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# Kenyan Coffee Sector Outlook: A Framework for Policy Analysis

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A FRAMEWORK FOR POLICY ANALYSIS**

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## I. INTRODUCTION AND SUMMARY

1. Long-term production prospects, as well as the outlook for domestic and export demand are indispensable in forming sectoral and macroeconomic policies, especially those related to pricing. This paper examines recent trends in the Kenyan coffee sub-sector and evaluates production and export prospects for Kenyan coffee under several scenarios. The analysis was done to provide background for an assessment of policies relating to the coffee sector in Kenya. Statistical and econometric tools were used in carrying out the analysis. 1/

2. In evaluating the long-term prospects for the Kenyan coffee sub-sector, scenarios with respect to important factors such as the potential yields and adoption rates of a new high-yielding variety and forecasts of international coffee prices have been considered. The analysis shows that under the assumption that future world coffee prices develop more or less as projected by the World Bank and that a price-supporting international export quota system is maintained, Kenya's coffee production would increase at about 2.8% p.a. during the period 1985/86-2000.

3. An important policy issue is whether Kenya should support the International Coffee Agreement (ICA) export quota system. Analysis indicates that Kenya's future coffee export revenues will not differ much whether the quota system continues or not, provided that Kenya obtains quota levels

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1/ The results of this analysis were incorporated in a model on the Lotus spreadsheet program to facilitate simulation exercises.

increasing at 2% p.a. However, if Kenya is to expand its robusta production substantially or if adoption of the new high-yielding variety (Ruiru 11) increases arabica production substantially, Kenya's coffee export revenues could be larger in the absence of the quota system. Another problem with the quota system is the possibility of Kenya accumulating large stocks.

4. The paper is structured as follows. Section I describes recent trends in Kenyan coffee production, consumption, exports, stocks, yields and prices. The performances of the estate and smallholder sectors are compared. Section II describes the characteristics of coffee production in the estate and smallholder sectors, covering topics such as costs of production, quality differentials and government policies. In Section III, coffee production in the estate and smallholder sectors is modelled econometrically using the vintage capital approach. Section IV describes projections of Kenyan coffee production using these models. The assumptions underlying the projections are outlined. Sensitivity of the projections to changes in real producer prices and to differing assumptions about the potential yields from the new coffee variety (Ruiru 11) is examined. The prospects for Kenya's coffee exports are described in Section V. The focus here is the International Coffee Agreement and, in particular, the outlook for the Agreement's export quota system and Kenya's likely quota allotment. The results of Section IV and V are brought together in Section VI in an examination of Kenya's future coffee demand/supply balance. Major points of interest are Kenya's export revenues from coffee and likely stocks under the various scenarios. Section VII draws together the various policy implications resulting from this analysis.

## II. RECENT TRENDS IN KENYA'S COFFEE SUB-SECTOR

5. Table 1 presents a balance sheet for Kenya's coffee production, exports, domestic consumption, and stocks since the late 1960s. Production has been increasing on average at a rate of 4.7% p.a. since 1968 and exports have increased at 3.9% p.a. during the corresponding period. As production has increased faster than exports, and given the low domestic consumption, stocks have accumulated. The stock level reached 1 million bags at the end of the 1980/81 season, following the imposition of ICA export quotas. As production continued to increase after the quotas were adopted stocks reached over 70% of Kenya's production in the last three years. Since the quotas were suspended in February 1986, Kenya has sold a large portion of its stocks. Had the ICA quota system continued during the 1985/86 season, stocks could have gone as high as 1.7 million bags (instead of the actual level of 1.2 million bags in October 1986).

6. Table 2 gives area, 1/ production and yield of coffee estates and smallholders combined. Several important features of the sector can be observed from the table:

- (i) There are no clear long-term trends in the estates' area and production. Estates' mature areas declined slowly from the early 1960s until the mid-1970s--just before the "coffee boom"--and increased thereafter;

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1/ "Mature area" in Table 2 signifies area under coffee trees of more than two years old.

**Table 1: KENYA COFFEE: STOCKS, PRODUCTION, AVAILABILITY AND EXPORTS--1969 TO 1984/85**  
( '000 bags)

Crop Year	Opening Stocks		Total Production	Domestic Consumption	Exportable Production	Gross Availability	Net $\Delta$ Availability For Export	Exports		
	Gross	Net $\Delta$						Total	To ICA Members	To Non-Members
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
STARTING 1 OCTOBER										
1968	127	-73	821	19	802	929	729	777	731	46
1969	152	-48	954	21	933	1,085	885	799	784	15
1970	286	86	1,036	23	1,013	1,299	1,099	953	783	170
1971	346	146	990	22	968	1,314	1,114	1,079	941	138
1972	235	35	1,261	20	1,241	1,476	1,276	1,200	1,153	47
1973	276	76	1,244	20	1,224	1,500	1,300	1,224	1,161	63
1974	276	76	1,171	20	1,151	1,427	1,227	1,088	1,014	74
1975	339	139	1,225	21	1,204	1,543	1,343	1,343	1,317	26
1976	200	0	1,699	20	1,679	1,879	1,679	1,428	1,364	64
1977	451	251	1,356	43	1,313	1,764	1,564	1,391	1,300	91
1978	373	173	1,232	40	1,192	1,565	1,365	1,231	1,195	36
1979	334	134	1,651	50	1,601	1,935	1,735	1,366	1,317	49
1980	569	369	1,715	68	1,647	2,216	2,016	1,205	1,110	95
1981	1,011	811	1,474	36	1,438	2,449	2,249	1,702	1,301	401
1982	747	547	1,551	50	1,501	2,248	2,048	1,427	1,291	136
1983	821	621	1,992	51	1,941	2,762	2,562	1,516	1,391	125
1984	1,246	1,006	1,558	50	1,508	2,754	2,514	1,604	1,330	274
1985	1,130	800	2,167	50	2,117	3,247	2,917	2,023	1,796	227
1986	1,224									

$\Delta$  Working stocks were 200,000 bags for the period 1968 to 1983; 240,000 bags thereafter.

Source: ICO

Table 2: KENYA COFFEE: AREA, PRODUCTION AND YIELD--1963/64-1984/85

Coffee Year	Estates				Smallholders				Total			
	Mature Area	Production		Yield	Mature Area	Production		Yield	Mature Area	Production		Yield
	(ha)	(tonnes)	('000 bags)	(kg/ha)	(ha)	(tonnes)	('000 bags)	(kg/ha)	(ha)	(tonnes)	('000 bags)	(kg/ha)
1963/64	32,538	28,405	473	873	13,000	15,373	256	1,183	45,538	43,778	730	961
1964/65	32,423	22,393	373	691	16,900	14,774	246	874	49,323	37,167	619	754
1965/66	32,267	25,683	428	796	27,400	25,523	425	931	59,667	51,206	853	858
1966/67	31,964	25,231	421	789	42,900	27,558	459	642	74,864	52,789	880	705
1967/68	31,188	13,246	221	425	49,900	20,515	342	411	81,088	33,761	563	416
1968/69	30,690	22,342	372	728	52,300	23,264	388	445	82,990	45,606	760	550
1969/70	29,903	26,521	442	887	54,057	26,275	438	486	83,960	52,796	880	629
1970/71	29,900	28,600	477	957	54,057	26,302	438	487	83,957	54,902	915	654
1971/72	29,535	29,984	500	1,015	55,555	28,362	473	511	85,090	58,346	972	686
1972/73	29,535	38,956	649	1,319	55,555	33,783	563	608	85,090	72,739	1,212	855
1973/74	29,129	31,152	519	1,069	55,600	36,767	613	661	84,729	67,919	1,132	802
1974/75	28,603	29,985	500	1,048	57,786	35,464	591	614	86,389	65,449	1,091	758
1975/76	28,603	37,675	628	1,317	57,786	36,135	602	625	86,389	73,810	1,230	854
1976/77	27,821	49,685	828	1,786	57,786	47,660	794	825	85,607	97,345	1,622	1,137
1977/78	29,402	33,685	561	1,146	59,206	47,744	796	806	88,608	81,429	1,357	919
1978/79	29,102	26,809	447	921	62,574	46,079	768	736	91,676	72,888	1,215	795
1979/80	31,232	39,109	652	1,252	71,172	51,900	865	729	102,404	91,009	1,517	889
1980/81	32,861	34,744	579	1,057	84,710	64,007	1,067	756	117,571	98,751	1,646	840
1981/82	33,635	34,392	573	1,023	97,423	52,531	876	539	131,058	86,923	1,449	663
1982/83	33,605	32,981	550	981	100,967	52,469	874	520	134,572	85,450	1,424	635
1983/84	35,711	54,258	904	1,519	114,235	74,683	1,245	654	149,946	128,941	2,149	860
1984/85	35,711	28,922	482	810	116,328	64,717	1,079	556	152,039	93,639	1,561	616

Source: Coffee Board of Kenya.

- (ii) Smallholders' area and production have increased at very rapid rates of 7.6% p.a. and 6.7% p.a., respectively, since the early 1960s;
- (iii) Yield has fluctuated fairly widely from one year to the next, but on average the estates' average yield has been considerably higher than that of smallholders. Average yields for the last 15 years for estates and smallholders are 1019 kg/ha and 664 kg/ha, respectively i.e., over 50% difference between the two sectors;
- (iv) There are no statistically significant trends in the yields of either the estates or the smallholders; and
- (v) After stagnating during the preceding 10 years, both area and production of the estate and smallholder sectors increased substantially in the last 6-7 years following the 1976-78 "coffee boom".

