there are well-developed

levees and numerous dhesheegs. This zone ends at the Fanoole Barrage at 0°44'45"N.

6. Zone VI

In this zone, south of the Fanoole barrage, the Jubba meanders over its own floodplain. Oxbows and ancient riverbeds are common in this reach, but levees and dhesheegs seem to be less abundant. Toward the end of this reach, the Shabeelle channels join the Jubba from the east, and a little further south, the river runs up against the coastal limestone/duneland ridge, which diverts the river in a southwesterly direction. Zone VI ends at latitude 0°03'N.

7. Zone VII

Along this final stretch, the Jubba retains little energy, and most of its silt has been deposited. It runs in a shallow incision with occasional floods, except where it crosses the limestone dune ridge to enter the sea. At its mouth, the river flows over a shallow sandbar. There is no evidence of tidal flushing at the mouth, and salinity seems not to penetrate more than about six kilometers (to Gob Weyn). There is no delta formation partly because the river has lost its energy and load of silt by the time it reaches the sea, but also due to the strength of the offshore currents sweeping alternately northeast and southwest across the river's mouth. Although no measurements exist, it appears that there may be appreciable losses of water in this final section through the riverbed, possibly along ancient former channels to the sea.

D. Census Methodology

The survey was aimed at observations and counts of items on and in the water as well as on the immediate riverbank. To accomplish a total enumeration of this rather narrow strip, the aircraft was flown at 90 kilometers per hour (kph), which is equal to 55 miles per hour (mph), into the prevailing wind of about 24 kph (15 mph), thus giving a ground speed down the river of 66 kph (40 mph). When items requiring more time for counting or scrutiny were seen, the aircraft circled in a steeply banked position, which allowed the observer to make a continuous observation of the same point, albeit from constantly changing angles of view. In most cases, the features recorded on the 1:100,000 map sheets have been completely enumerated, given limitations of the method, which are dealt with later in this report. These features are listed in Table 1 at the end of this section. The numbers of features in clusters of more than five

were so rare that no photography was necessary to aid in counting these items.

In addition to feature counts, 35-millimeter slides with oblique views of the river were taken using wide-angle and other lenses, and their locations marked on the 1:100,000 maps. These photographs are useful for general descriptions of the valley.

Bridges were emphasized on the 1:100,000 maps, while the original maps were not drawn well enough to show these features. The two bridges constructed since the maps were drawn (at Bu'aale and the Fanoole barrage) have been marked on the maps. Islands visible at the time of the survey flights were recorded--most of them are on the 1:100,000 maps. Refugee camps were also recorded and marked on the 1:100,000 maps.

One troop of baboons was seen with difficulty and marked on the map at the start of the survey, but in general, it was judged that these features would be too difficult to spot consistently while concentrating on searching for hippos and crocodiles. Hence, no further records were made of baboons. These will be covered in the strip-sampling census.

Table 1. Features Recorded During Total Enumeration

Symbol	Feature and Comment
AI	Area of Abandoned Irrigation -- These have not been comprehensively recorded. Only those bordering the river and having rather conspicuous signs have been noted. Thus, these data are an indicator, not a count.
AIW	Abandoned Irrigation Works -- These are fixed installations built in the past for irrigation water offtakes and subsequently abandoned (i.e., with no crops growing behind them). An attempt was made to record all of them.
BF	Boat Ferry -- This was the less common of the two types of ferries seen. It involved a boat crossing from the bank without the use of a cable (i.e., fitted with an engine). An attempt was made to count all of them.
BT	Boat -- Small boats made of rough planks have been totally counted. It is understood that, for the most part, boats which are not in the water will have escaped observation, and the count refers only to boats on the river at the time of the survey.

CF — Cable Ferry -- Most of the ferries consist of a low cable strung across the river which is used to pull boats along the river. The boat is attached to the cable by a pulley. The label "cable ferry" indicates that a cable and one boat was sighted. The boats used are mostly aluminum assault craft, but some wooden clinker-built boats are also used as cable ferryboats.

CL — Riverbank Clearing -- Where bush and forests at the edge of the river have recently been cleared (i.e., in the previous few weeks), a record of a riverbank clearing was made. As for abandoned irrigation areas, it is impossible to treat these as comprehensive, and they too should be regarded as indicative of the level of this type of activity, rather than an inventory of cleared patches.

CI — Riverbank Clearing for Irrigation -- Some of the riverbank clearings were obviously intended to become irrigation fields. These were recorded separately, although no attempt was made to produce a comprehensive inventory of these features.

Cn — Canoe -- Traditional dugout canoes on the river were totally counted. Several recently completed ones were seen. The rather twisted shape of several canoes suggests that suitable tree trunks are difficult to find.

Cr — Crocodiles -- All crocodiles in the water, on silty or sandy banks, in flooded areas and in haro (which are more or less permanent lakes representing tributaries of the Jubba cut off by the river's levee), except for the Waamo Haro were counted. Clearly, only a small proportion of the crocodiles in the river will be seen in an aerial survey, and this point is discussed later in the report.

CN — Crocodile Nests -- Evidence of old crocodile nest sites on islands in the Jubba River is seen in the characteristic shallow depressions left after the eggs have been excavated by the female. It is impossible to count more than a few such sites, and these data merely serve to indicate that crocodile are breeding on the river and favor the sandy islands for their nests.

