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Some Technical and Economic Aspects of Coffee  
Production on Peasant Farms in Bugisu/Sebei

I. INTRODUCTION

The basis of this paper is an investigation carried out between September 1964 and March 1965 into all aspects of coffee production in the districts of Bugisu and Sebei<sup>1</sup> in Eastern Uganda. This research was carried out for two reasons. Firstly a request for such a study was made by the International Bank for Reconstruction and Development, who are compiling a series of studies of agricultural development in sub-saharan Africa. A number of projects were selected for study in different countries and most of them have been covered by investigating teams from I.B.R.D. Makerere College was asked to provide teams to cover the two projects selected in Uganda, namely the Bugisu Coffee Industry<sup>2</sup> and Resettlement Schemes in Western Uganda. Secondly it is planned to study two other major areas of peasant-farm production of Arabica coffee in East Africa; Meru in Kenya and Kilimanjaro district in Tanzania, with a view to presenting a thesis covering certain aspects of production in all three areas.

This paper is mainly devoted to a description of the main factors which affect coffee production at the farm level. The field policies of the extension service and research into the problems involved are discussed in relation to the actual cultivation practices adopted, in an attempt to illustrate the need for a co-ordinated research and extension policy which takes full account of the farmers' actual social and economic background, rather than attempting to enforce a set of unattainable "ideals".

II. RESEARCH METHODOLOGY

In addition to a general survey of coffee production in all areas of the two districts a detailed field study of a sample of 40 coffee farmers was also carried out. Two sub-counties (or gombololas) were selected for sample areas as being typical of the coffee growing areas on Mount Elgon. These were Buginyanya in North Bugisu and Buwabwala in South Bugisu. Both had the advantage of covering the complete altitude range for coffee production from the forest edge at the upper limit to the cotton zone at the lower limit.

1. Before 1962 the two districts were combined as Bugisu District. Except where otherwise stated, Bugisu in this study refers to the combined area.
2. In addition to the writer, the Bugisu team included a social anthropologist, Mrs. Beverley Brock. Mr. Belshaw has acted as general advisor and editor for both projects.
3. In this paper a number of comparisons are drawn in particular with reference to Meru, where the writer has had some field experience. He apologises for any bias shown in that direction and believes that objective field research there will prove that the policies and practices relating to coffee production are less satisfactory than they appeared to him as an extension officer in the field.

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In Buginyanya, however, the coffee-cotton transition is abrupt and is divided by a scarp of some 500 feet.

It was considered desirable to attempt to assess the effectiveness of the Department of Agriculture's Progressive Farmers Scheme, and in each of the two sample areas a list of the "progressive" farmers was supplied by the local agricultural assistant.<sup>4</sup> Since it was also desired to stratify the sample by altitude to cover the full range of coffee production, the farmers were grouped by parish of residence. It was found in practice that the altitude ranges of parishes tended to be relatively narrow. In each of the two sub-counties a sample of ten "progressive" farmers was then drawn at random, but by parishes in proportion to the percentage of the total number residing in each parish. Each of the twenty sample farmers was then asked to introduce the writer to a nearby "non-progressive" neighbour. All the farmers were visited at least once, and where possible two or three times. During the visits, coffee production methods were observed and the farmers were questioned on a number of topics using a standard proforma. The subjects covered included social background and land tenure, resource levels, the farming system and coffee cultivation and processing methods. They were also asked to supply information about the frequency of extension visits, farmers' tours and courses attended, and visits paid to the local coffee research station and other experimental plots in the neighbourhood. In the following pages, the data quoted from farm visits refers to this 40-farmer sample. Where incomplete data was obtained, because of lack of time, this is indicated.

On eight of the farms only, i.e. four "progressives" and their "non-progressive" pairs, divided equally between the two sub-counties and between the high and low altitude zones, more detailed case studies were made. These involved the measurement of the size of the holdings, the areas under different land uses, number and distribution of fragments and other details relating to coffee areas on each farm.

### III. GENERAL BACKGROUND

Bugisu and Sebei districts lie on the Western half of Mount Elgon and extend on to the low-lying plains to the West and North. They cover a total area of 1677 square miles, of which in 1963 467.5 square miles were under montane heath and forests; swamps and open water covered 39 square miles and the cultivable area was 1170.5 square miles.<sup>5</sup> It was estimated in 1963 that the ratio of available cultivable land to cultivated land was 1.2 : 1.<sup>6</sup> Population pressure is high; in Bugisu (excluding Sebei) the average density is over 400 people per square mile; in some of the mountain areas it exceeds 1000 per square mile.<sup>7</sup> High population pressure is associated with considerable fragmentation of land holdings which is a major factor inhibiting the introduction of improved farming methods and a more intensive level of agricultural production.

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4. It is noteworthy that considerable confusion seemed to exist as to who were and who were not the "progressive" farmers. No list was available at District headquarters at the time, although one was later traced. It showed some discrepancies from the list supplied by the Agricultural Assistants.
  5. Forest Dept. Ann. Rept. 1962/63.  
Statistical Abstract 1963.
  6. Dept. of Agric. estimate for 1963 Ann. Rept. (to be published).
  7. Calculations by Mrs. Brock based on 1959 Uganda African General census, and data from Lands & Surveys Dept., all land over 7000 feet above sea level is excluded.

Arabica coffee was first introduced to the district in about 1912 after cotton had proved unsatisfactory as a cash crop for the hill areas.<sup>8</sup> It rapidly became the mainstay of the Bugisu economy. In 1962 the official estimates show an approximate area of 24,500 acres planted to coffee.<sup>9</sup> (Preliminary results of the F.A.O. Uganda Agricultural Census 1963-65 show that this figure may be considerably under-estimated.) Most of this acreage is concentrated on the mountain slopes between approximately 4000 and 6500 feet above sea level, where bananas are the predominant food crop. In these areas the soils are mainly red volcanic loams and are deep and fertile. Rainfall is abundant, generally averaging over 500 inches per annum, and well distributed throughout the year.

The importance of coffee can be judged from the fact that in at least one sub-county it covered as much as 20% of the total estimated crop acreage (excluding bananas) in 1964.<sup>10</sup> On some of the measured farms in the survey it covered 40% or more of the total farm acreage.

Government agricultural policy in the district has centred largely on coffee production and very little attention has been paid to alternative cash crops until quite recently. Consequently coffee planting has tended to extend into ecological areas unsuited to its growth, which has intensified the problems of production. The central importance of coffee in the District economy means that in years of low yields and/or relatively low prices hardship is suffered by many of the 50,000 or so coffee farmers in the area and District Council revenues have been seriously affected.

Official concern over low coffee yields, and an apparent decline in quality, particularly in the past two decades, has led to a number of important policy decisions being made. Two recent measures are particularly relevant to the present discussion. In 1959 the Bugisu Coffee Improvement Scheme was launched with the object of supplying specialist coffee field staff for a five-year period. Financial provision was subsequently made for continuation of the Scheme until the end of the first 5-year plan. For various reasons this staff has tended to become increasingly non-specialist and to take on general agricultural duties. The Bugisu Coffee Development Plan was inaugurated in 1961. This envisaged the expenditure of some £350,000 of the accumulated growers' funds on improvements such as construction of central pulperies, a replanting programme and organised chemical control of insect pests.<sup>11</sup>

A considerable volume of research has been carried out since 1925 into coffee production problems in Bugisu; the Bugusege research station was started in 1927.<sup>12</sup> For the past 13 years discussion has been continuing on plans to open a new enlarged Arabica research station in the area, and in fact financial provision has been made for this in estimates since 1955.<sup>13</sup> An entomologist has been stationed in Mbale since 1959, and concentrates on coffee problems.

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8. Morgan, 1958., Uganda Journal, XXII:2 pp 107-102
  9. Dept. Agric. Ann. Rept. 1962. appendix.
  10. Information: D.A.O. Bugisu/Sebei.
  11. Dept. of Agric. Ann. Rept., 1961, p. Minutes: Bugisu Coffee Board, 28-6-61.
  12. Dept. of Agric. Ann. Rept., 1930, p.16.
  13. A Five-Year Capital Development Plan 1955-1960, FIRST REVISION 1957.

In 1959, the Department of Agriculture issued a consolidated field policy for Arabica coffee growing in Uganda. <sup>14</sup> This policy still stands in essence, although recommendations for pruning have since been revised. The ensuing discussion of production methods is made in the light of this policy.

#### IV. COFFEE PRODUCTION TRENDS IN UGANDA

Under the International Coffee Agreement, Uganda is bound to restrict her coffee exports to a fixed quota. Already production is considerably in excess of this quota and is expected to rise much faster than the proposed 3% annual increase in the I.C.A. quota. <sup>15</sup> Under these conditions it might be asked whether in fact there is any point in attempting to raise yield levels in Bugisu, or even in discussing improved methods of production. However, in recent years, Arabica coffee prices have exceeded those for Robusta by approximately £150 per ton and there is obviously a case for substituting Arabica for Robusta within the limits of the quota. In addition, it is generally recognised that quality in Arabica is partly dependent on cultivation standards; in other words, that it is generally correlated with the level of production within certain limits, in particular that overcropping is prevented by pruning, and by raising the level of nutrition available to the trees and that pests and diseases are adequately controlled. <sup>16</sup> The considerable premiums usually offered for quality in the Arabica market make this aspect of production one of vital importance at farm, district and national levels.

#### V. COFFEE PRODUCTION IN BUGISU

A study of coffee yields in Bugisu over the past thirty years shows two distinct trends. Firstly overall yield levels appear to have declined in the years 1936/37 to 1943/44, and to have remained at a relatively lower level since the end of the war. (See Appendix I.) It should be emphasised that these yields are based on officially estimated coffee acreages, and that if, as the F.A.O. census may prove, these are underestimates, then actual yield levels may be significantly less. Over the ten-year period 1954/55 to 1963/64 the average yield appears to have been in the region of 5.1 cwts. clean coffee per acre. This may be compared with the following average yields extracted from D.A.O.s' annual reports for 1964:-

MERU	1963/64	-	7	cwt. clean coffee/acre
NYERI	1962/63	-	12.4	" " " "
"	1963/64	-	7.4	" " " "

(The Nyeri records are for a "random" sample of 40 farmers.) It is regrettable that average yields in these areas over a longer time-period are not available for comparative purposes.)