7. A key economic variable affecting production is the producer price. As noted elsewhere in the report, payments to smallholders vary substantially from one "society" to another and even among factories in a society. Factors that affect payments to farmers include: (i) quality of coffee produced; (ii) management skill of factory operators; and (iii) financial structure of societies. It is estimated that on average a smallholder coffee farmer receives about 86% of the amount paid by the Coffee Board (CBK) to the Kenya Planters Co-operative Union (KPCU). 1/ The smallholder payment share varies between 76% and 94%. 2/ Payments to the estates, on the other hand, depend only on the quality of coffee as they are paid directly by the KPCU.

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1/ The payment channel goes from CBK to KPCU and then to societies and estates. Societies pay farmers after deducting expenses.

2/ KPCU unpublished paper "Payment to farms" Nairobi, March 1982.

8. Table 3 shows average net payments by the CBK to the KPCU for 1 kg of clean coffee. The payments are shown in terms of nominal Kenya Shillings, in real terms with the consumer price index as deflator and relative to maize prices. Even excluding the "coffee boom" years of 1975-78, long-term real producer prices have shown an increasing trend.

Table 3: KENYA COFFEE: PRODUCER PRICES, /a 1965-84

Year	Nominal Prices (K. sh/kg of clean coffee)	Real Prices /b	
		(Deflated by CPI)	(Deflated by maize price /c)
1965	5.960	20.001	14.863
1966	5.300	17.099	15.014
1967	5.850	18.581	18.994
1968	5.580	17.632	20.217
1969	7.440	23.549	27.055
1970	5.680	17.615	17.057
1971	7.020	20.957	18.046
1972	8.740	24.652	22.468
1973	9.820	25.364	21.164
1974	9.400	20.579	13.429
1975	22.310	41.028	28.974
1976	39.520	65.240	44.404
1977	26.070	37.455	33.639
1978	26.600	32.699	29.888
1979	24.830	28.256	26.027
1980	21.330	21.330	21.330
1981	27.800	24.866	25.812
1982	34.890	25.903	22.656
1983	36.530	24.322	20.874
1984	46.600	28.070	n.a.

/a Net CBK payment to KPCU.

/b CPI 1980=100.

/c Maize producer price in Kenya, FAO data.

Source: CBK, FAO.



### III. SALIENT FEATURES OF KENYA'S COFFEE SUB-SECTOR

9. The discussion in this section is provided as background to the analysis that follows on the long-term production prospects.

#### (i) Production System

10. In Kenya, coffee is produced both by estates and smallholders. Before Independence in 1963, almost all Kenya's coffee was produced by estates owned by expatriate farmers. Before 1952, when the Swynnerton Plan was implemented, it was illegal for smallholders to grow coffee except for small trial areas in the Meru and Kisii districts. After Independence, legislation was enacted which required all estates to be registered for the purposes of the control of returns on capital and the remittance of profits abroad. The expatriates have gradually been selling the estates since that time. Some of the estates sold have been subdivided and distributed to smallholders. As a result, the smallholder sector expanded rapidly in the 1960s and again in the late 1970s. Its share increased from less than 50% of output in the 1960s to about 70% in the early 1980s.

11. Estate farming is different from smallholder farming in a number of aspects. The estates specialize in coffee growing; they are considerably larger (the majority being between 8 ha and 200 ha); they hire permanent staff and are capital intensive. Many of the estate farms are irrigated (67%) and use large amounts of chemical inputs. They also own their own factories for pulping coffee and often hire management and farming specialists to evaluate and improve performance.

12. Smallholder farms, on the other hand, are mostly very small. According to the Central Bureau of Statistics (see Table 4), 67% of them are less than 2

Table 4: KENYA COFFEE--NUMBER OF SMALLHOLDER FARMS BY CATEGORY AND BY PROVINCE AND THEIR PROPORTIONAL DISTRIBUTION BY SIZE (1979)

Farm size (Ha)	Province						Total	Total area (1000 ha)
	Western	Nyanza	Rift Valley	Central	Eastern	Coast		
	----- (%) -----							
Smallholdings								
less than 2	63	74	66	69	60	58	67	
2-4	32	23	20	27	33	31	26	
more than 4	5	3	14	4	7	11	7	
number (x 1000)	342	708	527	501	456	160	2694	(3216)
Intermediate farms number (x 1000)								
8-50	4	5	29	4	10	1	53	(1040)
Large Farms								
50-200	36	78	44	75	46	49	54	112
200-2000	45	18	51	22	23	35	40	895
more than 2000	19	4	5	3	31	16	6	1652
number (x 1000)	0.011	0.116	2.327	1.067	0.163	0.051	3.735	(2569)
All farms								
number (x 1000)	346	714	558	506	466	161	2751	(6915)

Source: Central Bureau of Statistics (1981, 1982); J. de Graaff, "The Economics of Coffee," Pudoc Wageningen, 1986.

ha and 93% are less than 4 ha. They do not specialize in coffee but normally have other enterprises such as maize/beans, English potatoes and/or cattle. A typical smallholder farm with 1.5 ha of land in the Central region has 0.5 to 0.6 ha for coffee, 0.4 ha for maize and beans intercropped, 0.1 to 0.2 ha each for English and sweet potatoes and 0.2 to 0.3 ha for pasture (see Tables 5 and 6). In some high altitude areas, tea is also grown as a cash crop. Most of the required labor is provided by the family and chemical input use and yield per

Table 5: KENYA COFFEE--PERCENTAGE OF SMALLHOLDERS GROWING  
SELECTED CROPS BY PROVINCE (1974/75)

	Western	Nyanza	Rift Valley	Central	Eastern	Coast	Kenya
	------(%)-----						
Coffee	5	21	5	45	44	1	27
Tea	4	-	15	18	11	-	12
Local Maize	74	80	59	95	99	94	86
Hybrid maize	73	36	92	67	30	19	50
Beans	79	39	22	98	86	28	69
English potatoes	-	1	8	86	52	2	32
Sorghum	37	75	1	1	16	2	30
Pyrethrum	-	18	16	8	7	-	9
Cotton	20	17	5	-	2	5	9

Source: Central Bureau of Statistics (1977); J. de Graaff, op. cit.

unit of land are substantially lower than on the estates. Almost none of the smallholders use irrigation.

(ii) Cost of Production and Profitability

13. Cost of production per hectare or per kilogram varies substantially from one estate to another and from one smallholder farm to another. A key parameter affecting production cost is yield; the higher the yield the lower the cost of production and thus the higher the profitability (see Table 7). Due to their much higher overhead costs, the production costs of estates are considerably higher than those of smallholders. A recent study of the smallholder sector done by the Coffee Research Foundation (CRF) indicates 1/ that the yield is strongly correlated with input expenditures. The study also

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1/ J.D.M. Roe and J.K. Nyoro, "Towards Improving Coffee Productivity in the Smallholder Sector," CRF.

Table 6: KENYA COFFEE: AVERAGE UTILIZATION OF LAND AMONG SMALLHOLDERS  
(Hectares)

Farm Size	Crop Zone	Area of Land (hectares)						/a
		Coffee	Maize & Beans	English Potatoes	Millet	Sweet Potatoes	Pasture	
<u>1.5 ha.</u>	Central UMI	/b	0.5	0.4	0.2	-	0.1	0.3
	Central UM2	/b	0.6	0.4	0.2	-	0.1	0.2
	Central UM3	/b	0.5	0.6	0.1	-	0.1	0.2
	Kisii		0.4	0.4	-	0.15	0.15	0.5
	Machakos		0.4	0.5	-	-	0.1	0.5
<u>3.0 ha.</u>	Central UM1	/b	1.0	0.8	0.4	-	0.2	0.6
	Central UM2	/b	1.2	0.8	0.4	-	0.2	0.4
	Central UM3	/b	1.0	1.2	0.2	-	0.2	0.4
	Kisii		0.8	0.8	-	0.3	0.3	0.8
	Machakos		0.8	1.0	-	-	0.2	1.0

/a Pasture area includes homestead and fallow land.

/b UM1, UM2 and UM3 refer to marginal coffee growing areas, major coffee growing areas and coffee and tea growing areas, respectively.

Source: J.K. Nyoro and J.D.M. Roe "Economics of Agricultural Production on Smallholder Coffee Farms in Kenya," CRF.

shows that smallholders' profitability would increase with yield, and that the percentage profitability increase would be largest for the farmers with very low yields (see Table 8).

14. Among inputs, fertilizer (C.A.N. and 20:20:0 are most commonly used) and fungicides (mainly copper) are most important; the latter often costing more than the former. In Kenya, these inputs constitute an important part of the production cost of coffee. Their share in total smallholders' production costs varies between 20 and 30% and the corresponding range for the estates is 30 to 40% (see Table 7). Fungicide is the largest cost component in the material inputs; it is required for the control of Coffee Berry Disease (CBD).

**Table 7: KENYA COFFEE: PRODUCTION COSTS OF CLEAN COFFEE (PER HECTARE AND PER KILOGRAM) ON SMALLHOLDINGS AND ESTATES UNDER VARIOUS ECOLOGICAL CIRCUMSTANCES (1981/82)**

	Smallholdings (coffee zone)			Estates	
	UM2	UM1	UM3	Non- irrigated	Irrigated
Yield (kg/ha)	700	600	400	950	1250
Plant density (plants/ha)	1200	1300	1300	1300	1700
Area in coffee (ha)	0.3	0.2	0.15	90	110
Wage rate (Ksh/man-day)	11.70	11.70	11.70	11.70	11.70
Total costs per ha (Ksh '000)	8.1	7.5	6.0	19.3	23.6
Costs per kilogram (Ksh)	11.5	12.5	15.0	20.3	18.9
(US\$)	1.21	1.32	1.58	2.14	1.99

Sources: Updated information from Ruthenberg (1980) (UM2 & non-irrigated estates), Jaetzold & Schmidt (1983) (UM1), Schall & Schmidt (1976) (UM3), Magogoni estate records (pers. communication 1974) (irrigated estates), J. de Graaff, *op. cit.*

15. According to a CRF study, coffee is the most profitable enterprise in the smallholder sector in most of the coffee growing areas (see Table 9). In most areas, coffee is closely followed in profitability by maize and beans.