DC — Dhesheeg with Cropping -- Some of the more obvious dhesheegs supporting flood-recession cropping were recorded during the survey, although they are generally not on the immediate riverbank. These records do not constitute an inventory, but simply indicate where these features are important.

DG — Water Birds -- Concentrations of water birds, mostly ducks and geese, were recorded. Obviously, these data are only indicative of the general distribution of water birds.

DK — Dhesheeg -- Some of the more conspicuous uncultivated dhesheegs lying close to the river were recorded, but the same remarks as above apply.

DP — Important Drinking Place -- Important drinking places are easily identified, whether or not livestock are using them or not, by the density of radiating tracks, appearance of the bank and, in many cases, thorn barriers constructed in the water to protect animals using such drinking locations from crocodile depradation. A complete inventory of important drinking places was made.

F — Back-Flooded Tributary Channel -- At the start of the survey, all back-flooded river channels were recorded. However, it was soon clear that all river tributaries in the incised (eroding) section of the river were back flooded, and thus, this feature was dropped, since topographic maps are an adequate source of these data. Back-flooded channels have only been marked on the maps between $3^{o}25'N$ and $3^{o}43'N$.

FI — Furrow Irrigation -- Open-channel irrigation was observed close to the river's mouth. These channels carry water to irrigate coconut groves and may be taking advantage of tidally influenced changes in river height.

FN — Fishnet -- Two fishnets were seen in the river. These features are difficult to spot from an aircraft, but experience on other rivers and lakes suggests that river fishing by net on the Jubba is not widespread.

FR — Firewood Raft -- Floating rafts made of firewood poled downstream by firewood collectors are common upstream of Luuq. The collector is able to take advantage of the natural accumulation of dry wood that occurs in the episodically flowing togga beds near the Jubba. These are gathered, held together with rope and launched for a journey downstream, carrying the "owner," who uses a poling technique to steer through the shallows.

FSp — Flowing Spring -- Springs feeding significant amounts of water into tributaries flowing into the Jubba River were recorded.

H — Hippopotamus -- All hippopotamus seen in the river and flooded areas were counted. Later in this report, the question of correcting for hippos under the water at the time of the count is addressed.

P — Pump -- All pumps observed, that were either working or judged to be functional from the condition of crops they serve, were recorded.

R — Raft -- Rafts made of three to five logs lashed together are found in the river's upper reaches. All those in the water were counted.

RFC — Riverbank Cropping -- The riverbank is planted with crops in a few places to take advantage of water penetrating the bank, an agricultural practice that resembles falling-flood cropping. The plantings made along the riverbank are not easy to spot, since they resemble natural vegetation, with only minimal land preparation. Thus, records are an index, rather than an inventory.

T — Turtle -- Two large river turtles were recorded in the river. It is not known which species occur in the Jubba, but the size of those seen (one meter or more across the carapace) is intriguing. The largest African river turtle is the Nile soft-shelled terrapin (Trionyx triuguis), but this is not known in the Jubba. Other possible candidates are the southern marsh terrapin, Pelomedusa subrufa subrufa, serrated terrapin, Pelusios sinuatus and P. subniger.

TN — Turtle Nest -- One small depression on a sandy island was judged to be an old nest site.

WM — Wind-Powered Pump -- Only two wind pumps were observed.

WS — Water Supply Installation -- Water supply installations, comprised of pumps, settling tanks and sterilizing units, were recorded.

IV. RESULTS

The results of this aerial survey are presented in two forms:

- this report, and
- initial annotated copies of the 1:100,000 maps, with all the observations together and a table giving the counts for each map sheet (i.e., each 20' of latitude for the river's course).

Copies of each map sheet are kept at the JESS offices in Mogadishu.

In this report, the results are broken down by river zone, based on the recommendations of Dr. Deshmukh in a communication of 5 September 1986. These tabulations are provided in Tables 2A-C. In one respect, the report departs from the recommended zonation in that sections were combined when very little apparent difference existed in the floodplain of two proposed sections. The locations of these zones and their general features are described in Section III.C.

The results are discussed in two parts. The initial discussion (Section IV.A) concerns the results of counts and records made from the aircraft in systematic form, and refers to all the types of features described in Table 1. In the subsequent discussion (Section IV.B), observations are made and inferences drawn in a more speculative vein.

A. Count and Record Categories

Hippopotamus

Counting hippos from the air is more easily accomplished in when the river is low and the hippos are concentrated in the deeper pools. At times of flood, hippos tend to disperse, especially from rivers where there is much human activity on the banks. Although every significant flooded area was searched carefully, hippos in flooded land are extremely difficult to spot, partly because it is impossible to predict where the deep pools are, but also because flooded areas present a much more patterned background against which to spot hippo heads. Some hippos had left the river channel and were seen in the flooded riverine strip in this census.