The statement that yields have declined must be qualified by reference to the second feature of the yield pattern which is also apparent from appendix I, i.e. biennial bearing. This tendency appears to be more marked at some times than at others and can cause considerable instability in the economies of individual farms as well as at a district level.

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14. Dept. of Agric., Dept. Circ. No. 8, 1959.

15. According to estimates prepared for the second 5-year plan the quota in 1964/65 stood at 103,000 tons against estimated production of 158,000 tons. By 1969/70 the quota is expected to rise to 129,000 tons and production to 253,000 tons (of which 235,000 tons will be Robusta).

16. There are a number of other factors which are related only to quality, e.g. harvesting and processing; it is not proposed to deal with these in this paper as quality aspects are very complex, and it is hoped to treat them separately in a further paper.

TABLE I : ESTIMATED TOTAL VALUE OF COFFEE  
CROP TO GROWERS IN BUGISU/SÉBEI. 1954/55 - 1963/64

Crop Season	Total production <sup>1</sup> parchment & buni (tons)	Estimated total value <sup>2</sup> of crop to growers £
1954/55	6666	2,015,662
1955/56	4175	1,349,576
1956/57	5365	1,420,353
1957/58	4989	1,198,602
1958/59	5115	764,072
1959/60	6215	1,013,722
1960/61	5464	972,623
1961/62	8883	1,703,786
1962/63	3503	587,499
1963/64	10002	1,881,841

(Source: Dept. of Agric. Ann. Repts.)

Notes:

1. No account is taken of illegal sales or sales to the Bugisu Coffee Marketing Association in 1961/62 and 1962/63. These may have added to growers' incomes fairly significantly.
2. These estimates refer to payments for crop made by the Co-operative Union to primary societies, where some further deduction may have been made in some cases.

Although the problem of biennial bearing is probably at least as important as that of overall yield it appears to have received little attention from the research division.<sup>17</sup> It is apparently a normal feature of Arabica coffee. However, Kenya experience indicates that good management can reduce the effects by controlling over-cropping through pruning and at low altitudes the planting of shade. More level production is then encouraged by judicious use of copper sprays and the application of nitrogenous fertilisers and mulch. It is questionable whether such a relatively high level of inputs would give adequate returns under the conditions pertaining in Bugisu, particularly in the absence of central pulperies which could help to earn quality premiums; however, experimental evidence suggests that some at least of these measures could prove profitable and the co-operative credit scheme has demonstrated a feasible way of enabling farmers to purchase the inputs necessary for short term improvements in productivity.<sup>18</sup>

Table 2 summarises the yield levels from the control (no treatment) plots in about 95 field trials of fertiliser and fungicide spray applications on farmers' coffee widely scattered throughout the district, in the years 1963/64 and 1964/65. These indicate very wide yield variations between the different counties in Bugisu and Sébei and that biennial bearing trends are not all in the same direction or of equal magnitude at the same time. It is suggested that more basic investigation is required to establish the effects of soil type, altitude, climatic conditions and other local factors on the pattern of bearing in Bugisu.

17. Some recent work by Butters at Kawanda on Robusta coffee may be relevant, however. This indicates that the yields of Robusta coffee are closely associated with moisture availability during the dry season.

18. Hunt, Miss D., R.D.R.4, 1965.

TABLE 2 : YIELDS OF FRESH CHERRY PER TREE IN CONTROL PLOTS OF NITROGEN FERTILISER X FUNGICIDE SPRAY TRIALS IN BUGISU/SEBEI, 1963/64 and 1964/65.

COUNTY* AREA	SOUTH BUGISU	MANJIYA	CENTRAL BUGISU	NORTH BUGISU	SEBEI
(a) 1963 / 64					
No. of <sup>1</sup> trials	20	15	10	30	20
Yield of control plots	10.40	3.19	4.09	21.82	8.16
(b) 1964 / 65					
No. of <sup>1</sup> trials	18	15	10	30	20
Yield of control plots	6.63	1.97	3.54	25.09	4.54

(Sources: Kawanda Research Station : unpublished data.)

Notes:

1. Each trial contains one 16-tree control plot.

VI. MAJOR FACTOR AFFECTING COFFEE PRODUCTION IN BUGISU

A. Maintenance of Soil Fertility

Although it has been recognised for a long time that yields were low and very variable, little effective research on fertility problems has been carried out until recently. There were some soil treatment experiments at Bugusege started between 1930 and 1936. These compared mulching, clean weeding, cover crops, weed cover, shading, etc. The results of these experiments do not appear to have been analysed or published, although it appears that they might have yielded useful information which could have been used as a guide line in formulating field policies.

The only investigation that appears to have been carried out into possible trace-element deficiencies was a pot-test of three Bugisu soils at Kawanda by Dr. E. M. Chenery, then Senior Soil Chemist, in 1955.<sup>19</sup> Nitrogen and Sulphur were the only elements found to be significantly deficient in this test. The need for trace elements is possibly rather marginal at this stage, whereas the application of some form of organic matter would probably prove beneficial and would help to increase the overall nutrient status of the soil. Since 1956, research on fertiliser applications has been in progress and indicates important potential for increasing productivity.

19. Dept. Agric. Ann. Rept., 1955, p.63.

### 1. Manuring:

No quantitative experiments appear to have been carried out in Bugisu on the response of coffee to applications of farmyard manure. In Kenya, experiments have not generally shown significant yield increases except under dry soil conditions in the absence of mulch and also when used in the planting hole. In Bugisu the soil in coffee plots is often powdery as a result both of too-frequent use of the flat-hoe (jembe) for weeding and apparently a deficiency of organic matter. This has led to erosion of the soil around the roots of old trees, which often appear to be exhausted and deficient in nitrogen and other nutrients.

In the survey of 40 farmers, 29 said they used manure of some sort but always in limited quantities. Half of these applied only "token" amounts and none of the others had applied manure to as much as half his coffee. All the manuring was restricted to coffee within easy reach of the homestead. The increased vigour of the trees near the homestead was undoubtedly an impressive demonstration to farmers of the value of organic manures and they appeared keen to increase applications. There were serious limiting factors, however, in the supply of materials for making manure and the high labour demands for its application, particularly to coffee situated at some distance from the homestead. The various sources of manure used were as follows:-

(a) F.Y.M. Supplies of F.Y.M. are limited since many farmers do not keep cattle. In the survey 23 out of 40 did (average of 2 head per cattle owner including youngstock) and of these only 7 had built a cattle kraal. Even when F.Y.M. was usually not produced because of a shortage of material for litter. There is also a demand for pure cow dung for building purposes. Some farmers appeared not to have understood the methods of manure production (possibly a deficiency in extension work). The raw dung available was generally thrown directly on to the coffee or mixed with compost.

(b) Compost: At least 25% of the farmers had constructed compost pits which were filled with refuse, coffee pulp, etc. Some very good compost was produced and the technique appears to have received considerable attention from extension workers. The compost is usually applied in coffee or banana plots, but always near the homestead.

(c) Coffee pulp: In the survey about one third of the farmers used pulp as a manure. Less than half in fact had their own hand-pulpers; many of the smaller farmers took their cherry to wealthier neighbours for pulping and left the pulp there, to the added benefit of the latter. In most cases the pulp was not composted but tipped raw on to the nearest coffee trees. This practice is not recommended as it may reduce the nitrate status of the soil or possibly lead to toxic conditions. A few farmers pulped directly into compost pits, and produced a well-rotted manure.

(d) Household Refuse: It is very common for the coffee trees nearest to a farmer's house to be the healthiest on the farm, as household refuse is thrown amongst the trees. This includes banana peelings and stalks, coffee pulp from hand pulpers, and other vegetable matter, which acted more as a mulch than a manure.

It would seem that the correct and more widespread use of compost pits should receive even greater attention. These pits make the best use of all the available materials including raw dung. There is also need for research into the value of coffee pulp, to determine its actual effects when applied both raw and rotted. The problems of labour and fragmentation preclude the widespread application of manure to coffee whilst the nearest trees may receive applications beyond the point of diminishing returns.

## 2. Mulching:

Mulching is widely recommended for coffee in various parts of the world. In five experiments in various areas of Kenya average responses in terms of increased yields of coffee were from 9.6% - 55.3%.<sup>20</sup> Reasons for the great attention it has received in the extension programme in Kenya include the obvious benefits of reducing soil temperature, conserving moisture in the dry season and supplying a certain amount of nutrients to the soil, as well as the prevention of weed growth. In addition, its use minimises the dangers of soil wash. Since it supplies humus as well as all the other benefits, and increases yield levels, it is considered far more important to apply mulch than organic manures.

The practice has been recommended for many years in Bugisu. In the soil treatment trials of the 1930's mentioned above, mulching appears to have given higher yields than either clean weeding on its own, the use of cover crops or uncontrolled weed cover for part of the year. Mulching with banana trash was stated to be a standard practice in 1934.<sup>21</sup> Later reports noted a decline in its use and in the post-war era, it was almost completely abandoned. It was one of the husbandry aspects upon which the new staff established under the Improvement Scheme (1959) concentrated. The response to their efforts has been generally poor. A large proportion of the coffee in Bugisu is not mulched at all. Of the 40 farmers visited 28 had attempted a little mulching. No one had covered more than an estimated 10-15% of his total coffee area, and in about half of these cases the amounts used were so little as to be quite ineffective. Generally the material used consisted of the prunings of bananas interplanted with the coffee. A few growers had also used sorghum stover, particularly in South Bugisu, where this is a popular crop in the coffee areas. It was only used where the plots of sorghum were in close proximity to coffee gardens.

One of the major reasons for the failure to mulch is the lack of available material. In Kenya recommendations to plant mulching grass have found fairly wide acceptance. One of the reasons for this has been the supplementary uses to which the grass can be put. For instance in Nyeri, Elephant grass (Pennisetum purpureum) is planted both for mulch and for dry-season feeding of exotic dairy cattle. In Meru Hyparrhenia sp. has become very popular because it is also useful for thatching. In both cases the grass may be diverted from use as mulch, but generally some is available for this purpose. In Bugisu fodder grasses are rarely planted since there is no intensive livestock enterprise, nor is grass generally used for thatching in the hill areas.