16. Some mention should be made, however, of the interpretation of the data comparing the profitability of coffee and other crops. Coffee is a cash-crop; meaning that a well-established marketing system exists for farmers to sell it and obtain cash in return. Maize/beans and other crops in the coffee-growing areas are mainly grown for on-farm consumption and marketing systems for these crops are either poorly organized or do not exist. In fact, it is generally illegal to transport maize from one district to another unless special permits are obtained. Farmers thus do not decide whether to grow coffee or maize solely in terms of the relative profitability of the two crops

Table 8: KENYA COFFEE--COST/BENEFITS OF ADOPTING PROPOSED a/  
INPUT PACKAGES RECOMMENDED BY CRF

Yield Group (from low to high)		1	2	3	4	5	6
Current Input Expenditure (Ksh)	Inputs: Fertilizers	271	517	479	634	749	1,065
	Fungicide	186	272	480	795	943	1,178
	Insecticide	<u>74</u>	<u>111</u>	<u>111</u>	<u>148</u>	<u>148</u>	<u>259</u>
	Sub-total	531	9000	1,070	1,577	1,838	2,502
	Knapsack Sprayer (hired @ 55/round)	<u>55</u>	<u>110</u>	<u>165</u>	<u>275</u>	<u>275</u>	<u>330</u>
	Total	<u>586</u>	<u>1,010</u>	<u>1,235</u>	<u>1,852</u>	<u>2,113</u>	<u>2,832</u>
Proposed Input Expenditure (Ksh)	Fertilizer	271	377	494	681	864	1,153
	Fungicide	529	847	1,147	1,297	1,448	2,048
	Insecticide	<u>37</u>	<u>37</u>	<u>37</u>	<u>37</u>	<u>37</u>	<u>37</u>
	Sub-total	837	1,261	1,678	2,015	2,349	3,238
	Knapsack Sprayer	<u>250</u>	<u>350</u>	<u>350</u>	<u>350</u>	<u>350</u>	<u>350</u>
	Total	<u>1,087</u>	<u>1,611</u>	<u>2,028</u>	<u>2,355</u>	<u>2,699</u>	<u>3,588</u>
Additional Expenditure (Ksh) (including hired labor)	Fertilizer	-	(140)	15	47	117	88
	Fungicide	343	575	667	502	505	870
	Insecticide	<u>(37)</u>	<u>(74)</u>	<u>(74)</u>	<u>(111)</u>	<u>(111)</u>	<u>(222)</u>
	Sub-total	<u>306</u>	<u>361</u>	<u>608</u>	<u>438</u>	<u>511</u>	<u>736</u>
	Knapsack Sprayer Hired labor	195 <u>-</u>	240 <u>1,065</u>	135 <u>1,901</u>	75 <u>1,666</u>	75 <u>1,288</u>	20 <u>1,214</u>
	Total	<u>501</u>	<u>1,666</u>	<u>2,694</u>	<u>2,179</u>	<u>1,874</u>	<u>1,970</u>
Current Revenue (Ksh) @4.30/kg cherry		1,806	4,440	7,600	11,965	18,135	25,585
Expected Revenue (Ksh)		6,020	9,783	13,921	18,060	22,575	30,100
Additional Revenue (Ksh)		4,214	5,343	6,321	6,095	4,440	4,515
Net Benefit (Ksh) of adopting input package		3,713	3,677	3,627	3,916	2,566	2,545

a/ The table shows how typical farmers in six yield level groups can increase their net revenues by switching to "proposed input expenditure" from "current input expenditure" farming practice.

Source: J.D.M. Roe and J.K. Nyoro, *ibid.*

Table 9: KENYA COFFEE: GROSS MARGIN PER MANHOUR OF THE MAIN ENTERPRISES WITHIN EACH SMALLHOLDER ZONE (KSH)

Enterprise	Zone	Central UM1	Central UM2	Central UM3	Kisii	Machakos
Coffee		7.6	7.0	6.4	5.9	5.4
Maize & Beans		7.4	6.2	5.6	7.4	4.4
English Potatoes		4.4	3.8	3.2	-	-
Dairy		5.4	5.3	5.0	16.5	4.0

Source: J.K. Nyoro and J.D.M. Roe "Economics of Agricultural Production on Smallholder Coffee Farms in Kenya--Supplementary Analysis," CRF.

calculated from their market prices but also on the basis of the cash-food requirements of the family. A smallholder farmer would be hesitant to grow only coffee, even if coffee prices were high, because with the present payment system he would not be sure when and how much he would be paid for his coffee and thus planning for basic living would be very difficult. On the other hand, as a farmer needs cash to pay for school fees, clothes, etc., he would also be hesitant to grow only maize/beans. 1/ Other factors to be taken into account in analyzing competition for land between coffee and maize/beans are: (i) coffee is a perennial crop with a lengthy gestation period; and (ii) in Kenya it is illegal to uproot coffee trees. 2/

1/ The very high real maize prices in the mid-1970s encouraged farmers to allot at least some portion of their land for growing maize.

2/ Although illegal, it is difficult to enforce this law. Uprootings of live coffee trees are known to take place when coffee prices are low.

(iii) Cross-Country Cost Comparisons

17. A comparison of production costs among major coffee producing countries was undertaken recently. The data are shown in Table 10. The figures under "cost per kg coffee" are slightly misleading as they do not take quality price premiums into account. To take quality price premiums into account, these cost figures were adjusted by adding 17% to Brazil, 10% to other arabica producers, 25% to robusta producers except Indonesia and 30% to Indonesia. These adjustment percentages correspond to the price differentials in international markets between Kenya's arabica coffee and other coffees. Kenya's relative production cost compares favorably in the column under "Comparable cost per kg coffee."

18. Cost comparisons with Brazil and robusta-producing countries are not directly relevant because coffee grown in these countries does not directly compete with Kenya's and because their production costs are lower due to the sun-drying process used (instead of washing). Among the washed arabicas, Kenya's production costs compare favorably with those of Colombia but not with Costa Rica. Part of the reason for the adverse comparison with Costa Rica is the higher labor requirement needed to produce high-quality coffee; but the figures suggest scope for increasing efficiency of labor in Kenya, especially in harvesting.

(iv) Quality

19. Kenya produces the finest coffee in the world in large quantities. On average, Kenya's coffee fetches a 10% premium over standard arabica coffees of Central America and Colombia. Great care is taken in picking, processing,

Table 10: PRODUCTION COSTS PER HECTARE OF GREEN COFFEE IN  
SELECTED COUNTRIES (1982)

	Costs of Labor			Costs of	Overhead &	Total	Yield	Cost	Comparable
	(man- days)	Wage per Worker (US\$/day)	Costs (US\$)	Material Inputs	Establish- Costs (US\$)	Costs (US\$/ ha)	(kg/ha)	per kg Coffee (US\$/kg)	Cost per kg Coffee <sup>/a</sup> (US\$/kg)
<u>Arabicas</u>									
Brazil	75	3.0	220	220	280	720	600	1.20	1.40
Colombia	150	4.0	620	200	520	1,340	800	1.70	1.87
Costa Rica	150	2.4	360	380	580	1,320	1,200	1.10	1.21
<u>Kenya</u>									
Estates	400	1.5	600	750	800	2,150	1,100	1.95	1.95
Smallholders	220	1.2	270	220	280	770	600	1.30	1.30
Rwanda	275	1.2	340	190	290	820	700	1.20	1.32
<u>Cameroon</u>									
Arabica	90	2.0	180	70	90	340	200	1.70	1.87
<u>Robustas</u>									
Robusta	110	2.0	220	50	100	370	400	0.90	1.13
Côte d'Ivoire	70	2.5	180	20	60	260	300	0.90	1.13
Indonesia	120	1.7	210	60	120	390	500	0.80	1.04

<sup>/a</sup> Adjusted to take quality price premiums into account.

Source: J. de Graaff, op. cit.

sorting, grading and classifying. <sup>1/</sup> Strict guidelines are observed at each stage. Coffee cherries are picked one-by-one and sorted depending on ripeness (classified to Cherry I, Cherry II and Mbunis) before pulping at co-operative factories. Co-operative factory washing and drying processes are carefully

<sup>1/</sup> "Grading" in Kenya refers to sorting green coffee beans by size. This operation is carried out by KPCU. In general the larger the size, the higher the price fetched at the Nairobi auction. "Classifying" refers to labelling coffee on the basis of liquoring tests done by the Coffee Board of Kenya.

monitored by factory managers. Estates have their own factories, so they wash and dry coffee themselves and deliver it to KPCU. When delivered to KPCU, parchment coffee is hulled and the resulting coffee beans are milled and graded. Before auctioning the coffee at the Nairobi Auction, the Coffee Board liquors and classifies them into ten "classes." This "classification" forms the base to determine how much a particular lot and thus factory should be paid for coffee delivered. However, at auctions only "grades" are disclosed to traders. Traders undertake liquor tests to decide how much they are willing to pay for lots offered at the auction. The Coffee Board keeps track of the prices each "class" of coffee fetches at the auction and calculates payment schedules to factories and estates. Table 11 shows the CBK's payments for all "classes" of coffee for 1983/84. Table 12 shows CBK's payments for some aggregate "classes" of coffee in recent years. As these tables show, there are large price differentials among "classes." Thus payments to factories and estates also can vary widely.