Even under perfect spotting conditions, only a proportion of hippos have their heads or a noticeable part of their heads above

TABLE 2A

CENSUS OF ANIMALS - JUBBA RIVER
September, 1987

Count/density per km

Zone	I	II	III	IV	V	VI	VII	Total
Hippopotamus	-	-	-	11.00	36.00	33.00	14.00	94.00
	-	-	-	0.11	0.33	0.21	0.19	0.10
Crocodile	7.00	37.00	28.00	40.00	54.00	30.00	5.00	201.00
	0.08	0.19	0.15	0.39	0.50	0.30	0.07	0.22
Crocodile	-	-	1.00	2.00	-	-	-	3.00*
nest	-	-	0.02	0.02	-	-	-	0.003
Turtle	-	3.00	2.00	1.00	-	-	1.00	10.00
	-	0.02	0.02	1.01	-	-	0.01	0.01
Turtle	-	-	1.00	-	-	-	-	1.00*
nest site	-	-	0.01	-	-	-	-	0.001
Water birds	-	4.00	-	13.00	8.00	6.00	7.00	38.00*
	-	0.02	-	0.13	0.07	0.04	0.10	0.04
Zone length (km)	90	199	189	103	108	156	73	918

* Not a comprehensive count, indicator only

TABLE 2B

CENSUS OF AGRICULTURE - JUBBA VALLEY
September 1987

Count/density per km

Zone	I	II	III	IV	V	VI	VII	Total
Dhesheeg	-	-	1.00	11.00	11.00	4.00	-	27.00*
	-	-	0.01	0.11	0.10	0.03	-	.03
Cropped	-	-	1.00	10.00	3.00	2.00	-	16.00*
Dhesheeg	-	-	0.01	0.10	0.03	0.01	-	0.02
Irrigation	-	-	7.00	1.00	-	-	4.00	12.00*
Clearing	-	-	0.04	0.01	-	-	0.05	0.01
Furrow	-	-	-	-	-	-	2.00	2.00
Irrigation	-	-	-	-	-	-	0.03	0.002
Agricultural	-	-	-	13.00	4.00	-	-	17.00*
Clearing (new)	-	-	-	0.13	0.04	-	-	0.02
River bank	-	20.00	2.00	1.00	2.00	-	1.00	26.00
Cropping	-	0.10	0.01	0.01	0.02	-	0.01	0.03
Irrigation	118.00	95.00	239.00	19.00	-	75.00	75.00	621.00
Pump	1.31	0.48	1.26	0.18	-	0.48	1.03	0.68
Abandoned	2.00	17.00	16.00	-	3.00	1.00	-	39.00*
Irrigation	0.02	0.09	0.08	-	0.03	0.01	-	0.04
Windmill	1.00	1.00	-	-	-	-	-	2.00
pump	0.01	0.01	-	-	-	-	-	0.002
Flowing	-	4.00	1.00	-	-	-	-	5.00
Spring	-	0.02	0.01	-	-	-	-	0.005
Water Supply	-	7.00	1.00	2.00	-	5.00	2.00	17.00
	-	0.04	0.01	0.01	-	0.03	0.03	0.02
Drinking Place	13.00	18.00	41.00	10.00	1.00	-	4.00	87.00
	0.14	0.09	0.22	0.10	0.01	-	0.05	0.09
Zone length (km)	90	199	189	103	108	156	73	918

* Not a comprehensive count, indicator only

TABLE 2C

COUNT OF IN-RIVER OBJECTS - JUBBA RIVER
September 1986

Count/density per km

Zone	I	II	III	IV	V	VI	VII	Total
Islands	35.00	15.00	7.00	6.00	1.00	-	-	64.00
	0.39	0.08	0.04	0.06	0.01	-	-	0.07
Bridge	-	1.00	1.00	1.00	1.00	1.00	1.00	6.00
	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cable Ferry	4.00	1.00	6.00	2.00	2.00	19.00	19.00	53.00
	0.04	0.01	0.03	0.02	0.02	0.12	0.26	0.06
Boat Ferry	1.00	2.00	-	-	-	-	-	3.00
	0.01	0.01	-	-	-	-	-	0.003
Boats	-	1.00	6.00	1.00	-	4.00	25.00	37.00
	-	0.01	0.03	0.01	-	0.03	0.34	0.04
Canoes	-	15.00	17.00	12.00	13.00	42.00	10.00	109.00
	-	0.08	0.09	0.12	0.12	0.27	0.14	0.12
Rafts	5.00	8.00	1.00	-	-	-	-	14.00
	0.06	0.04	0.01	-	-	-	-	0.02
Firewood Raft	11.00	-	-	-	-	-	-	11.00
	0.12	-	-	-	-	-	-	0.01
Fish net	-	-	-	-	-	-	2.00	2.00
	-	-	-	-	-	-	0.03	0.002
Refugee camp	1.00	10.00	-	-	-	-	-	11.00
	0.01	0.05	-	-	-	-	-	0.01
Zone length (km)	90	199	189	103	108	156	73	918

water. In clear water, this problem is less serious, but the Jubba in September is nearly opaque. Studies were made in the Rufiji River (Watson, 1979b) of this phenomenon, and there, it was deduced that undisturbed hippo groups had almost one-third of their members visible at any sampling moment. Thus, the total count of 94 hippos probably represents almost three hundred animals in the Jubba River. Correcting for individuals and groups not spotted in this census could put the total population in the range of 400 to 800. The Jilaal river count should offer some support for this estimate.

The hippos seen were in small groups and more than normally frightened by the passage of the aircraft indicating that they are under strong pressure from human populations along the river. The clear concentration of hippos in Zones V and VI is further evidence that they are probably in decline, being pushed into the last unused sections of the river.

