

LAND USE DATA INTEGRATION FROM MEDIUM SCALE AERIAL PHOTOS  
AND SMALL SCALE TOPOGRAPHICAL MAP USING SB 115 STEREOSKETCH

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ABSTRACT: Map revision for land planning in the African situation faces many technological and manpower problems, the most relevant of which is simplicity of a technological system for easy application by a middle level expertise. Research is needed to evolve less complicated operations for map revision.

This paper describes a methodology which has been based on how an opto-mechanical system, the SB 115 stereosketch has been used in compiling an agricultural land use map for an irrigated area in the Lower Senegal Basin, in the Dagana District of the Republic of Senegal. The Compilation was based on 1:10,000 aerial photographs taken in 1980 and 1:200,000 topographical map drawn in the 1950s. The operation has been so simplified to be undertaken at technician level of expertise.

## I BACKGROUND ISSUES

### 1.1. Where Map Revision is Urgently Needed:

Map revision which is a requirement for replanning the best use of land and environmental control measures is mostly needed for those parts of Africa where land-based human activities are intensifying with expansion in population and economic activities. (Table 1)

### 1.2. Systems Advancement and African Conditions:

Many technologically superior, yet complicated systems for map data processing are fast appearing on the market. Computer aided systems for map compilation are available and tantalizing. To what extent these complicated and electronically built systems are suitable to the present African conditions is yet to be fully examined. There is however a case for cautious intake of the very sophisticated ones because of many environmental factors (Table 2).

### 1.3. Middle of the Way Approach for the Present:

The high-tech electronic systems, coupled with the tendency to reduce manual and semi-manual techniques are consequent eliminators of labour intensive approaches. This is at present not friendly to the fragile economies of most African countries. The alternative that still recommends itself is opto-mechanical system with manual, semi-manual manipulations but capable of handling integrated uses of aerial photographs and satellite imageries.

The practice of ground surveying with traditional instruments by the surveyor aided by an army of field staff has indeed become old fashioned. Nevertheless, the advantages in the surveyor and his field staff developing intimate contact with the land and the people using it can hardly be substituted with technologically superior yet impersonal gadgets that approximate some value mathematically to present models which idealize very complex situations.

The present state of land use and environmental conditions call for closeness of contact between the technical people collecting the hard field data and the land-users. Such closeness of human contact is now much more facilitated with the advent of high resolution satellite imageries. The land user can now irrespective of formal education, be made to see the image of his physical surroundings and the type of use he is putting it to.

The foregoing issues therefore establish a case for research and

TABLE 1:

ACTIVITY AREAS REQUIRING SPATIAL INFORMATION UP-DATE  
FOR PLANNING CONTROLLED LAND USES

- Non-renewable resources exploitation affecting associated renewable resources basic to rural livelihood.
  - x Mining practices leading to loss of valuable soils, vegetation, changes in the quality of water, upsetting hydrological regime.
  
- Creation of Water Impoundment.
  - x -submerging hitherto valuable lowland farm plots
  - causing resettlement problems;
  - creating different sets of health hazards.
  
- Spontaneous Development of Frontierlands, with land-use practices.
  - Uncontrolled grazing;
  - shifting cultivation;
  - bush firing;
  - over-fishing, over-hunting;
  - wood extraction.
  
- Urban retail, Industrial and Residential growth leading to development of unapproved structures.

TABLE 2:

KEY ENVIRONMENTAL FACTORS  
MILITATING AGAINST THE USE OF ELECTRONICALLY  
CONTROLLED MAPPING SYSTEMS IN AFRICA

- High Temperatures and Humidities;
- High Dust Levels;
- Poor Housing Conditions;
- Erratic Electricity Conditions;
- Low Level Maintenance Consciousness;
- Complex Land-use situation defying Automated characterization Techniques;
- Cost in Relation to Marginal Importance of the end Results
- Low Priority accorded to Sophisticated Planning by Decision-Makers.

development of map data compilation techniques which still recognize the importance of visual, semi-visual and manual, semi-manual operations, supplemented with field visits to establish close contact with the land. The purpose being to collect much more reliable hard primary data on the basis of which other secondary and tertiary sophisticated data processes will then manipulate to establish realistic models for planning. This raises the question for middle level training of technicians capable of generating data from optomechanical systems application to image interpretation and compilation of base data from it. They must be capable of carrying out the associated field truthing and field interviewing to rectify the image interpretation map.

