MINISTRY OF AGRICULTURE
WESTERN REGION

FIRST RURAL DEVELOPMENT PROJECT

PHYSICAL DEVELOPMENT PLAN
BURNT GROUND SETTLEMENT SCHEME

RURAL PHYSICAL PLANNING UNIT

MONTEGO BAY, JUNE 1979

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BURNT GROUND SETTLEMENT SCHEME

Ministry of Agriculture
Rural Physical Planning Unit
Montego Bay, June 1979

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INTRODUCTION AND BACKGROUND

The Burnt Ground area (1751.6 acres located in the Parish of Hanover) was selected for development by the Government and the International Bank for Reconstruction and Development (World Bank) under the First Rural Development Project. When the Loan Agreement between the Government of Jamaica and the World Bank was signed on June 29, 1977 the area was slated for development of mainly crop production with a minor component of livestock production in 130 "complete farms" (Project Land Lease III farms) and 50 "supplementary farmlots" of two acres each (Project Land Lease II farmlots). The complete farms are small holdings that would need to produce an annual net cash income of J$2000 (added value J$3200) which at February 1977 price and income levels presented a viable small holders farm income.* Thus, an average complete farm was supposed to comprise 6 acres of land subdivided into about 2 acres annual crops, 2 acres tree crops and 2 acres pasture.**

When the preparation of the physical development plan of the Burnt Ground Settlement Scheme was initiated by the Rural Physical Planning Unit of the Ministry of Agriculture, Western Region, in the fall of 1978, it became clear that Government policy towards land use in the area had shifted to emphasizing dairy production rather than crop production. Hence, the physical development plan has been designed so that the majority of the farms is based on dairy production as major component. Minor components are citrus production and subsistence garden crop farming.
Planned farm sizes vary from about 9 - 10 acres for farms that are predominantly in dairy to about 5 acres for farms that have citrus production as the major enterprise.

* The relationship between net farm income, farm added value and the other factor shares that make up a farm income account, are presented in Annex II to this report.

** Table on page 13 of Draft Report 1205 - JM of June 14, 1976 Staff Projects Report Jamaica, First Rural Development Project.

SUMMARY OF RESULTS *

The Burnt Ground Settlement Scheme is an area of 1751.6 acres (708.8 ha.) located in southeast Hanover which was acquired by the Government for lease to "Project Land Lease phase II and phase III" farmers in the framework of the First Rural Development Project. In this report a physical development plan is presented which, on the basis of land capability assessment and general land use policy considerations, subdivides the area into productive land, consisting of farm land including ponds (1255.1 acres), village land including backyard gardens of the houselots (68.8 acres), areas for communal facilities (6.4 acres) and roads (68.7 acres), as well as non-productive forest land for watershed protection (351.8 acres). The farm land in the development plan provides for both PLL II as well as for PLL III farms.

There are 137 complete PLL III farms with an equal number of corresponding houselots in two villages: "Burnt Ground Village" in the vicinity of the Great House and "New Milestown" east of Milestown. The complete PLL III farms delineated on plan comprise two farm types:

- Farm Type No. 1 (121 farms) which concentrates on dairy farming having a size varying from 8.3 to 9.8 acres and a garden crop area of 0.3,acres in the backyard of corresponding farm houselots;

- Farm Type No. 2 (16 farms) which centres on citrus production having a size ranging from 4.5 to 4.7 acres and also, a garden crop area of 0.3 acres in the backyard of corresponding farm houselots.

The two farm types were defined and selected according to Government land use policy, present land use, marketing facilities and land capability.

Each farm of both types constitutes an economically viable small holding which has a size and a production capability that can guarantee each farmer-settler the target farm added value of J$3,200.- per year. Actual farm subdivision was done by means of a quantitative land capability assessment that determined the possible productivity levels per acre of land in the light of assumed management levels for the respective forms of land use and physical land limitations that restrict production. Maximum house-farm distance is 1.2 miles. However, many PLL III farmers live much closer to their land.

The planning of the two villages includes adequate reservations for communal facilities, such as a playfield, schools, health clinic, community centre, shops, etc.

The PLL II farm land constitutes an area of 136.8 acres and is planned in the northern part of the settlement scheme where it can be utilized by farmers living off the property in Milestown, Content and Copse within a distance of two miles. No definite forms of land use have been indicated for the PLL II land. This is left to the preference

* The effects of the torrential rains of June 12, 1979, which caused extensive damage in large parts of Western Jamaica necessitated some changes in the development plan. In particular, part of the existing citrus orchard was badly affected by flooding, so that many trees have died. Therefore, in total only 14 citrus orchard farms can be accommodated now, and land use in the affected area has to be changed to (dairy) pasture. Details of the changes in the development plan could not be included anymore in the main text of this report, but are given in an Appendix, in the back of this volume.

of individual PLL II farmers. The land capability assessment indicates that there are no particular serious limitations that would preclude the use of this land for any of the major forms of land use i.e. annual cropping, orchard farming, beef or dairy farming.

All PLL III complete farms and PLL II supplementary farm plots on plan have been provided access by farm roads and a few footpaths.

In Table 1: "Summary of Planned Land Use, Burnt Ground Settlement Scheme", detailed figures are given for all proposed categories of land use in terms of numbers, acreages and percentages.

Table 1

SUMMARY OF PLANNED LAND USE, BURNT GROUND SETTLEMENT SCHEME *

Category of Land Use	Number	Acreage (Acres)	Acreage (%)
PLL III Farm Land			
– Farm Type I	121	1084.4	62.0
dairy pastures	n.a.	1008.2	57.6
existing ponds	81	24.0	1.4
new ponds	98	10.9	0.6
gardens (backyards of houselots)	121	41.3	2.4
– Farm Type 2	16	79.4	4.5
existing citrus orchard	n.a.	71.6	4.1
new citrus orchard	n.a.	1.9	0.1
gardens (backyards of houselots)	16	5.9	0.3
PLL II Farm Land			
– Farm Type 3	68*	136.8	7.8
existing ponds	9	1.7	0.1
Forest Land			
– Existing Dense Forest and Woodlots	n.a.	82.6	4.7
– Degraded Forest and Bush Land to be Reforested	n.a.	269.2	15.4
Villages			
– "Burnt Ground Village"	1	50.4	2.9
farm houselots**	90	43.4	2.5
extra houselots	4	1.9	0.1
communal land (playfield, Great House etc.)	n.a.	5.1	0.3
– "New Milestown"	1	24.8	1.4
farm houselots ***	47	21.8	1.2
extra houselots	3	1.7	0.1
communal land (playfield, school reservation etc.)	n.a.	1.3	0.1
Roads			
– Existing Asphalted Road	6,220 ft****	5.7	0.3
– Existing Gravel Roads (to be upgraded to Farm Roads)	3,710 ft****	3.4	0.2
– New Farm Roads	63,500 ft***	58.3	3.3
– New Farm Footpaths	4,860 ft***	1.3	0.1
Miscellaneous			
– Concreted Catchment and Watertank	1	0.8	
TOTAL		1751.6	100.0

* See footnote on page vii

** Lots of 2 acres each

*** Including backyard gardens also listed under PLL III Farm Land

**** Length in feet. Farm roads have a reservation of 40 ft, footpaths 12 ft.

ACKNOWLEDGEMENTS

In the preparation of the development plan of the Burnt Ground Settlement Scheme, the staff of the Rural Physical Planning Unit of the Ministry of Agriculture - Western Region received assistance from many Government and private agencies. Their valuable contributions are acknowledged here.

The Survey Department arranged for the airphotography at scale 1:10,000 flown in March 1977 and prepared the base map at scale 1:2,500 with contours at 5 ft interval. An older base map at scale 1:5,000 compiled from aerial photography dated January 1968 was also made available.

Information on the present use of the area was provided by the site manager of the Agricultural Development Corporation (ADC) at Burnt Ground and the Hanover parish office of the Ministry of Agriculture.

Climatological data related to rainfall and evapotranspiration for several stations in the area where provided by the Meteorological Service in Kingston.

Soil analyses on physical and chemical properties of representative soils in the settlement scheme were carried out by the Soils Laboratory of the Agricultural Chemistry Division, Ministry of Agriculture in Kingston.

The Southern Region Rural Physical Planning Unit of the Ministry of Agriculture in Kingston provided constructive comments in the preparation of the land capability assessment for the area.

With a view to the added value calculations that were carried out under the various land utilization types, information was received from the Jamaican Development Bank, private enterprises in and around Montego Bay as well as through officers of the Western Region office of the Ministry of Agriculture and the staff of the Netherlands bilateral aid project attached to the Knockalva Agricultural Training Centre in Ramble, Hanover.

Costs related to the rehabilitation of the citrus orchard were given by the Regional Plant Production Unit of the Ministry of Agriculture - Western Region.

Costs for cleaning ponds and digging new farm ponds as well as prices for agricultural lime to neutralize soil acidity were related to the Planning Unit by the Staff of the Cornwall Youth and Community Development Project in Ramble, Hanover.

Planning standards for communal services in the rural scene of Western Jamaica were discussed in an exchange of letters with Wilson Chong and Associates, Architects and Planners, Kingston, and Town Planning Department. This resulted in specific recommendations for communal facilities in the Burnt Ground settlement scheme.

The National Water Authority and Tomlinson & Associates, Consultants in Kingston provided details for the water supply to the Burnt Ground settlement scheme as proposed in their study on water supply to a large area in South East Hanover under the Infrastructure component of the First Rural Development Project. This study is a follow-up of a preliminary investigation carried out by Nelson, O'Callaghan & Associates, Consulting Engineers in Montego Bay.

SECTION I

RESOURCES INVENTORY

1.1 LOCATION AND INFRASTRUCTURE

The Burnt Ground Settlement Scheme is located in the Parish of Hanover, approximately 15 miles (25 kilometers) southwest of Montego Bay, along the main road to Savanna-la-Mar, (see Map No. 1 "Location and Regional Infrastructure"). Except for the property's Great House, the area is not inhabited at present, and no villages occur in the area.

Milestown and Copse are two small villages located just outside the property, to the west and northeast respectively, providing some facilities like schools (pre-primary school at Milestown, approved school at Copse). health centre and postal agency (Copse), playfield (Milestown) and a church and a few shops in both places.

Haughton Grove and Ramble are somewhat larger villages at approximately 2 miles (3.5 kilometers) southwest of Burnt Ground. They provide such facilities as a community centre, and a farm supply store at Haughton Grove (these facilities are attached to the Cornwall Youth and Community Development Project) and a post office, court/police office, primary and secondary school, health centre, church, petrol station and shops at Ramble. In addition, a market place is under construction in Haughton Grove. The Knockalva Agricultural Training Centre, offering basic and advanced courses in agriculture is located just outside Ramble. Banking facilities are only available in Montego Bay.

The existing main roads, in or near the Burnt Ground Settlement Scheme (Montego Bay - Savanna-la-Mar, traversing through the area; Haughton Grove - Milestown; and the road to Copse, partly forming the eastern boundary of the property), are in reasonable to good condition. The road from Haughton Grove to Milestown has a flooding problem. A motorable track running through the northwestern part of the area connects Milestown with Copse. Several footpaths cross the property.

Water and electricity are supplied to the Great House from mains running along the Montego Bay - Savanna-la-Mar highway.

1.2 PRESENT LAND USE*

Approximately 1235.4 acres, or 70.5 percent of the Burnt Ground Property is presently being used as pasture. Under the management of the Agricultural Development Corporation about 1240 heads of beef cattle are kept in the area. The pastures have partly been improved by the introduction of such grass species as Pangola, Guinea, Napier and Paragrass. The pastures are subdivided by an extensive network of stonewalls, wire fences and gates. A total of 5 cattle pens exists in the area. Ninety four natural depressions and artificial ponds occurring throughout the property provide water to the cattle. They occupy 25.7 acres (1.5 percent). Individual fruit trees like mango, citrus and star apple, as well as huge cotton trees are found scattered over the pastures.

* See also Map No. 2 : Present Land Use

The Citrus Orchard of Burnt Ground under ADC management

Pastures of Burnt Ground under ADC management

Along both sides of the Montego Bay - Savanna-la-Mar highway a citrus orchard occurs, occupying a total of 71.6 acres (4.1 percent). Due to neglect the orchard is in a poor condition and a considerable number of trees has died. There are approximately 6,200 (sweet orange, ortanique and grapefruit) trees or about 87 trees per acre on average, as compared to an optimal density of 108 trees per acre. The orchard was established in 1953.

Patches of land around the Great House, and in a valley in the northeastern part of the area are grown to coconuts, sugar cane, dasheen, yam, pigeon pea, banana etc; they cover a total area of 15.7 acres (0.9 percent).

Most of the steep and hilly parts of the property, including some steep sideslopes of sinkholes and limestone outcrops are not cultivated but are covered either with dense forest (82.6 acres; 4.7 percent), a mixture of open forest and bush (232.8 acres; 13.3 percent), or bush vegetation only (55.1 acres; 3.2 percent.).

A few houses, including the Great House, and several sheds occupy a total area of 0.6 acres, while roads, tracks and footpaths amount to 25.7 acres (1.5 percent). A concreted catchmentand watertank exist near Milestown village, covering 0.8 acres. Another small watertank is present to the west of the Great House near the boundary of the property. This tank was formerly used to provide water to troughs in the feedlots around the Great House.

1.3 CLIMATOLOGY*

Only one fully operational rainfall recording station exists near the Burnt Ground Settlement Scheme. It is located in Shettlewood, approximately 1.5 miles (2.5 kilometres) east of Burnt Ground, at an elevation of 500 ft above mean sea level. Mean monthly and annual rainfall data from this station for the period 1931 - 1978 are presented in Table 2. This table also shows rainfall data from the Haughton Grove station, located to the west of the Burnt Ground area, at a distance of 1 mile (1.6 kilometres) and an elevation of approximately 700 ft above mean sea level. The recording period of this station is 1931 to 1954.

Table 2

MEAN MONTHLY AND ANNUAL RAINFALL (INCHES)
AT SHETTLEWOOD (1931 - 1978) AND HAUGHTON GROVE (1931 - 1954)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Shettlewood	3.4	3.4	3.8	7.5	13.6	10.9	9.7	11.8	11.9	12.6	5.8	3.4	97.8
Haughton Grove	3.5	3.2	4.0	8.9	14.9	11.6	10.4	12.5	12.0	12.9	6.2	3.8	103.9

* All Climatological data presented here were supplied by the Meteorological Service, Kingston. The location of the respective rainfall and meteprologic stations is indicated on Map No. 1 : Location of the Burnt Ground Settlement Scheme and Regional Infrastructure.

Evaporation is measured only at Smithfield station, approximately 8.5 miles (14 kilometres) northwest of Burnt Ground. This station is at a slightly higher elevation (900 ft above mean sea level) than the other two stations and rainfall is consequently higher. Table 3 shows mean monthly evaporation and (calculated) reference crop evapotranspiration for Smithfield (1970 - 1978), as well as mean monthly rainfall data.

Table 3

MEAN MONTHLY EVAPORATION, EVAPOTRANSPIRATION AND RAINFALL (INCHES) AT SMITHFIELD (1970 - 1978)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Evaporation	3.5	3.7	4.5	5.4	5.1	5.2	5.5	5.0	4.7	3.9	3.6	3.7	53.8
Evapotranspiration	2.7	2.8	3.4	4.0	3.8	3.9	4.1	3.7	3.5	2.9	2.7	2.7	40.2
Rainfall	5.0	6.1	4.1	6.4	11.3	13.2	9.8	10.9	12.5	15.6	6.7	3.6	105.2

Analysis of the rainfall and evaporation data for estimating irrigation needs** shows that even at 90 percent chance of occurrence, rainfall during the period from May to November is sufficient for rainfed agriculture. The length of the rainy season enables rainfed cultivation of two consecutive crops with a short to medium growing period (60 - 90 days, e.g. tomato, sweet pepper, peas etc.). The drier conditions in November would enhance ripening-off of the second crop. The December - March period is relatively dry and does not allow successful cultivation of rainfed annual crops (see also Fig. 1). Grass (pastures) and deep rooting crops (fruit trees) however, could still be grown, provided they are established in the wet period.

Northeast Trades blow throughout the year. Hurricanes occur infrequently, mainly during the period June - December. The probability of hurricanes hitting Jamaica once a year is only 15 percent.

Although no specific records exist it has been reported that lightning during thunderstorms forms a considerable danger, regularly killing cattle taking shelter from the storms under trees.

Mean daily minimum and maximum temperatures range from 68 - 82°F (Smithfield, 1970 - 1978).

* Class A pan evaporation is measured at Smithfield. Evapotranspiration is calculated from evaporation using a pan-coefficient of 0.75.

** Under this title a study was carried out by H. J. van Zel (1979) for the Cornwall Youth and Community Development Project at Haughton Grove. Rainfall data in this analysis were taken from Shettlewood (1946 - 1978), evaporation was taken from Smithfield (1970 - 1978). The conclusions given above, follow those from the report.

