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IMPLICATIONS FOR RURAL DEVELOPMENT FROM A LONG-RANGE PLANNING MODEL: AN ILLUSTRATION FOR JAMAICA*

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Introduction

This paper discusses the implications of long-term projections on planning for rural sector development in the context of a long-range planning model. To illustrate the utility of the model, Jamaica is taken as a case study.

Our starting point is the recognition of the importance of the rural sector and its potential contribution to overall economic development. The interdependence between the rural economy and the other sectors has been long recognized and the potential contribution of the rural population to national economic development of underdeveloped countries has been indentified.

The existence of persistent poverty in the rural sector can be explained by the non-optimum allocation of resources and inefficient resource use in that sector. Of course, one question that requires consideration is: what is the pattern of optimum resource allocation, and what are the factors which impinge on this allocation? A prerequisite to determining the optimum resource allocation pattern in the rural economy is an analysis of the future composition of that sector: what will be that sector's characteristics in terms of population size, age distribution, migration patterns, labour force size and quality, food consumption and social service requirements, investment requirements, and land densities? It is these latter variables with which this paper is primarily concerned. The object of this paper is to illustrate the usefulness of a long-range planning model in the quantitative projections of these variables, using Jamaica as a case study.

Rural Underdevelopment

To a very large extent, the problem of the less developed countries is the problem of the poverty of their rural population. Although low standards of living in rural areas is not confined to the less developed countries (they can be found in many developed countries), the problem is of a different dimension in the underdeveloped countries because the economy of these countries is mainly agricultural.

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The causes of rural poverty can be explained by any combination of factors. However, low productivity per person and the lack of gainful employment opportunities for the rural population can perhaps be ranked as the most important causes of persistent rural poverty.

The causes of low productivity and insufficient opportunities for gainful employment of the rural population are many: poor soils and unfavourable climates; backward production techniques and inadequate equipment; excessively high densities of rural population; low capital-labour ratios; a pricing mechanism which discriminates against the rural producer; inadequate access to capital markets and the lack of available marketing services.

The Importance of the Rural Sector

Over 60 per cent of the total population in the world is dependent on rural agriculture. Whereas in Europe approximately one person out of three, and in North America only one person in five, is dependent on agriculture, in Latin America, Asia, and Africa three out of every four obtain their living from the land.

Development of the rural sector is important for many reasons. First, the rural sector is a major source of food production. Any increases in food output could potentially result in foreign exchange savings on food imports and/or increased foreign export earnings through increased exports. Second, the rural sector represents a significant source of savings which can be invested in other sectors of the national economy. Third, the rural sector represents an important reservoir of surplus labour which may be utilized in the urban sector. Fourth, the rural sector represents a major source of demand for capital and consumer goods.

In recent years, the need for rural development has become a *live issue*. The current level of concern has been caused by *crisis* levels of rural-urban migration which tend to over-burden the existing level of social services in the urban sector and the need for increased domestic agricultural production to combat rapidly rising world food prices.

The Causes of Rural Backwardness

The rural sector in most developing countries is characterized by a number of constraining factors which account directly for the economic backwardness of this sector. Among the more important ones are: high rates of population increases caused by declining mortality rates without similar reductions in fertility rates; high dependency ratios; low productive land-man ratios; low capital-labour ratios; low savings rates; low skill levels resulting from inadequate educational opportunities; the absence of adequate technology; and high rates of unemployment.¹ This backwardness is reflected in extremely low standards of living, and income barely at subsistence levels resulting in the inability of the rural population to obtain sufficient health services and food requirements.

¹The term unemployment used here means both unemployment and underemployment.

Confronted with the hardships of rural life, the rural population is faced with the choice of migrating to the urban sector or continuing to live in rural poverty. In many developing countries, growing numbers have chosen to migrate to the urban areas as evidenced by the rapid rates of urbanization of these countries. Rural families consequently create additional pressures on urban employment opportunities and social services. In fact, by migrating, they may be substituting urban unemployment for rural unemployment.

