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INTERNAL REPORT

VISIT TO ETHIOPIA

12 TO 30 APRIL 1971

by

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DATE

NATURAL ENVIRONMENT RESEARCH COUNCIL

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I. INTRODUCTION

Visits were made to three areas in Ethiopia but owing to the distances involved and various difficulties over the transport and other arrangements, comparatively little time was spent in the actual field areas. Details are as follows:-

(a) Jijiga region - 1½ days

(b) Dirmatu region - 1½ days

(c) Mehal Meda - 1 day

The notes on each area appended below are based on these visits and on information from various sources, mainly from reports of the Livestock and Meat Board. Ground elevations shown in Figure 1 or quoted in the text are based on uncorrected readings of an altimeter recorded during this visit.

II. THE JIJIGA REGION

General Description The area of main interest is approximately 150 by 120 km and lies between the Fafan river and the border with Somalia (Figure 1). It is predominantly a grass or savannah-covered plain with little relief except in the Fafan and the Gerer river valleys. Rainfall is of the order of 300 to 500 mm annually and there is a protracted dry season. The two main rivers cease to flow during this latter period.

The region is currently used by cattle and camel-owning nomads. The available grazing is adequate to support a considerable increase in livestock numbers but a major restriction is lack of water. If water can be made available, the proposed scheme is to bring additional cattle in to the area for fattening prior to export. Initial water requirements are not high and six boreholes each producing some 125,000 gallons per day has been quoted. These boreholes should preferably be located on the areas of Government land (Figure 1), but the requirement is not a rigid one. Additional boreholes may also be required along the movement lines of the livestock which would trend from south to north.

Hydrogeology The greater part of the area is underlain by flat-lying or gently dipping sedimentary formations of Mesozoic or Tertiary age, mainly composed of sandstones and limestones, overlying basement rocks. The latter are exposed near Jijiga. The upper surface of the basement below the younger formations is reported by Elwerath (unpublished report) to be unweathered below a depth of one or two metres, and for all practical purposes, this weathered layer can be discounted as a potential aquifer. Potential aquifers occur in the Mesozoic and Tertiary sequence, and since these appear to be of generally permeable formations, a regional aquifer overlying the basement aquiclude seems probable. Surface dissection by run-off is not generally marked and some infiltration seems likely. Outcrops of mudstone have been noted on the Dugabor road and if extensive horizons should occur within the sedimentary sequence, there is also the possibility of high-level perched aquifers above the regional body.

Figure 1 shows sites of existing wells and dry (abandoned) boreholes. Unfortunately, water levels are available in the drilling records for the Jijiga wells only and no ground elevations are known other than the uncorrected altimeter measurements recorded during this visit. The absence of water at depths of 900 feet below ground level in the area a short distance to the south of Jijiga is a little surprising and it must be provisionally assumed that the aquifer occurring at Jijiga is local or that static water levels in the regional aquifer dip very steeply southwards.

Suggested Programme of Study. A general study of the area should be carried out to include a survey of the locations and ground elevations of existing wells, static water levels, water quality, appraisal of geological sequence from existing records, possibly supported by down-hole geophysical logs in existing boreholes and examination of terrain for surface exposures, and to locate areas of possible high infiltration.

2. The location of the basement surface and if possible intermediate aquicludes, should be attempted using surface geophysical methods. Seismic techniques would be most applicable for the basement surface since over the greater part of this area, it is likely to occur at 1000 feet or more below ground level. For the higher-level aquicludes, surface resistivity techniques might also be used. A map showing the depth to the basement is included in the report by Elwerath but since there is practically no control in this area it must be regarded with some caution. The contours are shown striking east-west and with the dip to the south. The feature is a little anomalous since a shallowing of the basement surface eastwards towards the ancient Hargeisa ridge might be expected.

3. Test drilling should be carried out at favourable locations. The geophysical surveys should extend over the areas of Government land and preference might be given to sites on these areas if other considerations are not too disadvantageous. It would seem probable that below the three more easterly areas, the regional aquifer is unlikely to be encountered at depths much less than 1000 feet, and the economics of production from such depths should be taken into consideration when potential sites are selected.

III DIRMATU REGION

General Description This is a lowland area between 3500 to 4000 feet above sea level which extends north of the Combulcha-Assab road and below the eastern escarpment in a belt about 200 km long from north to south and 80 km wide. The area was traversed northwards from the road to the Mile river, a distance of about 60 km, and east to west for some 15-20 km. The top of the escarpment is about 7000 feet above sea level at Bati and falls to the lower level of the Dirmatu area in some 20 km. The western part of the area occurs in the escarpment foothills and outcrops of volcanic rocks are abundant. The eastern part is much flatter and soil covered and grades into desert terrain. The soil is often gravelly, and bed rock, probably volcanic throughout is probably not deep.