Intermittent Gully East of Milestown crossing the road to Copse by means of a cross-drain

Gully floodplain north of cross drain in the road from Milestown to Copse

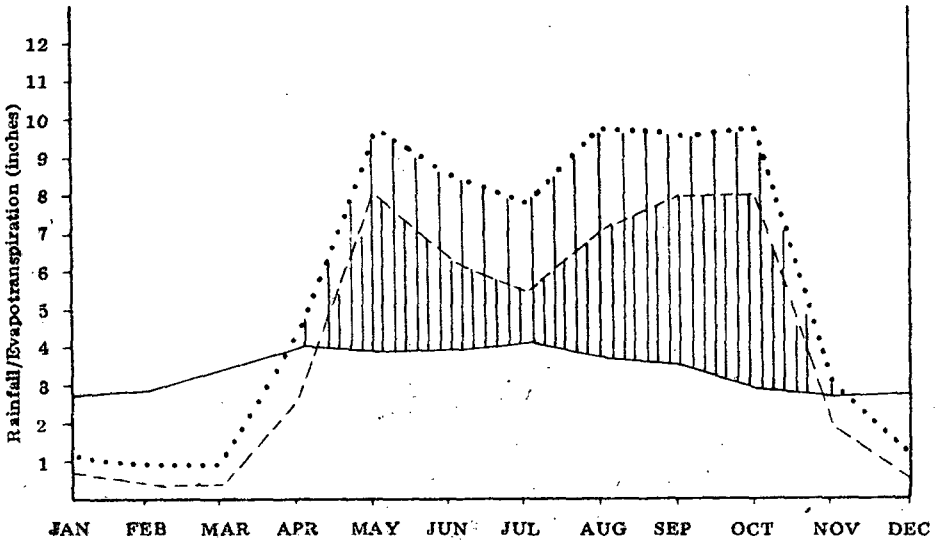


Fig. I Monthly Rainfall and Evapotranspiration pertaining to the Burnt Ground setting

——— Mean Monthly Evapotranspiration (Smithfield 1970 - 1973)

····· Rainfall at 75% chance of occurrence (Shettlewood 1946 - 1978)

– – – – – Rainfall at 90% chance of occurrence (Shettlewood 1946 - 1978)

Table 4

RAINFALL INTENSITIES (INCHES/HOUR) AT DIFFERENT RETURN PERIODS.

Station	Observation Period	Rain Period (hr)	Return Period (years) 5	10	50	100
Shettlewood	1946-1970	24	0.3	0.4	0.5	0.5
Sangster International Airport	1969-1977	12	0.3	0.3	0.4	0.5
		6	0.5	0.6	0.7	0.8
		2	1.1	1.3	1.6	1.8
		1	1.9	2.1	2.6	2.8
		½	2.6	3.0	3.6	3.8

Rainfall intensity data from Shettlewood, and Sangster International Airport (Montego Bay), are shown in Table 4. Rainfall intensity data for short periods are of importance in estimating design criteria for drainage structures (ditches, culverts, bridges etc.). Also, intensities of more than 1 inch per hour are generally considered as erosive to soils, in the literature, as at these intensities soil aggregates are dislodged by the impact of the raindrops. As soon as rainfall exceeds the infiltration rate of the soil, runoff starts and soil particles are carried away from sloping lands. The figures in Table 4 indicate that such high rainfall intensities are rather common even at short return periods.

1.4 HYDROGRAPHY*

The characteristic fractured and, therefore, permeable nature of the limestone deposits which form the parent rock in a large part of Cornwall, including Burnt Ground property, and in addition the high permeability of the well-structured soils that have formed from the limestone deposits, have resulted in the development of a typical limestone drainage pattern, i.e. absence of throughgoing perennial streams, and presence of a large number of sinkholes and depressions and short intermittent gullies that channel runoff into the sinkholes and depressions.

In the Burnt Ground area there is only one intermittent waterway with a considerable catchment, which is running east of Milestown through the property. This waterway has a conspicuous flood plain in which heavy rainstorms cause flooding once or twice a year. The sinkholes are true dissolution holes in which runoff quickly disappears underground. The depressions have been formed as sinkholes initially but their bottoms are floored with slowly permeable clays that have been washed in by runoff from the surrounding slopes. Surface runoff accumulating in these depressions, stagnates on the slowly permeable clay deposits thus forming natural ponds. As these natural ponds are used for cattle drenching, further compaction of the clay by the feet of cattle takes place resulting in still slower percolation of water. Flat areas surrounding

* See also Map No. 3 : Land Capability and Hydrography.

Limestone Plateau : Extended Farm ponds following the Flood 13/14 June 1979

the ponds may be flooded during and directly after heavy rainfall. In addition to natural ponds, several others have been made artificially. Most of the ponds (they number 94 in total) retain water throughout the dry period, whereas a few have been recorded to become dry in exceptional dry years. Silting-up and vegetation growth gradually decrease the capacity of the ponds, and they have to be cleaned at regular intervals. In a few cases (e.g. in the pond located directly south, and in another one southwest of the Great House) the water level in the ponds remains fairly constant during the dry season, indicating the probability that underground waterflow recharges these ponds. No studies have been done however, as to the potential of possible aquifers in the area.

1.5 PHYSIOGRAPHY AND TOPOGRAPHY

From the geological point of view, the Burnt Ground Property is underlain entirely by the so-called White Limestone Deposits, which are of Lower Miocene to Middle Eocene age (Tertiary). Two main physiographic units are distinguished : (i) the Dissected Limestone Plateau, and (ii) the Steep Limestone Hills. (See Fig. 2: Physiographic Cross Section).

The Dissected Limestone Plateau comprises about 80 percent of the area (1390.3 acres) and its undulating to rolling landscape ranges in elevation between 560 and 860 ft (170 - 260 metres) above sea level. The slopes are predominantly below 15 degrees. Subterranean dissolution of the limestone rock (formation of caves and cavities) has resulted in the occurrence of sinkholes and depressions at the surface, which usually are surrounded by steeper slopes (up to more than 30°). Short gullies channel run-off into many of the sinkholes and depressions. The large gully that runs east of Milestown through the property has a considerable flood plain.

The Steep Limestone Hills occupy 361.3 acres (20 percent) of land in the northern part of the area. The Hills occur as outcrops from the Plateau, and reach elevations of up to 1050 ft (340 metres) above mean sea level. Slopes are mainly steeper than 30 degrees, with the exception of small areas in between individual hills (saddles) and local valleys and depressions, in which slopes are generally below 15 degrees.

Acreage and relative distribution of the different slope classes in the entire area, are given in Table 5.

Table 5

DISTRIBUTION OF SLOPE CLASSES IN THE BURNT GROUND AREA

Slope Class		Acreage	
degrees	percent	acres	percent of total area
0 - 7	0 - 12	799.1	45.6
7 - 15	12 - 27	552.5	31.5
15 - 20	27 - 36	45.9	2.6
20 - 25	36 - 47	41.8	2.4
25 - 30	47 - 58	0.9	16.4
> 30	> 58	285.7	
Ponds		25.7	1.5
Total		1751.6	100.0

The Limestone Plateau

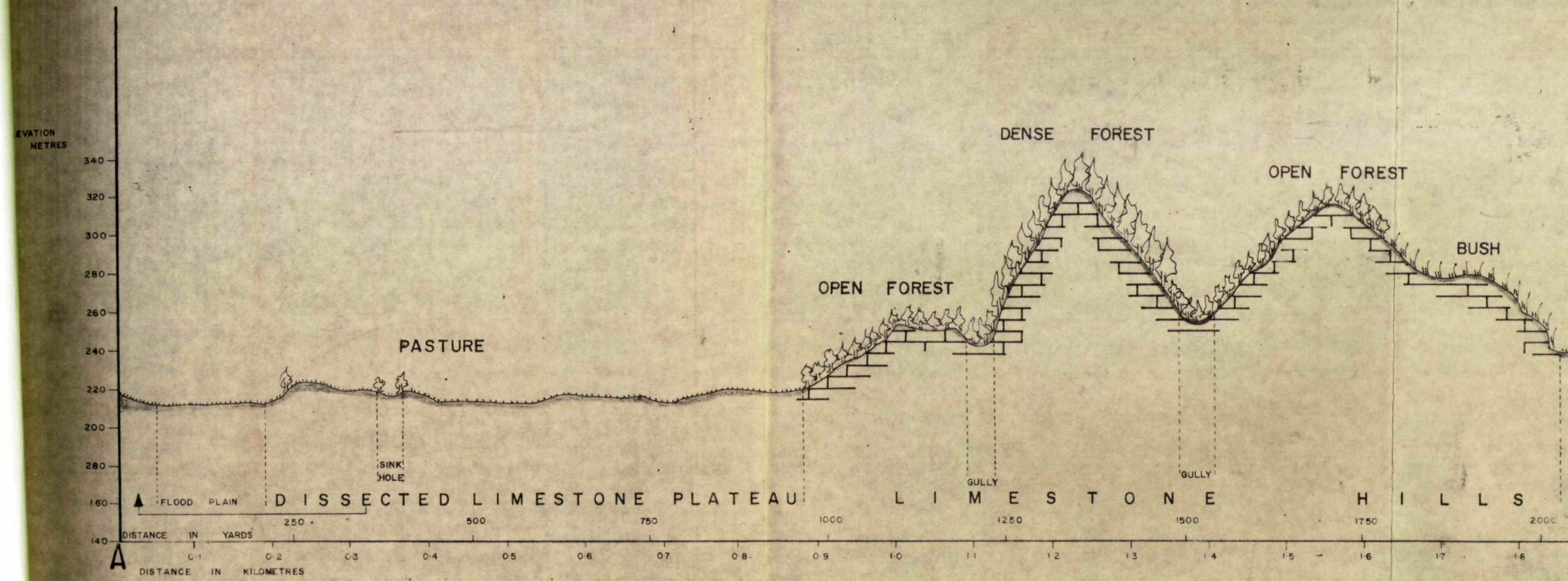
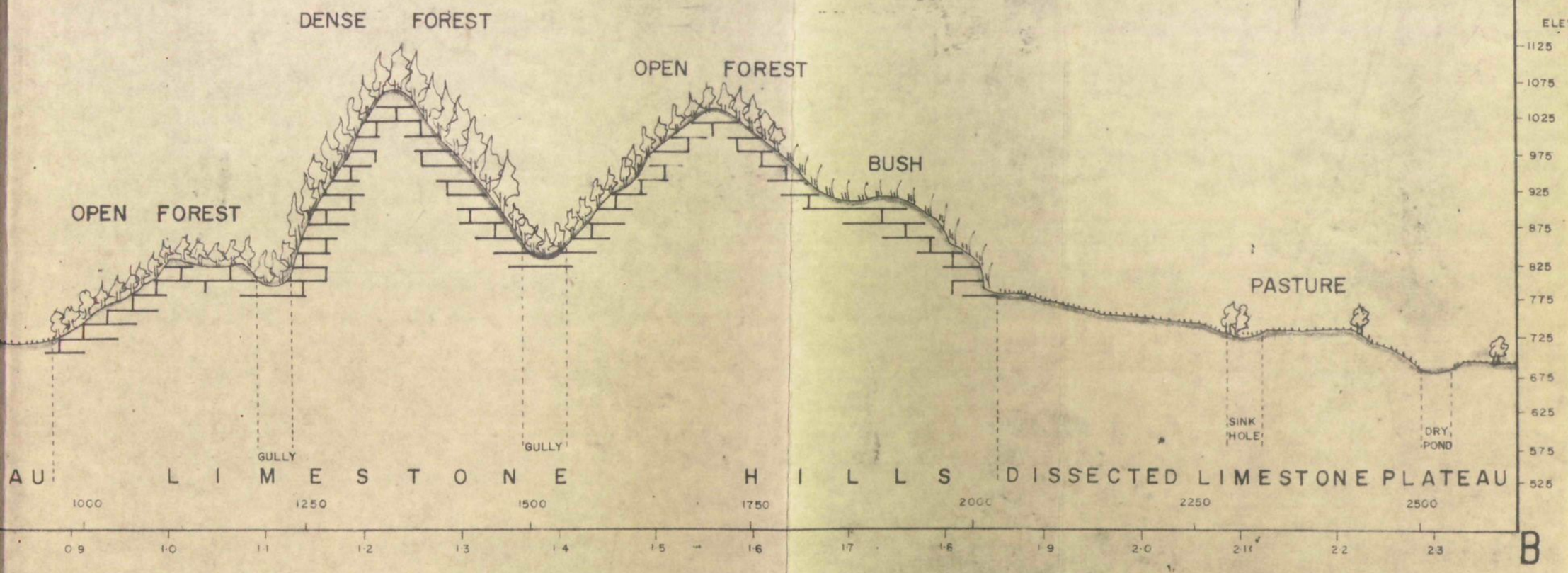


Fig. 2 PHYSIOGRAPHIC CROSS SECTION THROUGH THE NORTHERN PART OF THE BURNT GROUND SETTLEMENT S
(LINE AB IS SHOWN ON MAP No.3, LAND CAPABILITY AND HYDROGRAPHY)
HORIZONTAL SCALE ... 1:5000
VERTICAL SCALE ... 1:2000
VERTICAL EXAGGERATION ... 2·5 X



THROUGH THE NORTHERN PART OF THE BURNT GROUND SETTLEMENT SCHEME

MAP No.3, LAND CAPABILITY AND HYDROGRAPHY)

The deep, strongly weathered soils of the Limestone Plateau, profile 7

1.6 SOILS

In Chapter 1.5 Physiography and Topography it has been pointed out that the entire area of the Burnt Ground Settlement Scheme is underlain by limestone deposits. All soils are therefore, directly or indirectly, derived from the weathering materials of these limestone deposits.

The soils were investigated in the field (7 soil pit descriptions and 69 soil auger hole descriptions) and in the laboratory (44 soil samples from genetic horizons of the soil pit descriptions). (Refer to Annex V).

Limestone Plateau Soils

From the observations and laboratory analyses it appears that most of the soils occurring on the dissected limestone plateau (with the exception of the younger soils on bottoms of depressions in the plateau) are old, well-structured and strongly weathered.* They are more or less freely drained and humus-rich. The high organic carbon content (more than 1.5 percent up to 11 percent organic carbon) in the topsoils is reflected by their dominant colours, which are dark brown to grayish brown or dark yellowish brown. The high organic carbon levels of topsoils can be explained by the long history of pasture management in the area. Organic carbon contents gradually decrease with depth and below 30 cms (12 inches) subsoils are dominantly yellowish brown to strong brown or reddish yellow. These soils show considerable increase in clay content with depth due to translocation of clay from topsoils to subsoils. The increase in clay is in the order of 20 to 40 percent from fine clays in topsoils to very fine clays in subsoils. The clays however, have low activity (less than 24 meq per 100 gram clay) and base saturation is much less than 35 percent. Consequently, these soils are strongly to very strongly acid (pH water figures vary from 5.0 - 5.5 in topsoils to 4.5 - 5.0 in subsoils). The majority of the plateau soils are deep and well drained (refer to soil profile description No. 2 and 4). Their classification at family level in the USDA Soil Taxonomy is : clayey, kaolinitic (?), isohyperthermic Orthoxic Palehumult.**

A smaller portion of the plateau soils contains soft white, pale brown, yellowish red and red mottles in the subsoil within 125 cm (50 inches) of the soil surface which have been formed due to segregation of iron compounds (plinthite). Some of these soils contain relatively little plinthite; they are classified: clayey, kaolinitic (?), isohyperthermic Orthoxic Plinthic Palehumult (refer to soil profile description No. 3). Soils that have more than 50 percent plinthite within 125 cm (50 inches) of the surface are classified: clayey, kaolinitic (?), isohyperthermic Plinthohumult*** (refer to soil profile description No. 7).

* All these soils have been mapped as 73. Chudleigh Clay Loam in the Soil Survey of the Parish of Hanover.

** The descriptive terms in the classification refer to the family level (first three terms i.e. particle size class, mineralogy class and soil temperature class), the subgroup and lastly the great group.

*** No subgroup distinguished.

The shallow soils from limestone on the hill slopes (profile 5)

Soils that have been formed on bottoms of depressions in the limestone plateau* are younger than those that make up the actual surface of the plateau. They differ mainly from the other plateau soils in that they do not show clear signs of clay translocation from topsoils to subsoils and that they have characteristics associated with periodic wetness due to flooding by runoff during periods of heavy rainfall. This has resulted in dark gray, dark grayish brown, reddish brown and yellowish red mottled topsoils over yellowish brown to strong brown subsoils with few reddish mottles. Such soils are classified: very fine, kaolinitic (?) isohyperthermic Aquic Oxic Humitropept.**

Limestone Hill Soils

The soils that have developed in the steep limestone hills in the northern part of the settlement scheme are very different from those occurring on the dissected limestone plateau. The hill soils are strongly influenced by their parent material, i.e. the limestone. Hence, they have neutral to slightly acid soil reaction. Two main types can be distinguished.

The soils on the steepest sloping parts***are clayey, stony (20 - 40 percent weathering limestone and flint fragments by volume) and shallow to moderately deep over limestone or marl. They have very dark topsoils with granular and blocky structure which do not become hard when dry. Topsoils meet the qualifications that have been set for mollic epipedons. Subsoils have (dark) yellowish brown colours. Although relatively shallow these soils also show perceptible increases in clay with depth due to genetic clay translocation (argillic horizon). Their USDA taxonomic classification is: clayey-skeletal, mixed (?), isohyperthermic Typic Argiudoll or Lithic Argiudoll dependent on whether the soil depth to hard limestone is more than 50 cm, or less.

Hill soils on less steeply sloping saddle and sidevalley portions**** are deeper and less stony than the steep hillside soils. Their topsoils are less dark and thick than the hillside soils. Subsoils are yellowish brown to brownish yellow. They have a very sticky and very plastic consistence when wet. Considerable clay increase with depth has been noted due to clay translocation (argillic horizon). Their classification is : very fine, mixed (?), isohyperthermic Typic Tropudalf.

Soil Management Considerations

The soils of the dissected limestone plateau on the settlement scheme have generally favourable characteristics in that they are deep and have relatively gentle slopes and low stone contents (usually less than 15 percent). Their main management problem is their low natural fertility. Although organic carbon contents are high, clays are very inactive. Hence, the fertility of these soils is mainly carried by the organic matter.

* Mapped as 74 Lucky Hill Clay Loam in the Soil Survey of Hanover Parish.

** The Aquic Subgroup is tentative since it is not distinguished in the USDA Soil Taxonomy.

*** Mapped as 77 Bonny Gate Stony Loam in the Soil Survey of the Parish of Hanover.

**** Mapped as 75 Union Hill Stony Clay in the Soil Survey of the Parish of Hanover.

It is, therefore, extremely important that management systems for these soils take care of the maintenance of soil organic matter. Liming is also necessary in order to raise the soil reaction to levels that are favourable to most plants. The plateau soils are fairly resistant to erosion due to their strong structural development. Only minor areas are affected by wetness and flooding.