A number of factors may work to improve the conditions of the rural sector and reduce the rate of rural-urban migration. For example, some developing countries faced with rising food import needs, which are a direct result of low domestic production, are forced to increase investment in rural agriculture.

In addition, faced with world food shortages and rising world food prices, governments in underdeveloped countries begin to recognize opportunities for earning foreign exchange through the export of agricultural commodities. In order to increase production in the rural sector additional resources must be allocated for this purpose.

Internal political pressures also tend to bring about the implementation of policies aimed at equalizing the rural-urban income gap and creating a more equitable distribution of income.

Another factor leading to increased developmental efforts in the rural sectors in the combination of problems caused by the process of urbanization. As urbanization proceeds, the rural unemployed, previously invisible in the countryside, now become the urban unemployed. Large increases in urban unemployment, especially among young jobseekers, the deterioration of social services in some urban areas, the rising aspirations of the urban youth all combine to create a potential for violence.

Given these pressures for change, governments in underdeveloped countries are forced to implement policies directed at improving the economic conditions of the rural population.

Planning for Rural Development

Rural development planning originates as a response to scarcity of resources necessary for economic development. The unequal distribution of resources between the rural and urban sectors in the underdeveloped world has resulted in a widening gap between rural and urban incomes. Given this tendency, a major goal of rural development planning is to increase the flow of resources going to the rural sector in order to improve the standard of living of the population and to provide adequate employment opportunities for those people whom the urban sector is unable to absorb.

The Impact of Demographic Variables on Economic Development: An Overview of Theory

Recent theoretical and empirical analyses of the effects of demographic variables on national economic development indicate that

rapid population growth may significantly impede the rate of overall economic development. Population size, age structure, growth rate and geographic location have important implications for development objectives, such as rapid economic growth, equitable income distribution and adequate employment opportunities, and therefore are of vital interest to planners and policy-makers.

In general, population affects economic growth parameters through its impact upon the basic economic inputs of land, labour, and capital:

The supply of utilized agriculture land is influenced by the pressure of population upon the extensive land margin. Employment is influenced from the supply side by the size and age of the working age population, and from the demand side by the level of employment generating investment in the non-agricultural sector and by the supply of land in the agricultural sector. Investment is, in turn, affected by the impact of population upon the saving-consumption decisions of households, government, and business. In addition, population is seen to play a part in shaping the composition of investment via its role in determining the demands for investment in non-productive uses, e.g., schools and houses, rather than directly productive equipment. (1)

Population may also affect the quality of the labour force by its influence on the educational, health, and housing services and demands for food. With a given budget for social services, high rates of population growth may significantly reduce per capita expenditures on educational, health, and housing facilities. Also, with a given level of food production, high rates of population growth may reduce considerably per capita food consumption levels. Working in combination, these factors may have a devastating impact on the quality of labour thereby reducing labour's productivity.

High rates of population growth also affect other development objectives such as equitable income distribution and employment opportunities. In rural areas, high population growth increases density, which reduces labour's marginal productivity, and may hamper rural savings and agricultural capital formation. These demographic factors, in combination with the general, historical bias of public investment policy favouring urban industrialization over agricultural development, has tended to depress rural incomes to levels substantially below urban incomes (2).

The rural-urban income gap has in turn been a determining factor causing rural-out-migration. It is not however the sole determinant of rural-out-migration. Other influences such as the probability of finding urban employment, the attractions of *city life*, the unintentional influences of government policies in industrialization, rural development, urban wage policies, unbalanced infrastructure development, land reform, education and other social services, have all tended to contribute to the trend towards rapid rural out-migration. The rapid urbanization experienced in developing countries has led to serious development problems discussed earlier.