20. Two points should be clarified here on the quality-payment relationship. First, no detailed analysis on "classes"- "grades"- "prices at auction" relationships have been made in Kenya. Such analysis would be helpful to capture the impact of trends in demand and prices on quality, which, in turn, would help Kenyan authorities in making future policy on payment of quality premiums in a dynamic world coffee market. Another point is that although Kenya's coffee marketing system is very quality conscious, there are very limited incentives for a smallholder to improve quality. "Average" prices are paid to factories and not to individual smallholders. Thus, a quality improvement made by a smallholder is rewarded only to the extent that his improvement raises the average quality of coffee his factory delivers to KPCU.

Table 11: KENYA COFFEE: NET PAYMENT BY CBK TO KPCU BY  
"CLASSES" OF COFFEE--1983/84

	Ksh/kg	Ksh/50 kg
<u>Clean Coffee</u>		
1	42.45	2,122.50
2	42.15	2,107.50
3	41.95	2,097.50
4	41.50	2,075.00
5	40.80	2,040.00
1-5	41.40	2,069.95
6	37.80	1,890.00
7	16.40	820.00
8	15.35	767.50
9	14.30	715.00
10	13.25	662.50
6-10	29.00	1,450.04
1-10	38.06	1,903.09
<u>Hulled MBUNI</u>		
I	32.55	1,627.50
II	13.95	609.50
III	13.15	657.50
1-III	25.03	1,251.41
AVERAGE	36.65	1,832.68

SOURCE: CBK.

21. The "acid" taste of Kenyan coffee is much preferred by West Germans and Scandinavians. Due to its altitude and climate, Kenyan coffee is a unique kind with limited direct competition from other coffees, such as from Ethiopia, Tanzania and Papua New Guinea. It should be noted, however, that although some countries such as West Germany, Sweden, Finland and Austria



(v) Government Policies

23. The government intervenes in the coffee sector in the following major areas: (a) gazetting of land, (b) control of planting materials, and (c) imposition of export taxes. Some details of each intervention are given below:

24. Gazetting of Land. Coffee is allowed to be grown in Kenya only in areas specified or gazetted by the government. The gazetting is a means to control quality and, to some extent, quantity. Although the gazetting makes it illegal to grow coffee in other areas, this law is not strictly enforced. Following the "coffee boom" in the late 1970s, coffee was planted in a number of "ungazetted" areas.

25. Control of Planting Materials. The government attempts to control production through its control over the availability of seedlings. A policy of restricting area expansion, and thus production, by this means was adopted during the period 1966 to 1972 and 1980 to the present when Kenya had to restrain production due to the imposition of the ICA quotas.

26. This measure, like the gazetting regulation, has not been very effective--especially in recent years. Even during years of tight control, farmers were able to obtain seedlings for infilling purposes which many farmers used to expand coffee acreage.

27. Export Tax. As shown in Table 13, the coffee export tax in Kenya is low in absolute terms; it is especially low compared with other coffee-exporting countries. As the export tax schedule is progressive, the effective tax rate increases with coffee prices. Thus tax rates were 6-7% during the years 1978/79-1979/80 and over 9% in 1984/85. The high rate in 1984/85 was due to the high coffee prices in terms of Kenyan shillings which in turn was due to the substantial depreciation of the Kenyan currency against the US dollar.

Table 13: KENYA COFFEE: EXPORT TAX AND COUNTY CESS--1977/78-1984/85

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85
	----- (K. sh/kg of clean coffee) -----							
Export Duty	1.32	1.79	1.57	0.75	1.24	1.91	2.32	4.30
County Council "cess"	0.74	0.78	0.87	0.63	0.83	1.05	1.10	1.39
Net CBK payment to KPCU	26.07	26.60	24.83	21.33	27.80	34.89	36.53	46.60

Source: CBK.

28. Other government influences on the coffee sector include extension services provided through the Ministry of Agriculture and research work done at the CRF and control of imported quantity and pricing of fertilizer.

#### IV. ANALYSIS OF KENYAN COFFEE PRODUCTION

29. This section analyses coffee production in Kenya using the vintage capital approach. <sup>1/</sup> Since the estate and smallholder sectors are quite different, as discussed above, and since separate data on area and production are available, the analysis has been done separately for the two sectors.

30. Consistent long-term data relevant to coffee production in the two sectors are available only on production and mature growing areas. No data are available on new plantings and infillings. As information on new plantings is indispensable in the vintage approach, new planting areas were derived from the data on mature areas in the following manner. When mature area (defined as area under coffee trees of more than two years of age) increases from one year to another, it is assumed that new plantings equivalent to the difference between the two mature area figures have taken place three years previously. For example, if smallholders' mature area expanded by 15,167 ha in 1980/81, this increase in the mature area is assumed to be the result of new plantings of 15,167 ha in 1977/78. When mature area declines it is assumed that the trees were abandoned or uprooted in that year and no new plantings have occurred.

31. To calculate production capacity through the vintage approach, yield curves, i.e., changes in the average yield with age of tree, have to be provided. Yield curve data were obtained from agronomists at the CRF and from other coffee specialists in Kenya. Areas classified by age were multiplied by

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<sup>1/</sup> For details on the vintage capital approach, see, for example, T. Akiyama and P. Trivedi, "A New Global Tea Model," World Bank Staff Commodity Working Paper Number 17, March 1987.

the yield curves to obtain the basic production capacities. The basic production capacity variables were adjusted by the trend in yield over the last 20 years to take into account possible changes in yield over time. This adjusted production capacity, together with real coffee prices, was then regressed against actual production to give a relationship between actual production and production capacities and short-term price effects. Details of the main results obtained are discussed below.

(i) Smallholder Sector

32. The estimated new planting acreage for the smallholder sector was derived from the mature area data in the way described above. As no statistically significant trend in yield could be found from this sector (see Table 2), all the increase in smallholder production was attributed to increases in acreage. Since the early 1960s, most of the area of mature coffee trees held by smallholders has occurred in two periods--the 1960s and from 1979 to the present. The acreage expansion in the 1960s was mainly due to the changes in the laws which allowed smallholders to grow coffee and to the breakup of some estates which were sold to smallholders. The second large area expansion occurred in the late 1970s as a consequence of the "coffee boom". The virtual stagnation in acreage in the 1970s before the "coffee boom" was not only due to the low real coffee prices but also to the restrictions which government put on seedling availability to restrict production in line with the ICA export quotas.

33. Statistical analysis shows that smallholder new plantings are very sensitive to real coffee prices. 1/ The medium-term price elasticity (3 years) is estimated to be 3.6; i.e., a 10% increase in real coffee prices increases new plantings by 36% over a period of 3 years. This elasticity, however, should be interpreted with caution. The large new plantings which took place during the period 1975-1980 were caused not only by the high real prices but also by the change of law which allowed smallholders to expand acreage during the period. So it is likely that the estimate is based upwards.

34. The production capacity and real producer price were regressed against the actual smallholder production to evaluate the validity of the production capacity variable 2/ and to estimate the short-term price elasticity of supply. The short-term price elasticity of supply refers to the extent, say, of output increase when real coffee prices increase and farmers

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1/ "Real" coffee prices here refer to the CBK unit payment price to KPCU deflated by the Consumer Price Index. Statistical analysis using maize prices as a deflator gave inferior results, although maize prices are strongly correlated with the CPI (correlation coefficient of 0.97 for the period 1966-1984).

The estimated regression:

$$\text{KYNPSH} = 10142 + 132.9 \text{ CBKR} + 172.6 \text{ CBKR}_{-1} + 163.7 \text{ CBKR}_{-2} + 106.1 \text{ CBKR}_{-3}$$

(6.31) (3.12) (9.12) (6.33) (4.77)

$$R^2 = 0.769 \quad \text{S.E.E.} = 2606.0 \quad \text{D.W.} = 2.31 \quad \text{RHO} = -0.487$$

Period of Estimation: 1965/66-1981/82

where KYNPSH = Smallholders' new planting acreage (ha)  
CBKR = Real coffee price (1980 K. Shillings/kg of clean coffee).

2/ The coefficient for the production capacity variable should be significant and be fairly close to unity, as indeed it is.

apply more inputs and improve husbandry to increase production. The short-term price elasticity is estimated to be 0.33 1/ which suggests that smallholders change yields substantially when prices change.

(ii) Estates

35. The estates' coffee acreage declined fairly steadily up to the mid-1970s (at the rate of 1.2% p.a.) which was the result of low and stagnant real coffee prices. The "coffee boom" in the second half of the 1970s reversed the trend and by 1984/85 the estates' mature area was 28% larger than it was in the mid-1970s. Statistical analysis shows that new plantings and acreage

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1/ Period 1963/64-1984/85

$$\text{KYPDSH} = 0.92 \text{ KYPDCSH} + 8.87 \text{ CBKR}_{-1} + 134.6 \text{ DM6768}$$

(14.3)                      (6.37)                      (2.03)

$$\bar{R}^2 = 0.891 \qquad \text{S.E.E} = 91.7 \qquad \text{D.W.} = 1.88$$

where KYPDSH = Actual smallholder production ('000 bags)

KYPDCSH = Smallholder production capacity ('000 bags)

CBKR = Real coffee price (1980 K Shillings/Kg of clean coffee)

DM6768 = Dummy variable for 1967 and 1968 to account for the incidence of Coffee Berry Disease.

reductions by estates are very sensitive to real coffee prices. 1/ The results of the analysis suggest that the estates' acreage will remain stable if clean coffee prices are Ksh. 24-25/kg in 1980 prices. If prices are higher, area will be expanded and vice versa. An increase of one 1980 K.Sh. would increase area by about 70 ha.