The steeply sloping hill soils have unfavourable physical characteristics. In addition to their steep relief, these soils are shallow and stony. Their chemical characteristics are more favourable but these are offset by the adverse physical factors. Although these soils have well developed structures and are fairly resistant to erosion, the shallow effective soil depth renders them vulnerable to soil removal under conditions of intensive soil disturbance. Therefore, it is important that these soils are kept under protective vegetation cover.

The saddle and side valley areas in the hills are the best soils of the entire settlement scheme from the point of view of their physical and chemical characteristics. Their major drawback is limited extent and relative inaccessibility.

SECTION II

LAND CAPABILITY ASSESSMENT

II. I PRINCIPLES OF THE APPLIED METHODOLOGY

The preceding chapters provide basic information about the various physical factors that make up the physical environment of the Burnt Ground area. This section on land capability classification presents the agricultural interpretation of the data as an aid in the preparation of the land use plan for the settlement. Through its application the settlement has been subdivided into individual farms in such a manner that each farm constitutes an economically viable unit from which a settler may obtain the target returns from his/her inputs (refer to Section III).

For the agricultural interpretation of the physical data a quantitative land capability classification system has been developed which is meaningful for detailed planning of settlement areas such as the Burnt Ground area. It was considered that the traditional land capability classification commonly applied in Jamaica which groups land in Classes I through VI for general agricultural use could not be used because it is too general for detailed application. General capability of land is difficult to define since land that is suitable for one type of land use may be less suitable or even unsuitable to other types of land use, e.g. poor drainage conditions adversely affect the performance of most annual and tree crops whereas they have less or little effect on the productivity of pastures if planted with suitable grass species.

Therefore, it was decided to classify land capability in the Burnt Ground area for a selected number of promising and relevant types of agricultural land use, i.e. land utilization types. Each land utilization type is characterized according to its agricultural produce (e.g. tomatoes, oranges, milk, meat, etc.), its relevant level of management and related inputs (e.g. amount of fertilizers, insecticides, etc.). Each tract of land of the settlement scheme is grouped into land capability classes and subclasses (I through VI) according to physical limitations relevant to the respective land utilization type. Land capability classes group tracts of land pertinent to increasing degrees of limitation (e.g. slight, moderate, severe, etc.), whereas land capability subclasses group tracts of land according to kinds of limitations (e.g. flooding, slope, rockiness, etc.).

Land capability classes and subclasses are characterized in their absolute and relative value for agricultural production by means of assignment of productivity units. Within land utilization types productivity units are measures of productivity in terms of added value per acre per year. (One productivity unit corresponds to J$100.- of added value adjusted to February 1977 price levels in order to eliminate the effect of price increases).

The approach by land utilization type and the connection between land utilization type, land capability classes and productivity units have the practical value that, once the target income is established, for each type of farming (land utilization type) the minimum viable farm size can be determined for land without limitations to that particular use (Class I), for land with minor limitations (Class II), for land with rather severe limitations (Class III), etc.

All elements of the classification are explained in the following chapters. The geographic distribution of the land capability classes and subclasses per land utilization type is shown on Map No. 3 "Land Capability and Hydrography."

II.2 LAND UTILIZATION TYPES

II.2.1 General

In Chapter II.1 it has been pointed out that a small number of land utilization types has been selected and defined to serve as subject matters for the quantitative land capability classification of the Burnt Ground area. The selection and definition has been carried out on the basis of the following factors :

- Government land use policy towards agricultural production in the setting of the Burnt Ground scheme,
- present land use and agricultural produce,
- the prevailing level of farm management and technical know-how in adjacent areas,
- farm size and land tenure conditions.
- marketing aspects.

The Burnt Ground area is largely in pasture and the property has a long history in cattle livestock production. With the opening of the dairy plant in Montpelier (Cornwall Dairy Developments Ltd.) and the current price level of milk, prospects of dairy farming are good. Introduction of dairy farming would also agree with the general agricultural development policy for the Burnt Ground setting. Selected dairy farmer-settlers can be trained in dairy farm management techniques at the nearby Knockalva Agricultural Training Centre* Thus, the first land utilization type that has been selected deals with dairy farming.

Furthermore, the property includes a citrus orchard of 71.6 acres which, although neglected, can be rehabilitated and brought back to full production within a few years time. The market outlook for citrus is good and rehabilitation of the orchard would agree with the Ministry of Agriculture's policy of resuscitation of citrus production in the country which was announced recently at the 30th annual meeting of the Citrus Growers Association of Jamaica. Therefore, the second land utilization type selected pertains to citrus production.

Thirdly, backyard gardening of annual crops and vegetables is considered another feasible land utilization type important to subsistence crop production for the settler population. Crop surplus can be sold at the new roadside market at Haughton Grove.

* Additional training facilities could possibly be provided by the Shettlewood Dairy Project.

The other attributes which are related to the selection and definition of the relevant land utilization types concern the farm size and land tenure, the level of management and technical know-how. With a view to the schemes' association with the First Rural Development Project (FRDP) and Project Land Lease (PLL) the farm size is small by definition. In the framework of FRDP such small farms are considered to be economically viable if the level of added value exceeds $3,200. ~~per acre~~ per year at the February 1977 price levels. This translates into farm sizes varying from about 5 to more than 10 acres dependent on the type of land use (refer to Section III). Farms will be leased for a period of 49 years from the Government according to PLL regulations. The level of management is low to intermediate including family labour, the predominant use of simple farming tools and limited application of fertilizers, insecticides, concentrates, etc. Consequently, assumed outputs are not high but realistic. Farm water for dairying is supplied by farm ponds and it is assumed that each dairy farm will include at least one clean pond with sufficient capacity to provide water to cattle the year around. Orchard and garden crop farming is rainfed (refer to Chapter 1.3 on Climatology). The garden crop farming will be carried out in the backyards of houselots in the villages.

Summarizing, three land utilization types are selected, i.e.

Dt: Traditional Family-operated Dairy Farming
Oc: Family-operated Citrus Orchard Farming
Gr: Family operated Rainfed Garden Crop Farming

In this context, it should be remarked here that, although there are three land utilization types, the actual farm types that are proposed under the development plan (Section III) will include only two combinations of the three land utilization types. Garden crop farming (Gr) will be carried out in addition to either dairy farming (Dt) or citrus orchard farming (Oc). Labour requirements for the combined elements of each of the two farm types can be met by the farmer and his/her family and will not exceed 250 mandays per farm per year.

In the following, a descriptinn of each land utilization type is given as well as the respective calculations of added value per acre per year. (The relationship between farm added value and the other factor shares, e.g. value of output, non-factor inputs etc., is explained in Annex II to this report entitled "Farm Income Account according to Factor Shares").

II.2.2 Dt: Traditional Family-operated Dairy Farming

This land utilization type is centered around the production of milk in smallholdings of grazing pastures. The sale of meat and young stock form additional sources of farm income. The pasture area of each farm will be subdivided into 10 enclosures, each of which is grazed for approximately 2 days with intervals of about 18 days. All

enclosures will have access to a farm pond. Other assumptions include :-*

- There is one animal unit per 2 acres. One animal unit comprises one milking cow plus young stock.

- The cows are milked once a day in the morning by hand; during the day the calf runs with the cow, to be separated again in the afternoon.

- One cow will produce five imperial quarts of milk per day during 280 days, to a total of 1,400 quarts per year.

- Price of milk at Farm Gate is $0.36 per quart (Grade B). Due to lack of cooling facilities it is impossible to sell Grade A milk, nor evening milk.

- After dropping the first calf, a cow will stay in the herd for five years. At the end of her lifetime in the herd the cow is sold for $600.00.

- In the cow's lifetime four calves are born and raised; one is kept for replacement of the cow, and three are sold at the age of 18 - 24 months (one year after weaning) at $800.00 per head.

- Concentrates for cows and/or calves are not being used intensively. A minimal consumption of 1000 lbs per year (3 lbs, 330 days per year) per milking cow is assumed.

- The use of fertilizer is also minimal and is pegged at 2 bags per acre per year. Fertilizer is applied after each grazing period, also in the dry season (sulphate of ammonia, calcium ammonium nitrate, magnesamon or 20 - 0 - 20 and once or twice per year 21 - 14 - 14).

- Cost of veterinary service is $40.00 per cow of more than 2 years old and $20.00 per head of less than 2 years old.

The following calculations assume fully-developed dairy farms as from 5 years after establishment. Output and input calculations are first made for animal units, and then they are reduced to values per acre

* All price levels are from October 1978.

Value of Output * :

Sale of milk: 1,400 quarts at $0.36 per quart	$ 504.00
Sale of meat from old cow: $600.00 divided by 5 years	120.00
Sale of young cattle: $800.00 x 3, divided by 5 years	480.00
Total value of output per animal unit	$1,104.00
Value of output per acre $1,104 ÷ 2	$ 557.00

Non-factor Input :

Concentrates: 1,000 lbs @ $12.00 per cwt	$ 107.14
Veterinary Service	60.00
Fertilizer 2 bags per acre @ $14.00	56.00
Other expendable materials (detergents, disinfectants, fencing, etc.)	50.00
Total non-factor input per animal unit	$ 273.14
Non-factor input per acre $273.14 ÷ 2	$ 136.57

Added Value per acre :

Value of output ($557.00) - Non-factor input ($136.57):	$ 420.43
Rounded off at	$ 420.00

The target added value per farm in the First Rural Development Project has been set at $3,200 on the basis of February 1977 price and income levels. Due to increases in labour costs, interest on capital and required net profit, the target added value per farm at October 1978 price and income levels would amount to $3,800. Therefore, added value per acre for traditional family-operated dairy farming at February 1977 price and income levels would be (3,200 ÷ 3,800) x $420 = $353.68 or rounded off at $350.

2.3 Oc: Family-operated Citrus Orchard Farming

In this land utilization type ortaniques, sweet oranges and grapefruits are produced in smallholdings. Production is from a fully mature orchard, 75 percent of which is ortaniques/sweet oranges and 25 percent grapefruit. Other assumptions include**:

- tree density is 108 trees per acre (20 ft. x 20 ft.),
- the lifetime of the orchard is 40 years; each year 3 trees are replaced,

* The relationship between this and other factor shares is explained in Annex II Farm Income Account according to Factor Shares.

** Price levels are of March 1979.

- estimated yields are pegged at 350 boxes/acre/year
- use of fertilizer and chemicals is based on recommendations made by the Ministry of Agriculture, but levels are adjusted to suit prevailing agro-socio-economic conditions.

Value of Output

75% of 350 boxes ortaniques/oranges @ $3.50	$	918.75
25% of 350 boxes grapefruit @ $1.60		140.00 +
Total value of output per acre	$	1,058.75

Non-factor Inputs

Fungicides/Insecticides (Shell White Oil/Malathion, 2 appl/yr)	$	34.14
Fiddler Beetle Control (Dieldrin, 1 appl/2 yrs)		10.70
Slug Control (Sluggit, 1 appl/yr)		16.00
Fertilizer (Sulphate of ammonia, 8 bags/yr; complete, 3 bags/yr)		169.00
Lime (5 ton/6 yrs)		10.00
Replanting material (3 trees/yr)		0.45
Expendable material (fencing etc.)		10.00 +
	$	250.29

Added Value

Value of output ($1058.75) - Non-factor inputs (250.29)	$	808.46
Rounded off at		810.00

Due to increase in labour costs, interest on capital and required net profit, the target added value per farm at March 1979 price and income levels would amount to $4,000 as compared to $3,200 in February 1977. Therefore, added value per acre for family-operated citrus orchard farming at February 1977 price and income levels would be (3,200 ÷ 4,000) x $810 = $648 or rounded off at $650.

II.2.4 Gr: Family-operated Rainfed Garden Crop Farming

This land utilization type is centered around crop production in backyard gardens. The proximity of the garden to the farm house facilitates that close attention can be given to the crops, whereas the rather small area under cultivation allows for a relatively high management level in terms of fertilizer and chemicals application. The following assumptions.

are made :-

- Seven crops are selected as representative for the calculations of the added value for garden crop farming : yam (negro, yellow and renta yam), red beans, sweet pepper, tomato, pumpkin, cucumber and callaloo. These crops are commonly grown in the area surrounding the Burnt Ground property, and they cover a wide range of agronomical and economical characteristics (cultivation practices, input and output levels, marketing situation, etc.).

- With a view to their marketing prospects and to their susceptibility to pests and diseases, the crops are subdivided into low risk crops (yam; relatively easy to grow, stable market), fair risk crops (red beans, sweet pepper, pumpkin, cucumber and callaloo; fluctuating market prices) and crops carrying a high risk in growing (tomato; very susceptible to pests, unstable market). Based on these considerations the backyard area is subdivided into : 1/3 yams; 1/6 red beans and sweet pepper; and 1/12 each, pumpkin, cucumber, callaloo and tomato.

- The growing season (wet season) lasts from April/May through November, allowing cultivation of two crops of all selected crops except for yam. In the added value calculations however, only red beans and callaloo are assumed to produce two yields in one growing season, thus leaving ample room to the farmer to increase the backyard farming added value to levels considerably higher than calculated in this model.

- The assumed management level is relatively high compared to common farming practices in the surrounding areas. All crops receive fertilizer gifts, and most crops are protected from pests and diseases by spraying with chemicals. Yield projections and input levels are based on "Crop Husbandry Guide", Volume 1 of JDB's Handbook for Credit Officers, and on recommendations by the Production Unit, Ministry of Agriculture, Western Region. They have been adjusted however, to local conditions. Input and output levels for rootcrops (yams) have been reduced with approximately 25 percent, whereas for all other crops a reduction of 50 percent was applied

- Application of lime is included as a routine farming practice. A gift of 5 tons per acre, once every six years is required to increase the soil reaction to more favourable levels.

Added value calculations for each of the selected crops are summarized below. Detailed calculations and crop-specific information are presented in Annex IV : "Background information to the Added Value Calculations. Value of output, value of non-factor input, and added value figures are all expressed in J$ per acre per crop.*

NEGRO YAM

Value of Output	- tubers 6.5 tons @ $0.15/lb; heads 1.25 tons @ $0.20/lb		$2450
Value of Non-factor Input :-	- planting material 2.5 tons @ $0.30/lb (once every three years)	$500.00	
	lime/fertilizer (7.5 bags complete)	152.50	
	stakes	175.00	
		($827.50)	$ 825
	Added Value per acre per crop		$1625

YELLOW YAM

Value of Output	- tubers 5.5 tons @ $0.18/lb; heads 0.75 tons @ $0.20/lb		$2280
Value of Non-factor Input	- planting material 2.5 tons @ $0.30/lb (once every three years)	$500.00	
	lime/fertilizer (7.5 bags complete)	152.50	
	stakes	175.00	
		($827.50)	$ 825
	Added Value per acre per crop		$1455

RENTA YAM

Value of Output	- tubers 7.0 tons @ $0.08/lb; heads 1.0 tons @ $0.14/lb		$1400
Value of Non-factor Input	- planting material 2 tons @ $0.20/lb (once every three years)	$265.00	
	lime/fertilizer (7.5 bags complete)	152.50	
	stakes	175.00	
	Added Value per acre per crop	($592.50)	$ 590
			$ 810

The Average Added Value for a proportional mixture of negro, yellow and renta yam is $1300 per acre per crop

* All price levels are from March 1979.

RED BEANS

Value of Output :	- beans 500 lbs @ $0.90/lb		$ 450
Value of Non-factor Input :	- seeds 60lbs @ $1.00/lb	$ 60.00	
	lime/fertilizer (1.5 bags complete)	38.50	
	chemicals (4 applications)	62.00	
		($ 160.50)	$ 160
	Added Value per acre per crop		$ 290

SWEET PEPPER

Value of Output :	- sweet peppers 3.75 tons @ $0.20/lb		$1500
Value of Non-factor Input :	- seeds 1.5 lbs @ $25.00/lb	$ 37.50	
	lime fertilizer (3 bags complete,		
	1 bag sulphate of ammonia)	81.00	
	chemicals (4 applications)	62.00	
		($ 180.50)	$ 180
	Added Value per acre per crop		$1320

TOMATO

Value of Output :	- tomatoes 3 tons @ $0.60/lb		$3600
Value of Non-factor Input :	- seeds 0.25 lb @ $30.00/lb	$ 7.50	
	lime/fertlizer (3 bags complete);		
	1 bag sulphate of ammonia)	81.00	
	chemicals (4 applications)	62.00	
	stakes	540.00	
		($ 690.50)	$ 690
	Added Value per acre per crop		$2910

PUMPKIN

Value of Output	- fruits 3 tons @ $0.06/lb		$ 360
Value of Non-factor Input :	- seeds 2 lbs @ $10.00/lb	$ 20.00	
	lime/fertilizer (2 bags complete;		
	1 bag sulphate of ammonia)	62.00	
	chemicals (4 applications)	62.00	
		($ 144.00)	$ 145
	Added Value per acre per crop		$ 215

CUCUMBER				
Value of Output	-	fruits 2.5 tons @ $0.12/lb		$ 600
Value of Non-factor Input	-	seeds 2 lbs @ $18.00/lb	$ 36.00	
		lime/fertilizer (2 bags complete, 1 bag sulphate of ammonia)	62.00	
		chemicals (4 applications)	62.00	
			($160.00)	$ 160
		Added Value per acre per crop		$ 440
CALLALOO				
Value of Output	-	callaloo 3 tons @ $0.10/lb		$ 600
Value of Non-factor Inputs	-	seeds 0.25 lbs @ $3.00/lb	$ 0.75	
		lime/fertilizer (2 bags complete, 1 bag sulphate of ammonia)	62.00	
		chemicals (2 applications)	31.00	
			($ 93.75)	$ 95
		Added Value per acre per crop		$ 505

Taking into account the different areas occupied by the various crops (yams - 1/3 of the area; red beans and sweet pepper - 1/6; cucumber, pumpkin, callaloo and tomatoes - 1/12) and the fact that red beans and callaloo are grown twice per cropping season, the average added value for garden crop farming amounts to $1,127 per acre per year, at current price levels (March 1979). Due to increases in labour costs, interest on capital and required net profit, the target added value per farm at March 1979 price and income levels would amount to $4.000 as compared to $3,200 in February 1977. Therefore, added value per acre per year for Family-operated Rainfed Garden Crop Farming at February 1977 price and income levels would be: (3,200 ÷ 4,000) x $1127 = $902 or rounded off at $900.