## II OBJECTIVES AND RATIONALE OF THE EXERCISE

The problem of exercise was to integrate photo data (3) taken at 10,000 scale in 1980 with map data (1) compiled in the early sixties at 200,000 scale. The objectives to be achieved were as mentioned below:

### 2.1. Verification of Professed Advantages of the Stereosketch:

Basically the exercise was to find out to what extent the advantages professed for the Stereosketch SB 115, an optomechanical system (Table 3), could be practically realized within the context of the philosophy raised in the discussion above.

### 2.2. Relating the Exercise to Actual Development Issues:

The theme selected for the exercise was meant to produce a primary spatial information that could be used for secondary and tertiary surveys and data analysis in land evaluation which is fundamental to land use policy development. In this case the exercise was oriented to a potential development problem (Table 4).

### 2.3. Capability Assessment of the Instrument for Technician Level Expertise:

Possibilities for and constraints in using the instrument were to be determined for the purpose of providing recommendations to potential users of the instrument for solving similar resource mapping problems.

### 2.4. Rationale of the Exercise:

The ratio between the photo and the primary base map was 1:20. This was to be closed to 1:8 using manual techniques by adopting the "Union Jack" system (2) of scale change (Fig. 1). The rationale was to incorporate this manual method into the use of the instrument for situations where the base map and photo scale range is very wide. This situation is very real in many places. The instrument itself has scale ratio variation up to only 2:35 thereby limiting ratios beyond that value.

## III METHODOLOGY

### 3.1. Base Map Construction:

A base map at a scale of 25,000 was derived from the primary topographical map which was at 200,000. The 25,000 scale was so chosen to enable subsequent comparison of the details with enlargements of SPOT IMAGE scene of the area at 1:50,000 scale. The ratio would be 1:2 which is within the range permitted by the Stereosketch.

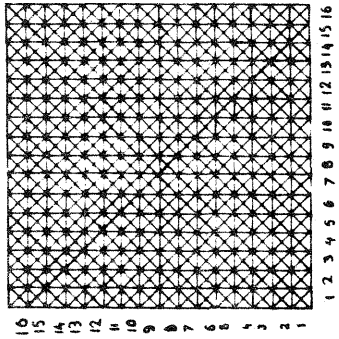
### 3.2. Preliminary Interpretation and Transfer of Information:

The photos were stereoscopically scanned with the Stereopret which affords 75% overlap of stereo field of view of the normal aerial photographs. At the preliminary level the following terrain information was derived for the preliminary map. (Fig. 2)