Crocodile

Crocodiles present the same types of spotting and counting problems as hippos, but they tend to disperse even more rapidly and widely in floods. This is particularly true of young animals which, at sizes as small as 15 centimeters, are virtually impossible to see from an aircraft. Several studies have been carried out to develop calibration factors for estimating relationships between numbers seen from the air and those present in the river (Graham and Beard, 1973; Parker and Watson, 1969; Watson and Graham et al., 1971; Watson and Parker, 1970). Essentially, these methods hinge on two additional sets of data:

- counts carried out at night from a boat or wading, using a spotlight to pick out and count crocodile eyes; and

- photogrammetric analysis of size (age), groupings, distribution and demographic modeling on the assumption of a stable population, to account for very small animals that are always missed from the air and often take to the land at night when a boat or wading person approaches.

Correction factors for rivers similar to the Jubba vary between 30 and 100 times, indicating a crocodile population of between 6,000 and 20,000 in the Jubba River. This large of a population is supported by observations. Crocodiles were observed at every site where they would be expected during high river flow (i.e., in the slack water of back-flooded channels, downstream tail from islands and flooded areas). Further circumstantial support of a large population derives from the widespread use of crocodile barriers in the form of branches

embedded in the riverbed, built by river users at sites where people and livestock draw water.

Crocodiles are found throughout the whole length of the river, with a degree of concentration in Zones IV and V where there is the least human activity. It is probable that crocodiles migrate upstream to breed since islands are their favored nesting site. This idea will be explored in the Jilaal survey when the numbers of suitable nesting sites exposed by falling river levels will become known. Nesting will probably begin about 90 days after laying as the river levels start to fall, with hatching being approximately synchronized with the end of Jilaal and the first Gu' floods. One would thus anticipate mating to peak in mid-November, followed by laying in mid-December and hatching in mid-March.

In their present numbers, crocodiles are pests. The NRA is ready to consider removing them from the list of protected species to enable legitimate and commercially profitable control to occur. A well-salted skin from a five-foot crocodile has a current market value of US$90. An efficient cropping control program in the Jubba could gross US$300 000 to US$1.5 million.

Crocodile Nest Sites

Crocodile nests are very difficult to spot, especially six months after the nests have been excavated. More information on nesting should become available after the Jilaal census and from boat sampling. In particular, the submergence of small sandy islands and sandbanks by the planned reservoir will have to be evaluated against observed nesting behavior.

Turtles

The observer was surprised to see large turtles in the Jubba. The possible species are noted in Table 1, and positive identification will depend on a closer sighting or preferably collection. It is possible that more than one species live in the river. Turtles are not suitable for aerial estimation methods, and although they were actively searched for, the number seen represents a minute fraction of the population, which certainly numbers in the thousands.

Turtle Nests

The spotting of a turtle nest is based on circumstantial evidence--the small size of a sandy depression and presence of a large turtle within a few meters. More data on turtle nesting

will have to be collected during the recommended river-sampling program.

Water Birds

Large flocks (more than 200) of ducks and geese were recorded, but were not the subject of systematic searching of the river's surface and bank. Hence, these data give an indication of the distribution of water birds, but no estimates of populations can be derived from them. Most concentrations were found on the shallow flooded margins of dhesheegs, with no apparent preference for cropped versus uncropped land.

Islands

Almost all the islands observed during this survey are already marked on the 1:100,000 maps. They are clearly a feature of the eroding section of the river. Their importance as relatively undisturbed sites for nesting crocodile, turtles and possibly some birds is considerable.

Flowing Springs

Some toggas joining the Jubba show water flow in the Xagaa season. They are fed from springs that are often obviously mineralized. Considerable numbers of springs are found in the tributary toggas that flow for a short distance before seeping back into the togga bed. Only those contributing significant flows into the Jubba by a surface channel were recorded.

Dhesheegs

Conspicuous dhesheegs close to the river were recorded, although no attempt was made to search for all of them. Thus, the results indicate only the approximate distribution of dhesheegs. They are clearly concentrated in Zones IV and V.

Dhesheegs with Cropping

As mentioned above, the survey did not attempt to search for all dhesheegs. Therefore, only an approximate distribution of dhesheegs with cropping is noted. It seems that higher proportions of dhesheegs are being cropped in Zones IV and VI, possibly reflecting the higher flooding hazards in Zone V.

Riverbank Clearings for Irrigation

The most considerable expansion of irrigation seems to be occurring in Zone III (onion and tobacco farms) and Zone VII (coconut, citrus, sugarcane and rice).

Riverbank Clearings

Some of these areas can eventually be irrigated, but no signs were seen from the air of what is planned for them. They are markedly concentrated in Zone IV, and many of these clearings are being made in the Jubba River's relict gallery forests. This point is discussed again later in the report. As for the features listed above, the data indicate only approximate distributions of riverbank clearings.

Furrow Irrigation

Two coconut plantations were observed to be taking water directly from the river by a channel, with no pump or head-works. The workings of the system, which only occurs in Zone VII, merit some attention. The tidally controlled rise and fall of the river's lower reaches may possibly be implicated.

Riverbank Cropping

Riverbank cropping seems to be most extensively practiced in Zone II.

Pumps

The overall degree of investment in water-extraction pumps is large. This is all the more notable in view of the poor level of infrastructure development of the valley. Pumps are found throughout the river's length, with the exception of Zone V. The 1984 AHT study estimated 380 to 390 functioning pumps on the river between the proposed dam site and Gob Weyn. The RMR estimate for this section of the river in September 1986 is 408 working pumps. In view of the occurrence of an additional 213 pumps upstream of the dam site, of which 95 are in the proposed reservoir zone (Zone II), it is recommended that studies of agriculture be extended to cover the whole valley. To date, most studies have focused only on the area south of the dam site, as is discussed later in this report.