II.3 QUANTITATIVE ASSESMENT PER LAND UTILIZATION TYPE

Land utilization types have been defined as forms of (agricultural) land use which are characterized in terms of their produce, level of management and related inputs. In this definition the non-physical factors that exert an influence on agricultural production are pegged at fixed levels. Thus, in the concept of land utilization types the various levels of productivity are determined by the variable physical land and soil factors. In this chapter (Tables 6,7 and 8) these variable physical factors or land qualities and characteristics are quantified relative to the respective land utilization types. This must be done since

land qualities and characteristics may have dissimilar effects on agricultural production in different land utilization types, e.g. limited soil depth is more restrictive to tree crops than it is to grasses.

Under each land utilization type six land capability classes (Roman numerals I - VI) are distinguished according to increasing degree of limitations which are linked to the land qualities and characteristics. Individual land capability classes are assigned productivity units (P.U.) which decrease proportionally from a maximum of 100 percent for Class 1 to less than 50 percent for Class VI. (Absolute values of productivity units are expressed in dollars of added value per acre per year at February 1977 price and income levels; 1 P.U. = $100.00).

The land capability classes can be described in terms of their degree of capability for production per land utilization types :

Land Capability Class I : no limitations to the envisaged land use, productivity rating 90 - 100 percent*.

Land Capability Class II : slight limitation to the envisaged land use, productivity rating 80 - 90 percent.

Land Capability Class III : moderate limitation(s) to the envisaged land use, productivity rating 70 - 80 percent.

Land Capability Class IV: severe limitation(s) to the envisaged land use, productivity rating 60 - 70 percent.

Land Capability Class V : very severe limitation(s) to the envisaged land use, productivity rating 50 - 60 percent.

Land Capability Class VI : extreme limitation(s) which preclude(s) the economic use of such land under the envisaged land use, productivity rating less than 50 percent.

Land Capability Classes are subdivided into subclasses according to kinds of limitations. In the Burnt Ground setting these limitations include slope, effective soil depth, soil stoniness, rock outcrops, internal soil drainage and flooding. (Other limitations that do not occur in the Burnt Ground area are nevertheless listed in Tables 6 - 8 due to the general nature of these tables which are applicable to the entire island). Limitations are symbolised by lower case letters.

* 100 percent productivity corresponds to a calculated absolute maximum in terms of P.U. which is determined per land utilization type.

limitation 'e' - slope, affecting susceptibility to erosion; the subdivision in slope phases is derived from the soil conservation service in Jamaica and therefore, has practical significance in soil conservation treatments, e.g. no permanent structures for slopes 0 - 7°, mechanical construction of bench terraces possible for slope 7° - 20°, manual construction of bench terraces possible for slopes 20° - 25°, manual construction of orchard terraces possible up to 30° slopes, etc.

limitation 'd' - effective soil depth to hard bedrock or indurated layers that are impenetrable to roots, influencing rooting space and availability of moisture and nutrients. Effective soil depth co-determines the feasibility of construction of soil conservation works, e.g. effective soil depth at a slope of 20 degrees must be at least 67 cm (approximately 26 inches) in order to build bench terraces with a width of 2.5 metres (8 ft).

limitation 's' - soil stoniness, restricting availability of moisture and nutrients (by taking up effective soil volume) as well as soil workability. The adverse effects of stoniness can be diminished by stone picking and incorporation of stones into stone walls and barriers.

limitation 'r' - rock outcrops, restricting effective soil surface area and land management. This limitation cannot be undone.

limitation 'w' - internal soil drainage determining soil aeration and occurrence of excessive soil wetness.

limitation 'f' - flooding, adversely affecting crop and pasture performance through physical damage and lack of oxygen.

Limitations related to availability of nutrients (natural fertility) are not considered in the land capability assessment since they can easily be corrected through the application of fertilizer and lime.

Explanation of the classification formula

Land capability classification formulae as used in the text and on the Land Capability Map (map No. 3) are composed of the following elements in order of placement :-

- a symbol for the land utilization type consisting of a capital and a small letter, e.g. Dt;

TABLE 6

TRADITIONAL FAMILY-OPERATED DAIRY FARMING (1D)

LAND CAPABILITY CLASSES, PRODUCTIVITY RATINGS AND INDIVIDUAL LIMITATIONS

IN THE BURNT GROUND AREA

Productivity P.U. (see: 1) 1)	e	Slope (degrees) 2)	g	Gullies (%) 2)	d	Effective Soil Depth (cm) 3)	t	Soil Texture 4)	s	Soil Stoniness (%) 5)	r	Rock Outcrop (%) 6)	w	Internal Soil Drainage 7)	f	Flooding 8)	h	Salinity Alkalinity 9)	a	Acidity (pH) 10)	m	Moisture Availability 11)
2.5 80 - 100		0 - 20		0 - 5		more than 50		loam, sandy clay loam, clay loam, clay, heavy clay, sandy clay, silty clay loam, silty clay, silt, silt loam		0 - 15		0 - 5		moderately well, well		Class 0 - 4		ECe less than 4, pH less than 8.5, ESP less than 15		higher than 4.5		- to be defined later -
1.5 60 - 90		20 - 25		5 - 10		25 - 50		sandy loam		15 - 35		5 - 15		somewhat poor, somewhat excessive		Class 5		n.a.		n.a.		-3bd-
2.5 50 - 80		25 - 30		10 - 15		n.a.		loamy sand, fine sand (50 - 250 µ)		35 - 50		15 - 25		poor		Class 6		ECe 4 - 8, pH less than 8.5, ESP less than 15		n.a.		-3bd-
2.5 60 - 70		n.a.		15 - 20		n.a.		n.a.		50 - 75		25 - 35		n.a.		n.a.		ECe 8 - 15, or pH 8.5 - 9.0, or ESP 15 - 25		4.0 - 4.5		-3bd-
2.1 50 - 60		n.a.		n.a.		n.a.		n.a.		n.a.		35 - 45		n.a.		n.a.		n.a.		n.a.		-3bd-
less than 50 percent of maximum productivity		more than 30		more than 20		less than 25		coarse sand (250 - 2000 µ)		more than 75		more than 45		very poor, excessive		Class 7		ECe more than 15, or pH higher than 8.5, or ESP more than 25		less than 4.0		-3bd-

n.a. = not applicable

Productivity of land is measured in terms of dollars added value per acre per year which, for this Land Utilization Type, is calculated from February 1980 price levels, and adjusted to those of February 1977 so that productivity has been given relative value by expressing it in Productivity Units: 1 P.U. = J$100.00 at February 1977 price and income levels. In addition, productivity is expressed here as a percentage of maximum productivity of Class 1 land.

1) Gully area expressed as percentage of total surface area. A gully can be defined as a natural intermittent waterway, at least 50 cm deep, with side slopes steeper than 30°.

2) Depth to hard bedrock or indurated layers that are impenetrable to roots and which cannot be obliterated by deep ploughing.

3) Textural classes are those described in USDA Handbook 18, 'Soil Survey Manual', and refer to the weighted average in the upper 50 cm of the soil, or to hard bedrock, or indurated layers shallower than 50 cm. Clay is defined as the textural class containing 40 - 60% clay particles; likewise heavy clay contains more than 60% clay particles.

4) Stoniness is weighted average of volume percent of coarse fraction in the upper 50 cm of the soil or to hard bedrock or indurated layers shallower than 50 cm. Coarse fraction is defined to include all particles in the soil larger than 2 mm diameter (gravel, stones).

5) Rock outcrop area expressed as percentage of total surface area.

6) Internal soil drainage classes are those described in USDA Handbook 18, 'Soil Survey Manual'.

7) Flooding is defined as submergence with water of at least 20 cm depth, for a period of more than 1 day. The following flooding classes are distinguished: Class 0: no flooding; Class 1: 1 or less floods of 1 - 2 days per 2 years; Class 2: 1 or less floods of 1 - 2 days, per year; Class 3: 1 - 2 floods of 1 - 2 days, per year; Class 4: 1 or less floods of 2 - 4 days per year, or 3 - 4 floods of 1 - 2 days, per year; Class 5: 1 or less floods of 4 - 10 days, per year, or 40 - 20 cumulative days of flooding (each flood of less than 4 days per year; Class 6: 1 - 2 floods of 4 - 10 days, per year, or 20 - 30 cumulative days of flooding (each flood of less than 3 days); Class 7: flooding conditions exceed those described under Class 6.

8) Salinity alkalinity classes are defined in terms of weighted averages in the upper 50 cm of the soil, of: Electrical Conductivity (ECe, mmhos/cm), pH, and Exchangeable Sodium Percentage (ESP = Sodium percentage of total Cation Exchange Capacity). They follow definitions described in USDA Handbook 60, 'Diagnosis and Improvement of Saline and Alkali Soils.'

9) Acidity is weighted average of the pH H_2O (1:1), air dried, in the upper 50 cm of the soil.

10) The relationship between moisture availability and reduced productivity per land class has not yet been defined, since it would entail detailed analysis of agro-meteorological data. For the time being, Class 4 availability of water for this Land Utilization Type can be defined as: "No dry season of three months or more during 4 years out of every 5 year period. A dry season is a period of time during which rainfall is less than soil moisture storage is less than the potential evapotranspiration.

TABLE 7

FAMILY-OPERATED CITRUS ORCHARD FARMING (Oc)

LAND CAPABILITY CLASSES, PRODUCTIVITY RATINGS AND INDIVIDUAL LIMITATIONS

IN THE BURNT GROUND AREA

Land Capability Class	Productivity (P.U. acre⁻¹) 1)	e Slope (degrees)	g Gullies (%) 2)	d Effective Soil Depth (cm) 3)	t Soil Texture 4)	s Soil Stoniness (%) 5)	r Rock Outcrop (%) 6)	w Internal Soil Drainage 7)	f Flooding 8)	h Salinity Alkalinity 9)	a Acidity (pH) 10)	m Moisture Availability 11)
1	6.5; 90 - 100	0 - 20	0 - 5	more than 100	clay loam, clay, silty clay, sandy clay, silty clay loam, silt loam.	0 - 15	0 - 5	well; somewhat excessive	Class 0 - 2	ECe less than 2; pH less than 8.5 ESP less than 15	higher than 4.5	- to be defined later -
2	5.9; 80 - 90	20 - 25	5 - 10	50 - 100	loam, sandy clay loam, silt	15 - 35	5 - 15	moderately well	Class 3	ECe: 2 - 4; pH less than 8.5 ESP less than 15	n.a.	- ibid -
3	5.2; 70 - 80	25 - 30	10 - 15	25 - 50	montmorillonite clay, sandy loam	35 - 50	15 - 25	somewhat poor	Class 4	ECe: 4 - 8, pH less than 8.5; ESP less than 15.	n.a.	- ibid -
4	4.8; 60 - 70	n.a.	15 - 20	n.a.	loamy sand, fine sand (50 - 250 mu)	50 - 75	25 - 35	n.a.	n.a.	ECe: 8 - 16, or pH: 8.5 - 9.0, or: ESP: 15 - 25	4.0 - 4.5	- ibid -
5	3.9; 50 - 60	n.a.	20 - 25	n.a.	n.a.	n.a.	35 - 45	n.a.	n.a.	n.a.	n.a.	- ibid -
6	less than 50 per cent of maximum; no productivity units assigned	more than 30	more than 25	less than 25	coarse sand (250 - 2000 mu)	more than 75	more than 45	excessive; poor; very poor	Class 5 - 7	ECe more than 16, or: pH more than 8.5 or: ESP more than 25	less than 4.0	- ibid -

n.a. not applicable

Productivity of land is measured in terms of dollars added value per acre per year which, for this Land Utilization Type is calculated from March 1979 price levels, and adjusted to those of February 1977. Productivity has been given relative value by expressing it in Productivity Units: 1 P.U. = J$100.00 at February 1977 price and income levels. In addition, productivity is expressed here as a percentage of the maximum productivity of Class 1 land.

Total gully area expressed as percentage of total surface area. A gully can be defined as a natural intermittent waterway, at least 50 cm deep, with side slopes steeper than 30^{o}.

Depth to hard bedrock or indurated layers that are impenetrable to roots and which cannot be obliterated by deep ploughing.

Textural classes are those described in USDA Handbook 18, 'Soil Survey Manual' and refer to the weighted average in the upper 100 cm of the soil or to hard bedrock or indurated layers shallower than 100 cm. Montmorillonitic clay is the type of clay with strong swelling and shrinking characteristics that cause damage to the root system.

Expressed in weighted average of volume percent of coarse fraction in upper 50 cm of the soil or to hard bedrock or indurated layers shallower than 50 cm. Coarse fraction is defined to include all particles in the soil larger than 2 mm diameter (gravel, stones).

Total rock outcrop area expressed as percentage of total surface area.

Internal soil drainage classes are those described in USDA Handbook 18, 'Soil Survey Manual.'

Flooding is defined as submergence with water of at least 20 cm depth, for a period of more than 1 day. The following flooding classes are distinguished : Class 0: no flooding; Class 1: 1 or less floods of 1 - 2 days per 2 years; Class 2: 1 or less floods of 1 - 2 days per year; Class 3: 1 - 2 floods of 1 - 2 days per year; Class 4: 1 or less floods of 2 - 4 days per year, or 3 - 4 floods of 1 - 2 days per year; Class 5: 1 or less floods of 4 - 10 days per year, or 10 - 20 cumulative days of flooding (each flood of less than 4 days) per year; Class 6: 1 - 2 floods of 4 - 10 days per year, or 20 - 30 cumulative days of flooding (each flood of less than 4 days) per year; Class 7: flooding conditions exceed those described under Class 6.

Salinity/alkalinity classes are defined in terms of weighted averages in the upper 50 cm of the soil, of: Electrical Conductivity (ECe, mmhos/cm), pH, and Exchangeable Sodium Percentage (ESP = Sodium percentage of total Cation Exchange Capacity). They follow definitions described in USDA Handbook 60, 'Diagnosis and Improvement of Saline and Alkali Soils.'

Expressed in weighted average of the pH H_2O (1:1), air dried, in the upper 50 cm of the soil.

The relationship between moisture availability and reduced productivity per land class has not yet been defined, since it would entail detailed analysis of agro-meteorological data. For the time being, Class I availability of water for this Land Utilization Type can be defined as: No dry season of three months or more during 4 years out of every 5 year period. A dry season is a period of time during which rainfall plus soil moisture storage is less than the potential evapotranspiration.

TABLE 7

FAMILY-OPERATED CITRUS ORCHARD FARMING (Oc)

LAND CAPABILITY CLASSES, PRODUCTIVITY RATINGS AND INDIVIDUAL LIMITATIONS

IN THE BURNT GROUND AREA

Productivity (P.U. acre⁻¹)	e	Slope (degrees)	g	Gullies (%)	d	Effective Soil Depth (cm)	t	Soil Texture	s	Soil Stoniness (%)	r	Rock Outcrop (%)	w	Internal Soil Drainage	f	Flooding	h	Salinity Alkalinity	a	Acidity (pH)	m	Moisture Availability
1)			2)		3)		4)		5)		6)		7)		8)		9)		10)		11)	
6.5, 90 - 100		0 - 20		0 - 5		more than 100	clay loam, clay, silty clay, sandy clay, silty clay loam, silt loam		0 - 15		0 - 5		well; somewhat excessive		Class 0 - 2		ECe less than 2; pH less than 8.5 ESP less than 15		higher than 4.5		- to be defined later -
5.9, 80 - 90		20 - 25		5 - 10		50 - 100	loam, sandy clay loam, silt		15 - 35		5 - 15		moderately well		Class 3		ECe: 2 - 4; pH less than 8.5 ESP less than 15		n.a.		- ibid -
5.2, 70 - 80		25 - 30		10 - 15		25 - 50	montmorillonitic clay, sandy loam		35 - 60		15 - 25		somewhat poor		Class 4		ECe: 4 - 8, pH less than 8.5; ESP less than 15.		n.a.		- ibid -
4.6, 60 - 70		n.a.		15 - 20		n.a.	loamy sand, fine sand (50 - 250 mu)		50 - 75		25 - 35		n.a.		n.a.		ECe: 8 - 16; or pH: 8.5 - 9.0; or: ESP 15 - 25		4.0 - 4.5		- ibid -
3.9, 50 - 60		n.a.		20 - 25		n.a.	n.a.		n.a.		35 - 45		n.a.		n.a.		n.a.		n.a.		- ibid -	
less than 50 per cent of maximum; no productivity units assigned		more than 30		more than 25		less than 25	coarse sand (250 - 2000 mu)		more than 75		more than 45		excessive; poor; very poor		Class 5 - 7		ECe more than 16; or: pH more than 8.5 or: ESP more than 25		less than 4.0		- ibid -

n.a. not applicable

Productivity of land is measured in terms of dollars added value per acre per year which, for this Land Utilization Type is calculated from March 1979 price levels, and adjusted to those of February 1977. Productivity has been given relative value by expressing it in Productivity Units: 1 P.U. = J$100.00 at February 1977 price and income levels. In addition, productivity is expressed here as a percentage of the maximum productivity of Class I land.

Total gully area expressed as percentage of total surface area. A gully can be defined as a natural intermittent waterway, at least 50 cm deep, with side slopes steeper than 30°.

Depth to hard bedrock or indurated layers that are impenetrable to roots and which cannot be obliterated by deep ploughing.

Textural classes are those described in USDA Handbook 18, 'Soil Survey Manual' and refer to the weighted average in the upper 100 cm of the soil or to hard bedrock or indurated layers shallower than 100 cm. Montmorillonitic clay is the type of clay with strong swelling and shrinking characteristics that cause damage to the root system.