Several demographic-economic models with varying degrees of sophistication have been developed over the last two decades that have attempted to quantify some of the theoretical relationships between long-term demographic trends and socio-economic development. These quantitative demographic-economic models were originally developed to project the impact of reductions in fertility rates, i.e., of reduction in the rate of population growth, on critical economic variables, such as labour force and capital formation. Growth equations, in turn, expressed the relationship between these factors of production and national output. Generally, these demographic-economic growth models have a demographic submodel from which several alternative population projections can be generated into the future, each differing in its assumptions regarding fertility rates. Population projections assuming declining fertility rates will result in populations growing at a slower rate than projections assuming constant fertility rates. Furthermore, the age structure changes with varying assumptions regarding fertility rates: with declining fertility rates the population becomes *older* and the ratio of dependents to working adults decreases. The demographic data from such alternative population projections is then used in the economic submodel to simulate the effects of declining fertility upon economic growth. One such model, the Long-range Planning Model (LRPM2) was applied to Jamaican data supplied by the Central Planning Unit in 1970.

The Application of LRPM2 to Jamaica

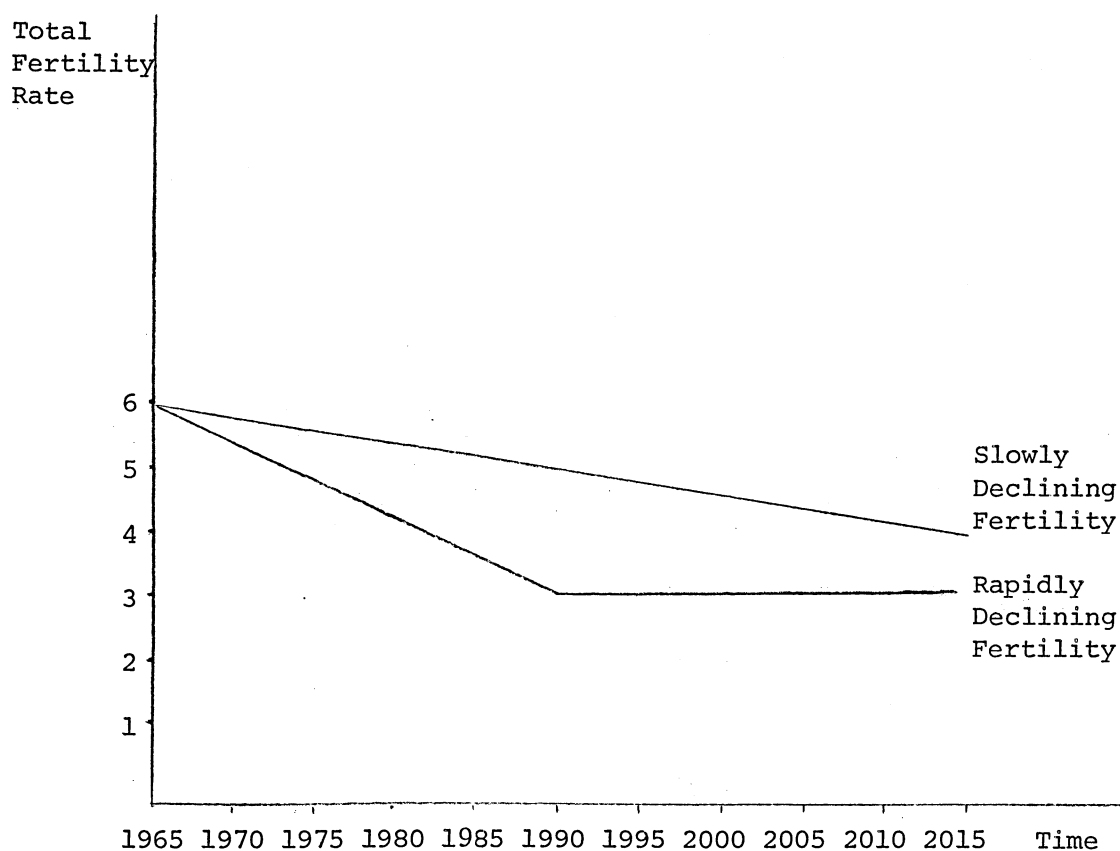
Two alternative population projections (1965-2015) representing a rapidly and slowly growing population are made for comparison purposes. Projection 1 assumes that the total fertility rate declines slowly, from 6.05 in 1965, to 5.2 in 1990, and 4.36 in 2015. The second projection assumes a rapid decline in the total fertility rate from 6.05 in 1965 to 3.25 in 1990, after which it remains constant.¹ The demographic projections are summarised in Tables 1 and 2.