36. Based on statistical analysis, the average yield of the estates has been increasing at about 2% p.a. if price, weather and CBD effects are taken out. (These effects are taken into account later.) This secular trend in yield was incorporated in the production capacity variable.

37. Results of statistical analysis also show that the production capacity variable captures the main production trend and that the short-term

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1/ Two regression equations were estimated to evaluate the effects of real coffee prices on estates' acreage; one on new planting acreage and the other on an algebraic sum of new planting acreage and area reduction.

$$\text{KYNPES} = -1410.0 + 34.7 \text{ CBKR} + 34.0 \text{ CBKR}_{-1} + 2009.3 \text{ DM80}$$

(-8.61) (5.32) (5.23) (8.62)

$$R^2 = 0.913, \quad \text{S.E.E.} = 223.6 \quad \text{D.W.} = 2.37$$

where KYNPES = Estates' new planting acreage (ha)  
DM80 = Dummy variable for 1980

Period of estimation: 1964/65 - 1981/82

$$\text{KYUPNPES} = -1713.1 + 24.3 \text{ CBKR} + 44.8 \text{ CBKR}_{-1} + 2242.6 \text{ DM80}$$

(-10.23) (6.75) (9.41)

$$R^2 = 0.920 \quad \text{S.E.E.} = 228.7 \quad \text{D.W.} = 2.01$$

Period of estimation: 1964/65 - 1981/82.

where KYUPNPES = Algebraic sum of new planting acreage and area reduction (ha).

price elasticity of supply is significant and is about 0.3 to 0.4. 1/ As in the smallholder sector, the short-term price elasticity is high. The similarity of the short-term price elasticities of supply for the smallholder and estates' sectors suggests that these elasticities are fairly robust.

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1/ The estimated regression for the estates' production is:

$$\log \text{KYPDES} = 0.818 \log \text{KYPDCES} + 0.371 \log \text{CBKR} - 0.671 \text{DM67} - 0.418 \text{DM84}$$

(13.5)                      (3.9)                      (4.14)                      (2.58)

$$R^2 = 0.723 \qquad \text{S.E.E.} = 0.157 \qquad \text{D.W.} = 1.76$$

Period of estimation: 1964/65-1984/85

where KYPDES = Actual estates' production ('000 bags)  
KYPDCES = Estates' production capacity ('000 bags).

## V. PRODUCTION PROSPECTS

38. Based on the analysis described in Section III, coffee production projections are made in this section under several scenarios. In order to make projections, assumptions have to be made for exogenous variables. These variables include international coffee prices, the exchange rate of the Kenyan Shilling against the US dollar, the inflation rate in Kenya, yield trends and population growth rates. The following assumptions were made.

- (i) International coffee prices. Future international coffee prices, which affect Kenya's F.O.B. export unit values, are assumed to take the values as projected by the World Bank.
- (ii) Kenya's exchange rate and inflation rate: A statistical test was made to see if the purchasing power parity (PPP) assumption holds between Kenya's exchange rate and the world inflation rate proxied by the World Bank's Manufacturing Unit Value (MUV). <sup>1/</sup> The results show that the Kenyan shilling depreciated during the period 1970-85 to adjust for the differences between the domestic and international

---

<sup>1/</sup> The following regression equation was used in the projection exercises:

$$\log \left( \frac{\text{KYCPI} * 7.4204}{\text{KYER}} \right) = 0.9705 \log \text{MUV}$$

(189.9)

$$R^2 = 0.987 \quad \text{S.E.E.} = 0.046 \quad \text{D.W.} = 2.03 \quad \text{Rho} = 0.503$$

Period of estimation: 1970-1985

where KYCPI = Kenya's consumer price index (1980=100)  
KYER = Kenyan Shilling exchange rate against U.S. dollar  
(Number of Shillings per U.S. dollar)  
MUV = Bank's international inflation index.

inflation rates. As projected values for MUV are available, it was assumed that the PPP will hold in future. For the purpose of the current exercise, it was assumed that the Kenyan hilling exchange rate against the US dollar will be constant and Kenya's inflation index will increase at the same rate as the MUV.

(iii) Kenya's producer prices. The "Base Case" projection assumes the present payment system to continue. A statistically derived relationship between the CBK's payment and the ICO "Other Milds" Indicator Price was assumed to hold in future. 1/

(iv) Yield. As noted in Section III, for the last two decades yield has been increasing at 2% p.a. in the estate sector while no increase has been observed in the smallholder sector. Projections of yields are difficult as the new high-yielding variety, Ruiru 11, is expected to be introduced in large quantities in a few years' time. Although the yield of Ruiru 11 can attain twice that of the present variety in experimental stations, little information exists on yields at the farm level. Discussions with agronomists suggest 50% above the

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1/ The following equation was used in the projection exercises:

$$\log \left( \frac{\text{CBK}}{\text{KYER}} \right) = -3.894 + 0.9926 \log \text{POMICO}$$

(44.2)      (49.7)

$$R^2 = 0.991 \qquad \text{S.E.E.} = 0.058 \qquad \text{D.W.} = 1.80$$

Period of estimation: 1962-1984

where: CBK = CBK payment (K. Shillings/Kg of clean coffee)  
POMICO = "Other Milds" Indicator Price (US¢/lb)

traditional variety to be a good estimate. 1/ The figure of 50% is assumed here. The future shares of Ruiru 11 in total trees in the smallholder and estate sectors are those assumed by Roe and Nyoro. 2/ Yields of existing areas are likely to increase with improvement in the standard of coffee management and with infilling by Ruiru 11. Table 14 shows the expected increase in yield of existing coffee areas. The Table also shows the expected increase in yield for cases where the Ruiru 11 yield is 25% and 75% higher than the traditional varieties.

- (v) Effects of population growth. Population in Kenya is expected to grow at well over 3% p.a. in the medium term and by year 2000 to be about 66% more than in 1986, according to the estimates by the Central Bureau of Statistics. 3/ Population in rural areas probably will not grow as much as the total population but even a population increase of 44% in rural areas would have an important impact on coffee production.

Possible effects include:

A larger population implies more land will be required for housing and for other infrastructure such as schools and shops. This would reduce the available farm land including that for growing coffee.

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1/ This figure corresponds to the "conservative" assumption in "Economic Implications of Introducing the New Hybrid Variety of Arabica Coffee" by J.D.M. Roe and J.K. Nyoro, Manuscript, CRF, 1985.

2/ Ibid.

3/ See Population Projections for Kenya 1980-2000, Central Bureau of Statistics, 1983.

Table 14: EXPECTED YIELD INCREASE FOR 1985-2000 /a

Ruiru 11 Yield Improvement	Smallholder			Estate		
	Base case (50%)	25%	75%	Base Case (50%)	25%	75%
<u>Period</u>	-----(% p.a)-----					
1985-1988	0.0	0.0	0.0	2.0	2.0	2.0
1989-1995	0.8	0.4	1.3	2.8	2.3	3.4
1996-2000	1.8	1.0	2.7	3.6	2.5	4.5

/a These estimates were made in the following way for the "Base Case":

1985-1988. No significant quantity of Ruiru 11 will be available. Expected yield increases are based on the historical trends.

1989-1995. Roe and Nyoro in their study 1/ expect adoption of Ruiru 11 by 1995 to be 10% and 15% for smallholder and estates, respectively. Ruiru 11 is assumed to yield 50% higher than the traditional variety. Thus for the smallholder sector, the yield index in 1995 will increase to 1.05 ( $=0.9 + 0.1 * 1.5$ ) from 1.00 in 1989 or 0.82% p.a. The corresponding figures for the estates sector are 1.18 ( $=0.85 * 1.02^6 + 0.15 * 1.5$ ) and 2.8% p.a.

1996-2000. Roe and Nyoro expect adoption of Ruiru 11 to be 30% and 40% for smallholders and estates, respectively, by year 2000. The yield indices for 2000 are 1.15 ( $=0.7 + 0.3 * 1.5$ ) and 1.408 ( $= 0.6 * 1.02^{11} + 0.4 * 1.5 * 1.02^5$ ). For smallholders and estates, respectively, it is assumed that after 1996, yield of estates' Ruiru 11 will increase by 2% p.a. This gives yield growth rates of 1.8% p.a. and 3.55% p.a. for smallholders and estates, respectively.

Source: EPDCS, World Bank.

1/ Ibid.

- Smallholder farm plots will be subdivided as they are passed from one generation to another. This implies that the average size of smallholder farm plots will decline even further from the current average of about 1.5 ha.
- With less land per farm family, yields may increase as farmers strive to obtain enough production to support their food and cash needs.
- A larger population may imply larger numbers of casual laborers which many estates and smallholders employ, especially during harvesting time. This may lead to lower wages for these workers, which could reduce the production cost of coffee.
- Another possibly important effect is the share of land farmers will allocate to coffee as population increases. As the average land plot becomes smaller, farmers might allocate a larger share of land to maize to maintain their subsistence level. Or, they could allocate more land to cash crops to maximize their cash income.

39. It is beyond the scope of the current study to analyze all the effects set out above in detail. However, a cross-section analysis was made to evaluate the relationship between population density and area expansion. Population densities of eight major coffee growing districts were regressed against the percentage increases in total smallholder coffee acreage of the corresponding districts in the late 1970s. The results of the analysis indicated a strong relationship between population density and acreage expansion; larger acreage expansion occurred in the late 1970s in the districts where population densities were lower such as Meru, Embu and

Machakos. 1/ (An exception was Kiambu which had high population density and large acreage expansion.) The estimated elasticity was -0.48. In other words, area expansion was reduced by 4.8% when population density increased by 10%, ceteris paribus.