Expressed in weighted average of volume percent of coarse fraction in upper 50 cm of the soil or to hard bedrock or indurated layers shallower than 50 cm. Coarse fraction is defined to include all particles in the soil larger than 2 mm diameter (gravel, stones).

Total rock outcrop area expressed as percentage of total surface area.

Internal soil drainage classes are those described in USDA Handbook 18, 'Soil Survey Manual.'

Flooding is defined as submergence with water of at least 20 cm depth, for a period of more than 1 day. The following flooding classes are distinguished: Class 0: no flooding; Class 1: 1 or less floods of 1 - 2 days per 2 years; Class 2: 1 or less floods of 1 - 2 days per year; Class 3: 1 - 2 floods of 1 - 2 days per year; Class 4: 1 or less floods of 2 - 4 days per year, or 3 - 4 floods of 1 - 2 days per year; Class 5: 1 or less floods of 4 - 10 days per year, or 10 - 20 cumulative days of flooding (each flood of less than 4 days) per year; Class 6: 1 - 2 floods of 4 - 10 days per year, or 20 - 30 cumulative days of flooding (each flood of less than 4 days) per year; Class 7: flooding conditions exceed those described under Class 6.

Salinity/alkalinity classes are defined in terms of weighted averages in the upper 50 cm of the soil, of: Electrical Conductivity (ECe, mmhos/cm), pH, and Exchangeable Sodium Percentage (ESP = Sodium percentage of total Cation Exchange Capacity). They follow definitions described in USDA Handbook 60, 'Diagnosis and Improvement of Saline and Alkali Soils.'

Expressed in weighted average of the pH H_2O (1:1), air dried, in the upper 50 cm of the soil.

The relationship between moisture availability and reduced productivity per land class has not yet been defined, since it would entail detailed analysis of agro-meteorological data. For the time being, Class I availability of water for this Land Utilization Type can be defined as: No dry season of three months or more during 4 years out of every 5 year period. A dry season is a period of time during which rainfall plus soil moisture storage is less than the potential evapotranspiration.

TABLE 8

FAMILY-OPERATED RAINFED GARDEN CROP FARMING (Gf)

LAND CAPABILITY CLASSES, PRODUCTIVITY RATINGS AND INDIVIDUAL LIMITATIONS

IN THE BURNT GROUND AREA

Productivity (P.U. per ac. %)	c	Slope (degrees)	e	Gullies (%)	d	Effective Soil Depth (cm)	t	Soil Texture	s	Soil Stoniness (%)	r	Rock Outcrop (%)	w	Internal Soil Drainage	f	Flooding	h	Salinity / Alkalinity	a	Acidity (pH)	m	Moisture Availability
1)		2)		3)		4)		5)		6)		7)		8)		9)		10)		11)		
5.5 - 90 - 100		0 - 7		0 - 5		more than 100		clay loam, clay, silty clay, sandy clay, silty clay loam, silt loam		less than 15		less than 5		well; moderately well		Class 0 - 1		ECe less than 4 2 pH less than 8.5; ESP less than 15		higher than 6.0		(none defined) Inter
3.0 - 80 - 90		7 - 15		5 - 10		50 - 100		loam, sandy clay loam, silt, heavy clay		15 - 35		5 - 15		somewhat poor		Class 2		n.a.		5.0 - 6.0		Inter
4.5 - 70 - 80		15 - 20		10 - 15		25 - 50		sandy loam		35 - 50		15 - 25		poor; somewhat excessive		Class 3		ECe 4 - 8, pH less than 8.5, ESP less than 15		4.5 - 5.0		Inter
2.5 - 60 - 70		20 - 25		15 - 20		n.a.		loamy sand, fine sand (50 - 250 mm)		n.a.		25 - 35		n.a.		n.a.		ECe 8 - 16, or pH 8.5 - 9.0 or ESP more than 15		4.0 - 4.5		Inter
1.5 - 50 - 60		n.a.		n.a.		n.a.		n.a.		n.a.		n.a.		n.a.		n.a.		n.a.		n.a.		Inter
less than 50 per cent of the Ground Nut productivity (not assigned)		more than 25		more than 20		less than 25		coarse sand (250 - 2000 mm)		more than 50		more than 35		excessive; very poor		Class 4 - 7 very severe		ECe more than 16, or pH higher than 9.0		lower than 4.0		Inter

Productivity of land is measured in terms of dollars added value per acre per year which, for this Land Utilization Type is calculated from February 1980 price levels, and adjusted to those of February 1977. Productivity has been given relative value by expressing it in Productivity Units: 1 P.U. = J$400.00 at February 1977 price and income levels. In addition, productivity is expressed here as a percentage of the maximum productivity of Class I land.

Total gully area expressed as percentage of total surface area. A gully can be defined as a natural intermittent waterway, at least 50 cm deep, with side slopes steeper than 30°.

Depth to hard bedrock or indurated layers that are impenetrable to roots and which cannot be obliterated by deep ploughing.

Textural classes are those described in USDA Handbook 18, 'Soil Survey Manual', and refer to the weighted average in the upper 50 cm of the soil, or to hard bedrock, or indurated layers shallower than 50 cm. Clay is defined as the textural class containing 40 - 60% clay particles; likewise heavy clay contains more than 60% clay particles.

Expressed in weighted average of volume percent of coarse fraction in the upper 50 cm of the soil or to hard bedrock or indurated layers shallower than 50 cm. Coarse fraction is defined to include all particles in the soil larger than 2 mm diameter (gravel, stones).

Total rock outcrop area expressed as percentage of total surface area.

Internal soil drainage classes are those described in USDA Handbook 18, 'Soil Survey Manual'.

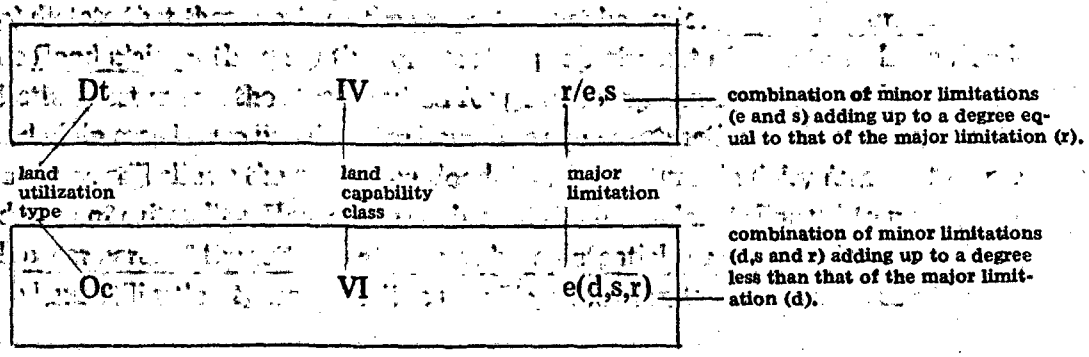
Flooding is defined as submergence with water of at least 20 cm depth, for a period of more than 1 day. The following flooding classes are distinguished: Class 0: no flooding; Class 1: 1 or less floods of 1 - 2 days per 2 years; Class 2: 1 or less floods of 1 - 2 days per year; Class 3: 1 - 2 floods of 1 - 2 days per year; Class 4: 1 or less floods of 2 - 4 days per year, or 3 - 4 floods of 1 - 2 days per year; Class 5: 1 or less floods of 4 - 10 days per year, or 10 - 20 cumulative days of flooding (each flood of less than 4 days) per year; Class 6: 1 - 2 floods of 4 - 10 days per year, or 20 - 30 cumulative days of flooding (each flood of less than 4 days) per year; Class 7: flooding conditions exceed those described under Class 6.

Salinity alkalinity classes are defined in terms of weighted averages in the upper 50 cm of the soil, of: Electrical Conductivity (ECe, mmhos cm^{-1}), pH, and Exchangeable Sodium Percentage (ESP = Sodium percentage of total Cation Exchange Capacity). They follow definitions described in USDA Handbook 60, 'Diagnosis and Improvement of Saline and Alkali Soils.'

Expressed in weighted average of the pH H_2O (1:1), air dried, in the upper 50 cm of the soil.

The relationship between moisture availability and reduced productivity per land class has not yet been defined, since it would entail detailed analysis of agro-meteorological data. For the time being, Class I availability of water for this Land Utilization Type can be defined as: No dry season of three months or more during 4 years out of every 5 year period. A dry season is a period of time during which rainfall plus soil moisture storage is less than the potential evapotranspiration.

- a symbol for the land capability class, i.e. Raman numerals I-VI;
- one or more lower case letters symbolizing the limitation(s) occurring under the land capability classes.



Concerning the limitations the following formula compositions may occur :

- Land capability classes I have no limitations; formulae include only symbols for the land utilization types followed by Roman numeral I e.g. Dt I.
- Land capability classes II have only one limitation, e.g. Gr IIe.
- Land capability classes III through VI may either have only a major limitation (e.g. Gr IIIe); or a combination of a major limitation and one minor limitation e.g. Gr IIIe(r); or a combination of a major limitation with two or more minor limitations e.g. Oc VIe (d,s,r); or a combination of two or more equally intensive limitations (e.g. Dt IV r/e,s). In the latter case, the classification is lowered one class level. (Thus, in the last example limitation "r" is in fact a Class III limitation and limitations "e" and "s" are both Class II limitations; the combination of one Class III limitation with two Class II limitations results in a classification at Class IV intensity).

Annex I to this report includes information related to land capability subclass acreages and corresponding potential productivity expressed in productivity units.

II.4 CONCLUSIONS

The land capability assessment which has been carried out for the Burnt Ground area places emphasis on the capability potential of the development area for three selected types of land use, i.e. dairy farming (Dt), citrus orchard farming (Oc) and garden crop farming (Gr). As a first step these land utilization types were identified in terms of their produce (output), level of management and related inputs. The actual capability assessment was carried out by

means of landform analysis by stereoscopic interpretation of recent airphotos at approximate scale 1:10,000, slope analysis, and field observation 7 soil pits and 69 auger holes.

The assessment results (Map No. 3 'Land Capability and Hydrography') show that the larger part of the land of the steeply sloping hills in the northern portion of the property as well as scattered smaller tracts of land of steeply sloping sinkholes and areas including limestone outcrops have limitations that preclude their commercial use for any of the three selected types of land use. Hence their adverse land capability characteristics (slope, rock outcrop) dictate that these parts of the property must be under protection forest.

The flood plain of the gully that crosses the property east of Milestown has a flooding limitation that makes the atea unsuited for garden crop and citrus orchard farming. The flood plain area is also unsuited for houselots and construction. The flooding limitation however, still allows the use of the floodplain for pastures in dairy farming to a moderate degree of suitability. Hence, the landuse of the floodplain is limited to pasture.

All other parts of the settlement scheme have potential for commercial use under the three land utilization types, as well as for village location to various degrees of suitability.

Summarizing, the land capability assessment allows for a physical separation of the forest land from the farm land. It also provides the basis for the creation of suitable farm types including minimum farmsize calculation in the design of the development plan (Section III), Furthermore, it indicates unsuitable sites for the houselots in the villages.

SECTION III

THE DEVELOPMENT PLAN

III:I PLANNED LAND USE

On the basis of Government policy, general land use considerations, the marketing situation and the land capability assessment, the development plan for the Burnt Ground Settlement Scheme has been drawn up around the following forms of land use :

- Protection forest and woodlots in those places as dictated by the land capability assessment; i.e. the steeply sloping hills in the northern part of the area and steeply sloping sinkholes, limestone escarpments and limestone outcrops which cannot be economically used under either one of the three selected land utilization types (Class VI land). Protection forest is also planned for some scattered relatively small areas classified as Classes III, IV or V under the various land utilization types which, due to poor accessibility, are impractical for inclusion in the productive agricultural lands.

- Citrus orchard farming, as presented by the existing situation in areas along part of the Montego Bay - Savanna-la-mar highway crossing the property.

- Two villages : one large village centered around the Burnt Ground Great House and another, smaller village to the east of Milestown.* The house lots in the villages are large and will consist of a domestic area and a large productive garden. Communal facilities are distributed over the two village sites.

- Grazing pastures for dairying make up the remainder of the settlement scheme.

- Farm roads and footpaths connect the village sites with the farm lands.

The agriculturally productive portion of the settlement scheme consists of the citrus orchard, the grazing pastures and the gardens of the houselots in the villages.

The servicing and infrastructural portion of the scheme is made up of the domestic and communal grounds in the villages as well as the roads and footpaths.

The forest and woodlots are marked as watershed-protective vegetation. Therefore, they are considered non-productive. Nevertheless, modest extraction of timber and bamboo for domestic purposes and staking yams and tomatoes can be done by the farmer settlers.

* In the following the proposed villages will be referred to as "Burnt Ground Village" and "New Milestown" respectively.

III.2 FARM TYPES

The farmer-settlers in the settlement area will be provided with land and support services under the Government's Project Land Lease in two different schemes: PLL II and PLL III.*

Under the PLL III Scheme, prospective full-time farmers will be provided with a house and farm land on a 49 year lease, sufficient to provide a minimum farm added value of J$3200.00 per year, at February 1977 price and income levels.

The PLL II Scheme provides practicing farmers, living within a radius of approximately 2 miles from the settlement area, with supplementary farm land. Such land, up to a maximum of 2 acres per individual farmer is leased also for a period of 49 years.

Two types of farms are proposed under the PLL III Scheme in the Burnt Ground area.

The first farm type is composed of a dairy farming and a garden crop farming component. Dairy farming forms the main source of income. The garden, designed as a backyard of approximately 15,000 sq. ft (0.34 acres) to each houselot forms a subsistence component.

From the calculations of added value per land utilization type in Chapter II.2 the productivity of such a garden is deduced to be 3 productivity units or J$300.00 (Feb. 1977).

In order to reach the target added value of J$3200 per year, the dairy farming component should thus provide at least J$3200 - J$300 = $2900 per year (29 P.U./year). The productivity of Class I land (land without physical limitations) for this land utilization type is 3.5 P.U./acre/year. Therefore, the minimum required farm size is 29 ÷ 3.5 = 8.3 acres. Similarly, on Class II land (productivity 3.2 P.U./acre/year) the minimum farm size would be: 29 ÷ 3.2 = 9.1 acre, etc.

Based on land capability and the above calculations the size of the individual dairy farms is established, and actual lots are plotted on the development plan. The plan provides for 121 complete farms of type No. 1. According to differences in the physical characteristics of the land, (dairy) farm sizes range from 8.3 to 9.8 acres.** The total productivity per farm however, does not vary.

The management activities for this farm type are described in Chapter II.2. under the land utilization types "Traditional family-operated dairy farming" and "Family-operated rainfed garden crop farming", respectively. The assumed levels of inputs and outputs are relatively low (e.g. one animal unit per 2 acres grazing pasture; a cropping intensity of only slightly more than one for garden cropping; limited use of fertilizer and chemicals; etc). Therefore, there is ample room for intensification and raise of farm income. The prospects for dairy farming are good, in particular with respect to the market situation and they are further enhanced by Government policy stimuli for this form

* The PLL I Scheme under which programme lands leased by the Goverment are sublet to practicing farmers for periods of 5 years, is not applicable to FRDP settlement schemes.

** These figures are excluding possible existing farm ponds (non-productive areas).

of agricultural production. The combination of dairy farming and garden cropping provides a diversification of activities and spreading of risk.

Farm type No. 2 is also a complete farm model (PLL III). It is centered around a major citrus orchard component, and a subsistence garden crop farming component. This backyard garden (0.34 acres) provides a minimum added value of J$300.00 (3 P.U.) anually. The citrus orchard component provides the main portion (29 P.U.) of the target added value, and varies in size from 4.5 to 4.7 acres, according to differences in land capability (See Chapter II.2, and related minimum farm size calculations similar to those given for farm type No. 1 above). The development plan provides for 10 complete farms of type No. 2.

The management activities for this farm type are those described under "Family-operated citrus orchard farming" and "Family-operated rainfed garden crop farming" in Chapter II.2. The assumed levels of inputs and outputs are relatively low (e.g. citrus yield levels are pegged at 350 boxes/acre/year; a cropping intensity of only slightly more than one for garden cropping; limited use of fertilizer and chemicals; etc.). Therefore, also in this farm type there is room for intensification and a significant raise in the farm added value to levels higher than the target level of February 1977 of J$3200.00. The prospects for citrus orchard farming are good and the Government is actively promoting expansion of citrus production in a country-wide resuscitation and rehabilitation programme. The combination of citrus orchard farming with garden cropping provides a desirable diversification of produce and a corresponding reduction of risk.

Under PLL II Scheme, relatively small lots (1 - 2 acres) are leased to farmers living off the property in order to increase their income to a more satisfactory level than at present.

These supplementary farm lots can be used for example for: grazing pasture for dairying or beef production, (citrus) orchard, rainfed garden crop farming, etc. The selection of the farm type for the PLL II lots will depend on the farmers preference, the distance to the farmer's house, his additional land and the PLL II lot, the presence of a farm pond etc. A total of 136.8 acres of PLL II land has been identified on the development plan, which depending on the size of the lots can accomodate approximately 68 to 136 PLL II supplementary lots.

III.3 FOREST AND WOODLOTS

Forest and woodlots will occupy a total of 351.8 acres (or 20.1 percent) in the settlement scheme. The major concentration is in the steeply sloping hills in the north, whereas patches scattered over the area occur on steeply sloping sinkholes, limestone escarpments and limestone outcrops. Existing dense forest that does not need to be improved takes up 82.6 acres (4.7 percent). The area in the northern hills which is slated for reforestation is at present partly under bush, partly under a degraded form of open forest. In order to maintain the shallow soil cover on these hills, sinkholes, escarpments and outcrops, the re-establishment of a closed forest cover is desired. Hence, the primary purpose of the forest is watershed protection. However, modest extraction of timber and bamboo from forest areas and woodlots by farmer settlers must be possible.