The degree of fragmentation also limits the availability of mulching material. In Nyeri district of Kenya, land consolidation has led to farm planning and mulching grass areas can be placed close to the coffee. In Bugisu the highly fragmented conditions mean that even were it possible to persuade farmers of the need to grow mulching materials, their ability to adopt the practice would be seriously limited by the difficulties of transporting grass to the scattered plots of coffee. This also precludes wider use of the residues of sorghum and maize.

The most easily available material is banana prunings and trash. The Department of Agriculture has encouraged the cutting down and splitting of the old stems in order to effect some control of the banana weevil by disturbing its breeding cycle. However, once again banana residues are very heavy and the degree of fragmentation limits their use to that coffee in close proximity to the banana plot. The pros and cons of interplanting are discussed below, but one advantage relevant here is that it makes some mulching material available in situ.

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20. Pereira and Jones, 1950. E.A.A.J., XV:4 pp. 174-177.

21. Dept. Agric. Ann. Rept. 1934.



The labour demands for mulching are fairly high, particularly in the fragmented system. (On consolidated holdings in Nyeri the labour inputs per acre on mulching were only about one fifth of those for weeding, according to a recent survey.)<sup>22</sup> However, labour inputs may not be entirely limiting even in Bugisu since mulching could be undertaken in the dry season, which is a relatively slack time of the year. It would probably involve either a sacrifice of leisure, relatively highly valued at this the peak drinking season, or expenditure on hired labour.

It would certainly appear that an increase in mulch application would be highly beneficial in Bugisu. Its use has been recommended for many years and it was included in the Arabica Cultivation Policy (1959).<sup>23</sup> In this the planting of Elephant grass was advocated and the recommended method of application was in alternate rows across the slope. The use of banana trash, maize or sorghum stover and other-crop residues are also approved. Application of this policy in Bugisu is unlikely to succeed, partly because the limiting factors have not been taken into account by extension workers. The benefits of mulching do not appear to have been widely enough publicised, and there was little conviction on the part of the farmers interviewed of the need for it. In this as in other practices, advantage does not appear to have been taken of the possibilities of using the better farmers for demonstration to others in their neighbourhood.

### 3. Nitrogen Fertilisers:

Kenya commenced trials in 1947 and definite recommendations were issued for estates in about 1955.<sup>24</sup> The use of fertilisers has been practised among African coffee farmers since about 1961; in 1964 it is reported that in Meru District, 689 tons of nitrogen fertilisers were purchased for use in coffee.<sup>25</sup> However, no fertiliser experiments on coffee were started in Bugisu until 1956, when one comparing eight rates of Nitrogen application (20 - 160 lbs. N per acre) and an untreated control was laid down on the Bugusege Research Station. Over an eight-year period this has shown a small linear response to nitrogen (0.16 - 1.36 cwts. of clean coffee increase per acre). A second experiment, started in October 1959, measured the main effects of applications of N, P. and K., a mulch treatment and their interactions. There have been no significant yield increases from any treatment. The conclusion drawn is that "probably neither N., P. or K. fertilisers have a significant beneficial effect on coffee growing on level, uneroded soils of the Bugusege series". A third experiment was started in 1962 to compare times of application and types of Nitrogen fertilisers. In 1963 no significant difference was recorded between the types of fertiliser or their interactions with the times of application but a late application gave significantly higher yields than a split application. Further evidence from field trials covering the range of soil types in the area was considered necessary and in 1963, the 95 small plots were laid down on growers' farms in all areas of Bugisu. These compare the effects of N. fertilisers alone, copper fungicide sprays alone and a combined treatment. Even in the first year some significant increases from both fertilisers and spraying have been recorded and in the second year very big increases are

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22. F.E.S.U. Rept. 21, 1962.

23. Dept. Agric. circ. no. 8, 1959.

24. Kenya Coffee Board Bulletin, Nov., 1955.

25. D.A.O. Meru Ann. Rept. 1964

evident from preliminary results. 26

The level of experimentation on fertilisers in recent years is thus fairly extensive. However, this work appears to have been started at a late stage; it is unfortunate that the follow-up field trials were delayed a further seven years especially in view of the long-recognised atypicality of the Bugusege soil. The Department of Agriculture still has not committed itself to definite recommendations for use of nitrogen fertilisers on Arabica coffee in Uganda. Reasons for further hesitancy are not clear, although more evidence from the field trials is said to be necessary. There has been a feeling in the Department that the prime need was to raise the low standards of overall management first. To some extent this seems reasonable as, for instance, fertilisers can encourage weed growth and lead to overbearing in the absence of proper pruning. However, fertilisers would in general rapidly raise both production and quality. Increased yields from Nitrogen would also encourage the adoption of other recommended practices.

There is now some evidence of growing interest in improved methods and a tendency towards an intensification of production. Since soil fertility is already or soon becomes a limiting factor, there is no great incentive to improve overall management practices in the absence of some improvement in this direction. It usually takes some years between the introduction of new practices and their general acceptance by growers and an early start should have been made in explaining the value of fertilisers and demonstrating their use. It would appear for instance that even the field trials have not been used as a demonstration; in the survey only two farmers had trials on their coffee, and one of these denied that fertilisers had ever been applied to the plots. The application had obviously been made without his attention being drawn to it. Of 39 farmers asked, 27 said they had heard of fertilisers but most of these had never seen them. Only one farmer had tried to apply any. In 1964 he purchased 200 lbs. of superphosphate for use on coffee and vegetables. Unfortunately, responses to phosphates in mature coffee are unusual, and his experiment is likely to lead to disappointment.

#### 4. Erosion Control:

The volcanic soils of Mount Elgon are relatively stable and soil erosion has not been a serious factor in Bugisu; in consequence erosion control has received much less attention than in some other densely populated hill areas of East Africa. Some effort has been made to persuade farmers to follow the simple expedient of planting live bunds mainly with Coleus spp. or the grass Paspalum notatum. With recurrent cultivation the soil tends to build up into fairly level terraces behind the bunds. All the work is done by the farmer himself and bunds are aligned by eye. In Bugisu digging of terraces is not usually resorted to, although a few simple tie-bunds were seen.

It appeared in the farm sample that soil conditions in coffee gardens were not entirely satisfactory. Whilst of the 40 farmers 36 had made some effort at bunding and three of the others were on flat land, nevertheless on 19 farms some erosion was noted. In general the bunds are widely spaced and poorly maintained. Constant use of flat hoes combined with a lack of mulch or manure has resulted in powdery soil conditions. Gully erosion was not seen, but in the dry season, soil movement commonly occurred when walking across the slope and trees were often seen with roots exposed to the air. These observations confirm those of Wallis and others of the Kenya Department of Agriculture who visited Bugisu in 1961. 27 They considered soil conditions to be quite serious and advocated a change in weeding policy to allow the regular slashing of weeds with digging only once a year. The 1959 Policy 28 advocated alternate-row

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26. Kawanda Research Station Ann. Rept. Part II 1963-64. pp. 78-89.

27. Wallis, Jukes and de Vink, unpublished safari report, 1961.

28. op. cit.

mulching across the contour. In the absence of sufficient material, its concentration in every third or fourth row would help somewhat to reduce erosion effects. Efforts to persuade farmers to maintain their bunds and to reduce the spacing between them do not appear to have been vigorous enough to effect any significant improvement.

## B. Planting Material

### 1. Varieties

A considerable amount of investigation has been carried out into varietal problems, but trials have usually been rather short term and this has led to at least one serious policy mistake in the past. The aim of trials in the past has been to find the highest yielding variety. Unfortunately, this criterion is not sufficient on its own. Resistance to disease and climatic conditions and tolerance of the prevailing standard of management are also necessary, and in fact the disease factor has now become very important in the new variety trials.

The original type of arabica coffee was introduced into Uganda from Nyasaland (Malawi) in 1900 and was known as "Nyasaland". It had originally been derived from a single tree imported into Nyasaland from Edinburgh which in turn originated in Central America (probably Costa Rica). It is described as a "drooping" type with long primaries and much secondary growth. It is rather prone to leaf fall and dieback and is slow growing. It is fairly drought resistant. It is similar in many characteristics to Blue Mountain which was imported into Kenya in 1903<sup>29</sup> "probably derived from a Nyasaland type".<sup>30</sup> Seed of "Nyasaland" was supplied to Bugisu Native Administration from around 1911 onwards and it was the only variety planted in Bugisu for many years. Seed was selected locally and it came to be known as the "Bugisu Local" variety. A very large proportion of the present coffee acreage is made up of this type.

Many variety trials have been carried out in Bugisu. The first series of these was a number of observation plots at varying altitudes comparing five varieties. These were planted in 1936<sup>31</sup> and showed the immediate superiority, as far as short-term yields were concerned, of Kents, a Kenya type originally imported from Mysore in India. In 1944-45 an "increase plot" of Kents was established at Bugusege for seed production and the variety began to be issued from around 1948. By 1951 severe "dieback" was reported from Kents planted at the lower altitudes in Bugisu. The variety soon became unpopular with growers who blamed its introduction for the decline in yields. Melville et al.<sup>32</sup> described it as an erect type, developing less secondary growth and having less leaf than Bugisu Local. They also commented "it is a type which one would expect to suffer severely from overbearing especially in view of the additional effects of pests and diseases in reducing leaf...the variety trial was uprooted when the coffee was still quite young, because it was considered to have achieved its purpose. With a perennial crop like coffee which might be in the ground for fifty years, this was a bad mistake...."

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29. cp. P.A. Jones, 1956, who states that Blue Mountain was introduced into Kenya in 1913 from the Blue Mountains of Jamaica. (Coffee Board of Kenya Monthly Bulletin XXI, pp. 305-309.)

30. Information: Kawanda Coffee Research Unit card index.

31. Dept. Agric. Ann. Rept. Pt. II. 1937-38 p. 94

32. Melville, Jones & Cottington, 1952. (unpublished safari report.)

.... varieties should, however, be evaluated in a trial under the exact conditions which will apply in commercial practice.... field observations show that Kents coffee is too high a yielder for the level of cultural husbandry at present practised by the Bagisu". They recommended a return to Bugisu Local for the time being and the establishment of a new series of variety trials containing some of the improved Kenya selections. These recommendations were carried out and in 1953 and 1954 a number of trials were established at widely scattered centres covering the full altitude range of coffee growing in Bugisu. These district variety trials were only cropped for three to five years and were then uprooted to make way for a new series of trials planted in 1963, which are now coming into bearing. Results showed that the Kenya selections, particularly SL14 and SL28 outyielded the other varieties at most centres. Bugisu Local gave the lowest yields but still averaged 10.8 hundredweight of clean coffee per acre, which is considerably higher than district average yields. The time allowed for this programme was very short, although in this case there was much supporting evidence from Kenya. Melville's criticisms of the earlier trials would also apply in large measure to this second series.