40. This relationship was incorporated into the projections as follows. It was assumed that rural population density will be 44% higher in 2000 than at present and that 10% higher population density lowers area expansion by 5% in the smallholder sector, ceteris paribus. In other words, if the model projects, mainly because of increases in prices, new plantings of 3,000 ha in 1999/2000, the simulation run with the population effect will reduce new plantings to 2,340 ha ( $=3000 * (1-.44*.5)$ ). As it turned out, the simulation results showed no significant impact of the assumed increase in population pressure on coffee production through the year 2000. The production-depressing effects of increasing population density are likely to be significant, however, beyond the year 2000.

41. With the above assumptions, (i) to (v) above, the "Base Case" projections were made by first estimating new plantings and production

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1/ The estimated regression equation is:

$$\text{ARX} = 2.66 - 0.0044\text{POPD} + 0.704\text{DM6}$$

(11.14)      (4.00)

$$R^2 = 0.683 \quad \text{S.E.E.} = 0.291 \quad \text{D.W.} = 2.20$$

where ARX = Districtwise coffee acreage expansion between 1977/78 and 1984/85

POPD = Population density of districts

DM6 = Dummy variable for Kiambu.

capacities. These were then used to calculate production for both the smallholder and estate sectors.

42. Table 15 shows the projected new plantings and production in both the smallholder and estate sectors together with some key assumptions. 1/ The "Base Case" run shows that Kenya's production by the year 2000 will be about 3 million bags or 50% higher than the current level. 2/ This increase translates to 2.8% p.a. growth for the period 1985/86-1999/2000. Mainly due to the assumptions on the adoption rate of the high-yielding variety, Ruiru 11, and thus on yield, production growth rates are not uniform throughout the period. Production is projected to increase at a low rate of 1.2% p.a. for the period 1985/86-1990/91 because the production in the base year 1985/86 was temporarily increased due to high prices and because low real producer prices in the following years are expected to keep production low. Production is expected to increase at the rate of 3.3% p.a. for the period 1990/91-1995/96 and at 4.1% p.a. for the period 1995/96-1999/2000 as the Ruiru 11 adoption rate accelerates (see Table 16). The production share of smallholders is projected to remain about the same during the period (about 60%).

43. By the year 2000 smallholders' acreage is projected to be about 170,000 ha or 40% (48,200 ha) larger than currently, while that of estates is projected to be about 39,000 ha or 10% larger than the current level. The

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1/ The projections were made using a spreadsheet program (Lotus 1-2-3) incorporating all the elasticities and coefficients estimated by regression analysis. It was possible, therefore, to perform sensitivity analysis instantaneously.

2/ The model has not taken uprooting or abandoning of coffee trees into account. The rate of these activities in the last 12 years appears to have been small. To the extent that uprooting becomes more important in the future the production projections will be biased upward.

Table 15: KENYA COFFEE: "BASE CASE" COFFEE PRODUCTION PROJECTIONS--1985/86-1999/2000

Crop Year	ICO "Other Milds" Indicator Price (US\$/lb)	MUV 1983=100	Exchange Rate (K.Sh./\$)	Kenya CPI	CBK Payment (K.Sh/kg)	Real CBK Payment (1980/K.Sh.kg)	Smallholders		Estates		Total Production ('000 bags)
							New Planting (ha)	Production ('000 bags)	New Planting (ha)	Production ('000 bags)	
1981/82 <sup>∆</sup>	139.90	101.20	10.90	134.70	27.80	20.64	2,093	876	0	573	1,449
1982/83 <sup>∆</sup>	131.60	100.00	13.30	150.20	34.90	23.24	2,758	874	98	550	1,424
1983/84 <sup>∆</sup>	144.30	98.20	14.30	166.00	36.50	21.99	1,907	1,245	140	904	2,149
1984/85 <sup>∆</sup>	145.60	99.20	16.40	187.40	46.60	24.87	2,978	1,079	194	482	1,561
1985/86	195.10	118.00	16.10	194.70	61.65	31.66	4,194	1,190	509	829	2,019
1986/87	142.90	119.20	16.10	196.68	45.25	23.01	4,595	1,271	437	754	2,025
1987/88	145.20	127.40	16.10	210.21	45.97	21.87	4,307	1,220	122	745	1,965
1988/89	150.00	131.80	16.10	217.47	47.48	21.83	3,457	1,247	84	760	2,007
1989/90	156.50	128.40	16.10	211.86	49.53	23.38	2,574	1,297	130	809	2,105
1990/91	160.60	131.40	16.10	216.81	50.81	23.44	2,660	1,359	177	842	2,201
1991/92	164.70	134.40	16.10	221.76	52.10	23.50	2,884	1,402	178	868	2,270
1992/93	168.80	137.50	16.10	226.88	53.39	23.53	3,024	1,439	178	876	2,316
1993/94	172.90	140.60	16.10	231.99	54.68	23.57	3,024	1,485	178	893	2,379
1994-95	177.00	143.90	16.10	237.44	55.97	23.57	3,008	1,537	176	927	2,464
1995/96	182.30	147.20	16.10	242.88	57.63	23.73	3,004	1,591	178	972	2,564
1996/97	187.50	150.60	16.10	248.49	59.26	23.85	3,012	1,662	183	1,012	2,674
1997/98	192.80	154.00	16.10	254.10	60.92	23.98	3,033	1,735	187	1,030	2,764
1998/99	198.00	157.60	16.10	260.04	62.56	24.06	3,057	1,809	190	1,056	2,866
1999/2000	203.30	161.20	16.10	265.98	64.22	24.14	3,073	1,886	191	1,103	2,989

<sup>∆</sup> Actual figures except new plantings.

Source: EPDCS, World Bank, "Kenya Coffee Production Model."

Table 16: KENYA COFFEE: SENSITIVITY ANALYSIS ON KENYA COFFEE PRODUCTION, BY PRODUCER PRICES

Crop Year	Real Producer Prices														
	Base Case			10% Higher			20% Higher			10% Lower			20% Lower		
	Small- holders	Estates	Total	Small- holders	Estates	Total	Small- holders	Estates	Total	Small- holders	Estates	Total	Small- holders	Estates	Total
1985/86	1,190	829	2,019	1,190	829	2,019	1,190	829	2,019	1,190	829	2,019	1,190	829	2,019
1986/87	1,271	754	2,025	1,271	781	2,052	1,271	807	2,078	1,271	725	1,996	1,271	694	1,965
1987/88	1,220	745	1,965	1,241	772	2,012	1,261	797	2,058	1,200	716	1,916	1,180	686	1,865
1988/89	1,247	760	2,007	1,261	787	2,054	1,286	813	2,100	1,227	731	1,958	1,208	699	1,907
1989/90	1,297	809	2,105	1,319	840	2,158	1,341	869	2,210	1,274	776	2,051	1,252	742	1,994
1990/91	1,359	842	2,201	1,388	877	2,265	1,417	911	2,328	1,330	806	2,136	1,301	770	2,071
1991/92	1,402	868	2,270	1,440	907	2,347	1,478	945	2,423	1,364	828	2,192	1,326	791	2,117
1992/93	1,439	876	2,316	1,489	921	2,410	1,539	964	2,503	1,390	833	2,222	1,340	795	2,135
1993/94	1,485	893	2,379	1,551	943	2,494	1,617	992	2,610	1,419	845	2,264	1,353	807	2,160
1994/95	1,537	927	2,464	1,621	982	2,603	1,705	1,036	2,741	1,453	873	2,326	1,369	832	2,202
1995/96	1,591	972	2,564	1,693	1,034	2,727	1,795	1,095	2,890	1,489	912	2,401	1,387	868	2,255
1996/97	1,662	1,012	2,674	1,784	1,080	2,864	1,905	1,149	3,054	1,541	944	2,485	1,419	897	2,316
1997/98	1,735	1,030	2,764	1,876	1,104	2,981	2,018	1,179	3,197	1,593	957	2,550	1,452	908	2,360
1998/99	1,809	1,056	2,866	1,971	1,138	3,109	2,133	1,220	3,353	1,647	977	2,625	1,485	927	2,412
1999/2000	1,886	1,103	2,989	2,069	1,191	3,260	2,252	1,280	3,532	1,703	1,017	2,720	1,520	963	2,483

Source: EPDCS, World Bank, "Kenya Coffee Production Model."

share of coffee area held by smallholders is projected to increase to 81% by the year 2000 compared with 77% at present.

44. The large difference in the projected area expansion rates by smallholders and estates seems reasonable as the smallholders have the possibility of switching land currently planted to food crops and/or used for pasture to coffee; but there is extremely limited land available for the establishment of new estates or for adding more acreage to the existing estates.

45. Simulation runs were made to evaluate the effects of changes in real producer prices on production. Table 17 shows the results of the simulation runs with different price levels--runs with real producer prices 10% and 20% higher and lower than the "Base Case". These simulation results show that Kenya's coffee production is fairly sensitive to changes in real producer prices, especially in the long run. Long-run price elasticities, defined as the percentage change in production 10 years after the prices are changed by 10%, are 7.3% for the smallholder, 6.7% for the estates and 7.1% for the total. 1/ The long-term price elasticities of the smallholders are higher than those of the estates because the smallholders' new plantings respond much more to prices.