In the first projection, the population growth rate is 2.7 per cent per annum, while in the second the growth rate is 1.8 per cent per annum. Thus, for Projection 1, the total population by 2015 would be 6.6m. and in Projection 2, only 4.2m. The alternative fertility assumptions also have implications for the age structure of the population. Whereas in the 1965 base year 45.9 per cent of the population is under age 15, by the year 2015 the percent of the population under age 15 is 41.4 per cent in Projection 1 and 33.1 per cent in Projection 2. Thus, a more rapidly declining fertility implies an older population.

The migration project results are displayed in Tables 1 to 3. The urban population grew over the projection period at an annual rate of 4.3 per cent in Projection 1 and 3.4 per cent in Projection 2. Rural population grew over the projection period at

¹The explanation for this rapid rate of decline is that after 1966 the Jamaican Government adopted a policy that family planning would become an integral part of the population control programme.

Figure 1. Fertility Decline Assumptions



an annual rate of 0.5 per cent in Projection 1. In Projection 2 the rural population actually declines, at an annual rate of 0.4 per cent.

The impact of different fertility and population growth assumptions on the number of rural-urban migrants is summarized in Table 4. Under conditions of rapid population growth over the projection period, the average annual rate of growth of migrants is 1.4 per cent while on the other, the rate of growth of migrants is only 0.5 per cent. Thus, lower rates of population growth imply a significant slowing down of the rate of growth of migration.

Table 1. Projection 1: Rapid Population Growth - Slowly Declining Fertility

(thousands)

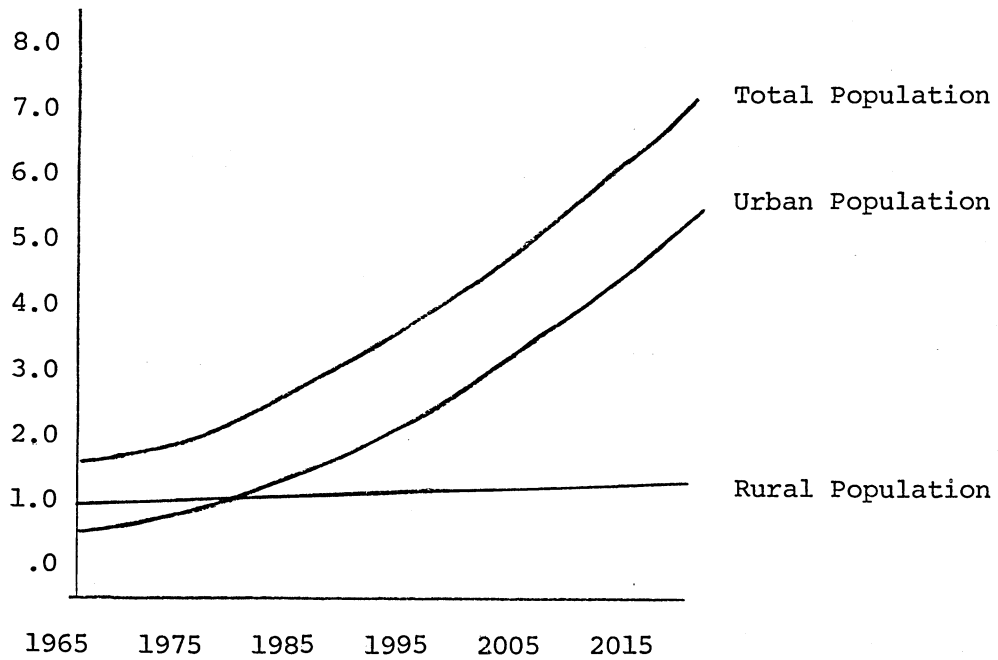
	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015
Total Population	1765.2	1919.0	2139.2	2447.3	2822.3	3262.2	3767.5	4346.1	5008.8	5762.1	6605.9
Total Males	858.2	949.6	1060.7	1215.8	1404.8	1626.7	1882.0	2174.4	2508.9	2888.4	3311.9
Total Females	907.0	969.4	1078.5	1231.5	1417.5	1635.5	1885.5	2171.7	2499.8	2873.7	3294.0
Births		355.1	390.0	457.4	534.4	608.6	682.6	764.3	858.6	963.3	1072.7
Deaths		71.2	69.7	74.4	84.4	93.6	102.3	110.8	120.9	135.0	153.9
Crude Birth Rates		0.0386	0.0384	0.0399	0.0406	0.0400	0.0388	0.0377	0.0367	0.0358	0.0347
Crude Death Rates		0.0077	0.0069	0.0065	0.0064	0.0062	0.0058	0.0055	0.0052	0.0050	0.0050
Life Expectancy at Birth:											
Male		65.10	66.84	67.68	67.68	67.68	67.68	67.68	67.68	67.68	67.68
Female		68.97	70.70	71.51	71.51	71.51	71.51	71.51	71.51	71.51	71.51
Gross Reproduction Rate		2.938	2.854	2.770	2.685	2.601	2.518	2.436	2.354	2.272	2.190
Population:											
Urban	635.5	795.5	987.0	1244.5	1566.4	1957.3	2421.6	2966.8	3602.6	4335.1	5164.9
Rural	1129.7	1123.4	1152.2	1202.8	1255.9	1304.9	1346.0	1379.3	1406.2	1427.0	1440.1
Urban Share	0.3600	0.4146	0.4614	0.5085	0.5550	0.6000	0.6427	0.6826	0.7192	0.7523	0.7819
Rural-Urban Migration		104.7	100.2	115.3	131.2	146.8	161.0	173.4	183.4	190.7	195.0