The 1959 Policy <sup>33</sup> recommended the planting of Bugisu Local or Kents until "better varieties are found". The inclusion of Kents was surprising in view of Melville's recommendations to the contrary. However, mainly as a result of the 1953/54 planted trials a new variety policy was adopted in 1960/61. <sup>34</sup> This has particular reference to the replacement scheme. The recommended varieties are:

Medium and high altitudes - SL14 or SL28  
Low altitudes - KP423 or KP162

Wallis et al. <sup>35</sup> advised caution over introduction of the high-yielding SL types partly in view of their susceptibility to both Leaf Rust and Coffee Berry Disease (C.B.D.) They further suggested that Bugisu Local had given adequate yields under good husbandry in the trials and had formerly proved capable of a reasonable quality in the days when central-pulpery coffee was produced prior to about 1950. Their advice, however, has not been accepted.

The 1963 planted series of trials compares some of the Kenya selections with others from Tanzania. Uganda joined an East African Arabica Coffee Breeding Scheme in 1963. <sup>36</sup> This aims at producing high-yielding, disease-resistant hybrids. Some of these hybrids have been included in a number of "sorting" and "intermediate" trials laid down in Bugisu in recent years. A small observation plot of Indian "rust-resistant" varieties has been laid down at Bugusege and in 1965 it is planned to plant some trials in the district including "C.B.D.-resistant" types from Rwanda. In the latest trials it is noted that the cultivation standards are again far superior to those in most of the nearby growers' plots. Most of the farmers visited had failed to understand the purpose of variety trials and assumed them to be demonstrations of unattainable standards of husbandry.

## 2. Production of Planting Material

Prior to about 1960, nurseries had been the responsibility of a number of different organisations including the Native Administration, the Department of Agriculture and the Co-operative Societies. The Bugisu Coffee Rules <sup>37</sup> provided for the licensing of private

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33. op. cit., p. 1

34. Information: Officer-in-charge, Kawanda C.R.U.

35. op. cit. 1961

36. Kawanda R.S. Ann. Rept. Pt. II 1963-64 p. 64

37. Legal Notice 174 of 1960.

nurseries which were to supply seedlings for replanting only. In 1963 the Uganda Government decided to stop additional plantings (but not replacement) in view of the International Coffee Agreement.<sup>38</sup> By 1962 about 140 licences had been issued and the departmental nurseries were closed down. Private nurseries produced seedlings for sale in 1963 and 1964. Many illicit nurseries have also been established in the last few years.<sup>39</sup>

Only two private nurseries were visited during the survey but these confirmed reports of poor standards of management generally. The seedling beds were not dug deeply enough and no manure or fertiliser was used. Seedlings are generally issued when far too small, despite the high prices charged (range quoted from cts. -/17 to cts. -/30). A few farmers expressed dissatisfaction with the quality of seedlings sold from private nurseries. There appears to be a lack of control over the persons to whom seedlings are issued and no records of sales are maintained; many of the seedlings are possibly used for extension of acreage, which is not accounted for in the official estimates. Nursery owners obviously need facilities for training and for regular visits by an extension worker with specialised knowledge of nursery management, as well as closer supervision of the distribution of seedlings.

In 1962, the Replacement Scheme was started as part of the Coffee Development Scheme. A large central nursery has been established to raise seedlings of improved varieties. The nursery is supervised by Department of Agriculture but financed by the trustees. It covers an area of  $4\frac{1}{2}$ -5 acres with a capacity of some 400,000 seedlings. In general, they are of a good size and few insect pests were noted, although no spraying is undertaken. A serious outbreak of Leaf-Rust disease was noticed, although this seemed to cause the Agricultural Assistant in charge little concern. It is, however, likely to retard the growth of the seedling. It had originally been hoped to produce seedlings for a total cost of cts. -/10 each, but labour charges alone were stated to be about cts. -/55 per seedling in July 1964.<sup>40</sup> Seed obtained from Kenya costs shs. 100/- per lb. (however, some is locally produced.) This is equivalent to approximately another cts. -/10 per seedling. Seedlings are issued free under the scheme, and the growers will obviously not be concerned about this situation; however, the implications for the future of the scheme are serious, and a much higher level of supervision is required here to reduce labour costs.<sup>41</sup>

It was noted that little experimentation had been carried out on nursery techniques. A few trials of sowing seed direct into seedling beds were attempted by the Bugisu Coffee Board's field officer some years ago, but nothing else has been recorded. The use of fertilisers, spraying to control leaf-rust, the most economic method of watering and many other aspects of seedling production would be worth some investigation.

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38. Proposals to reverse this decision have been made by the working party on the second Five Year Plan.
39. D.A.O.'s files, 1962.
40. D.A.O.'s files.
41. Apparently some steps have already been taken.

### C. Replacement Schemes

Two replacement schemes have been initiated in Bugisu. The aim has been to uproot old or neglected trees and provide free seedlings for replanting.

#### 1945-1957

This scheme started on an experimental basis in Central Bugisu, and was later extended to other parts of the district. The aim was to uproot and replace neglected coffee plots. Complete records of issues in 1950-52 have not been traced, but from figures available it would appear that about one million seedlings were issued. This was equivalent to about 10% of the total number of trees in the ground in 1945. There is no information on the degree of control achieved to ensure that the seedlings were used for genuine replacement. During the latter years the co-operative societies took over the nurseries and many illegal issues of seedlings took place at that time.

#### 1963 (The Coffee Development Scheme)

Towards the end of 1960 the D.A.O. proposed a replacement scheme to cover 1000 acres per year. He suggested a payment of cts. -/60 be offered for every seedling successfully established, providing the grower had followed the rules of correct planting and establishment. These proposals were discussed by the Bugisu Coffee Board and incorporated into the Development Scheme. The intention was to spend £100,000 on the project over a five-year period.

Some 860,000 seedlings have been issued under the scheme in the first three years (1963-1965). At the recommended spacing of eight feet by eight feet part this is equivalent to approximately 1250 acres. However, since they have replaced coffee mainly planted at the pre-1959 spacing of six by six this is equivalent to replacing approximately 700 acres. This constitutes only two and half per cent of the District's total estimated acreage in 1963, although the rate in 1964-65 was considerably higher than in the first two years. The slow progress made so far may not be due to the limitations of seedling availability since they can generally be purchased from private nursery owners by the Department of Agriculture and this was in fact done in 1964 to supplement the central nursery supply. The cts. -/60 subsidy payment has not proved very satisfactory. Firstly, the sum appears to be too low to be a very effective inducement. The loss of crop even on poor trees should not be worth less than cts. -/50 per tree per year. Since it takes some three or four years before the new trees will come into bearing, and establishment costs are high, the subsidy is not likely to cover more than 25% of the loss involved. The Department of Agriculture was apparently considering cessation of the subsidy payments in 1965.

The present operation of the subsidy is open to abuse. Most of the inspection work, carried out about six months after planting, is done by the Field Assistants who are local men, usually from the same lineage as farmers in their area. In these circumstances they are loath to penalise growers and make themselves unpopular. One A.A.O. who was determined to make a conscientious assessment for subsidy payments in 1964 arranged that either he or his senior assistant personally visited all the farmers with new replacement coffee in the County. As a result they recommended payment of the subsidy on only 4042 trees out of a total of 70,949 issued. The normal level for payment has apparently been in the order of 70-80% of trees issued.

Of 37 farmers asked, five said they had never heard of the scheme and four others indicated they had not understood it. It appears then that an expensive and potentially important scheme has been launched without the full publicity required. 10 farmers (eight of them "progressive") out of 20 in South Bugisu had joined

the scheme against four out of 20 in North Bugisu. All the farmers who claimed to be ignorant of the scheme were from North Bugisu, which probably indicates variations in the drive and efficiency of extension staff between different areas. Little care had been taken over establishment and most farmers visited had failed to comply with some of the conditions laid down and showed a lack of real enthusiasm for the scheme.

In view of the high costs of replacement and the comparatively slow return, it is doubtful whether this is a very effective way of utilising funds allocated to coffee improvement, particularly in view of the undoubted potential for increases in yields of Bugisu Local trees. In addition, as has already been pointed out, the varieties currently in use for replacement in the high-altitude zones are known to be susceptible to C.B.D. and it would appear a wiser policy to abandon the programme until C.B.D.-resistant material can be made available. A greater return would seem to be guaranteed from a programme of multiple simultaneous improvements in husbandry, possibly utilising some of the Development Scheme funds for short-term credit for fertilisers, etc. or to finance increased labour input. On the other hand there is still a need for a more limited programme of replacement of the old, exhausted trees which are beyond rehabilitation. Farmers could be encouraged to do this, using planting material from the privately-owned nurseries. The low-altitude replacement scheme using tested varieties with considerable resistance to Leaf-Rust appears to be a much more satisfactory one which could well continue at the present level.

#### D. Establishment of Young Coffee in the Field

District Annual Reports suggest survival rates of newly planted seedlings of from 70% to 90% depending on the season. Rates of 50% or below are not unknown. Although there have occasionally been dry years, rainfall distribution is generally very favourable to planting. A study of 30 years' average rainfall figures at the Bugusege Research Station indicate a very even pattern of distribution in the area with at least one inch of rain in every month and an annual average of 56.35 inches; in fact some parts of the District are considerably wetter than Bugusege. 42

Planting usually takes place between April and June. From observations in the field it was clear that good planting methods and post-planting care had been neglected. Although the field survey was carried out before the planting season, standards in the previous year had been poor and little attention was given to young trees in their early, unproductive years. The issue of free or highly subsidised seedlings and the failure to penalise those who by neglect permit unnecessary losses have tended to encourage bad establishment methods. In Meru District when a similar situation arose some local co-operative societies agreed to charge a higher price for "infill" seedlings.