46. Table 17 shows the growth rates to be fairly high in the 1990s even in cases where producer prices are reduced by 10-20%. This is because of the assumption on yield which is greatly affected by the adoption of Ruiru 11. It is assumed in the model that the adoption rate will not vary with the real producer prices, obtaining an estimate of the price effect on the adoption rate has not been possible. If the adoption rates vary with real producer prices, which remains more realistic, the effects of changes in real producer

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1/ As discussed in Akiyama and Bowers, price elasticities change with time.

Table 17: PROJECTED PRODUCTION GROWTH RATES WITH DIFFERENT  
REAL PRODUCER PRICES

Period	Base Case	Real Producer Prices			
		10% Higher	20% Higher	10% Lower	20% Lower
-----(% p.a.)-----					
1985/86-1990/91	1.7	2.3	2.9	1.1	0.5
1990/91-1995/96	3.1	3.8	4.4	2.4	1.7
1995/96-1999/2000	3.9	4.6	5.1	3.2	2.4
1985/86-1999/2000	2.8	3.5	4.1	2.2	1.5

Source: EPDCS, World Bank.

prices on production growth rates will be more pronounced than those indicated in Table 17.

47. A sensitivity analysis was also done for the yield of Ruiru 11. The "Base Case" assumed 50% increase in yield. Simulations under the assumption of 25% and 75% yield increase were carried out. These assumptions translate to the overall yield increase, given in Table 18. The figures in Table 18 could also be interpreted as the expected yield increase with different Ruiru 11 adoption rates while holding the yield increase of Ruiru 11 at 50%. The "25% Case" corresponds to the case where the smallholders' adoption rates are 5% and 15% in 1995 and 2000, respectively, and when the estates' adoption rates are 5% and 13% in 1995 and 2000, respectively. Similarly the "75% Case" corresponds to the case where the smallholders' adoption rates are 15% and 45% in 1995 and 2000, respectively, and when the estates' adoption rates are 25% and 67% in 1995 and 2000, respectively.

48. In Table 18 no significant differences in total production can be observed up to 1995. However, with the increase in adoption rates in the latter half of the 1990s, the differences become larger. Expected production differs by 5-6% in 2000 between the 25% and 50% yield increase assumptions and also between the assumptions of 50% and 75% yield increase.

Table 18: KENYA COFFEE: SENSITIVITY ANALYSIS ON KENYA  
COFFEE PRODUCTION, BY RUIRU 11 YIELDS

Crop Year	Base Case (50%)			25%			75%		
	Small- holders	Estates	Total	Small- holders	Estates	Total	Small- holders	Estates	Total
1985/86	1190	829	2019	1190	829	2019	1190	829	2019
1986/87	1271	754	2025	1271	754	2025	1271	754	2025
1987/88	1220	745	1965	1220	745	1965	1220	745	1965
1988/89	1247	760	2007	1247	760	2007	1247	760	2007
1989/90	1297	809	2105	1292	805	2098	1301	812	2114
1990/91	1359	842	2201	1350	835	2185	1369	850	2219
1991/92	1402	868	2270	1388	856	2244	1418	879	2297
1992/93	1439	876	2316	1420	861	2281	1461	891	2353
1993/94	1485	893	2379	1461	874	2335	1514	913	2427
1994/95	1537	927	2464	1506	903	2409	1573	951	2524
1995/96	1591	972	2564	1554	943	2497	1635	1002	2637
1996/97	1662	1012	2674	1612	973	2585	1721	1050	2771
1997/98	1735	1030	2764	1671	983	2653	1809	1077	2886
1998/99	1809	1056	2866	1730	1000	2730	1902	1113	3014
1999/2000	1886	1103	2989	1791	1036	2826	1997	1171	3168

Source: EPDCS, World Bank, "Kenya Coffee Production Model."

## VI. PROSPECTS FOR KENYA'S COFFEE EXPORTS

49. Kenya's coffee sector is very much dependent on developments in the international coffee market as most of the coffee produced is exported. In this section, prospects for the international coffee market and the impact of likely developments in the world market on Kenya's exports and production are examined.

50. The short-run prospects in the international coffee market have become more uncertain following the suspension of the ICA export quota system in February 1986. The suspension took place following the skyrocketing of coffee prices on the news of a prolonged drought in Brazil. With the boom over, the quota system is likely to be re-implemented sometime in 1987. It is expected that a new international coffee agreement, with export quota provisions, will come into force after the present one expires in September 1989. However, the allocation of quotas during the remaining period of the current agreement and under the new agreement could well be different from the allocation between September 1980 and February 1986. Judging from the recent discussions held at the ICO, future quota allocations will likely be based more on recent production capacities; heavy penalties, probably in terms of quota reductions, could be imposed on countries which "undership" <sup>1/</sup> or sell large quantities of coffee to non-quota markets at prices substantially lower than those of the quota markets.

51. The projected world coffee prices used in the next section are based on the continuation of the export quota arrangement through the year 2000.

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<sup>1/</sup> "Undershipment" occurs when a country exports less than its quota.

Under this scenario, Kenya's exports can be projected by projecting the global export quotas and Kenya's export quotas as well as Kenya's non-quota exports.

52. Prospects for Kenya's coffee exports could be substantially different if the quota system is not implemented during the period 1987-2000. Thus two scenarios are considered: with the export quota system in operation and without the quotas. In neither case were explicit assumptions made about the occurrence of adverse weather in major producing countries, e.g., frosts or droughts in Brazil, but their implications are discussed for each scenario.

(i) Prospects for Kenya's Exports under the ICA Export Quota System

53. As the quality of Kenya's coffee is very high, its demand is strong--especially in north European countries. Kenya has had no export "shortfalls" and has been producing considerably larger quantities than its quotas in recent years. These factors will work in Kenya's favor in its representations to obtain higher quotas in the future.

54. Kenya's export quotas have been between 1,200,000 and 1,400,000 bags for the period 1980/81-1985/86 with the most recent quota being 1,330,000 bags. As quotas were suspended for most of 1985/86, Kenya exported a substantially larger quantity in that season than in the previous season. Assuming that the quotas will not be implemented soon, Kenya will also export a large quantity during 1986/87. If the quotas are reintroduced for the 1987/88 season, Kenya's allotment should be higher than for 1985/86 due to the factors discussed above and an expected increased global quota for 1987/88. It is assumed, therefore, that Kenya's 1987/88 quota will be 1,436,000 bags, or 8% higher than that for 1985/86. For the remainder of the current agreement, i.e., until September 1989, it is assumed that Kenya's quota will increase at 2% p.a. In the likely event that Kenya obtains favorable treatment in quota

allocations beyond September 1989, it is assumed that its quota will be 1,500,000 bags for 1989/90 and increase at 2% p.a. thereafter under a new agreement.

55. The assumed annual increase in Kenya's quotas is considerably higher than Kenya's actual quota increases in recent years, which have been stagnant. This rather high quota increase assumption is based on another assumption, i.e., that quotas in future will be allocated more on the basis of production capacities of exporting countries and on the demand for specific types of coffee than in the past. Another consideration is that severe adverse weather in major producing countries in the future will lead to Kenya obtaining larger quotas.

56. Non-quota markets are not expected to expand as rapidly as in the recent past since the ICA restrictions on discounts and export quantities to these markets are expected to become much more severe in the future. Kenya's non-quota exports are assumed to increase at 4% p.a. for the period 1987/88-1999/2000.

57. The projected coffee prices for the quota market under this scenario are the most recent projections of the World Bank. Export prices for the non-quota markets are assumed to be 25% below those of the quota markets. This price differential is due mainly to the difference in the quality of coffee exported to the two markets.

(ii) Prospects for Kenya's Exports Without the Export Quota System

58. Although Kenyan and world export quantities will be larger in the event that where there is no ICA quota system, world prices would likely be lower. How much world prices would be lower in the absence of the quota system depends greatly on the assumptions made about the quota system. If, for

example, the price floor is set lower and the global quota set at a higher level, then in recent years the quotas may not have very much of a price-raising effect. On the other hand, if the price floor is increased and the global quota is reduced, the price-increasing effects of the quotas could be significant. For the purpose of the current exercises, two "no quota" cases were considered: one with price 10% lower and the other with prices 20% lower than in the "with quota" case above. The differences for Kenya between the existence or non-existence of the quota system are not only in terms of export prices and quantities but also in terms of production. If world prices are lower, Kenya's production will also be substantially lower as a result of the price effect. (It is assumed that all the exportable production, i.e., production minus domestic consumption, will be exported.)

59. An extreme scenario of very low prices could be considered. In such a case, the production cost data in Table 10 suggest that Kenya's smallholders should be able to survive but estate production could fall sharply.

60. Export projections under the scenarios (i) and (ii) above are analyzed in the next section.

## VI. PROSPECTS FOR KENYA'S COFFEE SUPPLY/DEMAND BALANCE

61. The analysis and projections of Kenya's production and exports made in the previous two sections can be combined to project Kenya's coffee supply/demand balance. Table 19 shows Kenya's coffee supply/demand balance for the period 1985/86-1999/2000, together with projected export revenues. World coffee prices are assumed to be 10% and 20% lower when there are no quotas compared with prices when there are quotas. Domestic consumption is assumed to increase at 3% p.a. Estimated export revenues are calculated by multiplying world prices and export quantities. Real export revenues are nominal export revenues deflated by the MUV.

62. The projections of the Kenyan coffee sector shown in Table 19 do not take into account the likelihood of future "coffee booms." From past experience, it could be assumed that some major weather abnormality would occur at least once before the year 2000 and this would imply lower stock accumulations by Kenya. However, "adding in" the likelihood of coffee price booms would not contribute much to the relevance of the above analysis for coffee sector pricing policy per se. This is not to argue that such windfalls are irrelevant to policy but rather to suggest that they should be discussed in a wider context which includes exchange rate, money supply and trade policy, because their impact is economy-wide.