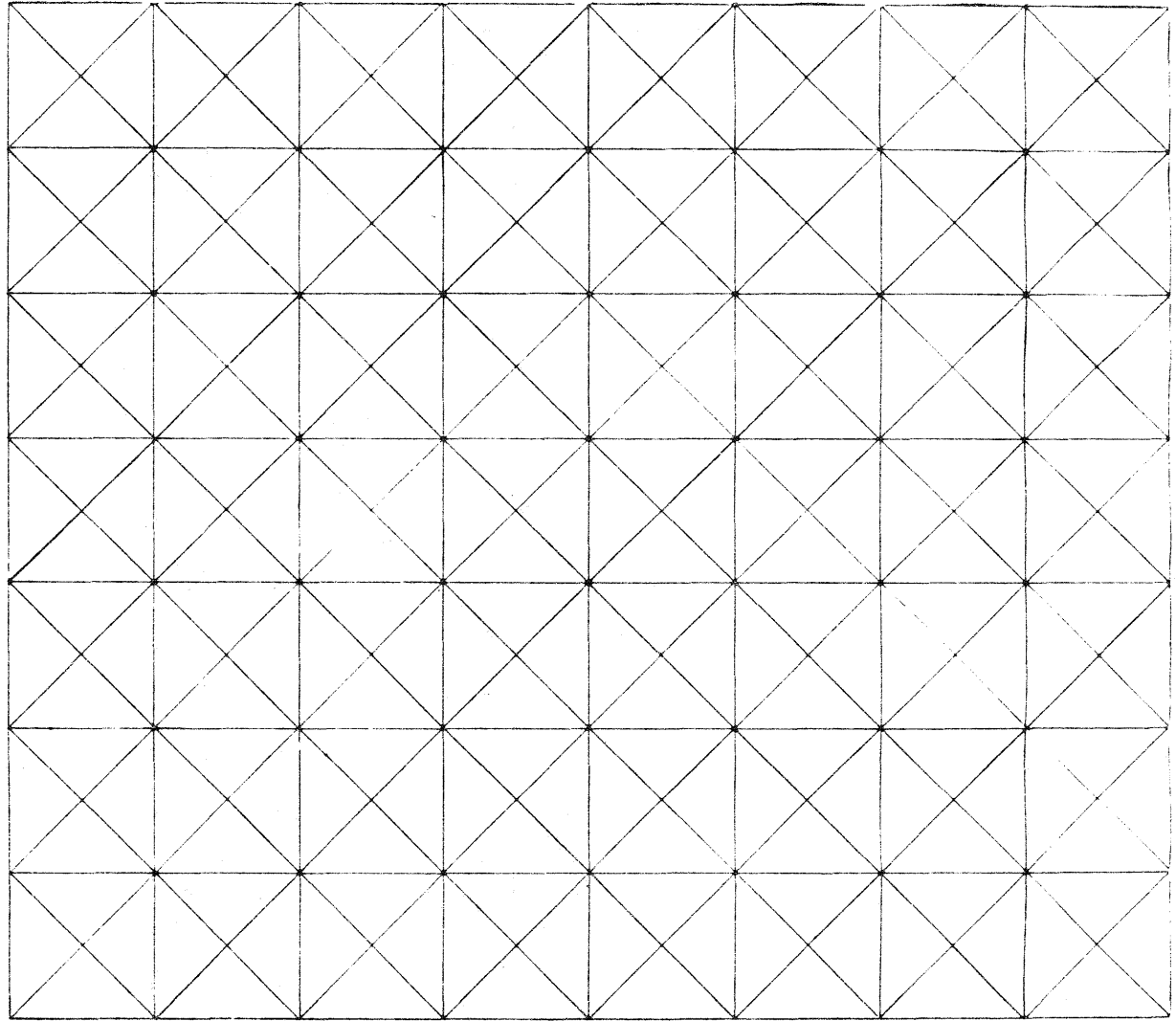
- Settlement-undifferentiated
- Main irrigated plots - undifferentiated;
- Principal drainage ways;

Fig. 1 The Union Jack System of Scale Conversion.

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8 x  
Scale  
Conversion



16 15 14 13 12 11 10 9 8

TABLE 3:

ADVANTAGES OF THE STEREOSKETCH FOR RESSOURCES  
AND ENVIRONMENTAL MAPPING (4)