Table 2. Projection 2: Slow Population Growth - Rapidly Declining Fertility

	('000)										
	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015
Total Population	1765.2	1908.0	2090.8	2323.2	2569.6	2810.1	3057.6	3337.4	3643.2	3965.9	4299.6
Total Males	858.2	944.0	1036.2	1153.2	1277.2	1398.5	1523.7	1665.3	1819.8	1982.0	2148.2
Total Females	907.0	963.9	1054.5	1170.0	1292.4	1411.6	1533.9	1672.1	1823.4	1984.0	2151.4
Births		343.5	350.6	378.1	399.3	399.0	410.9	448.8	481.1	506.9	530.5
Deaths		70.5	67.8	70.7	77.9	83.4	88.5	94.0	100.3	109.1	121.8
Crude Birth Rates		0.0374	0.0351	0.0343	0.0326	0.0297	0.0280	0.0281	0.0276	0.0266	0.0257
Crude Death Rates		0.0077	0.0068	0.0064	0.0064	0.0062	0.0060	0.0059	0.0057	0.0057	0.0059
Life Expectancy at Birth:											
Male		65.10	66.84	67.68	67.68	67.68	67.68	67.68	67.68	67.68	67.68
Female		68.97	70.70	71.51	71.51	71.51	71.51	71.51	71.51	71.51	71.51
Gross Reproduction Rate		2.842	2.566	2.290	2.024	2.737	1.599	1.599	1.599	1.599	1.599
Population:											
Urban	635.5	791.0	964.7	1181.4	1426.1	1686.1	1965.2	2278.2	2620.4	2983.8	3361.7
Rural	1129.7	1117.0	1126.1	1141.8	1143.4	1124.1	1092.3	1059.2	1022.8	982.2	937.9
Urban Share	0.3600	0.4146	0.4641	0.5085	0.5550	0.6000	0.6427	0.6826	0.7192	0.7523	0.7819
Rural-Urban Migration		104.1	97.9	109.5	119.5	126.4	130.7	133.1	133.4	131.3	126.9

Figure 2.