63. The following points can be drawn from Table 19:

- (i) As world prices are expected to decline in 1987 and 1988, Kenya's coffee export revenues are likely to decline sharply during this period from the 1986 level. In real terms, the coffee export revenue in 1988/89 is projected to be at least

Table 19: KENYA COFFEE: PROJECTIONS OF KENYA'S COFFEE SUPPLY/DEMAND  
BALANCE--1985/86-1999/2000

Crop Year	Product- ion	Quota Market	Exports Non-quota Markets	Total	Domestic Consump- tion	Year-end Stocks	Export Revenue		
							(Current '000 US\$)	(1986 '000 US\$)	(1986 '000 /a Ksh)
----- ('000 bags) -----									
<b>A. WITH QUOTAS</b>									
1985/86	2,019	2,021	0	2,021	50	1,098	572,519	572,519	9,217,562
1986/87	2,025	2,021	0	2,021	52	1,050	419,339	415,117	6,683,390
1987/88	1,965	1,436	300	1,736	53	1,227	347,027	321,422	5,174,895
1988/89	2,007	1,465	312	1,777	55	1,402	366,584	328,201	5,284,032
1989/90	2,105	1,500	324	1,824	56	1,627	392,471	360,682	5,806,980
1990/91	2,201	1,530	337	1,867	58	1,903	411,867	369,866	5,954,836
1991/92	2,270	1,561	351	1,912	60	2,201	431,959	379,250	6,105,926
1992/93	2,316	1,592	365	1,957	61	2,498	452,771	388,560	6,255,814
1993/94	2,379	1,624	380	2,003	63	2,810	474,327	398,084	6,409,145
1994/95	2,464	1,656	395	2,051	65	3,158	496,652	407,261	6,556,907
1995/96	2,564	1,689	411	2,100	67	3,554	523,217	419,426	6,752,765
1996/97	2,674	1,723	427	2,150	69	4,009	550,469	431,310	6,944,095
1997/98	2,764	1,757	444	2,202	71	4,501	579,023	443,667	7,143,036
1998/99	2,866	1,793	462	2,254	73	5,038	608,320	455,468	7,333,032
1999/2000	2,989	1,828	480	2,309	76	5,643	639,004	467,757	7,530,889
<b>B. WITHOUT QUOTAS (World Prices 10% Lower)</b>									
1985/86	2,019	-	-	2,021	50	1,098	572,519	572,519	9,217,562
1986/87	2,025	-	-	2,021	52	1,050	419,339	415,117	6,683,390
1987/88	1,937	-	-	1,884	53	1,050	357,454	331,080	5,330,388
1988/89	1,959	-	-	1,904	55	1,050	373,216	334,138	5,379,629
1989/90	2,055	-	-	1,999	56	1,050	408,753	375,645	6,047,887
1990/91	2,145	-	-	2,087	58	1,050	437,963	393,300	6,332,125
1991/92	2,204	-	-	2,145	60	1,050	461,624	405,295	6,525,250
1992/93	2,237	-	-	2,175	61	1,050	479,883	411,827	6,630,418
1993/94	2,279	-	-	2,216	63	1,050	500,590	420,125	6,764,016
1994/95	2,340	-	-	2,275	65	1,050	526,233	431,518	6,947,439
1995/96	2,416	-	-	2,349	67	1,050	559,626	448,613	7,222,675
1996/97	2,501	-	-	2,432	69	1,050	595,963	466,956	7,517,996
1997/98	2,567	-	-	2,496	71	1,050	628,865	481,857	7,757,903
1998/99	2,641	-	-	2,568	73	1,050	664,455	497,498	8,009,715
1999/2000	2,736	-	-	2,661	76	1,050	706,902	517,459	8,331,094

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Table 19 contd...

Crop Year	Production	Quota Market	Exports Non-quota Markets	Total	Domestic Consumption	Year-end Stocks	Export Revenue		
							(Current '000 US\$)	(1986 '000 US\$)	(1986 '000 Ksh) /a
----- ('000 bags) -----									
C. WITHOUT QUOTAS (World Prices 20% Lower)									
1985/86	2,019	2,021	0	2,021	50	1,098	572,519	496,608	9,217,562
1986/87	2,025	2,021	0	2,021	52	1,050	419,339	360,076	6,683,390
1987/88	1,906	1,436	300	1,853	53	1,050	312,606	251,150	4,661,606
1988/89	1,908	1,465	312	1,854	55	1,050	322,972	250,816	4,655,406
1989/90	2,002	1,500	324	1,946	56	1,050	353,760	282,000	5,234,219
1990/91	2,086	1,530	337	2,028	58	1,050	378,403	294,758	5,471,011
1991/92	2,139	1,561	351	2,080	60	1,050	397,875	303,007	5,624,132
1992/93	2,162	1,592	365	2,101	61	1,050	411,905	306,619	5,691,178
1993/94	2,187	1,624	380	2,124	63	1,050	426,527	310,504	5,763,274
1994/95	2,229	1,656	395	2,164	65	1,050	444,831	316,402	5,872,755
1995/96	2,284	1,689	411	2,217	67	1,050	469,412	326,402	6,058,354
1996/97	2,346	1,723	427	2,277	69	1,050	495,965	337,079	6,256,532
1997/98	2,391	1,757	444	2,319	71	1,050	519,444	345,242	6,408,055
1998/99	2,443	1,793	462	2,369	73	1,050	544,901	353,889	6,568,545
1999/2000	2,514	1,828	480	2,438	76	1,050	575,741	365,568	6,785,320

a/ Calculated by multiplying "1986 US\$ export revenues" by exchange rates given in Table 15.

Source: EPDCS, World Bank, Kenya Coffee Production Model.

40% less than that of the 1985/86 level, regardless of whether the quotas are reintroduced or not.

- (ii) As world prices and Kenya's exports increase after 1988/89, Kenya's real export revenues are likely to be on an increasing trend. The rates of increase differ by the assumptions made: 3.3% p.a. for the case with quotas; 3.5% p.a. for the case without quotas and 20% lower prices and 4.0% p.a. for the case without quotas and 10% lower prices.
- (iii) Kenya's total real coffee export revenue for the period 1987/88-1989/2000 is projected to be, in terms of 1986 US dollars, \$5.17 billion with quotas, \$5.52 billion without quotas and 10% lower prices and \$4.66 billion without quotas and 20% lower prices. In other words, the results show that Kenya's total real export revenues for the next 14 years would not differ very much whether there are quotas or not--if world prices decline by up to 15% in the absence of the quota system.
- (iv) If the quota system continues, Kenya's stocks accumulate quickly, especially in the second half of the 1990s when production is expected to increase rapidly. This situation is very likely if one considers that the current production capacity is about 2 million bags and the recent export quantities have been only about 1.5 million bags.

## VII. POLICY IMPLICATIONS

64. Analysis of the Kenyan coffee sub-sector has revealed a number of important features of the sub-sector. The analysis also leads to several policy implications.

65. Optimal policies critically depend on whether some form of international export quota system continues. For example, as the results in Table 19 show, a continuation of the recent large production increase and a restrictive world export quota system (at least for Kenya) would lead to large stock accumulations, whereas little stock accumulation would occur if the quota system were to be discontinued. So, a first policy question is whether Kenya should support the quota system.

66. Simulation results shown in Table 19 suggest that future export revenues are not likely to be very different whether the quota system continues or not. It should be noted, however, that these results apply only if the assumptions made are realized. The simulation results and other analysis revealed that the following factors are critical in evaluating the effects of the quota system on the coffee sub-sector.

- Restrictiveness of the quota system
- Kenya's future quota allotment
- Kenya's future production increases
- Costs of maintaining stocks.

67. The ideal situation for Kenya would be one in which the quota system is sufficiently restrictive to support world prices and Kenya obtained increases in export quotas which by and large corresponded to the increases in

production, so that no large stock accumulation occurred. If Kenya's quota increases are small compared with its production increases and large accumulations of stocks occur, the quota system would be of little benefit to Kenya's coffee sub-sector. It should also be noted that the operation of the quota system could exclude the possibility of Kenya expanding its robusta production substantially as this could push Kenya's production level considerably above its quota. Close monitoring of future developments in the world and Kenya's coffee markets should be observed to evaluate the effects of the quota system on Kenya's coffee sub-sector. The Kenya coffee production model developed here should be a useful tool to carry out the evaluations.

68. Simulations of the Kenyan coffee sector also show that if Kenya's production increases and its export quota growth is low, Kenya could accumulate large quantities of stocks. In such a case, the current producer payment system would cause the Coffee Board to accumulate large debts. 1/ In that case, the CBK may consider changing its payments system. Under an alternate system, the CBK could pay producers only from the money received from coffee sold. This would cause producer prices to be lower but would not lead to borrowing by the CBK.

69. Coffee competes for land use with food crops in the smallholder sector. This competition could become much more severe with the expected increases in population. Rapid increases in food crop yields, especially of maize, are necessary for coffee production to increase. Otherwise, population pressures could force farmers to divert land from coffee food crops. The

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1/ Under the current system, all the coffee produced, including that held in stock, is paid for at market prices. This system forces the CBK to borrow to pay the growers for coffee that is stocked.

government imposes restrictions on domestic maize trade, i.e., on prices and on inter-district transport. More liberal policies on maize trade would allow farmers greater freedom in deciding which crop to grow and in what proportions on the basis of profitability considerations.