Abandoned Irrigation Area

Only the more conspicuous areas of abandoned irrigation close to the riverbank were recorded, and these data are to be used only as a guide to distribution of the feature. Abandonment of irrigation areas seems to be found primarily in Zones II and III. It has already been observed that there appears to be a north-to-south shift in irrigation occurring in the Baardheere region. So far, no reasons can be advanced for the shifting irrigation in Zones II and III. However, the most likely factors are salinity, fertility and varying transportation costs, which are changing as a result of new tracks being opened. Work on the ground during the boat sampling program will be necessary to clarify this hypothesis.

Abandoned Irrigation Works

Most of these operations are associated with large irrigation schemes that are now abandoned. Several seem to have never been used. It would be most useful if the AHT study or JESS team were to examine the history of some of these schemes, since there will be useful lessons to be learned about how not to plan irrigation in the Jubba Valley (see the recommendations in Section V).

Wind-Powered Pumps

Only two of these systems were recorded. Their cost efficiency should be established so that their potential value in the Jubba Valley can be determined and appropriate guidance offered to farmers.

Water Supply

With at least 17 fixed installations observed, the Jubba is obviously a crucial supply of water for towns, villages, individual farms and refugee camps along its length. A water-use analysis will be required to show what sort of disruption of supply is acceptable during the dam construction and, more critically, set constraints on the quality of the water flowing out of the reservoir.

Important Drinking Places

Not all the important drinking places recorded during the survey were being used by large numbers of livestock at that time. The Jilaal survey should throw more light on this issue. The river appears to be important for watering large numbers of

livestock mainly in Zones I and IV. In Zones V to VII, it is used chiefly by small groups of resident farm-associated livestock.

Bridges

The Jubba River is crossed by six bridges at Luuq, Baardheere, Bu'aale, Fanoole Barrage, Kamsuuma and Muudey Qaraf. However, the management of the Fanoole Barrage does not, in fact, allow vehicles to cross the river. Thus, there is clearly a need for one or two more bridges, with favored sites being Jilib and Saakow.

Cable and Boat Ferries

These two types of ferries indicate the amount of commercial traffic. Ferries are found throughout the Jubba River, but are concentrated in Zones VI and VII.

Boats and Canoes

Small boats and dugout canoes are found along the whole river and progressively increase in number as one goes down the river. Boats replace canoes as the dominant craft only in Zone VII, possibly because suitable trees for making of dugout canoes no longer grow in this zone.

Rafts

Log rafts are found only in Zones I and II. The transportation of firewood by raft is only carried out north of Luuq.

Fishing Nets

The period of high river flow is not the best time to assess levels of fishing activity by observing nets, traps, etc. More decisive information on this activity can be collected in the Jilaal survey and by boat sampling.

Refugee Camps

Large refugee camps occur near Luuq and further downstream at about latitude $3^{o}20'N$. Many will be significantly affected by the developing reservoir, but it is hoped that they will not be occupied by the time the dam is constructed. Minimal planning

information at the end of 1987 will include taking a census of the people in the camps as well as performing some socioeconomic investigations. These data will be of importance to JESS and MJVD and hence, should be encouraged to make arrangements with NRC to have easy access to this information, perhaps in a data-base format. If possible, JESS should frame some of the issues it would like to have considered by the refugee camp survey for submission to NRC and UNHCR.

B. Discussion

A number of observations were made during the aerial survey that raise interesting points. These include the items discussed in the following subsections.

Tapping Hyphaene

Almost all the Hyphaene sp. trees that predominate in the middle section of the valley are being exploited, as is revealed by the very small number of trees with complete living crowns. Many have been entirely killed, and many more are reduced to one live crown out of four, eight or 16 in an old tree. Some study of overuse of these trees is necessary and could be carried out conveniently during the boat sampling program (see the recommendations in Section V).

Mangoes

The first mangoes were seen at 2°37'N, while traveling south along the river. Mangoes are not established at present north of the area studied by AHT, and their northern limit seems to be the dam site. This coincides with the idea that elephants, who are the key distributors of mango seeds, would not be able to enter the narrow northwest part of the gorge, thus limiting the observation of mangoes to south of the dam site.

Onions, Sweet Potatoes and Tobacco

Although onions are the most abundant crop to be seen in September at Baardheere, further south, sweet potatoes or tobacco appear to be almost as extensive on the small bunded (diked) fields. The AHT report makes no mention of sweet potatoes. This may be a recently introduced crop, possibly indicating overproduction of onions.

Bananas

Although small groves of bananas occur throughout the valley, commercial plantations are not found north of $2^{o}03'N$.

Dhesheegs

During the aerial survey, the impression was gained that dhesheeg cropping, with or without irrigation, is declining and is less important than riverbank irrigation and rain-fed cropping. Admittedly, the Xagaa is the least informative time to investigate dhesheeg cropping. In addition, several areas interpreted as dhesheegs by AHT, and presumably included as potentially irrigable land, appear to have salinity or drainage problems, based on the existing vegetation. As of September 1986, dhesheeg management through the creation of inflow channels does not seem to be a widespread practice. As recommended in Section V, up-to-date photography of the valley at 1:10,000 scale could shed some light on this subject.