Projection 1: Rapid Population Growth - Slowly Declining Fertility



Projection 2: Slow Population Growth - Rapidly Declining Fertility

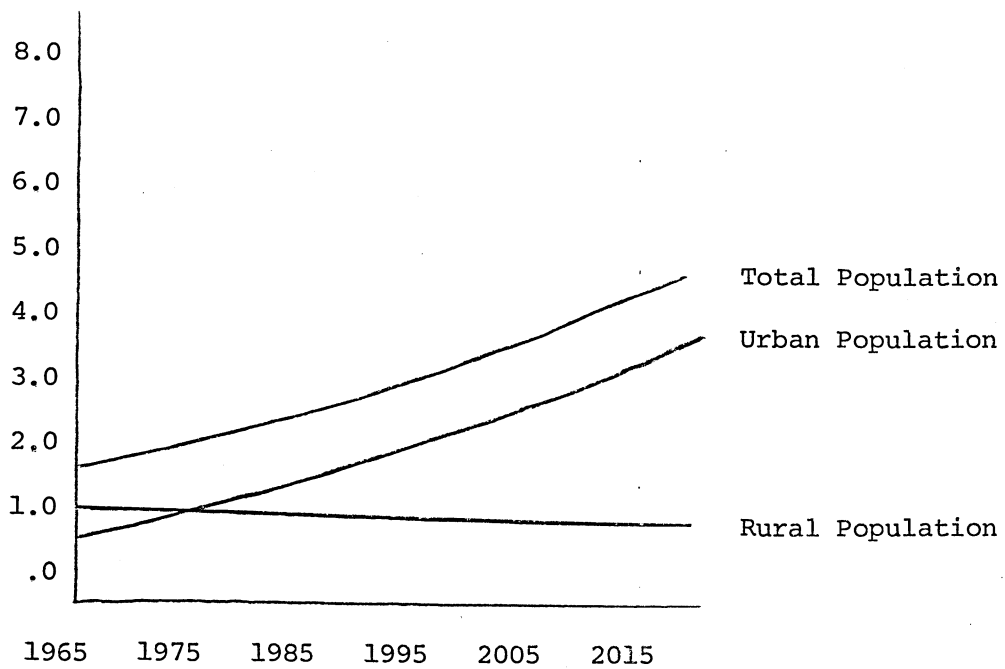


Table 3. A Comparison of Rural-Urban Population Growth Rates¹
Under Different Fertility Assumptions

		1965-1990	1990-2015	1965-2015
<i>Total Population:</i>	Slowly Declining Fertility	2.5	2.9	2.7
	Rapidly Declining Fertility	1.9	1.7	1.8
<i>Urban Population:</i>	Slowly Declining Fertility	4.6	3.9	4.3
	Rapidly Declining Fertility	4.0	2.8	3.4
<i>Rural Population:</i>	Slowly Declining Fertility	0.6	0.4	0.5
	Rapidly Declining Fertility	0.1 ²	0.8 ²	0.4 ²

¹ Average annual percentage rates

² Rate of decline

Table 4. A Comparison of Rates of Growth¹ of Rural-Urban Migration Under Different Fertility Assumptions

	1965-1990	1990-2015	1965-2015
Slowly Declining Fertility	1.7	1.1	1.4
Rapidly Declining Fertility	1.0	0.0	0.5

¹ Average annual percentage rates.

Table 5. Implications of the Rate of Fertility Decline upon the Population's Age Structure