The Bugisu Coffee Rules 1962 43 (Sec. 23) state that "Coffee

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E.A. MET. DEPT.,  
42. Summary of Rainfall in Uganda, 1962

43. Legal Notice 200 of 1962.

trees and seedlings shall be planted in properly prepared sites, in clean, deeply cultivated land, free from bananas, perennial grasses and weeds and at intervals specified by an authorised officer" and that (Sec. 24) "adequate soil and water conservation measures shall be maintained on all land on which coffee is grown..." The 1959 policy<sup>44</sup> also stresses the need for good planting methods and care of young seedlings. Recommendations include the digging of planting holes to be left open for six weeks to permit adequate weathering, the use of manure in the planting hole, the shading of young plants and adequate soil conservation measures.

Of 38 farmers asked, 23 said they had used some manure in recent plantings but the amounts were probably very small, as only very small quantities are available, and farmers are not in the habit of purchasing manure. Only 10 out of 31 asked said they had been using manure at all apart from the last few seasons. Most farmers said that they now prepare holes as recommended and try to shade the young plants from the sun, but they agreed that they had not formerly done so. Some young coffee seedlings were planted in old banana gardens, which help to provide a shade canopy. Many of the plots of young trees were very weedy and several instances were seen where 25% or more of the last season's planting had died. It is therefore apparent that although standards have now been laid down and some advance has been made, there is still much scope for improvement.

#### E. Interplanting with Bananas

Some interplanting was carried out in the early days and the first experiments on coffee in Bugisu were some observation plots at sub-county headquarters to determine the value of bananas as a shade tree in coffee. In 1927 these plots were reported to have shown the practice to be inadvisable.<sup>45</sup> There are many conflicting references to interplanting, e.g. in January 1939 the Government Botanist reported favourably on the benefit of bananas as a "nurse" crop for young coffee trees. He also thought the coffee was more likely to be mulched if interplanted with bananas. In 1940 he suggested the need for a trial to be laid down, and suggested that unless interplanting was adopted the balance of land-use would be upset by the high proportion under coffee.<sup>46</sup> In 1954 the Coffee Officer suggested that bananas were of benefit in young coffee but that they should later be thinned and finally eliminated altogether. Despite much controversy, no factorial trial was laid down to determine the effects and economics of interplanting, although a small observation trial was started at Bududa farm in 1950 and run for a number of years.

The most important trials carried out in East Africa on the problem have been those by Lyamungu Coffee Research Station in Tanzania.<sup>47</sup> Robinson states, "It is generally considered that bananas are not a good permanent shade for coffee although under certain circumstances they may be satisfactory as a temporary shade for 4 to 6 years. The shade cover they provide is uneven, pseudostems tend to fall down and damage the coffee tree; the banana stool or

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44. op. cit.

45. Dept. Agric. Ann. Rept., 1927.

46. Kawanda Coffee Research Unit files.

47. Robinson in Lyamungu Ann. Res. Rept. 1961.



clump spreads irregularly and requires regular attention.... it has a big demand for plant nutrients and soil moisture...." 48  
An initial survey of certain areas of peasant coffee production on Kilimanjaro and a number of factorial trials which included interplanting treatments were analysed. These showed that interplanting reduced coffee yields considerably and that this decrease is approximately linear to increasing density of bananas. Part of the decrease can be attributed to the displacement of a number of coffee trees. However, there are indications that the yield per tree is also decreased - presumably due to effects of overshadowing and competition for soil moisture and nutrients. In the two experiments described, interactions with applications of cattle manure and various pruning systems were tested, and under all treatments interplanting reduced yields of coffee. Unfortunately, the effects of such improved techniques as fertiliser application do not yet appear to have been tested. It was agreed that in certain circumstances (i.e. where land is very limited) it may be necessary to interplant. However no attempt was made to assess the economics of interplanting and it would appear that even this work offers an inadequate basis for any definite pronouncements.

Policy in Bugisu has fluctuated between an active encouragement of interplanting, comparative indifference and, of late, definite discouragement. From about 1940 interplanting started to become popular. A coffee census carried out in 1955 indicated that 29% of the mature coffee and 37% of the young non-bearing trees were interplanted. 49. Interplanting was "not recommended" in the 1959 policy and has now been legislated against in the Bugisu Coffee Rules 1962 at least as far as new plantings were concerned.

In this study, densities of bananas were estimated only in the general farm survey and for the purpose of evaluation described as follows:

- Dense = one banana plant per 450 square feet or less  
(about 96 stools or more per acre)
- Scatter = more than 450 square feet per banana plant  
(less than 96 stools per acre)

The overall results judged on those plots visited on the forty farms were:

Bananas densely interplanted	40%
Bananas scattered only	47½%
Nil bananas	12½% (Five "progressive" men with more-than-average land.)

A common practice has been to plant coffee into old banana gardens which are progressively thinned until only a scatter remains. Half the farmers, however, had planted bananas into young coffee within the first three years after establishment. At least one had planted some bananas into mature coffee. This he expected would eventually die out leaving a pure stand of bananas (a reversal of the usual process!)

Of the 40 farmers 18 said they did not now like interplanting. These were equally divided between "progressive" and "non-progressive". Whilst some were probably just repeating the current official "line" a few appeared to be convinced either that competition effects were bad, or that bananas encouraged insect pests. Some of the other 22 favoured interplanting because of the shade effects of the bananas

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48. ibid. p. 31

49. Dept. Agric. Ann. Rept., 1955

and the mulching material they provided. 7 of them (6 "non-progressive") said that they were forced to interplant from the sheer necessity of food supply.

It is very difficult to estimate the economic advantages or otherwise of interplanting, since the net gains or losses of coffee and bananas must be set against labour inputs - and there is no information available on these. There is therefore much scope for further research in this field and little ground for legislation one way or the other. Since it appears inevitable that some interplanting will continue anyway, the possibility of advising on a recommended spacing and management routine for interplanting might also prove more effective in the long run, than the present legislation which is designed to achieve the technical ideal but which is unenforceable and has not convinced the majority of farmers.

F. Weeding

Uncontrolled weed growth was compared with various other treatments in the cultural trials at Bugusege in the 1930's and it invariably gave the lowest yields of coffee. These results are borne out in cultivation trials at the Kenya Coffee Research Station where the effects of controlling weed growth have been very significant. Farmers in Bugisu appear to recognise the benefits of weeding better than any other aspect of production; its beneficial effects are more easily demonstrable, and the weeding of crops is a traditional agricultural practice. However, from the early days of coffee planting, weeding has often been unsatisfactory. One of the main reasons for this is undoubtedly the very high labour demands.

In the Nyeri Survey,<sup>50</sup> labour inputs for weeding were 489 workhours per acre in a year, which comprised 25.3 o/o of the total labour inputs for mature coffee. Weeding is particularly necessary in the wet season, when farm labour requirements as a whole are at their peak. When coffee prices were at their peak acreage was increased at the expense of yields, but the recent price decline together with increasing population has made it desirable to intensify production by raising cultivation standards, thus tending to increase seasonal labour demands. In addition, where there are other strongly limiting factors to production, which are less easily remedied, for example infertility, a high incidence of pests or diseases, or the coffee has become old and exhausted, the low marginal returns from labour inputs on weeding are a strong disincentive.

The survey was carried out during the dry season, when overall labour demands are at their lowest, nearly all the plots seen had been recently weeded. There were signs of past neglect in some plots and the trash of tall weeds and couch grass (Digitaria scalarum) was visible in places. There was evidence of much rehabilitation of coffee plots in recent years through eradication of couch by hand methods. There was a great deal of variation in the number of times which farmers claimed they had to weed in a year. 30 out of 39 asked, said more than six times although this often included the slashing of tall weeds in the rains. Of the others the minimum claimed was two rounds of slashing and two of cultivating during the year. The figures appear very high,

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50. F.E.S.U. Report 21, 1962.

particularly in view of the seasonal bottleneck and they may have become exaggerated in farmers' memories; there is no doubt however, that weeding of coffee does occupy a very important place in the farming calendar. The importance of the slashing of weeds as a stop-gap measure is emphasised as it was practised by 22 out of 37 farmers. The 1959 policy recommended clean weeding at all times as the ideal, but Wallis et.al.<sup>51</sup> noted the serious danger of soil erosion in Bugisu where the coffee is frequently clean weeded, under the present standards of erosion control. They recommended that weeding should consist of regular slashing and only one cultivation round annually, at the beginning of the dry season. This, or an adaptation of it deserves active consideration since it would also release labour which might be employed in other productive work, particularly in more-timely picking of coffee, which would help to improve quality. It is also of interest to note that in the 1928 and 1930 cultivation trials the use of a cover crop for part of the year gave promising results and might repay further consideration and experimentation.

The use of a forked-hoe or "lumbugu-fork" for coffee weeding instead of the flat-hoe which is normally used, was also advocated<sup>52</sup>. During the survey, the results of using flat hoes were quite apparent. Where weeding had recently been carried out; coffee feeder roots had usually been cut, often quite seriously. Coffee is mainly a surface feeder and this damage almost certainly reduces the ability of the trees to take up soil nutrients.

In addition, the frequent use of flat hoes has encouraged the formation of powdery soil conditions, thus increasing the dangers of erosion. The Bugisu Coffee Board's field officer tried to introduce lumbugu forks in 1955 and they were made available through the Bugisu Co-operative Union at that time, and are now available at cheap prices under the Government's subsidy scheme. They have, however, never been in popular demand, and in 1964 only 224 were sold among 70,000 or more cultivators in all parts of Bugisu - less than one per 300 cultivators. According to the ex-Coffee Officer, one of the objections

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51. op.cit. 1961.

52. ibid.

raised has been the weight of the lumbugu fork. He arranged for a lighter type to be stocked by the Union, but the latter apparently failed to promote sales through adequate publicity. Some farmers claimed that they turned up sub-soil during digging and were unsatisfactory when preparing land for annual crops. It would appear that extension workers have so far failed to convince the majority of farmers of their value for coffee cultivation; possibly indicating a lack of drive and neglect of demonstration techniques in this particular campaign.