Permanence of Haro and Dhesheeg Lakes

The well-developed aquatic vegetation of several of the haros and dhesheegs suggests that they do not dry up seasonally. Indeed, the negligible draw-down zones of some haros (for example, the Radille Haro) indicates groundwater recharge. During the aerial survey, these bodies of water were observed to support many large crocodiles.

Gallery Forest

Recently, a University College of London team studied two relict gallery forests, one south of Hangoodle and the other west of Duqiyo Weyn. They concluded that the gallery forest of the middle Jubba is being rapidly removed to permit the development of small farms. They urged the GSDR to take steps to conserve these two forests as they are the last worthwhile gallery relicts on the Jubba River.

During this aerial survey, the two sites selected were examined from the air and extensively photographed. Although parts of these forests have closed canopy, much of the cover is sub-canopy bush, and there are numerous old clearings. In addition, the Duqiyo Weyn section already has a freshly burnt two-hectare clearing on the riverbank, and the Hangoodle relict is bisected by one of the few functional water management channels feeding the dhesheeg to the east. Several sites of comparable quality were located in the valley, but it should be noted that land-use changes in the middle Jubba region are

occurring rapidly. If a representative section of this type of forest is to be saved, all appropriate government agencies should take concerted action immediately--there is no time to carefully survey the resources in advance. The key criteria are:

- is the forest relict located where effective management can be maintained, and
- do mechanisms exist to conserve the forest over the long term?

If the answers to these questions are positive and the NRA, as the GSDR custodian, decides the gallery relicts are sufficiently important to warrant protection, it is essential that immediate and radical action be taken (see the recommendations in Section V). It is admitted that these areas may not contain unique species, but they may be a unique association if gallery forests in the extreme southern portion of Somalia and on the lower Tana River are sufficiently different.

Fish Traps

Two barrel-shaped baskets were seen suspended on the surface of the water by a long pole, holding the baskets two meters away from the bank. Two ropes appeared to be attached to the ends of the baskets, and these ropes were also fixed to the bank. These are probably traps for fish, prawns, turtles or crocodiles, but more information is needed. It is hoped that some of these will be seen during the boat sampling program.

Coconuts

Coconuts become an important crop south of $0^{o}43'N$.

Mangrove

One very narrow strip of mangrove grows near the mouth of the Jubba. The comparison is striking relative to the vast mangrove swamps at the mouth of the Rufiji River and the less extensive, but not inconsiderable, areas at the mouth of the Tana River.

V. RECOMMENDATIONS

Based on the findings of the aerial survey and their interpretation, 10 recommendations are presented here. Some were communicated to ARD in early October 1986.

First, JESS should place greater emphasis on studies in the Jubba River and floodplain. The level of human activity in the whole valley is higher than it was in 1983/1984 and is apparently expanding. The 621 pumps judged to be operational for riverbank irrigation represent an appreciable investment of resources. The refugee camps have probably played a role in starting the process of bank irrigation in the Luuq-Garba Haarey area, but other factors are undoubtedly involved. The implication of these findings is that proportionally more effort should be spent collecting information about and attempting to understand the processes taking place in the riverine strip.

Second, it is advised that JESS expand its agronomic work to fill in gaps in the AHT results. The AHT survey stops at the Baardheere dam, and significant agricultural activity takes place north of this site. In addition, a number of issues are not well-stated in the AHT survey. For example, the cropping patterns suggesting 331 percent and 350 percent land utilization are impossible, given the sequences of crops, their maturation requirements, and time needed to prepare the ground and sow crops. The importance of tobacco seems to be overstated, and several important crops (e.g., sweet potatoes, beans) are not given sufficient attention. Using the methodology described, it is impossible to find out how many farms were visited, how questionnaire responses were checked for bias, and what sampling errors should be attached to the estimates. The elaborate and well-structured calculations based on these data will carry the same sorts of sampling error into the final economic estimates.

Third, JESS should commission 1:10,000 aerial photography of a strip on both banks of the Jubba River. The dynamic concentration of human activity in the valley makes it vital to have up-to-date, large-scale maps of the valley. RMR suggests two strips of monochrome aerial photography of 1:10,000 scale covering about two kilometers on each bank for the whole river or for, at least, representative and important sections. This would cost about US$35,000. It would greatly enhance the usefulness of and strengthen deductions from the fieldwork being carried out, apart from being an important tool in planning and carrying out this work. Comparisons with the 1983 photography would also be possible, giving precise information on recent changes in land use. In addition, this photography would be an invaluable aid in bringing the AHT analysis of small-scale agriculture up to date and would be indispensable if any cadastral program is intended for the inundation area.

Fourth, a three-week boat sampling program should be carried out along the full length of the river. It is clear from the air, that many interesting parts of the valley are not accessible to vehicles. Moreover, a sequential journey down (or up) the whole length of the river in Somalia would provide an important perspective for understanding its dynamics. Finally, some aspects of the valley require studies of the river itself and its animal population. For these reasons, RMR feels a carefully managed voyage from Luuq to the ocean is needed, at least once and possibly twice during the studies. Such a trip ought to be planned in the same way as a sampling flight, with a series of specific questions in mind and a valid methodology for answering them. In addition, it is important that it be supervised by someone experienced in working on African rivers habituated by crocodiles and hippos. RMR would be able to plan and manage such a journey, taking up to five scientists/consultants (ecologists, agronomists, sociologists, hydrologists, land-use planners, botanists and pedologists would be the types of disciplines to include). The river could be covered in daily stretches of about 40 kilometers over a three-week period.