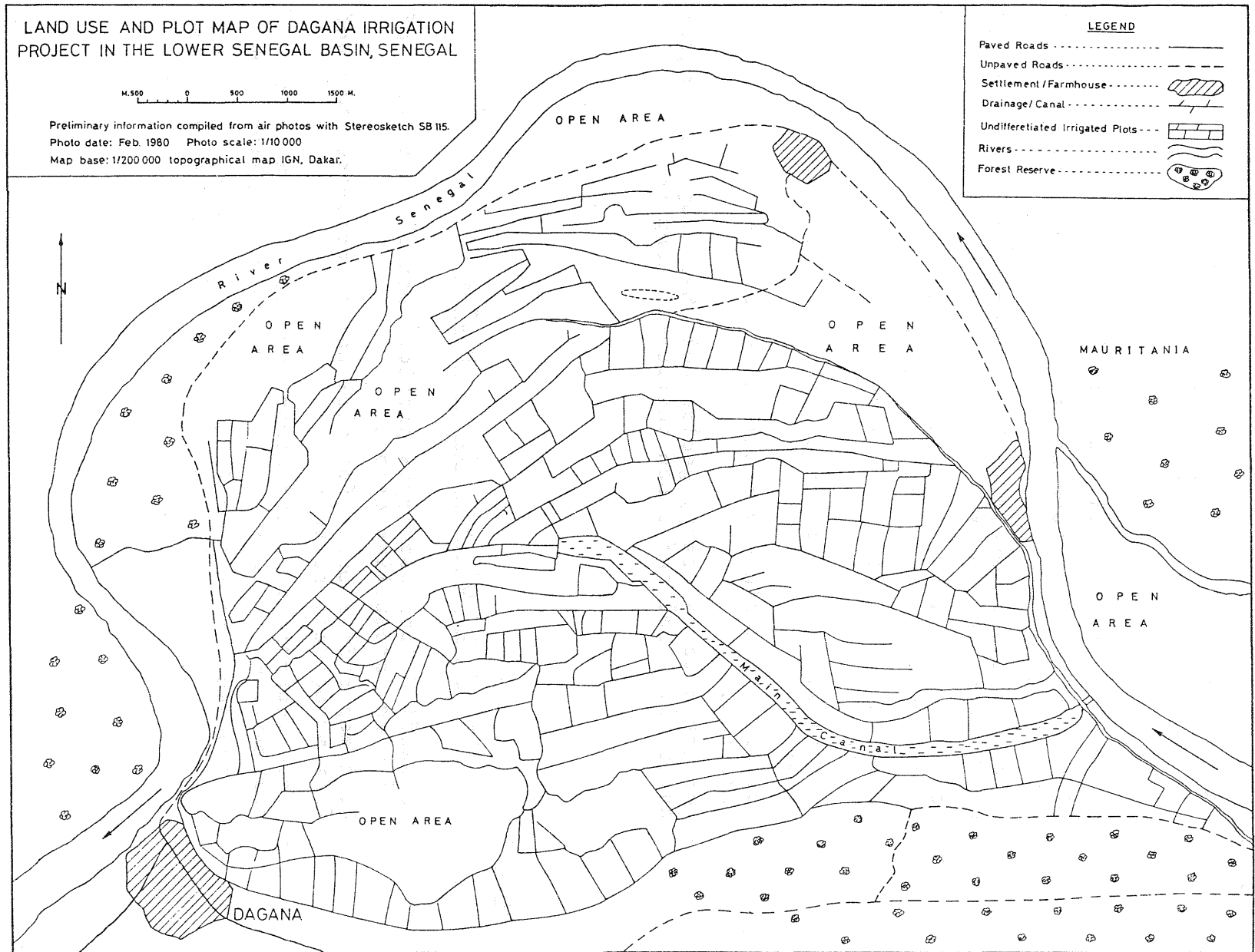
- Easily assembled, easily dismantled, easily transported.
- Simple to use for image interpretation and transfer of details.
- Binocular Stereoscopic vision offering appreciation of elevations and depths.
- Better identification and interpretation of the physical characteristics of terrain features.
- Direct transfer of interpreted information at variable drawing format.
- Possibility for integrated airphoto-satellite imagery viewing.
- Suitable to harsh environmental conditions and hard handling.
- Adaptable to forestry, geological, hydrological, agricultural, rural and urban settlement mapping.

TABLE 4:

RELEVANCE OF LAND USE AND PLOT MAP

- Classified land use types provide spatial picture of different productive areas.
- Plot map offers basis for plot-based socio-economic and farm management surveys.
- Socio-economic and farm management surveys are sources of diagnostic data for land evaluation and productivity assessment.
- Plot-based information facilitate subsequent image analysis and organization of geographic information system

Fig 2



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- Main canals;
- Open spaces;
- Forest reserves.

This classification is at a crude level because of lack of reference knowledge of the agricultural calendar, the crop type and cropping patterns of the area, and the functional buildings of the settlements. Information about these will assist subclassification to third level land use types.