III.4 CITRUS ORCHARDS (PLL III)

The planned citrus orchard area will include 71.6 acres of existing orchard area plus 1.9 acres of new orchard that will have to be planted. With the inclusion of the 1.9 acres the total citrus area will accomodate 16 PLL III farms of Farm Type No. 2. The citrus orchard components in these 16 farms will vary in size from 4.5 to 4.7 acres.

The existing citrus orchard is neglected but it can be rehabilitated. The cost of rehabilitation per acre for the first year of operation amounts to approximately J$750.* A detailed breakdown of these costs is given in Annex III:- "Rehabilitation Cost for Citrus Orchard.". Adequate management levels for citrus orchard farming are presented in Section II.2 "Oc. Family-operated citrus orchard farming", and in more detail in Annex IV to this report entitled: Background Information to the "Added Value Calculations.

At present, citrus trees are lined out in the orchards following the contour. Since the slopes are gentle and with maintenance of a closed grass cover underneath the trees this practice does not serve any practical purpose. Therefore, in the future new plantings can be done in straight rows so as to facilitate easy spraying and cutting activities. With a view to better marketing prospects, new planting should concentrate on sweet orange and ortanique.

The 16 citrus farm lots will be farmed by farmers who will occupy farm houses on lots in the "Burnt Ground Village." Related houselots and citrus farm lots carry similar numbers thus showing their relationship on the Development Plan (Map No. 4). Maximum distance between these houselots and citrus orchards is less than one mile. For most citrus farmers however, this distance will be much less.

At present, theft of fruits is very common. This is due to current lack of ownership interest, inadequate fencing and location of the orchards along the highway. When farmers of farm type No. 2 will develop their farms they will have to take care that their farms are properly fenced, particularly those sections that border on the highway.

* Calculated March 1979.

III.5 DAIRY PASTURES INCLUDING PONDS (PLL III).

Dairy pastures and ponds are proposed to occupy 1043.1 acres (or 59.6 percent of the total area) on the settlement scheme. These grazing pastures make up the dairy farm component of 121 complete farms of type No. 1.* Dependent on land capability, net areas of dairy farm lots vary in size from 8.3 to 9.8 acres. They can support 4 animal units under the prevailing traditional management practices. Intensification from the current level would permit an increase in the number of animal units with time to 8 at a maximum. Out of the total of 121 dairy farming lots, 74 lots will be farmed by PLL III settlers residing in the "Burnt Ground Village" and 47 lots will be utilized by farmers living in "New Milestown". The dairy farm lots are arranged around both villages in such a fashion that the maximum house-farm distance is not more than 1.2 miles. In most cases however, the house-farm distance is much less and many lots are adjacent or close to the houselots. All grazing lots have access to farm roads. The direct relationship between dairy farm lots and farm houses is indicated by corresponding farm/houselot numbers.

In order to enable rotation of grazing, each farm grazing lot must be subdivided into a number of enclosures. The moment to start grazing is when grass is 4 - 6 inches (10 - 15 cm) tall. Grazing interval should be in the order of 18 - 20 days.

After every 2 or 3 grazing periods, grass tufts and weeds have to be bushcut. Since this bushcutting must be carried out per individual enclosure it can be done manually. If, after a bushcutting, weeds start growing again it is advisable to apply a chemical weed killer in the early stages of weed growth. Fertilizer is best applied after grazing periods. These and other non-factor inputs are described in Chapter II.2 under land utilization type "Traditional family-operated dairy farming", as well as in Annex IV "Background Information to the Added Value Calculations."

In Fig. 3 by way of example two actual dairy farm lots are subdivided into 10 enclosures, thus providing a grazing rotation of 18 days. The enclosures are laid out in such a way that they all have access to a pond. The number of existing ponds (81, with a total area of 24.0 acres) appeared insufficient to accommodate all grazing lots. Therefore 98 new ponds (10.9 acres) that will have to be dug, are proposed for development. Their position is shown on the development plan. Existing ponds will have to be cleaned and some ponds will have to be deepened, so that they will retain sufficient water throughout the dry season. Ponds that are located on a slope should be provided with a spillway. Digging new ponds by bulldozer (D4/D6) has been carried out recently on Haughton Grove and Nyerere Community farms in the same area. It costed $400 per pond. Cleaning of ponds will cost about $80 per pond. In a few cases, mainly southwest of "Burnt Ground Village", some ponds are superfluous and can best be filled in. This is also marked on the development plan.

The ponds can be stocked with fish. African perch, mud fish and other fish species have shown to be doing well.** Fish does not only present the farmer-settlers with an addi-

* The other farm component being garden crop farming on backyards of farmhouses in the villages. Refer to Chapter III.2 on Farm Types.

** Personal Communication from Mr. Raymond Delisser, former owner of Burnt Ground.

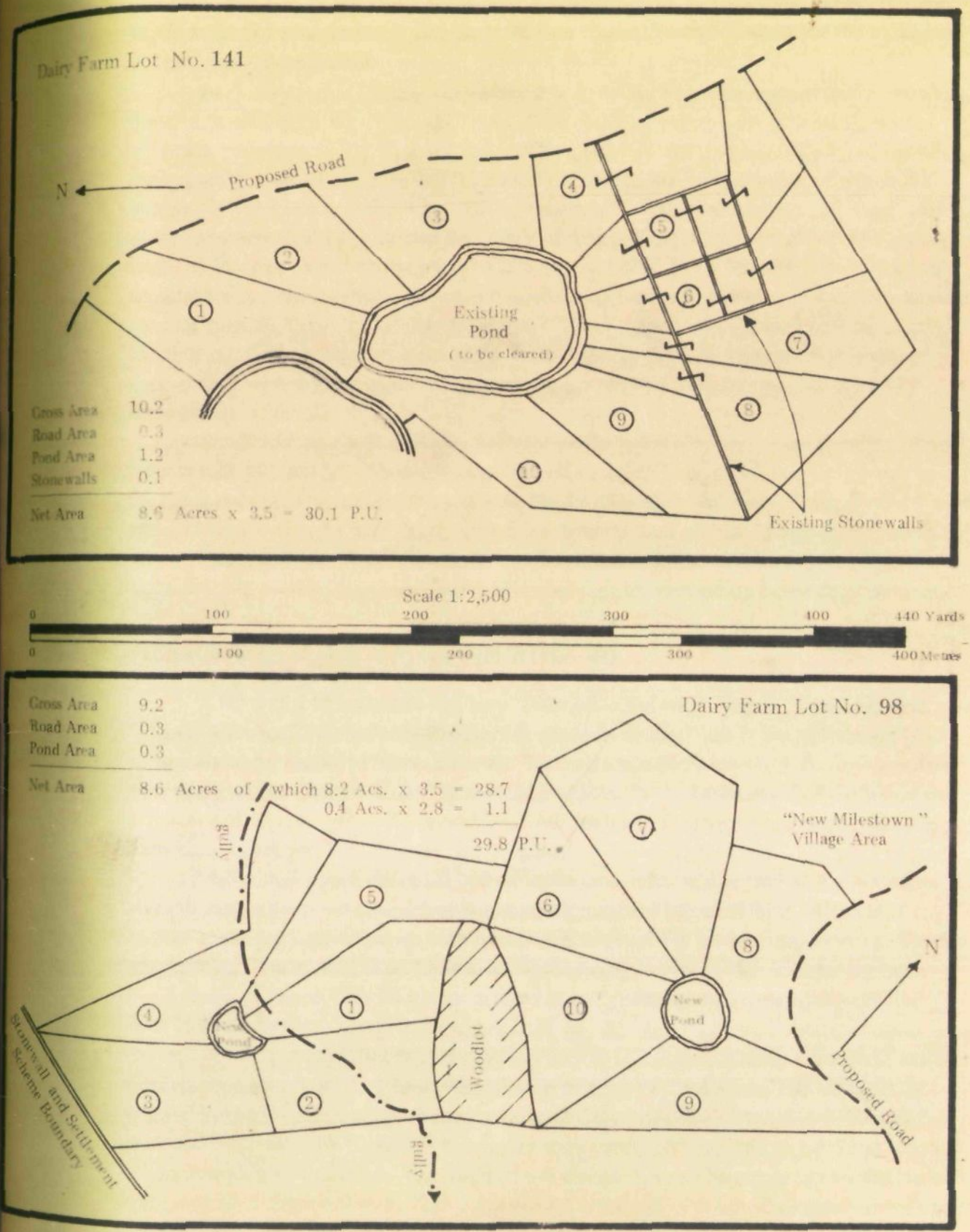


Fig. 3 Two Examples of PLL III Dairy Farm Lots Subdivided into 10 Enclosures for Rotation of Grazing.

tional source of protein but it also feeds on liver flukes thereby diminishing the incidence of this water-borne disease.

In the lay-out of grazing enclosures it is advisable to incorporate as many existing features (stone walls, wire fences) as possible in order to reduce cost of fencing. In the examples presented in Fig. 3, dairy farm lot No. 141 has 940 metres (3085 ft) of outside fences, and a total of 1000 metres (3280 ft.) of internal enclosure fences, of which 200 metres (655 ft.) can be formed by existing stonewalls. Dairy farm lot No. 98 has a total of 1190 metres (3905 ft.) outside boundary of which 65 (215 ft.) is made up of a stonewall. Its internal enclosure fences total 825 metres (2705 ft. in length). The cost of external fencing must be shared between neighbouring farmers. The cost of internal enclosure fencing must be borne by individual farmers. In order to spread the high cost involved in the fencing of all enclosures at one time, tethering may form an alternative to grazing during the first few years of farm implementation. In this way, farmers can gradually build up their fences.

Small milking sheds could be built (of native materials) on grazing farmlots. This however, should not be a necessary condition for loan disbursement, as it is at present, for dairy farmers who apply for loans with the Jamaican Development Bank. In many cases the milking shed can be built later, after dairy farmers have generated sufficient income.

Reports about theft of cattle in the Burnt Ground area and its surroundings are not uncommon. It might therefore be advisable that farmers set up homeguard services.

III.6 VILLAGE HOUSELOTS AND GARDENS (PLL III)

A total of 144 houselots has been designed in the two villages. "Burnt Ground Village" includes 94 houselots (90 of which are farm houses) and "New Milestown" comprises 50 houselots (47 farm houses). The extra houselots are set aside for communal facilities (refer to Chapter III.8 "Communal Facilities"). In the location of the house lots very steep, rocky, stony or wet spots have been avoided. Drainage ways in the village area have been incorporated as houselot boundaries.

The houselots are about 70,000 sq. ft. in size. The smaller part of the houselots is for domestic purposes (the actual house and immediate surroundings). An area of 15,000 sq. ft. (or 0.34 acres) on each houselot is reserved for garden crop farming. Garden crop farming is proposed as an integrated farming component in PLL III farming types No. 1 and 2. Thus all PLL III farmer-settlers in both villages are encouraged to utilize their large backyards as intensively as possible.

The farm model that is presented in Chapter II.2 under "Family-operated Rainfed Garden Crop Farming" describes a situation in which one third of the 15,000 sq. ft. is planted to yams. Red beans and sweetpepper occupy one sixth of the area (2500 sq. ft.) each and the remainder is planted to equally large areas (1250 sq. ft.) to tomatoes, cucumber, pumpkin and callaloo. The small size of the garden and its proximity to the farmer's residence allow for a relatively high management level under which all crops receive chemical fertilizers and most crops are sprayed against pests and diseases. Liming of the soil is included as a routine farming practice in order to increase the soil reaction to a more

favourable level. Apart from chemical fertilizers the crops may receive any available quantities of farm yard manure produced by poultry, pigs and other livestock. Such applications are particularly beneficial since the fertility of the limestone plateau soils is largely carried by the organic matter. Most of the crops included in the farm model can produce two yields per growing season (April/May through November). In the added value calculations for this land utilization type (refer to Chapter II.2) only two crops (red beans and callaloo) are assumed to produce two yields, thus leaving ample room to the farmer to increase the added value of garden crop farming to a level which is considerably higher than what is calculated.

The houses which will be built on the houselots are a modified version of the Ministry of Housing's basic dwelling unit: a 3 bay farm house using locally supplied materials. Farmer-settlers may add to this basic design. Water and electricity will be provided to individual houselots. Disposal of sewage and organic waste can be done through absorption pits* on individual houselots as the house density is about 2.5 per acre. A density of 5 - 6 houses per acre has been mentioned by the Town Planning Department as the maximum density for installation of absorption pits. Village street lights can be installed at space intervals of 150 - 200 ft. Hydrants must be spaced about 500 ft. apart.**

III.7 SUPPLEMENTARY FARM LOTS (PLL II)

A total of 136.8 acres of PLL II land has been identified on the development plan This land is located in the northern part of the property in order to accomodate prospective PLL II farmers living in Milestown, Content and Copse at a maximum distance of 2 miles from the property. Dependent on the size of the PLL II lots (varying from one to two acres) between 68 and 136 farmers may receive supplementary farm lots.

Currently, the land that has been set aside for PLL II supplementary farm lots is used as grazing pastures on the limestone plateau and the larger side valleys between the northern hills and as annual crop land on the narrower side valleys and saddle areas. This situation, in combination with farmers' background and preference for certain farming type(s) and produce(s) will determine the uses to which the various PLL II lots will be put. If this land is to be developed as grazing pastures for either dairying or beef production, then farm ponds will have to be dug in addition to the few existing ponds.

Farm roads and footpaths are designed so as to give access to all PLL II farm land.

The location of the PLL II land is clearly shown and separated from the PLL III land on Map No. 4 "Development Plan."

* Absorption pits are deep pits reaching down to the permeable substratum, i.e. fissured limestone, lined with non-cemented smooth stones through which the effluence can seep away.

** Recommendations of Town Planning Department.

III.8 COMMUNAL FACILITIES

The farmer-settler community of the two proposed new villages "Burnt Ground Village" and "New Milestown" must be provided with certain communal facilities. Map No. 1 "Location of the Burnt Ground Settlement Scheme and Regional Infrastructure" shows the existing communal facilities in the communities surrounding the settlement scheme, that are Haughton Grove/Ramble, Milestown/Content and Copse.

Rural planning standards for communal facilities are not established as yet in Jamaica. Therefore, the following proposals with regard to the number and type of facilities are tentative. In the final arrangement much will depend on the availability of funds, professional staff (teachers) and private initiative (church, shops, etc.).

Furthest distance to any of the communal facilities seems to be the determining factor in planning these facilities. For instance, furthest distance to a (primary) school should not exceed 1.5 miles or 36 minutes walking time (at 2.5 miles/hr for primary school students). Public transport in the Burnt Ground setting is not very reliable and most distances can only be covered by walking. For Burnt Ground, the nearest primary school in Ramble is more than 2 miles (or more than 48 minutes walking time) from the proposed village sites on the property. This situation implies the need to establish a new primary school on the property. Therefore, it is proposed that in "New Milestown" two houselots are set aside for a primary school that will serve a catchment area including "New Milestown" and "Burnt Ground Village" on the settlement scheme and Milestown, Content and Copse off the settlement scheme.

A kindergarten can be combined with the new primary school in "New Milestown." Another kindergarten can be established on an extra houselot in "Burnt Ground" to satisfy local needs.

The "Great House" on the settlement scheme can serve as communal building. It can accommodate the office of the Site Manager as well as a health clinic.

An area of 47 acres has been set aside for the playfield to the north of the Great House. This area is already fairly level and with some improvement it can be made suited to include a soccer/cricket field.

Churches exist in Ramble and Milestown outside the property. If personal initiative indicates a need for a church on the settlement scheme, then an extra houselot can be reserved in "Burnt Ground Village." Other facilities such as shops, bars and a postal agency must be decided upon later.

The communities of "Burnt Ground Village" and "New Milestown" can make use also of the facilities offered by the Cornwall Youth and Community Development Project, particularly the farm supply store and roadside market in Haughton Grove. The farm supply store of Haughton Grove has been informed already that it must take into account that in the future it will have to serve the farmer-settlers of the Burnt Ground scheme also.

III.9 ROADS, CROSS DRAINS, CULVERTS AND BRIDGES.

Two categories of roads occur. First, there are the existing asphalted roads: Shettlewood - Ramble crossing through the area, Haughton Grove - Milestown along the western boundary of the scheme, and the road to Copse alongside the eastern boundary. These roads do not come under the responsibility of FRDP. They need to be improved though. Mainly because of inadequate drainage potholes have formed in these roads, whereas flooding frequently affects part of the Haughton Grove - Milestown road. The second category of roads consists of the proposed farm roads. Partially these are aligned along existing (gravel) roads (e.g. the road from the highway to the Great House, and part of the Milestown - Copse road). Their total length is 67.210 ft (20.500 m). Proposed reservation is 40 ft (12 m), with 20 ft (6 m) carriageway. In order to facilitate alignment of Road V* (northeast of "New Milestown") in between an existing stonewall and the steep slope alongside a narrow area of PLL II land, a reservation of 20 ft only is made for this road. Its carriageway therefore will be approximately 12 ft. In view of the limited area which this road is serving, this is still considered sufficient. In the villages the roads have the same reservation (40 ft) and carriageway (12 ft) as farm roads. Town Planning Department has recommended however that village roads are asphalted and provided with concreted side drains.

In addition to the above there will be 4860 ft (1480 m) of footpaths to give access to some PLL II farm lands in the northern part of the scheme. Footpaths have a reservation of 12 ft (3.6 m).

All roads have to be provided with side drains where there is adjacent higher terrain, and with cross drains, culverts or bridges were waterways cross the roads. The position of required side drains, cross-drains and culverts as well as the required diameter of culverts** is shown on Map No. 4 "Development Plan". The roads are designed on hill crests as often as possible, in order to minimize on the length of the side drains and number of cross-drains and culverts. The Bill of Works (Chapter III. 11) lists the number of cross drains and culverts, and their diameter.

One site in the settlement scheme requires construction of a bridge. It is between Milestown and "New Milestown" where farmroad S crosses the large gully. At present the dustroad Milestown - Copse crosses the gully by means of a swale-drain. Calculated capacity of the new bridge is 3136 cusec.** A wide, gently sloping drain crosses

* Roads and footpaths are labelled with capital letters and length in feet on Map No. 4 "Development Plan."