Hydrogeology Rainfall is considered to be between 300 and 500 mm annually and markedly seasonal. The area is intersected by a number of water courses ranging from minor stream cuts to quite prominent valleys incised up to 20 metres below the general plain level and between 100-200 metres across. At the time of my visit, two only, the Myawaw and the Mile rivers had water which was flowing quite strongly at several hundred litres/sec. No lateral springs were noted and it seems likely that this flow is derived from the high plateau. The valleys' sides and floors may show rock outcrops or fluviatile sediments of various ages. One cliff section in the Myawaw valley showed about 15 feet of gravelly silt overlying 15 feet of fine silty material. Rock outcrops in the valley floors and the coarse gravel in the stream bed suggests that the present phase is a degradation one and that no very great thickness of stream sediments can be expected below the existing valley floors. Neither are these fluviatile younger formations likely to have any significant lateral extent.

In addition to the flowing rivers, two quite large but dry valleys were noted, the Fursa and the Chawwaha. Both have hand-dug wells sunk in the valley floors. One in the Fursa valley showed a thin sand and gravel layer about one metre in thickness above weathered basalt. The well was about 7 metres in total depth and water appeared to be entering near thebottom through joints in the basalt. Water quality is said to be good. Several wells were noted in the Chawwaha, all very shallow, and containing rather poor quality water.

Potential Water Supplies These include both groundwater and surface water sources and are as follows:-

(A) Surface water sources.

i. By abstraction from the perennial rivers or;

ii. From reservoirs above dams on either the perennial or ephemeral rivers. Small dams only would be possible since the valleys are narrow and not deeply incised, but suitable dam sites should not be difficult to find. Distribution by reticulation would be easier from a reservoir since river levels would consequently be raised.

(B) Groundwater sources:-

i. From wells sunk in valley floors. Potential supplies are probably not too favourable since stream sediments are not thought to be very thick below the valley floors. Known wells penetrate rock at shallow depths. Wells within the bedrock volcanics may penetrate permeable horizons but little is known of the sequence in this area. The saline water in the wells in the Chawwaha is an unfavourable feature in this respect.

ii. Wells in watershed areas. Again potential does not seem high since rainfall is low, particularly in the more easterly desert areas and the permeability of the volcanic sequence may be such as to preclude withdrawals from distant supply sources such as the main flowing streams or the wetter foothill regions.

Suggested programme of study This should include a general investigation of the surface topography, geology and hydrology - streams, springs, valley configurations and structure, surface formations etc. Subsurface investigations might include geophysical techniques to determine stream sediment distribution and depth above bedrock but probably the main method will be test drilling. Shallow test drilling in the valley floors should be carried out initially and if the results prove favourable, testing of the interfluve areas may also be considered.

IV. MEHAL MEDA REGION

This is a dissected highland region around 11,000 feet above sea level. Slopes in the region are often steep but the area of particular interest which is some 15 km square is flat-lying and occurs on a minor watershed between two subparallel streams and extends eastwards on to a major watershed. Rainfall is probably in excess of 700 mm per annum. The associated streams run in steep-sided valleys, 200-500 feet below the interfluves, and flow occurs throughout the year. At the time of my visit, the flow in one of the streams crossed was small, probably between 25-50 litres/sec. Since there is a marked dry season, this flow is presumably a base flow, probably derived from springs, some of which were noted in the area. One spring close to the Mission station which borders the area where development is proposed, is a high level spring issuing from jointed volcanic rock. Flow is small but continues throughout the year and is probably derived from a perched aquifer developed in the jointed volcanic rock overlying a more massive horizon.

The rock types occurring in the area include lavas - basalt, porphyry, felsite etc., and pyroclastics - ash, agglomerates, tuffs etc. The lava flows are jointed but vesicularity is not marked. The surfaces of individual flows are not very broken probably for the same reason. The ash beds are fine grained and porous but probably not very permeable. The regional dips appear sub-horizontal but local dips are often of moderate angles and variable in direction.

The location of this area on a watershed, and the type of terrain and rock types occurring are not indicative of the ready availability of groundwater supplies. Local shallow supplies are possible but deep-seated aquifers of regional extent are unlikely. A short field investigation of a few weeks duration is suggested in order to locate and measure flows of springs and streams, evaluate baseflows, rainfall/run off relations, surface terrain and infiltration characteristics. The availability and development costs of surface water supplies should be considered. If these costs are high, test drilling for alternative groundwater supplies may be proposed if a favourable site occurs.

V CONCLUSIONS

The development of adequate water supplies in all these three areas presents problems. In the Jijiga region, particularly that area to the east of the Gerer river, groundwater is the only possible resource but supplies are likely to occur at fairly considerable depths. In the Diramatu region, both surface and groundwater supplies should be considered but the general geology does not seem very favourable for the latter. The possibility should not, however, be discounted without adequate investigation. In the Mehal Meda area, development of surface water supplies seems a more logical approach.