#### G. Pruning

The standard of pruning is very important to production in terms of yield and quality. It has great influence on the health of the trees and on the control of insect pests. A number of changes in pruning method have been made. Until 1925, single-stem pruning was almost universal in Uganda but in that year the Government's coffee specialist advised a change to the multiple-stem system<sup>53</sup>. In 1928, under advice from a new coffee specialist a change was made back to single-stem<sup>54</sup>. However by 1930 it was noted that this was proving quite unsatisfactory in the lower altitudes, where it was causing severe overbearing. Single-stem pruning was abandoned in 1931 and seedlings were capped in the nurseries to produce two stems as an interim measure whilst awaiting the outcome of experiments at Bugusege Research Station before finally deciding on the system to be adopted.

The first experiment to be laid down at Bugusege in 1927 was to compare three pruning treatments, i.e., single-stem, multiple-stem and Agobiada (a Guatemalan system consisting of the pegging of primary growth to encourage formation of secondary growth). In 1930 the second trial was laid down comparing single-stem, a modified system of multiple stem and "natural growth". In the first trial, the Agobiada system gave the highest yields followed by multiple-stem pruning. The objections to the former system were that it was too complicated for practical operation and that, although the yields were higher, bean size (a quality factor) was reduced. It also gave a dense foliage which led to a high incidence of insect pests. It is noteworthy that although the system has been tried in both Kenya and Tanzania, it has virtually been abandoned in favour of normal multiple-stem pruning. No analysis of the second trial has been traced but it appears

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53. Dept. Agric. Ann. Report, 1925, p.32.

54. Dept. Agric. Ann. Report, 1928, p.20.

that the Modified Multiple-Stem system proved best and this was finally adopted for Bugisu coffee in 1936. In essence it consisted of cutting out old stems or "heads" in rotation and allowing new "suckers" to grow up from the base of the tree as required for replacement "heads".

Pruning is a skilled operation and requires training and experience. Simple "rule-of-thumb" methods can make it much easier to grasp. The cutting away of bearing wood is always unpopular among peasant farmers in the absence of adequate quality incentives. These two aspects - standard methods and incentives - have been missing in Bugishu and pruning standards have been low, despite the use of trained pruners. Melville noted the general failure to remove the lower primary branches to encourage new growth. He recommended the adoption of simple "rule-of-thumb" methods using a standard length of measuring stick to determine the amount of bearing wood to be left after cutting up and a return to the normal system of Multiple-Stem pruning as practiced by African growers in Kenya. Discussion continued for a number of years and rules for cutting-up were included in the 1959 policy. An entirely new pruning policy was issued in 1964 which involves a return to the normal Multiple-Stem system<sup>55</sup>. Coffee which is already mature is to be maintained on the Modified Multiple-Stem system. The inclusion of both methods on the same farms may lead to confusion among growers. The long delay from 1952 to 1964 in formulating a new policy is striking. Much discussion took place in the intervening period<sup>56</sup> but no attempt was made to compare the two systems in trials in the field.

Up to 1935, pruning was the responsibility of the growers themselves. The failure of most of them to carry out the operation effectively led to the training of specialised "pruning fundis" after that date. These were employed by co-operative pruning societies, the members of which were charged Cts. -/02 per tree pruned by the "fundis". However, the movement was not widespread and in 1938, the Department of Agriculture's concern at poor pruning standards was one reason for the Native Authority (Amendment) Rule<sup>57</sup> which empowered chiefs in Bugisu to order proper pruning to be carried out. At the same time selected growers were given training in pruning techniques and were issued freely with pruning tools by the Native Administration.<sup>58</sup> They were allowed to prune for their neighbours and became part-time "fundis" who

55. Dept. Agric. Pruning of Arabica Coffee, 1964.

56. Kawanda Coffee Research Unit files.

57. Legal Notice 94 of 1938.

58. Dept. Agric. Ann.Rept., 1938.

hired themselves out. Growers often failed to pay the "fundis" who refused to do further work for them but by 1946 a satisfactory position was reported because of pressure brought to bear on the former by Chiefs.<sup>59</sup>

In 1955 pruning became the responsibility of the Co-operative societies under the direction of the Coffee Officer and the "fundis" were paid fixed monthly wages. No direct payment was made by the growers for pruning services. The following year they were taken over by the Bugisu Co-operative Union and in 1957 a change from monthly wages to payment on the number of trees pruned apparently proved disastrous: "fundis" who worked fast enough earned up to Shs.400/- per month instead of their previous wage of Shs.60/- or less. Pruning standards were very poor, and in 1958, a return was made to monthly payment. In 1960 members voted for a return to individual pruning as the total costs of organised pruning were considered very high (over £30,000 in 1959).

In practice many farmers have continued to employ the "fundis" on a private basis, although pruning seen in the survey was often poorly carried out. In December 1964 Bugisu Co-operative Union encouraged a number of societies to re-start official pruning gangs, financed by levies on growers' crop deliveries. This move was also partly prompted by the Department of Agriculture's refusal to carry out insecticide spraying in areas where proper pruning had not been done. Two societies were visited where pruning gangs were in operation. The standard of work was an improvement on that of most individual farmers. On fairly light pruning, both gangs were achieving about 100 trees pruned per man-day. Costs of labour were in the region of Cts.-/02 per tree, which is no higher than the general level of costs pre-1960 and can be regarded as satisfactory.

In the farm survey 12 out of 40 farmers had a fairly high standard of pruning and 17 others were definitely poor. 16 said they did all their own pruning, 15 employed "fundis" on contract only and nine did some of their own and also employed "fundis". Of those who employed pruners to do all the work, most said they did not know how to do pruning themselves, although some wanted to learn. Of 39 farmers asked, 24 said they would prefer organised pruning since the "fundis" were trained and would be able to work more quickly. Of those who preferred individual pruning, several

59. Dept. Agric. Ann. Rept. 1946.

thought it would be cheaper and others that they could do better work for themselves. Several mentioned that the organised gangs had done careless work in the past.

Labour demands for pruning are quite high. In the F.S.S.U. Survey in Nyeri the inputs on mature coffee averaged 323 work-hours per acre of 537 trees (9 feet by 9-feet). This constituted 16.7 c/o of total labour inputs. Pruning in Bugisu takes place in the dry season when labour demands are at their lowest and the main opportunity cost is a sacrifice of leisure. It is usually carried out by men, and for those with larger areas of coffee, some outside help will be essential if pruning is to be completed at the right season. The use of "fundis" has enabled extension workers to concentrate on training a relatively small number of people, and has provided seasonal employment for a large number of men. (For example, in 1957 there were 128 Head pruning "fundis" and 2832 fundis employed in the district<sup>60</sup>. However there is a need for individual farmers to receive instruction in pruning methods, so that they can at least work with and direct the work of contract pruners employed by them. Instruction in pruning lends itself to group demonstration techniques, although these have not been used much until recently. Of 55 farmers asked, 14 had seen demonstrations of pruning. The Department of Agriculture staff also require training in pruning, so that they can demonstrate the technique adequately to farmers instead of merely telling them what to do.

#### H. The Control of Insect Pests.

This is a very complex subject in Bugisu and the ravages of pests are among the main causes of decline in yield and quality.

##### 1. The Major Pests of Coffee in Bugisu

(a) *Antestia* (*Antestiopsis* spp.): This sucking bug causes several damage to both vegetative growth and crop. A typical symptom is the proliferation of secondary and tertiary growth due to damage caused to terminal buds. Damage is also caused to flowers and young green cherry, thus reducing the amount of crop set. In a later stage attacked beans may rot completely or a fungus is introduced causing discolouration, particularly a condition known

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60. Coffee Officer's Ann. Rept., 1957.



as "zebra bean" which reduces saleable value considerably. Antestia is more serious in the high altitude areas and tends to increase in the presence of shade or where pruning is inadequate. Some particularly severe attacks were noted during farm visits particularly in the high altitude area in North Bugisu where some farmers complained of an almost complete loss of crop in some seasons. Chemical control work has been carried out with varied success since 1954. The development and organization of this work is discussed later in this section.

(b) Lacebug (*Habrochila ghesquierei*): This small sucking bug feeds mainly on the undersides of coffee leaves. Small numbers are found in most areas, but under certain conditions, the populations multiplied rapidly and can give rise to severe defoliation. In the survey a certain amount of Lacebug was noted in most coffee plots, especially in North Bugisu but it was nowhere serious. However during a visit to Manjiya county - outside the sample areas a severe out-break was seen which had led to considerable defoliation. In recent years routine sampling has been carried out in an attempt to establish the pattern of population fluctuation. It was hoped that anti-Antestia spraying would help to reduce Lacebug populations. Whilst this has occurred in some cases, in others the Lacebug population has actually risen as a result of spraying. The main insecticide currently in use is Malathion 50 o/c and whilst it will kill the adult and nymph stages of *Habrochila*, unhatched eggs are left untouched and give rise to a new generation, unhampered by competition or predators, which are also killed off. In view of this there is an urgent need to find a more suitable insecticide.

(c) Berry Borer (*Stephanoderes harpei*): From the early days this small black beetle has caused severe damage to both yields and quality. The adults bore into coffee cherry. If the bean is still soft inside they cannot breed there, but their damage prevents it from maturing properly. If the bean is hard, they will breed, destroying the contents. This damage is considered in the trade to be one of the most undesirable features of Bugisu coffee. No chemical control has yet been devised in Uganda although trials with ground-dusting are in progress. The recommended control measures concern crop-

hygiene and these were given publicity by the Entomologist in one of a series of "farmers leaflets" issued by the Department of Information in about 1957. The measures include picking the crop at least once every two weeks during the crop periods and at least once a month at other times of the year, the use of a ground-sheet when picking to collect falling cherry, and collection of any cherry which does fall on the bare ground. Dried cherry ("buni") and light coffee should be burnt, buried or quickly dried and sold off the farm.

Many of the farmers visited were aware of these recommendations but few put them into practice. Less than 20 o/o of the farmers seen had made any attempt to clean up "buni" left on the coffee trees, although the harvest was over, and there was less work to do than at other times. The new season's crop was forming and the carry-over of infection was causing an attack to build up in the young green cherry. The failure of farmers to follow the simple recommendations was puzzling as so many of them expressed concern at the presence of Berry borer. Lack of quality incentives has probably influenced this attitude since visible losses are greater in terms of quality rather than quantity. In addition some had mis-understood the reasons for the anti-*Antestia* sprays and were disappointed that these had not controlled Berry borer. Extension workers do not appear to have emphasised sufficiently the effect of the pest in reducing production nor to have explained the reasons behind recommended control measures. There is also a need to impress on growers the purposes of the spraying campaign, and its limitations.