** The discharge capacity of culverts and bridges is calculated by means of the formula Q = C.I.A, where : Q = discharge in cusec (cubic feet per second); C = runoff coefficient (percent of rainfall occurring as runoff, varying according to landuse: cultivated land = 0.7; pasture = 0.4; forest = 0.2); I = rainfall intensity in inches per hour for 10 year frequency, in a duration equal to the "time of concentration" (= the time required for water to flow from the most remote point of a watershed, to its outlet); A = catchment area in acres. The calculated discharge is related to available standard-size culverts of 2 ft diameter (maximum discharge 30 cusec) 3 ft diameter (maximum discharge 70 cusec) or 4 ft diameter (maximum discharge 125 cusec). Discharges of less than 15 cusec can be channelled across roads by means of superficial, concreted cross-drains. Discharges of more than 125 cusec require bridges for adequate drainage, or large cross-drains if terrain conditions are not favourable to bridge construction, such as in wide, gently sloping drains.

Road F at a point 7300 ft. from its start. The calculated discharge (10 years frequency) of the drain at this site is 192 cusec. In view of the gentle slopes occurring, it is proposed to construct a large, superficial concreted cross-drain here.

III.10 WATER SUPPLY AND ELECTRICITY

III.10.1 The Shettlewood Water Supply System

Domestic water supply to the Burnt Ground Settlement Scheme has been investigated by Nelson, O'Callaghan & Associates, Consulting Engineers in Montego Bay in 1978. Another consultant (Tomlinson & Associates, Kingston) is currently investigating the situation again at the request of the National Water Authority under the infrastructure component of the First Rural Development Project.

These investigations so far indicated* that the most reliable sources are the two Shettlewood springs which supply the "Shettlewood Water Supply Scheme." (See Map No. 5: "Proposed Water Supply to the Burnt Ground Settlement Scheme"). This scheme serves a wide area in southeastern Hanover ranging from Belvedere and Chester Castle in the southeast to Knockalva, Haughton Grove, Chichester and Mount Peto in the southwest and to Milestown in the northwest. The Shettlewood scheme meets the Friendship Water Supply Scheme at places located between Milestown and Copse and between Burnt Ground and Copse.

The northern most of the two Shettlewood sources has an estimated yield of 1.7 - 2 million Imperial gallons per day. It has been reported however, that during periods of long drought, the water yield is reduced considerably. There are three pumps operating at this source; two turbine pumps of 50 H.P. each are run by the Hanover Parish Council (one was out of order in 1978) whereas the Shettlewood property runs a "Ram" pump. The southern source, approximately 0.5 mile to the southeast has an estimated yield of 2 million Imperial gallons per day and is fairly consistent throughout the seasons. The pump with a capacity of 50 H.P. is operated by the Agricultural Development Corporation's Shettlewood dairy complex. In 1978, the pump was out of service due to damage by lightning and unavailability of spare parts.

Water pumped from the two sources is stored in three interconnected steel water tanks of 68,000 Imperial gallons (ADC), and 55,000 + 42,000 Imperial gallons (Hanover Parish Council) with a total capacity of 165,000 Imperial gallons, located on a hilltop east of Burnt Ground having an elevation of 925 ft (282 metres) above mean sea level. Although the three tanks are interconnected, the full capacity of 165,000 Imperial gallons is not realised due to improper connections.

From the storage area 3 inch and 4 inch pipes radiate in several directions (see Map No. 5). The Great House of Burnt Ground is served presently from the 3 inch main running along the highway Shettlewood - Rumble.

The current total average demand for the Shettlewood Water Supply System is about 137,000 Imperial gallons per day.

* Refer to report prepared by Nelson, O'Callaghan & Associates, December 1978. Tomlinson & Associates have not yet established their findings (June 1979). However, personal communications were received.

III.10.2 Proposed Water Supply to Burnt Ground Settlement Scheme

The total population of the Burnt Ground Settlement Scheme is estimated at 720 persons (144 households; 5 persons at average per household). Average water demand is assumed to be 35 US gallons per person per day, plus an extra similar quantity per day for each garden. Thus, total average daily water demand will amount to: (720 + 144) x 35 = 30,240 US gallons or approximately 25,200 Imperial gallons. If taken from the Shettlewood Water Supply Scheme the total average demand of that scheme will increase to 137,000 + 25,200 = 162,200 Imperial gallons per day. This can be adequately met by the water yield of either of the two sources although preference is given to the southern source as being the most reliable. The rated capacity of the pumps is 125 Imperial gallons per minute or 180,000 Imperial gallons per day for both the Hanover Parish Council pumps at the northern source, and 120 Imperial gallons per minute or 172,800 Imperial gallons per day for the ADC pumps at the southern source. The capacity of each of the pumps (when in good order) would be sufficient to meet the target of 162,200 Imperial gallons per day including the Burnt Ground Settlement Scheme. Preferably, the pumps should be concentrated at the southern source with one pump in operation and the other two as stand-by pumping facility. This would imply adequate repairs for one Hanover Parish Council pump and the ADC pump which were out of order in 1978. The potential storage capacity of 165,000 Imperial gallons for the three tanks on the 925 ft hill would just be more than one day's demand for the entire area including Burnt Ground. This, however, would entail improvement of the connections between the three tanks to achieve full potential storage capacity. If deemed necessary another storage tank with a capacity of 25,000 - 30,000 Imperial gallons could be installed next to the other three tanks in order to boost the storage capacity.

The village sites can be supplied directly from the main running along the Copse - Burnt Ground road: first to "Burnt Ground Village" and then to New Milestown (see Map No. 5). From "New Milestown" further extension of the main into Milestown and Content could be considered in the framework of the overall water supply development under the infrastructure component of FRDP.

III.10.3 Electricity

Electricity power lines run along the main highway Shettlewood - Ramble. From the highway current is provided to the Great House. This line must be upgraded to bring electricity to "Burnt Ground Village," and the playfield area, and from there to "New Milestown."

III.11 BILL OF WORKS

Roads	
- existing roads to be upgraded to farm roads	3,710 ft
- new farm roads	53,530 ft
- new village roads	9,970 ft
- new farm footpaths	4,860 ft
Round-about	1
Houselots	144
Farmhouses	137
Community buildings	
- existing community building, to be improved	1 (Great House)
- kindergartens	2
- primary school	1
Playfield in "Burnt Ground Village" for cricket/soccer, to be levelled	3.3 Ac.
Cross-drains	9
Culverts	
- Ø 2 ft	7
- Ø 3 ft	6
- Ø 4 ft	4
Bridges	1 (3136 cusec)
Water main Ø 3 ins	11,850 ft.
Distribution water pipes Ø 2 ins	6.710 ft.
Connections of water pipes with houses and community buildings	147
Fire hydrants (500 ft apart, in villages only)	16
Street lights (200 ft apart, in villages only)	46
Farm ponds	
- existing ponds to be cleaned	90
- new ponds to be dug	98
- existing ponds to be filled	4
Stonewalls to be removed	850 ft
Orchard	
- existing orchard to be rehabilitated	71.6 Ac
- new planting of citrus	1.9 Ac.
Forest	
- area to be reforested	269.2 Ac.

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ANNEXES I - IV

ANNEX I

Land Capability Classes and Subclasses, Acreages per Land Utilization Type and related Potential Productivity Units

Dt Traditional Family-operated Dairy Farming			Oc Family-operated Citrus Orchard Farming			Gr Family-operated Rainfed Garden Crop Farming		
Class & Subclass	Acreage	Productivity Units	Class & Subclass	Acreage	Productivity Units	Class & Subclass	Acreage	Productivity Units
Dt I	1304.9	4567.2	Oc I	1292.9	8403.9	Gr I	744.3	6698.7
Subtotal	1304.9	4567.2		1292.9	8403.9		744.3	6698.7
Dt IIe	4.3	13.8	Oc IIe	4.3	25.4	Gr IIe	509.9	4130.2
Dt IIs	54.8	175.3	Oc IIs	54.2	319.8	Gr IIs	19.5	158.0
Dt IIr	2.4	7.7	Oc IIr	2.4	14.1			
Subtotal	61.5	196.8		60.9	359.3		529.4	4288.2
Dt IIIe	0.5	1.4	Oc IIIe	0.5	2.6	Gr IIIe	38.7	278.6
Dt IIIe/s,r	2.0	5.6	Oc IIIe/s,r	2.0	10.4	Gr IIIe(s)	34.5	248.4
Dt IIIs	1.2	3.3	Oc IIId/s/r	0.1	0.5	Gr IIIe(r)	2.4	17.3
Dt IIIs/r	2.0	5.6	Oc IIIs	1.2	6.3	Gr IIId/s/r	0.1	0.7
Dt IIIr(e)	0.6	1.7	Oc IIIs/r	1.9	9.9	Gr IIIs	1.2	8.6
Dt IIIr(s)	6.1	17.1	Oc IIIs/f	0.7	3,6	Gr IIIs/f	0.7	5.0
Dt IIIf	14.1	39.5	Oc IIIr(e)	0.6	3.1	Gr IIIf	12.0	86.4
			Oc IIIr(s)	6.1	31.7			
			Oc IIIf/w	11.9	61.9			
Subtotal	26.5	74.2		25.0	130.0		89.6	645.0
Dt IVe(s)	0.5	1.3	Oc IVe(s)	0.5	2.3	Gr IVe	4.3	27.1
Dt IVe/s,r	0.6	1.5	Oc IVe/s,r	0.6	2.8	Gr IVe(s,r)	2.0	12.6
Dt IVs/d,r	14.2	35.5	Oc IVd/s/r	14.2	65.3	Gr IVe/s,r	1.9	12.0
Dt IVr/e,s	31.5	78.7	Oc IVr/e,d,s	31.5	144.9	Gr IVe/r/d,s	5.6	35.3
						Gr IVd/s(r)	14.2	89.5
						Gr IVr(e)	0.6	3.8
						Gr IVr/e,s	0.5	3.2
Subtotal	46.8	117.0		46.8	215.3		29.1	183.5
Dt Vr(s)	0.8	1.7	Oc Vr(s)	0.8	3.1	Gr Ve/d,s,r	31.5	170.1
Subtotal	0.8	1.7		0.8	3.1		31.5	170.1
Dt VIe	1.1	no	Oc VIe	1.1	no	Gr VIe	1.6	no
Dt VIe(s)	0.7		Oc VIe(s)	0.7		Gr VIe(s)	1.3	
Dt VIe(s,r)	279.9	productivity	Oc VIe(s,r)	0.8	productivity	Gr VIe(s,r)	1.0	productivity
Dt VIe/s,r	0.8	units	Oc VIe(d,s,r)	279.9	units	Gr VIe(s,r)	0.4	units
Dt VIe(r)	0.5		Oc VIe(r)	0.5		Gr VIe(d,s,r)	279.9	
Dt VIr	0.4	assigned	Oc VIr	0.4	assigned	Gr VIe/r	0.5	assigned
Dt VI r(e)	2.0		Oc VIr(e)	2.0		Gr VIr	0.2	
			Oc VIf(w)	14.1		Gr VIr(e)	2.2	
						Gr VIr(e,s)	0.8	
						Gr VIf	14.1	
Subtotal	285.4	—		299.5	—		302.0	—
Ponds	25.7	—	Ponds	25.7	—	Ponds	25.7	—
TOTAL	1751.6	4956.9		1751.6	9111.6		1751.6	11935.5

ANNEX II

FARM INCOME ACCOUNT ACCORDING TO FACTOR SHARES*

Farms that will be established under Government's Project Land Lease Phase III, are by definition small in size. They are designed to generate a minimum net farm income of J$2750 per year, calculated at February 1977 price and income levels. Such income is assumed to be the minimum required to support an average farm family of 5 persons. Net farm income includes cost of family labour (calculated at replacement cost), produce consumed on farm, and residual. If the produce consumed on farm is estimated at J$750 per year, than the farmer's net cash income would be J$2000 at minimum.

The level of management on the farms is low to intermediate, including family labour**, use of simple handtools, moderate applications of fertilizer and chemicals etc. Under these conditions, fixed costs like depreciation and interest are relatively low. Total fixed costs (including land rent) are estimated at J$450 per year.

Net farm income and fixed costs together constitute the added value of produce. Based on the above, the required minimum added value per farm is J$2750 + 450 = J$3200 per year (Feb. 1977).

Added value plus non-factor costs (costs of current inputs such as fertilizers, chemicals, feed, planting material, expendables etc.) are to be covered by the total value of output (=farm produce).

* Refer to Fig. 4

** Although the farms are essentially family-operated, some specific farm activities such as ploughing by tractors, are carried out on contract basis. In such cases the cost of hired labour are to be included in the factor costs and they form one of the components of the added value.

ANNEX III

REHABILITATION COSTS FOR CITRUS ORCHARD

Along part of the Montego Bay - Savanna-la-Mar highway, crossing the southern part of the Burnt Ground Settlement Scheme, a citrus orchard was established in 1953 by the former owner of the property. It comprises a total area of 71.6 acres. Due to neglect the orchard at present is in a poor condition: many trees have died, all trees need pruning and clearing from wildgrowth of epiphytes, all kinds of pests thrive abundantly in the orchard, many trees are affected by diseases and the grass cover under the trees is in need of bush-cutting. Also the actual tree density is below optimum.

Field visits to the orchard, together with the Regional Plant Production Officer of the Ministry of Agriculture, Western Region, have revealed that the orchard can still be rehabilitated and brought back into production. Detailed analysis of air-photographs showed that the orchard comprises approximately 6200 trees, or about 87 trees/acre. It was estimated that 15 percent of these trees is diseased or otherwise unproductive. At present, the trees are lined out following the contour. Since slopes are mainly gentle and a closed grass cover underneath the trees can easily be maintained, this practice does not serve any practical purpose. Therefore, in the future new planting should be done in straight rows so as to facilitate easy spraying and cutting activities. At the optimal planting distance of 20 x 20 ft, the required tree density would be 108 tree/acre (total 7732 trees). At present, approximately 75 percent of the trees are orange and ortanique trees, whereas about 25 percent is grapefruit. With a view to their better marketing prospects, only oranges and ortaniques should be replanted.

Activities, labour inputs and costs involved in the rehabilitation of the citrus orchard are itemized below. All cost are expressed in dollars per acre, and cover the first year of rehabilitation. Wages and prices refer to March 1979. Labour costs are based on J$7.00 per manday (8 working hours). Unit costs of fertilizer and chemicals are listed in Table 10, Annex IV "Background Information to the Added Value Calculations".

1.	Pruning and clearing of trees	- 10 trees/manday; 87 trees/acre		$ 60.90
2.	Bush-cutting	- 2 mandays/acre		14.00
3.	Fungicide and Insecticide application	- 3 times in first year:		
		Shell White Oil - 1½ gal/appl.	$ 36.00	
		Malathion - 1 pt/appl.	15.18	
		Labour - 2 md/appl.	42.00	
				$93.18

4. Fiddler Beetle Control - 2 times in first year			
	Dieldrin - 4 lbs/appl.	$ 42.80	
	Labour - 2.5 md/appl.	35.00	
			$ 77.80
5. Slug Control - 2 times in first year			
	Sluggit - 2 lbs/appl.	$ 32.00	
	Labour - 2 md/appl.	28.00	
			$ 60.00

6. Fertilizer Application - Recommended per tree:

	N	P	K	
spring	1.5 lb	nil	nil (= appr. 6 lbs sulphate ammonia)	
midyear	1.5 lb	1 lb	nil (= appr. 4 lbs sulphate of ammonia + 7 lbs7 - 14 - 14)	
fall	1.5 lb	nil	nil (= appr. 6 lbs sulphate of ammonia)	
in total	16 lbs sulphate ammonia per tree, or appr. 16 bags/acre			$ 224.00
	7 lbs 7 - 14 - 14 per tree, or appr. 7 bags/acre			133.00
	Labour - 1 md/appl			21.00
				$ 378.00

7. Felling of old diseased trees and removal of stumps

15 percent of existing trees, i.e. 13 trees/acre @$2.00/tree		$ 26.00

8. Replanting: Total number to be replanted:

15 percent of existing trees + additional trees up to a density of 108 trees/acre = 13 + (108 - 87) = 34 trees @ $0.15/tree	$ 5.10	
transport @ $0.05/tree	1.70	
digging mounds @ $0.60/mound	20.40	
planting (including application of Dieldrin) 5 pl/hr	5.95	
dieldrin @ $0.04 lb/tree	7.28	
		$ 40.43

GRAND TOTAL = $ 750.31

REMARKS

1. During the year of rehabilitation, there is still an income from the orchard, which is estimated at 25 percent of the expected maximum output, or 87½ boxes/acre. At assumed farm gate prices of $3.50 per box of oranges or ortaniques (75 percent of the trees), and $1.60 for grapefruits (25 percent) this amounts to :

	75% x 87½ x $3.50	=	$ 229.70
and	25% x 87½ x $1.60	=	35.00
			$ 264.70

Harvesting costs, calculated at $0.40/box will amount to $35.00 per acre. From the first year of rehabilitation, the output of the orchard will gradually increase until after 4 - 5 years full production will be reached.

2. In the preparation of the development plan, it appeared that the area of the existing orchard was just too small to accomodate 17 farms with an area large enough to provide the target farm income. Therefore, an extension of 1.9 acres to the existing orchard is necessary (parts of farms 36 and 37). Costs of establishment of a citrus orchard in this area are given below. All costs occurring in the first year of establishment are included; they are expressed in dollars per acre. Prices and wages are the same as those used in the calculation of the rehabilitation costs (see above). It should be noted that fertilizer and chemical inputs are adjusted to the small size of the newly planted trees.