Additional work is recommended in each area. It is difficult to predict time requirements but several months of field work may be required for the initial investigations. This could include some supervision of test hole drilling if suitable equipment is available. Suggested staff requirements are for a hydrogeologist, experienced in geophysical techniques, and possibly supported by an experimental officer. Additional assistance including some support staff, could I understand, be provided by the Geological Survey of Ethiopia.

Addendum On the road between Mehal Meda and the junction with the main road to Addis Ababa were noticed a series of outcrops of a fine-grained, white rock which has proved to be kaolinite. The outcrops are several feet thick in the road cuttings and would appear to be laterally extensive. A report by the Mineral Resources Division of the Institute of Geological Sciences will be enclosed or sent separately at a later date. The occurrence may merit further investigation.

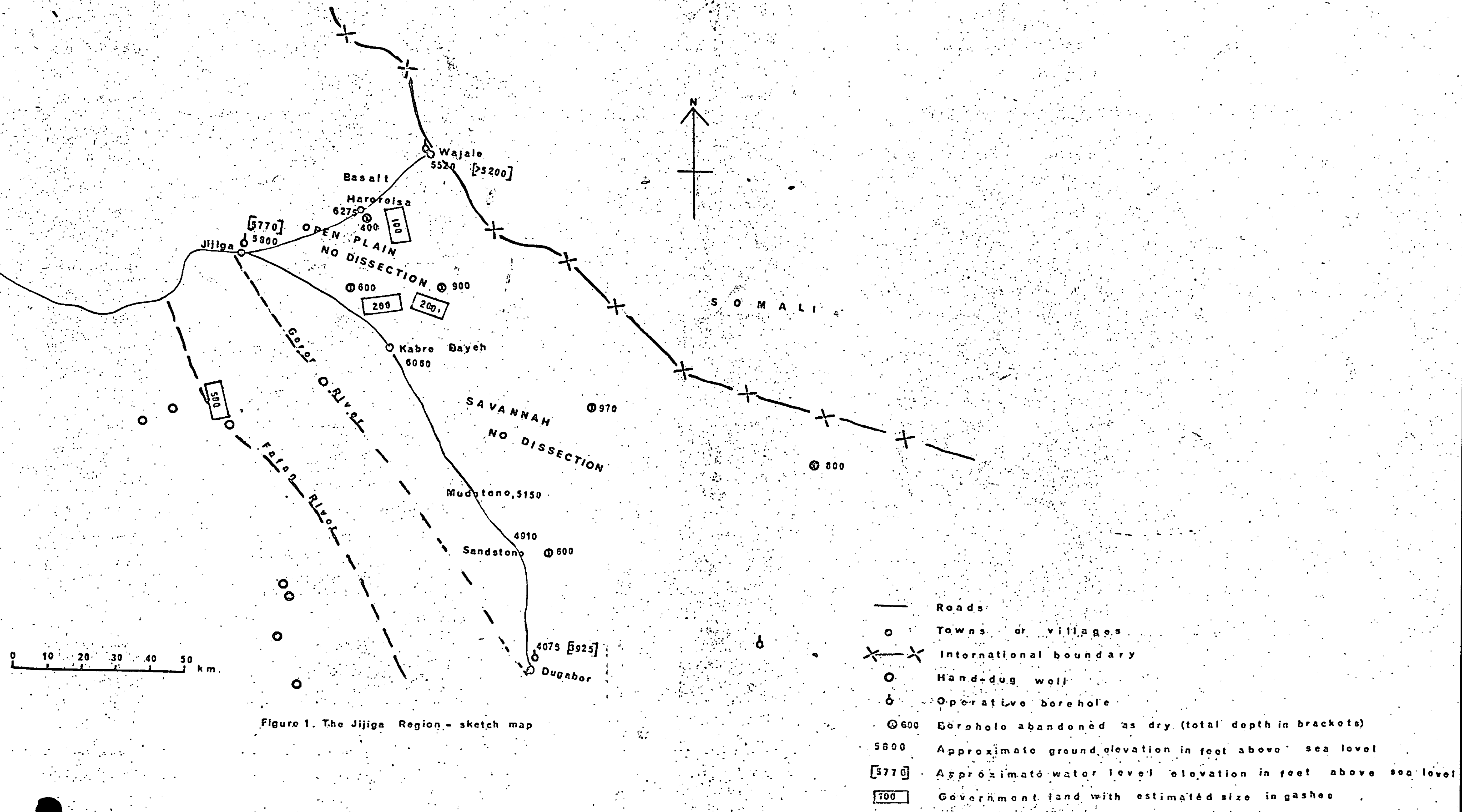

Figure 1. The Jijiga Region - sketch map