(d) White Stem Borer (*Bixadus sierricola*): This is a large beetle, whose larvae bore into the lower portion of the coffee stem causing ringbarking and serious internal damage which restricts the flow of moisture and nutrients in the tree. Its occurrence is widespread in Bugisu, but distribution appears to be variable and much more damage was seen in the sample area in the South than in the North. In 1963 the Entomologist issued a farmers' leaflet recommending chemical treatment to prevent attacks of stem borer. This consists of painting the stems annually with a solution of Dieldrin 18 o/o to a height of 2 feet from the ground. This treatment has proved very effective in Kenya and Tanzania. However, Dieldrin is covered by the provisions of the

Pharmacy and Poisons Ordinance<sup>61</sup> and is only available from licensed traders and pharmacists in Mbale. Before a farmer can purchase the insecticide he is obliged to sign a poison register which is possibly a deterrent among suspicious people. Evidence from trade circles in Mbale indicated that the small quantities sold are mainly used for eradication of termites. Despite the issue of a leaflet by the Entomologist in Mbale, of which some 100 copies or more had been distributed, farmers still appeared to be in need of basic instruction in the technique of control and only one farmer was seen (he was outside the sample) whose trees had been treated.

(e) Root Mealybug (Pseudococcus latipes): This is serious, although its incidence is rather localised. In certain parts of Buginyanya sub-county in North Bugisu, particularly at the lower altitudes, bad attacks were seen, where large patches of trees had been killed out or greatly weakened. Chemical control measures were recommended in a farmers' leaflet published in 1957, and revised in a departmental circular in 1964. However, some of the recommended chemicals are again subject to the Poisons Ordinance. The treatment (1958) consisted of dusting the surface roots at the base of the stem with Lindane (2.5 c/o BHO). This costs about Cts. -/20 per tree to apply. A number of farmers said they had effected a good control with this in the past, but there appeared to be little interest in applying the treatment at present. The dust was no longer available at local co-operative societies. The trade in Mbale indicated that demand is very limited indeed. Since the issue of the leaflet in 1957, very little follow-up work appears to have been carried out either by the Department of Agriculture or by the trade.

## 2. Entomological Research in Bugisu

Due to the very serious threat from coffee pests an entomologist was posted to Mbale in July 1959 and has concentrated most of his time on coffee problems. His laboratory is not adequately equipped and he is obliged to rely almost entirely on the goodwill of local growers to allow him to lay down field experiments on their coffee. The conditions within an experiment are often varied and farmers may later object to the continuation of trials. Current ground-dusting trials for berry-borer control may have to be abandoned for this reason. It is not possible to supervise all operations

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61. Ordinance No. 22, 1957.

on the coffee involved in experiments although some trial plots are picked and yield recorded by the entomologists' labour force. Current research includes control of Antestia and Lacebug, routine sampling to determine the population pattern of Lacebug and the breeding cycle of Bixadus. The Entomologist has been assisted by an A.A.O. who has undertaken investigations on the performance of various spray pumps, the out put of varying jet sizes and their efficiency in terms of leaf deposit. He has also looked into the organisation of the District spray teams and given some supervision in their operation.

The need for a suitable alternative to Malathion has been mentioned previously particularly in connection with control of Lacebug. Investigations were carried out earlier in Kenya and since 1962 other chemicals such as Fenitrothion have been used on coffee there. They were found to be cheaper and more efficient. They are somewhat more toxic but not at a level which was considered too dangerous for use under peasant farming conditions. Investigations were commenced in Bugisu about 1965 but have not yet been completed, although the superiority of Fenitrothion has been demonstrated<sup>62</sup>. It is difficult to see why extensive field trials on Fenitrothion etc. could not have been instituted at the time similar work was being carried out in Kenya.

### 3. Organisation of Chemical Control.

Starting in 1954, various dusts (mainly pyrethrum extracts) were used for control of Antestia. Small hand dusters were issued to growers on payment of Shs. 5/- deposit. Within a few years there were 7000 hand dusters in the district.<sup>63</sup> Large areas were treated but dusting was abandoned after 1957 as it had not proved satisfactory. Reasons for this were the variable quality of the dust, deterioration of the quality of the dust in storage and complacency on the part of the growers. Therefore spraying was adopted after successful trials in 1957 and 1958. Motorised knapsack sprayers were used in 1959 and organised spray teams were instituted.<sup>64</sup> In 1962 these were taken over by the Trustees administering the accumulated funds.

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62. Entomologist's Ann. Report 1963/64

63. Bowden, Jones & Woodcock, *E.A.A.F.J.*, XXVII, pp. 61-65, 1961.

64. ibid.

The plan adopted then was to restrict spraying to the areas around central pulperies. Up to 1964, all costs were met from the trust funds but in 1965 co-operative societies have undertaken to supply manual labour. Annual expenditure on the spraying organisation has been in the region of £25,000 since 1962. In the past it has been necessary to purchase a large number of motorised knapsack sprayers, and in 1965 some 120 are in operation in the district. The original models purchased in 1958 are still in operation and have proved sturdy and reliable, although repair costs are high and the A.A.O. (entomology) calculated that over a five year period repairs to the original machines had cost 125 c/• of initial cost (i.e. spares, labour and workshop facilities). Bowden et.al. quote costs for the best team in 1961, which covered 641 ares, at 26/02 per acre. However in 1963 and 1964 average costs were 35/90 and 22/40 per acre respectively.<sup>65</sup>

These costs do not appear excessive. In a recent dosage trial, one application of Malathion 50 o/o at 2 pints per tree increased cherry yields by 3.4 hundredweight per acre.<sup>66</sup> At a low price of Cts.-/25 per pound of cherry this increase would be worth Shs.95/-. Nevertheless, the efficiency of the teams could be improved and a full-time technical supervisor with transport is needed.<sup>67</sup>

Although some success has been achieved, Antestia remains a very serious pest in many areas. One reason is that the area sprayed is limited; in 1964 it was less than 35 o/c of the estimated coffee acreage, (not all coffee areas require Antestia control however). The lack of adequate supervision has also prejudiced the effectiveness of the scheme. For example, it was reported that in 1963 only 1.30 pints per acre of 50 c/• Malathion were applied against a recommendation of 2.00 pints per acre. Insufficient pruning and too much shade from interplanted bananas and trees encourage Antestia to breed and tend to reduce the spray cover achieved.

The dangers of fire have been convincingly demonstrated; in two fires in recent years caused by careless handling of petrol, 14 machines have been completely destroyed and six have been seriously damaged. With initial

costs at approximately £65 each, these losses are considerable and replacements

65. D.A.O.'s Ann. Reports, 1963 & 1964.

66. Entomologist's Ann. Report, 1963/64.

67. Since this report was drafted an A.A.O. has been posted to Mbale to supervise spraying.

are not always readily available in East Africa.

One beneficial effect of spraying is that in certain areas where coffee had previously been neglected because of the poor yields attributed to Antestia damage it has brought about considerable improvement. Growers in these areas are being encouraged to restore their plots with promises of spraying if they do so. On the other hand, the incidence of Antestia in areas bordering the forest is often very high and the spraying organisation may not be able to cope with it economically. These areas are really ecologically unsuited to coffee growing and the introduction of alternative cash crops, e.g. tea, pyrethrum, etc. might prove sounder policy both technically and economically.

Increasing attention is being given by the Department of Agriculture to the possibilities of introducing individually owned hand pumps, and a number of makes have been under trial<sup>68</sup>. Pumps are already available under this scheme.<sup>69</sup> Of the 40 farmers visited 3 already had pumps (only one had used his so far, and that was for spraying cotton). One or two others also wished to purchase a pump. Before the use of hand pumps can succeed it will be necessary to train staff who can then instruct farmers on correct mixing and application of chemicals. The distribution of equipment and chemicals will also require much more attention.

#### I. Control of Diseases. 1. Leaf Rust (HEMILEIA vastatrix).

This is widespread in occurrence but only normally serious in areas below about 5000 feet above sea level. There are marked fluctuations in the level of infection from year to year, but in some years the disease causes serious defoliation which can lead to dieback and thus prevent the proper ripening of the crop. The economic losses from the effects of the disease are probably very heavy in bad years. In Kenya, control by spraying with copper fungicides has been practised on estates for many years and the Department of Agriculture issued recommendations specifically for peasant farmers in 1961.

Field spraying trials were first conducted in Bugisu in 1955-1956, and although no result of these could be traced, very good visual responses were reported. In 1961 a large-scale anti-leaf rust spray trial laid down at Bugusege. This compared 5, 7 and 12 spray applications per year with an untreated control. In the first year there was little response, but in the

68. Entomologist's Ann. Report, 1963/64.  
69. D.A.O.'s Ann. Report 1964.

second year spraying gave significant increases of up to 11 cwt. of clean coffee per acre. The 95 field trials to test responses to applications of nitrogenous fertilisers and anti-rust sprays laid down in 1963 have so far generally shown significant increases from anti-rust sprays, as well as a positive interaction between fertilisers and sprays. Nevertheless no recommendations have yet been issued although they are now under active discussion. The 1959 Policy recommended the use of organised teams to combat leaf rust. This system would be difficult to operate, because the need to apply a number of sprays, precisely timed at intervals of a few weeks would necessitate the use of very large and expensive teams and it is here that individually owned hand pumps appear particularly attractive. Various methods of applying anti-rust sprays were tried in Meru District, Kenya, in 1960 and the conclusions were that the use of individually owned spray-pumps was the only feasible method of applying timed sprayings to large numbers of scattered peasant-owned coffee plots.<sup>70</sup> This system of spraying has been encouraged in Kenya among peasant farmers since about 1961. There are now over 1600 individually owned hand sprayers in use in anti-leaf rust and anti-Coffee Berry Disease spraying in Meru.<sup>71</sup> These pumps have mainly been made available through co-operative societies and may be obtained on credit; the growers repaying by deduction from their coffee payouts. It has been agreed in principle by the Uganda Department of Agriculture that individual ownership of pumps should be encouraged and further delay now appears unnecessary. At the same time, extension workers do not seem to have impressed on farmers the importance of improved husbandry in reducing the effects of Leaf Rust, enabling coffee to resist the attack, or to recover much more quickly from its effects. The introduction of nitrogenous fertilisers would also be helpful in this respect. The fungicides are expensive and although farmers may be persuaded to purchase a pump at subsidised prices, unless chemicals are also subsidised initially, they may not be taken up, particularly in poor crop years. A great deal of preparatory work is required before a spraying programme is initiated. Sprays are only effective as a preventative measure and applications must be carefully timed and applied every year. Experience elsewhere is that all too often

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70. Wallace, unpublished papers. 71. D.A.O. Meru, Ann. Report, 1964.

farmers have ignored instructions because of a failure to grasp the real purpose of the sprays, due in turn to inadequate explanation. Sprays applied after the disease has appeared are too late to stop the leaf fall which results from rust attacks.