1. Bush-cutting	- 2 md/acre		14.00
2. Planting	- 108 trees/acre @ $0.15/tree	16.20	
	transport @ $0.05/tree	5.40	
	digging mounds @ $0.60/mound	64.80	
	planting (including application of Dieldrin) 5 tr/hr	18.90	
	Dieldrin @ 0.04 lb/tree	23.10 +	
			128.40
3. Fungicide and insecticide application	- 3 times in first year		
	Shell White Oil ½ gal/appl	12.00	
	Malathion ¼ pt/appl	3.80	
	Labour 1 md/appl	21.00 +	
			36.80
4. Fiddler beetle control	- 1 time in first year (in addition to application given at planting time)		
	Dieldrin 1 lb/appl	5.35	
	Labour 1 md/appl.	7.00 +	
			12.35
5. Slug control	- 2 times in first year		
	Sluggit 0.5 lb/appl.	8.00	
	Labour 1 md/appl.	14.00 +	
			22.00

6. Fertilizer application (at rates assumed under normal management level, see Chapter II.2.3 "Family-operated Citrus Orchard Farming")

sulphate of ammonia: 8 bags/acre	112.00	
complete (7-14-14): 3 bag/acre	57.00	
Labour: 3 application; 1 md/appl.	21.00	
		190.00 +

GRAND TOTAL ($/acre) 403.55

For the total additional area of 1.9 acres total establishment costs will amount to 1.9 x 403.55 = $766.75

Although from the above calculations it may appear that rehabilitation of the existing orchard is actually more expensive than establishment of a new orchard ($750/acre for rehabilitation, against $403/acre for establishment), it should be noted that the existing orchard is still producing (at present, production is estimated at 25 percent of the maximum production) and will reach full production within 4 - 5 years after rehabilitation. Young citrus trees will start producing after 4 - 5 years and reach full production only after approximately 8 - 10 years. Moreover, renewal of the complete existing orchard would require felling and removal of the old trees, which activities bring along considerable costs (about $175/acre). In the description of the land utilization type "Family-operated Citrus Orchard Farming" and in the corresponding added value calculations, replacement of old trees is included at a rate of 3 trees/acre per year, so that in approximately 40 years (a trees' lifetime) all trees are replaced.

ANNEX IV

BACKGROUND INFORMATION TO THE ADDED VALUE CALCULATIONS

In this annex, background information is compiled relative to the added value calculations for the distinguished land utilization types. It contains data on labour inputs in the different farm types; unit prices of fertilizer, lime, chemicals etc; general crop husbandry data; a detailed calculation of added value for yam cultivation; and a standardized model for pesticide applications.

1. Labour Inputs

Dt: Traditional Family-operated Dairy Farming

The dairy farm lots range in size from 8.3 to 9.8 acres. The pastures are subdivided into 9 or 10 enclosures over which the cows (4 animal units = cow + calf) are rotated. A grazing period lasts 2 days, a grazing cycle therefore lasts 18 - 20 days.

The cows are milked every day in the morning, by hand. The calf runs with the cow during the day, and is separated in the afternoon. Modest amounts of concentrates are being fed daily to the cattle. After each grazing period the enclosures should be fertilized, also in the dry season (2 bags/acre/year, or approximately 12 lbs at a time). After 2 - 3 grazing periods, grass tufts and weeds occurring in the pastures have to be bush-cut. Once per two weeks the animals should be sprayed with detergents and desinfectants against possible diseases and parasites (ticks). At least once a year farm ponds should be cleaned.

All farm activities and their time requirements are listed below. Labour inputs are given for the complete dairy farming component (approximate average size 9 acres) of farm type No. 1. (See Chapter III.2 Farm Types). The figures are excluding walking time to and from the house. A manday is assumed to comprise 8 working hours.

- Milking: 4 cows, once per day: 1 hr/day	35 md/yr.
- Transport of milk to collecting point, including cleaning of cans: 1 hr/day	35
- Feeding of concentrates and separation of cow and calf: ½ hr/day	23
- Fertilizing of enclosure after grazing period : 1 hr/2 days	23
- Bush-cutting: ½ md/acre, once every 40 days	41
- Spray detergents and desinfectants: 2 hr/2 weeks	6.5
- Clean farm ponds	8
- Others (repair fences, etc.)	8
TOTAL	179.5 md/yr/farm

Oc: Family-operated Citrus Orchard Farming

The citrus orchard lots range in size from 4.5 to 4.7 acres. Optimum tree density is 20 x 20, or 108 trees per acre. Routine activities in the orchards include spraying, fertilizing, bush-cutting, pruning, harvesting, felling of old trees and planting of new trees. Lime is applied at a rate of 5 tons once every 6 years. Labour requirements for these farm activities are indicated below, expressed in mandays per acre per year. These figures exclude walking time to and from the farmhouse.

- spraying: 3.5 applications/year	3.5 md/acre/yr
- fertilizing 3 applications/year	3
- bush-cutting 10 times/yr	10
- harvesting 17.5 boxes/manday	20
- pruning	3
- felling and removal of old trees : 3 trees/yr	1
- replanting of new trees, including digging of mounds, watering, and application of Dieldrin: 3 trees/yr	0.5
TOTAL	41.0 md/acre/yr

At an average orchard farm size of 4.6 acres, total annual labour input would amount to 4.6 x 41 = 188.6 mandays. The labour input involved in the application of lime is estimated at 10 mandays per application.

Gr: Family-operated Rainfed Garden Crop Farming

The houselots in the villages are designed to accommodate a backyard garden of 15.000 sq. ft. (0.34 acre). The proximity of the garden to the house facilitates that close attention can be given to the crops, also through labour by family members. Table 9 shows activities and labour inputs for the cultivation of those crops included in the added value calculations for garden crop farming. All figures are expressed in terms of mandays/acre per crop. The actual garden model comprises 5000 sq. ft. of yams, 2500 sq. ft of red beans and sweet pepper, and 1250 sq. ft. of each, pumpkin, cucumber, callaloo and tomato. Two crops of red beans and callaloo are grown per cropping season. Based on these assumptions, total annual labour input for backyard gardening would amount to 23 mandays per garden.

Table 9

ACTIVITIES AND LABOUR REQUIREMENTS (MANDAYS/ACRE/CROP) FOR CULTIVATION OF DIFFERENT CROPS IN BACKYARD GARDENS

	Yam	Red Beans	Sweet Pepper	Tomato	Pumpkin	Cucumber	Callaloo
Land preparation (ploughing*, digging hills, rowing etc.)	34	10	10	10	10	10	10
Seedbed preparation and maintenance	-	-	2	2	-	-	1
Transplanting (including first fertilizer application)	-	-	10	10	-	-	8
Planting/direct seeding (including first fertilizer application).	12	6	-	-	5	5	-
Weeding	15	10	10	10	10	10	10
Spraying	-	2	2	2	2	2	1
Second/Third fertilizer application	2	1	1	1	1	1	1
Staking	12	-	-	10	-	-	-
Pruning	-	-	-	3	-	-	-
Harvesting	15	5	10	10	5	5	8
TOTAL	91	34	45	58	33	33	56

2. Unit Prices

Table 10 shows unit prices of fertilizer, lime, agricultural chemicals and stakes. The prices indicated were collected in March 1979, by means of a market survey. Only items available at the time of survey are included. It should be noted that availability as well as prices of the different items are subject to considerable changes in time and place.

* Although the farms are esentially family-operated some specific farm activities such as ploughing by(small) tractors is carried out on contract basis.

Table 10

UNIT PRICES OF AGRICULTURAL MATERIALS*

Description		Price (J$)
Fertilizer :	Sulphate of Ammonia	14.00/bag (= 1 cwt.)
	Complete (7-14-14)	19.00/bag (= 1 cwt.)
Ground lime		8.00/cuyd (= approx. 1 ton)
(transport costs, according to PWD standards, are $0.20/cuyd/mile if the transport distance is approximately 20 miles)		
Chemicals :		
	Malathion	40.50/gal
	Basudin	8.87/lb
	Perfecthion	18.80/qrt
	Shell White Oil	8.00/gal
	Dieldrin	5.35/lb
	Daconil	8.60/lb
	Dithane	4.95/lb
	Sluggit	8.00/lb
Bamboo stakes for yams		0.35/stake
Bamboo stakes for tomatoes		0.15/stake
(bamboo stakes have an estimated life-time of 2 years)		

* March 1979

Crop Husbandry

In Table 11 general crop husbandry information is listed, such as required amount of seeding/planting material, plant density/planting distance, time to harvest and assumed yield levels. As to the latter, it should be noted that due to the prevailing low management level in the area surrounding the Burnt Ground Settlement Scheme, projected yields as used in the added value calculations have been pegged at rather low, but realistic levels.

Table 11

CROP HUSBANDRY

Crop	Required amount of seeding/planting materials		Planting Distance	Time to Harvest	Assumed yield/acre/crop
	Direct Seeded	Nursery Sown			
Yam-negro	heads : 2.5 tons		78 x 78 inches	7 - 9 months	tubers 6.5 tons;heads 1.5 tons
yellow	heads : 2.5 tons		78 x 78 inches	7 - 9 months	tubers 5.5 tons; heads 0.75 tons
-renta	heads: 2 tons		78 x 78 inches	7 - 9 months	tubers 5.5 tons; heads 1.0 tons
Red Beans	seeds 60 lbs		30 x 2.5 inches	90 days	500 lbs
Sweet Pepper		seeds 1.5 lbs	30 x 2.5 inches	60 - 80 days	7500 lbs
Tomato		seeds 0.25 lb	48 x 3 inches	60 - 80 days	6000 lbs
Pumpkin	seeds 2 lbs		84 x 84 inches (5 seeds/hill)	90 - 120 days	6000 lbs
Cucumber	seeds 2 lbs		60 x 42 inches	60 days.	5000 lbs
Callaloo		seeds 0.25 lb	18 x 12 inches	45 - 60 days	6000 lbs
Citrus		108 seedlings	20 x 20 ft	4 -5 years (first harvest)	350 boxes/yr

* See also detailed calculation of added value for yam cultivation (Annex IV. 4)

4. Detailed Calculation of Added Value for Yam Cultivation

In the added value calculation for the cultivation of yams, a model had to be made, covering six consecutive years of cultivation. This was necessary, as new planting material for yams has to be bought by the farmer only after cultivation of three crops. In two out of three years the farmer produces his own planting material (tuber heads). It is assumed however, that after the third yield, the reproductive quality of the tuber heads has dropped below economical levels. Consequently, the heads are then all sold as ordinary tubers. This 3-year cycle is superimposed on a two-year cycle for the use of bamboo stakes, which are assumed to last two years. Inputs and outputs during a 6-year cultivation cycle of (negro) yams are presented in Table 12.

Table 12

INPUTS AND OUTPUTS DURING A SIX—YEAR CULTIVATION CYCLE OF NEGRO YAM

YEAR	1	2	3	4	5	6	Annual Average	Adjusted Annual Average*
Value of Output								
tubers (@ $0.15/lb	7 tons; $2100	7 tons; $2100	12 tons; $3600	7 tons; $2100	7 tons; $2100	12 tons; $3600	8.7 tons; $2600	6.5 tons; $1950
heads (@ $0.20/lb)	2.5 " ; $1000	2.5" ; $100	— ; —	2.5 " ; $1000	2.5 " ; $1000	— ; —	1.7 " ; $ 666	1.25 " ; $ 500
	(+ 2.5 tons used for planting)	(+ 2.5 tons used for planting)		(+ 2.5 tons used for planting)	(+ 2.5 tons used for planting)			
						TOTAL	$3260	$2450
Value of non-factor input								
Planting material (@ $0.30/lb)	2.5 tons; $1500	— ; —	— ; —	2.5 tons;$1500	— ; —	— ; —	1.7 tons; $500	1.7 tons; $500
lime	5 tons; $ 60	— ; —	— ; —	— ; —	— ; —	— ; —	; $ 10	$ 10
fertilizer	10 bags; $ 190	10 bags; $190	10 bags; $190	10 bags; $ 190	10 bags; $190	10 bags $190	10 bags $190	7.5 bags; $14250
stakes (@ $0.35/pc)	1000 pcs; $350	— ; —	1000 pcs; $350	— ; —	1000 pcs; $350	— ; —	; $175	; $175
							; $875	; $827.50

* As explained in Chapter II.2.4 "Family-operated Rainfed Garden Crop Farming", yield projections and input levels are based on the "Crop Husbandry Guide" of the Jamaican Development Bank. These input and output levels have been reduced however in order to adjust to the prevailing low management level in the area surrounding the Burnt Ground Settlement Scheme. For rootcrops, the reduced yield level is put at 75 percent of the JDB projections. Inputs in planting material do remain unchanged, as do those of lime and stakes.

5. Insecticide and Fungicide applications

In order to arrive at an average cost figure for the application of agricultural chemicals, mixtures of three currently available insecticides and two fungicides have been combined into the model shown below. This model takes into account that consecutive applications of mixtures of these pesticides should not contain the same compounds.

Application No.	Insecticide	Fungicide	Total
1	1 pt Malathion; $5.06	1 lb Daconil; $8.60	$ 13.66
2	1 pt Basulin; $8.87	2 lbs Dithane; $9.90	$ 18.77
3	1 pt Perfecthion; $4.70	1 lb Daconil; $8.60	$ 13.30
4	1 pt Malathion; $5.06	2 lbs Dithane; $9.90	$ 14.96
5	1 lb Basudin; $8.87	1 lb Daconil; $8.60	$ 17.47
6	1 pt Perfecthion; $4.70	2 lbs Dithane; $9.90	$ 14.60
		AVERAGE	$ 15.46
		Rounded off at	$ 15.50

In the added value calculations, applications of pesticides have therefore been calculated against $15.50 per application.

APPENDIX

EFFECTS OF THE JUNE 12, 1979 RAINSTORM ON THE DEVELOPMENT PLAN

APPENDIX

EFFECTS OF THE JUNE 12, 1979 RAINSTORM ON THE DEVELOPMENT PLAN

The torrential rainstorm of June 12, 1979* and its aftermath have caused flooding in several parts of the Burnt Ground Area. In most cases the floodwater discharged rather quickly through sinkholes (soak-aways), but on a few places, continuing underground inflow of water caused an increase of the water levels in depressions (geologic basins) even after the rains had stopped. The resultant prolonged flooding in these areas caused the death of existing vegetation. Approximately 30 acres of pasture and 7.8 acres of citrus orchard have thus been affected. As rehabilitation of this part of the citrus orchard would involve high costs (see Annex IV) it is now proposed to remove the dead trees, and plant grass instead. Also, replanting of grass is necessary in the other areas affected by prolonged flooding. Summarizing, the following changes in the development plan are required :

1. The total number of citrus orchard farmlots has to be reduced from 16 to 14. These 14 lots occupy a total area of 64.7 acres. The originally proposed establishment of 1.9 acres of new citrus orchard, which was necessary in order to allow lay-out of 16 complete citrus farmlots, has now become superfluous and this area can remain in pasture (see map No. 6; page 64)

2. All dead citrus trees in the flooded area will have to be removed, as well as some healthy trees in a narrow strip along the flood-affected area, in order to allow establishment of one extra dairy farmlot of 8.9 acres on this site (see map No.6; page 64). The felling and removal costs of these trees are estimated at J$240.00 per acre if a D6 bulldozer, with ripper is used.

3. New grass cover has to be established in all flood-affected areas in the Burnt Ground Settlement Scheme. Itemized cost estimates, expressed in J$ per acre are as follows :

Land preparation (tractor - ploughing, 2 cuts @ J$20.00/acre)	J$ 40.00
Cutting grass (3 sq. chain/acre; 2 mandays)	14.00
Loading/unloading (2 mandays)	14.00
Hauling (tractor @ J$12.00/hr)	48.00
Spreading (4 mandays)	28.00
Harrowing/covering (tractor @ J$20.00/acre)	20.00
TOTAL	J$164.00

* According to the Meteorological Service, Kingston rainfall of 20 inches/24 hr and higher was recorded. Such rainfall has an estimated frequency of occurrence of less than once in five hundred years. The rains and subsequent floods caused extensive damage in large parts of Western Jamaica.

Planting material (tanna grass is proposed for the higher areas, and para grass for the lower-wetter-parts) is available from pastures in the Burnt Ground Area.

4. Two extra farmponds will have to be dug in the additional dairy farmlot (No. 5)

5. The total number of PLL III complete farms in the Burnt Ground Settlement Scheme will be reduced by one, from 137 to 136. There will be 122 farms of Farm Type No. 1 (dairy farms with a minor component in backyard garden farming), and 14 farms of Farm Type No. 2 citrus orchard farms with a minor component in backyard garden farming). One houselot in "Burnt Ground Village" (No. 37) will become vacant.

Areas flooded around Farm Ponds
needing replanting

Planting material (tanna grass is proposed for the higher areas, and para grass for the lower-wetter-parts) is available from pastures in the Burnt Ground Area.

4. Two extra farmponds will have to be dug in the additional dairy farmlot (No. 5)

5. The total number of PLL III complete farms in the Burnt Ground Settlement Scheme will be reduced by one, from 137 to 136. There will be 122 farms of Farm Type No. 1 (dairy farms with a minor component in backyard garden farming), and 14 farms of Farm Type No. 2 citrus orchard farms with a minor component in backyard garden farming). One houselot in "Burnt Ground Village" (No. 37) will become vacant.

Citrus Orchard on Burnt Ground and Edwards' farm bordering on Burnt Ground flooded following the torrential rains of 12/13 June 1979.

MAP NO. 6 SECTION OF DEVELOPMENT PLAN ADJUSTED FOLLOWING JUNE 12, 1979 RAINSTORM

LEGEND

68 — Dairy Pasture } PLL III Farmland

36 — Existing Citrus Orchard } PLL III Farmland

Existing Asphalted Road

Existing Gravel Road to be upgraded to Farm Road

Burnt Ground Settlement Scheme Boundary

Flood Boundary

Farm Boundary

Farm Boundary (existing drainageway)

Existing Ponds to be cleaned

Existing Ponds to be filled

New Ponds

AREA LOCATION PLAN

COPSE

MILES TOWN

HAUGHTON GROVE

29
68
69
36
76
32
31
1
2
3
4
16
5
7