	Year	Total Population ('000)	Ratio to Total Population					
			Age			Age		
			0 to 14	15 to 64	Over 64	0 to 14	15 to 64	Over 64
<i>PROJECTION 1</i>								
Rapid Population Growth -								
Slowly Declining Fertility								
	1965	1765.2	811.0	875.7	78.5	0.459	0.496	0.044
	1970	1919.0	894.0	935.3	89.7	0.466	0.487	0.047
	1975	2139.2	978.3	1052.6	108.4	0.457	0.492	0.051
	1980	2447.3	1115.0	1206.9	125.3	0.456	0.493	0.051
	1985	2822.3	1292.2	1397.5	132.6	0.458	0.495	0.047
	1990	3262.2	1501.6	1626.4	134.2	0.460	0.499	0.041
	1995	3767.5	1716.0	1923.6	128.0	0.455	0.511	0.034
	2000	4366.1	1934.9	2289.8	121.4	0.445	0.527	0.028
	2005	5008.8	2173.1	2714.3	121.4	0.434	0.542	0.024
	2010	5762.1	2440.4	3181.1	140.6	0.424	0.552	0.024
	2015	6605.9	2734.0	3690.9	181.0	0.414	0.559	0.027
<i>PROJECTION 2</i>								
Slow Population Growth -								
Rapidly Declining Fertility								
	1965	1765.2	811.0	875.7	78.5	0.459	0.496	0.044
	1970	1908.0	883.0	935.3	89.7	0.463	0.490	0.047
	1975	2090.8	929.8	1052.6	108.4	0.445	0.503	0.052
	1980	2323.2	991.0	1206.9	125.3	0.427	0.519	0.054
	1985	2569.6	1050.3	1386.7	132.6	0.409	0.540	0.052
	1990	2810.1	1097.3	1578.6	134.2	0.390	0.562	0.048
	1995	3057.6	1128.6	1801.0	128.0	0.369	0.589	0.042
	2000	3337.4	1175.9	2040.1	121.4	0.352	0.611	0.036
	2005	3643.2	1254.1	2267.8	121.4	0.344	0.622	0.033
	2010	3965.9	1345.3	2480.0	140.6	0.339	0.625	0.035
	2015	4299.6	1423.0	2695.5	181.0	0.331	0.627	0.042

Demographic Implications for Rural Social Services: Education, Health and Housing

The quantification of demographic trends, such as population growth, age structure and migration projections calculated above, can be useful in planning for social service requirements and costs for either the country as a whole, or for the rural and urban sectors separately.

The Rural Education Sector

The impact of fertility on the rate of population growth and the age structure affects the school-age population. In rural Jamaica, the general ages at which children attend primary school are between 6 to 12 years; in junior secondary children are between 13 and 15 years; and in senior secondary children are between 16 to 18 years old. Table 6 illustrates the effect of alternative population projections upon the size of these school-age populations. Under conditions of rapidly declining fertility of Projection 2, there is a significant reduction in all three rural school-age groups.

In 1965, it was estimated that for the country as a whole, the enrollment rate was 83 per cent for the primary school-age group, 76 per cent for the secondary junior, and 9 per cent for secondary senior. It was estimated that by the end of the projection period the enrollment rates in primary and secondary junior will be 95 per cent and in secondary senior the rate will be 40 per cent. Table 6 shows the impact of the increasing enrollment assumption. It should be noted that for Projection 1 enrollment increases are significantly larger than the increases in school-age population for all groups. In Projection 2, enrollment levels decline but not as much as the school-age population.

To determine the required educational expenditures for each educational level, the numbers of students enrolled in each level were multiplied by cash expenditures per student. Cash expenditures per student were calculated under the following assumptions:

- Primary: (i) 6 per cent of all educational facilities are replaced annually;
(ii) unit investment cost per student is \$42 for the entire projection period; and
(iii) unit operating cost per student is \$9 for the entire projection period.
- Secondary junior: (i) 4 per cent of all educational facilities is replaced annually;
(ii) unit investment cost per student is \$200 for the entire projection period; and
(iii) unit operating cost per student is \$30 per student.
- Secondary senior: (i) 4 per cent of all educational facilities is replaced annually;
(ii) unit investment cost per student is \$400 for the entire projection period; and
(iii) unit operating cost is \$40 per student.