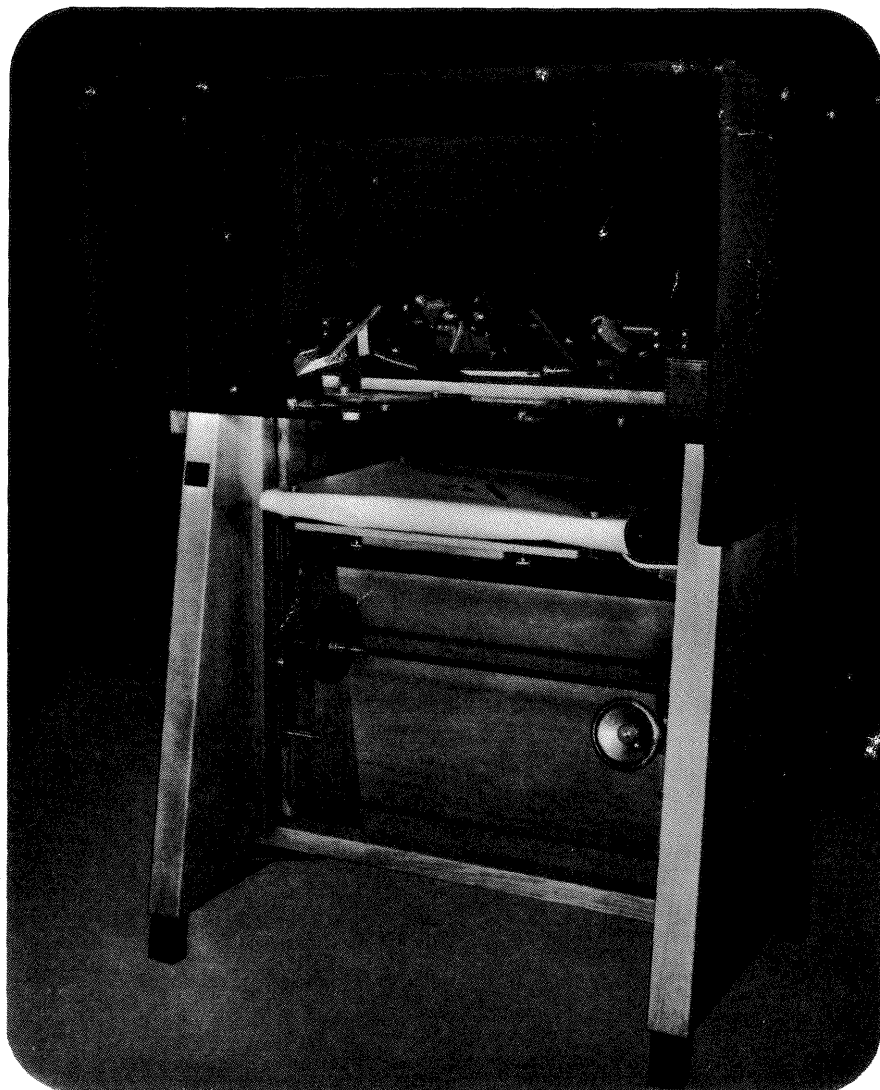
#### IV PROBLEMS AND POSSIBILITIES

The ratio of photo to map base which the exercise adopted was 2.5. This exceeded the maximum of 2.35 the Stereosketch permits. However, with the 5° tilt of the drawing board, bit-by-bit transfer of information at ratio 2.5 was successful by limiting details to be transferred to where the tilt of the board resulted in coincidence of corresponding points on both the photo and the map.

This experience has taught that the maximum scale ratio of the instrument has to be considered at the initial stage of base map adaptation. This would prevent the inconvenience of having to go over the exercise of scale conversion again.

The Stereosketch (Fig. 3) takes paper prints and this makes it easier to use because paper prints of photographs are more common than film diapositives. Resources surveying institutions could borrow copies of the paper prints easily from the Survey institutions, the state custodians of aerial photographs.

Fig. 3



The SB 115  
Stereosketch.

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