The JESS boats may be suitable for this survey, but further experience in the dry season will answer this question. The ideal vessel would be a hard bottomed Zodiac with a water-impeller engine. The cost would be about US$5,000, if JESS boats are used, or US$10,000 using all RMR equipment.

Fifth, it is recommended that the NRA consider lifting its protection from crocodiles in the Jubba River and collect more information about their breeding biology. The numbers of crocodiles seen, and their positions at most of the sites where one would expect to see them at periods of high river flow, suggest that the population is large (several thousand) and probably in need of control. Losses of livestock and people due to crocodile must be occurring, and considerable effort is required and costs incurred in avoiding this type of predation. If the NRA is recommends the initiation of some degree of crocodile control, a survey of nesting sites and study of the breeding cycle would be invaluable. Some of these data would come from the river survey discussed in the fourth recommendation.

Sixth, the question of soil suitability should be continuously addressed until an objective and sound survey is produced. The world has seen several failures of huge development projects because of faulty or inadequate information on soils. At present, a major resource issue that has to be addressed before implementing a development plan for the Jubba Valley concerns soils. One of the least successful ways of classifying the production potential of soils is from aerial photographs. This is particularly true with reference to irrigation. There is no alternative to assessing the

characteristics of complex and heterogeneous soils to large numbers of samples, soil pits, infiltration tests and so on. Although the JESS terms of reference specifically exclude soils, which are being studied by the U.S. Bureau for Reclamation (BuRec), JESS should be actively involved with both AHT and BuRec in trying to get a credible and realistic description of valley soils. The combination of disciplines and corporate experience of these three groups could be valuable in checking the soils data.

Seventh, small-scale studies need to be undertaken during the boat sampling. A number of small-scale studies and investigations could be initiated or even completed during the boat sampling program, including:

- capturing and identifying turtles and studying their breeding biology;
- classifying islands and their role in the river's ecology;
- sampling the chemical composition and flow rates of springs feeding into the Jubba ;
- studying furrow-irrigation systems near the river's mouth;
- observing the daily cycle of salinity penetration into the Jubba;
- studying processes leading to the frequent shifting of irrigation on farms in the middle Jubba region;
- studying the exploitation of the Hyphaene palms;
- analyzing the cost efficiency of wind-powered pumps for irrigation; and
- studying river fishing and trapping methods, including their economics.

Eighth, JESS should be kept informed about the planned refugee camp survey and make suggestions for suitable questions, if practical. In view of the large numbers of people involved, it will be important to understand how the refugee camps operate at present and what is intended for them in the future. JESS should make sure it stays in touch with the appropriate persons at UNHCR and NRC concerning this issue.

Ninth, it is recommended that two new bridges be built. From a development perspective, it is suggested that the GSDR consider conducting feasibility studies to determine the cost

efficiency of two new bridges on the Jubba River at Jilib and Saakow.

Tenth, a water-use analysis is advised. It is recommended that a comprehensive water-use analytical study be started for the Jubba River catchment, with the ultimate objective of developing a water-use model and, hence, a water master plan. This important activity seems to have been neglected. Of course, water-quality considerations would be decisive in some parts of the model, and some mathematical modeling of water quality in the planned reservoir might have to be considered.

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APPENDIX A

Scope of Work for Subcontract RMR-A

1. As part of a contract between Resource Management and Research (RMR) and Associates in Rural Development, Inc. (ARD), the subcontractor (RMR) will undertake activities in aerial photography described in this scope of work as a part of ARD's Jubba Environmental and Socioeconomic Studies (JESS) project in Somalia.

2. Format of photography described in this scope of work is referenced to the RMR costing document of 28 May 1986 and letter to ARD of 23 July 1986, unless specified otherwise.

3. Technical directions for this scope of work will be determined through discussions and agreements between Dr. R. Murray Watson of RMR and Dr. Ian Deshmukh of JESS. Subcontract discussions and negotiations must be approved and authorized by ARD corporate officers in Burlington, Vermont, U.S.A.

4. The subcontractor will hold briefing meetings with the USAID project manager, JESS chief of party and Dr. Deshmukh prior to commencement of work.

5. The subcontractor will deliver oblique color-slide photographs to JESS of the inshore marine zone (approximately 100 square kilometers) adjacent to the Jubba River estuary and 1:50,000 photocopied maps of conspicuous inshore habitats, land use, shore erosion/deposition and coastal reefs. Delivery date will be agreed between RMR and JESS.

6. Color slides will be labeled on the mount.

7. Timing of photographic flights will be arranged by mutual agreement between JESS and RMR, and will usually be programmed to coincide with the aerial censusing tasks.

8. The subcontractor will make a complete aerial count of hippopotamus, crocodiles and in-river human activity at a period of high river flow in 1986, tentatively scheduled for September. Results will be delivered to JESS and recorded on a photocopied 1:50,000-scale map.

9. The subcontractor will conduct an aerial census of terrestrial features of the Jubba Valley. Features to be included are livestock by species, large wildlife by species, livestock enclosures (in use/abandoned), functioning water sources by type, houses by type, stages in the cropping cycle and types of cropping, crop species (if identifiable), evidence of burning, evidence of timber or fuelwood extraction and charcoal

kilns. Where possible, the type of activity will also be recoded (e.g., livestock grazing or browsing on range/stubble/stall-fed, watering, moving to water). A complete list of features will be determined by mutual agreement between RMR and JESS.