One further longer term approach to control is the use of resistant or tolerant varieties. Some have already been introduced in the lower areas under the replacement scheme (K 7 and KF 423). Their resistance is limited because of the presence of several distinct races of Hemileia vastatrix in the area. Several new hybrids which may be rust tolerant have been included in some of the recently established variety trials in Bugisu.

#### Coffee Berry Disease (C.B.D.)

This disease is caused by the fungus COLLEOTRICHUM Coffeanum. Its attacks cause the death of flowers and young berries and the rotting of cherry at all stages. It has been a cause of very severe losses in some areas of Kenya and in Rwanda for many years. It was first reported in North Bugisu in 1959. By 1962 it was considered to be severe in some areas of Sebei. A survey in that year indicated that some 43,000 trees were likely to be affected. A more thorough survey was undertaken in August 1964; in a random sample of 1006 coffee plots visited in Sebei, 66 o/e had some infection.<sup>72</sup> This disease is generally more severe in the high altitude areas, although it tends to move into lower altitude zones in high rainfall years.

In 1963 a plan was published to uproot all coffee plots in the worst affected areas of Sebei and to discontinue coffee planting in those areas. In other areas infected plots were to be uprooted and replaced with coffee of a "resistant" variety. Not unnaturally, this aroused vigorous protests in the areas concerned. At the same time although it had been hoped to use Blue Mountain as a replacement variety because of its previous reputation for resistance in Kenya, new information that it was a low yielder and not as resistant as had been hoped precluded its use. The uprooting plan later had to be abandoned<sup>73</sup>. Other strains reported to have a high level of resistance have recently been imported by Uganda from Rwanda. It has been decided

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72. Kawanda, Coffee Research Unit Files.

73. D.A.O.'s Files.



not to issue these until they have been tested in variety trials under Uganda conditions. The first of these were planted in Western Uganda in 1964 and several have been started in Bugisu in 1965. No results are expected until 1970 at the earliest. It has now been agreed that individual spraying with hand-pumps should be introduced in the C.B.D. areas, although no official announcement of policy has yet been made. It is proposed to sell pumps under the subsidy scheme. As with leaf rust a number of well-timed, closely - spaced sprays will be necessary. In this case the Kenya recommendations are being adopted with some adaptation for differences in rainfall pattern<sup>74</sup>.

The rate of spread of C.B.D. in Bugisu appears to be much slower than it has been in some other high-rainfall areas of East Africa. There are possibly factors at work which modify the usual effects of C.B.D. These are unlikely to be climatic as conditions in Bugisu are similar to areas affected in Kenya, particularly Kisii District where C.B.D. is severe. It seems more likely that the Bugisu local variety may have some resistance to the disease. Evidence of a common origin with Blue Mountain has already been discussed and this later has some resistance to C.B.D. although in parts of Kenya this has now broken down.

The incidence of C.B.D. in Bugisu has severe implications for the replacement scheme, although these do not seem to have been recognised by the Department of Agriculture. The replacement of Bugisu local varieties, which may possess some C.B.D. resistance, by ex-Kenya varieties which plainly do not, is clearly a dangerous policy, and the working Party on the second 5 - year plan has now recommended that the replanting programme be confined to the issue of the rust-resistant variety K.P.423 to low altitude areas only. There is obviously some possibility of a sudden break through of C.B.D. in Bugisu and it is vital that plans are laid now for establishing a spraying regime. At the same time an extension campaign is needed to inform farmers of this new threat to their coffee. A new district-wide survey would help to ascertain more accurately the spread and level of infection of C.B.D. in Bugisu.

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74. Information: Kawanda Coffee Research Unit.

Conclusions:

1. Despite a serious national overproduction problem, the premium for Arabica coffee make it desirable to increase its share of the I.C.A. quota by improved production methods which raise both yields & quality. The Bugisu economy is very dependent on the coffee crop, and biennial bearing is a cause of instability.

2. The various aspects of production illustrate the complexity of farm level decisions. Farmers have often forgone the possibilities of increased production in terms of yield per acre or per tree through acceptance of recommended techniques for a number of social and economic reasons. Fragmentation of holdings, lack of adequate resources, including technical knowledge, a strong leisure preference and the presence of other biological factors which limit production.

3. Many facets of coffee husbandry policy have failed to take account of these considerations and have aimed at "ideal" solutions without sufficient consideration of the economics or feasibility of introducing new techniques. In addition much good advice has failed to go over because of inadequate extension methods. The need for provision of short-term credit to purchase inputs which will give a profitable increase in production is apparent.

4. A considerable volume of research has been carried out over the years in the area, much of it of great value. However a number of weaknesses are apparent. Most of this work has not been analysed and published and even when results were obtained, they were often ignored in the formulation of field policies. A number of important husbandry aspects have not been included in the experiments. In many cases research into important new techniques has lagged badly behind that of Kenya, and insufficient use appears to have been made of research findings from there.

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APPENDIX I

COFFEE YIELDS : BUGISU AND SEBEI, 1934/35 - 1963/64

CROP YEAR	TOTAL PRODUCTION <sup>1</sup> PARCHMENT AND BUNI (TONS)	ACREAGE OF COFFEE <sup>2</sup> IN BEARING (OFFICIAL ESTIMATE)	AVERAGE YIELD TONS <sup>3</sup> PARCHMENT AND BUNI PER ACRE	AVERAGE YIELD TONS <sup>4</sup> CLEAN COFFEE PER ACRE (78% PARCHMENT & BUNI)	AVERAGE YIELD CWTS. CLEAN COFFEE PER ACRE	TWO-YEAR AVERAGE <sup>5</sup> CLEAN COFFEE PER ACRE
1934/35	1378	2114	.65	.51	10.2	
1935/36	2034	2825	.72	.56	11.2	10.7
1936/37	1321	3527	.37	.29	5.8	
1937/38	2079	4013	.52	.41	8.2	7.0
1938/39	1822	5027	.36	.28	5.6	
1939/40	4156	6080	.68	.53	10.6	8.1
1940/41	2165	6952	.31	.24	4.8	
1941/42	3010	7375 <sup>B</sup>	.41	.32	6.4	5.6
1942/43	2264	7969	.29	.23	4.6	
1943/44	3679	8451	.44	.34	6.8	5.7
1944/45	2705	8752	.31	.24	4.8	
1945/46	2875	9372	.31	.24	4.8	4.8
1946/47	3180	9922	.32	.25	5.0	
1947/48	2996	<sup>6</sup> *10108	.30	.23	4.6	4.8
1948/49	3003	*10259 (8)	.29	.23	4.6	
1949/50	3003	*10523 (9)	.29	.29	5.8	5.2
1950/51	4370	*10762 (9)	.41	.32	6.4	
1951/52	2330	*11515 (9)	.20	.16	3.2	4.8
1952/53	2352	*12348 (9)	.19	.15	3.0	
1953/54	3122	*13304 (11)	.23	.18	3.6	3.3

1954/55	6666	*14354 (12)	.46	.36	7.2	
1955/56	4175	*15390 (13)	.27	.21	4.2	5.7
1956/57	5365	*16419 (14)	.33	.26	5.2	
1957/58	4989	*17200 (17)	.29	.23	4.6	4.9
1958/59	5115	17823 (18)	.29	.23	4.6	
1959/60	6215	19624 (20)	.32	.25	5.0	4.8
1960/61	5464	21000	.26	.20	4.0	
1961/62	9883 <sup>9</sup>	23906	.41	.32	6.4	5.2
1962/63	4503 <sup>9</sup>	24006	.19	.15	3.0	
1963/64	10002	24085	.42	.33	6.6	4.8

(Sources: Dept. of Agric. Ann. Repts., D.A.O. Ann. Repts., D.A.O.'s files, D.A.O. Bugisu)

Notes:

- (1) Separate figures for parchment & buni are not available for some years.
- (2) "Bearing" coffee assumed to be total acreage planted three years or more before commencement of crop season on 1st July ( e.g. Total coffee acreage in 1950/51 = bearing acreage in 1934/35)
- (3) These yields, and those of subsequent columns are entirely dependent on the estimated or adjusted acreage used in this Table. The preliminary investigation of the F.A.O. Uganda Agricultural Census suggest that Bugisu coffee acreage may in fact be considerably higher. If this is confirmed the yields will in fact be relatively lower.
- (4) Where records are available, clean coffee production varies between 75% and 80% of the total production of parchment and buni.
- (5) The two-year yield averages are included to minimise biennial bearing effects on the long-term yield trends.
- (6) The acreage marked \* have been re-assessed since official estimates in these years cannot be reconciled with issues of seedlings. The basis for re-assessment is an assumed establishment rate of one acre ( at 6 ft x 6 ft spacing) per 1600 trees issued - approximately equivalent to the overall establishment rate in those years assuming the official acreage estimates in 1943 and 1955 to be correct.
- (7) 1957 acreage estimate has been reassessed since official figure appears erroneous.
- (8) The figures in brackets refer to acreage in '000 acres drawn from Uganda Protectorate, Revised Crop Acreage Estimates 1945-1954, 1959 p.1. Discrepancies may be explained because " The 1945 figures are based on the planting returns for 1939" (p.1) No account appears to have been taken of the considerable expansion in the years 1940-1945.
- (9) 1000 tons per annum added to total production in 1961/62 and 1962/63 to cover unrecorded sales by the Bugisu Coffee Marketing Association ( which has produced no trading records and has since been proscribed).

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