10. The census will be stratified as follows: the overall area includes the length of the Jubba River in Somalia and the Dhesheeg Wamo to Afmadow Region. The riverine zone (area directly influenced by river regime) will be censused at five-percent coverage (total area is approximately 5,650 square kilometers). A river-dependent zone stretching 30 kilometers on both sides of the riverine zone will be sampled at three-percent coverage (total area is approximately 37,500 square kilometers). Further stratification based on vegetation and land use will be provided by JESS. Census data will be recorded at the level of small land-use/vegetation units or "facets" (sensu RMR) of the type defined in the AHT dhesheeg-study photo mosaics.

11. The subcontractor will make census flight lines perpendicular to the direction of river flow, centered on the river and mapped. The flight lines will be selected by mutual agreement between RMR and JESS to obtain adequate sampling of land-use/vegetation strata and highlight specific areas selected by JESS. The flight lines must be carefully recorded for ease in duplication of future JESS/RMR aerial censuses of the Jubba Valley.

12. The approximate timing of censusing will be late September 1986. JESS and RMR will endeavor to maintain flexibility of timing to allow for unusual circumstances occurring in the valley.

13. The subcontractor will supply census data to JESS in a timely fashion in the following forms: IBM PC-AT compatible disks, as recorded along individual flight lines and related to individual "facets," as defined above, and time of day; tabulated densities with statistical errors (numbers and biomass, where appropriate) and estimates of area or other features per stratum; magnitude of conversion factors used; set of oblique color slides taken during census for enumeration of herds and other features.

14. At the conclusion of this subcontract, the subcontractor will prepare a final report in a format defined by Dr. Deshmukh, At a minimum, it will include recommendations for future remote-sensing activities or repetitions of work described above, which could form the basis for future subcontract agreements between ARD and RMR for JESS activities.

APPENDIX B

Comments on AHT Agricultural Report

The report titled DHESHEEG AND SMALL- AND MEDIUM-SCALE IRRIGATION AGRICULTURE IN THE JUBBA VALLEY (AHT for MJVD, Mogadishu, Somalia, 1984) contains numerous mathematical anomalies and irregularities. In brief, it mainly raises a number of methodological issues that JESS will have to tackle. Examples of some of the problems include those listed below:

Annex 1

> Page 8 -- Nineteen percent of farmers have farms of 2.5 to 5.0 hectares in size near Bu'aale, and 15 percent have farms of this size in the rest of the district. How then can only 13 percent of farmers in the whole district have farms of this size?

These data amply illustrate the great care which would have to be exercised in devising an appropriate sampling program for farms in the Jubba Valley.

> Page 19, Figure 6 -- The Xagaa percentages add up to 93, not 100, percent.
>
> Page 31 -- Calculations of the weight of individual maize seeds deriving from planting density, numbers of seeds per hole and seed application rate differ by more than 300 percent, which is impossible. (Maize seeds in Baardheere weigh .15 gram and in Saakow, .51 gram.) Similar anomalies occur elsewhere for other crops. This is typically the sort of internal inconsistency that should be used to reexamine field data.
>
> Page 31 -- It is not explained why planting times are two to three times longer in Baardheere than Saakow, although the planting intensity is less. Is this because more replanting is needed because of crop damage in the early stages? Is it germination failure? Is it a typing error?
>
> Page 32 -- The weeding interval for onions in Baardheere is given as 18 days. Presumably, eight days is intended.
>
> Page 33 -- Onions in Saakow are irrigated more frequently than in Baardheere, but are other crops irrigated less frequently?

Page 39 -- Does the weeding of tobacco really follow a 10, 35-40, 60-day cycle in Bu'aale and Jilib? One would expect more weeding of this crop.

Page 41 -- Some confusion arises over calculating the costs of transportation. Whose time is included in the cost of transportation?

Page 41 -- It is implied that 100 farmers were interviewed in Bu'aale District. Is this correct?

Page 42 -- Calculations based on yield of tobacco used 0.3 ton per hectare, not 0.4 ton per hectare, as stated.

Page 45 -- Once again the weights of maize and sesame seeds show large and unlikely variations. For 4.3 times as many holes, it seems unlikely that 0.6 times as much seed will be used.

Throughout, labor costs vary between 30 and 80 per day. In addition, harder work is assigned more person-days.

Page 90 -- Were livestock weighed, or what was the source of these weights? The "social-security" argument about subsistence livestock overlooks many of the realities and necessities of subsistence livestock management. Milk production receives scant attention, but it is infinitely more important than honey in the Jubba Valley production system.

Page 91 -- The "wide range of answers" does not prevent estimations from being made, provided that legitimate sampling procedures are followed. If this is the case, what steps have been taken to ensure that the answers given about crop production are true? Much more work has to be done on studies of the animal production system in the valley.

Page 92 -- The agro-economics involve a large number of assumptions. Are any checks possible, for example, from the accounts of a well-run banana plantation?

Annex 2

Page 1 -- Were 70 percent of the dhesheegs visited and categorized? How many are there, and how many have water management?

Page 45 -- The authors should indicate how far the water-abstraction legislation is being followed.

Annex 3

Page 1 -- The plotting of one (or even two) meter contours would have been very useful. Was it tried? How many ground-control points are there for the interpretation work, and where are they? This would be an excellent way of checking interpretation. What quantifications were used to assess intensity of land use?