Given the number of students enrolled at each educational level (Table 6), total educational requirements were calculated (Table 7) and

Table 6. The Impact of Demographic Trends upon School-Age Population and School Enrollments

	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	('000) Ratio of Terminal Year to Base Year
<i>PROJECTION 1</i>												
Slowly Declining Fertility - Rapid Population Growth:												
Primary school-age population	230.1	232.3	230.9	235.4	246.5	261.7	269.6	270.5	268.4	266.0	263.6	1.14
Secondary junior school-age population	76.9	84.5	86.6	87.1	87.8	92.1	97.7	100.5	100.5	99.6	98.8	1.28
Secondary senior school-age population	66.4	71.0	80.6	79.3	80.9	81.3	86.9	91.1	92.4	91.8	91.0	1.37
Primary enrollment	191.2	198.3	202.4	212.0	228.0	244.2	253.9	257.0	255.0	252.7	250.4	1.31
Secondary junior enrollment	58.4	67.4	72.6	76.7	81.2	86.0	92.0	95.4	95.5	94.6	93.9	1.61
Secondary senior enrollment	6.3	7.6	9.6	10.6	12.1	16.9	25.1	36.4	37.0	36.7	36.4	5.78
<i>PROJECTION 2</i>												
Rapidly Declining Fertility - Slow Population Growth:												
Primary school-age population	230.1	232.6	226.8	217.9	209.8	202.5	184.6	165.9	157.2	150.7	140.8	0.61
Secondary junior school-age population	76.9	84.5	86.9	85.8	81.2	78.2	75.5	68.1	60.7	57.8	55.4	0.72
Secondary senior school-age population	66.4	71.0	80.5	79.4	78.1	72.5	70.9	67.0	58.9	53.5	52.1	0.78
Primary enrollment	191.2	198.5	198.9	196.2	194.0	189.0	173.9	157.6	149.3	143.1	133.8	0.70
Secondary junior enrollment	58.4	67.4	72.8	75.5	75.1	73.0	71.1	64.7	57.7	54.9	52.7	0.90
Secondary senior enrollment	6.3	7.6	9.6	10.6	11.7	15.1	20.5	26.8	23.6	21.4	20.8	3.30

Table 7. Rural Educational Requirements and Costs¹

	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	Total for 50-Year Period
<i>PROJECTION 1</i>											
<i>Primary</i>											
Total education costs	11.5	11.7	12.4	13.4	14.3	14.7	15.0	14.8	14.5	14.4	136.7
Number of new units required*	65.3	64.1	71.4	81.5	86.5	84.1	79.7	74.8	74.0	73.2	754.6
Total investment costs	2.7	2.7	3.0	3.4	3.6	3.5	3.5	3.3	3.1	3.1	31.9
Total operating costs	8.8	9.0	9.4	10.0	10.7	11.2	11.5	11.5	11.4	11.3	104.8
<i>Secondary Junior</i>											
Total education costs	13.8	13.4	15.3	16.0	16.8	18.1	18.5	18.1	17.8	17.7	165.5
Number of new units required*	21.4	19.0	18.9	20.1	21.3	23.7	22.1	19.2	18.5	18.1	202.3
Total investment costs	4.3	2.8	3.8	4.1	4.2	4.7	4.4	3.8	3.6	3.6	39.3
Total operating costs	9.5	10.6	11.5	11.9	12.6	13.4	14.1	14.3	14.2	14.1	126.2
<i>Secondary Senior</i>											
Total education costs	2.4	3.2	3.2	3.8	6.0	9.1	13.2	10.4	10.3	10.1	71.7
Number of new units required*	2.6	3.7	3.0	3.8	7.6	12.1	17.2	7.8	7.2	7.0	72.0
Total investment costs	1.0	1.5	1.2	1.5	3.0	4.8	6.9	3.1	2.9	2.8	28.7
Total operating costs	1.4	1.7	2.0	2.3	3.0	4.3	6.3	7.3	7.4	7.3	43.0
<i>PROJECTION 2</i>											
<i>Primary</i>											
Total education costs	11.5	11.4	11.3	11.2	10.8	9.8	8.8	8.5	8.1	7.6	99.0
Number of new units required*	65.4	59.9	56.7	56.4	52.6	39.7	33.9	38.0	37.9	32.4	472.9
Total investment costs	2.7	2.5	2.4	2.4	2.2	1.7	1.4	1.6	1.6	1.4	19.9
Total operating costs	8.8	8.9	8.9	8.8	8.6	8.1	7.4	6.9	6.5	6.2	79.1
<i>Secondary Junior</i>											
Total education costs	13.7	14.5	14.7	14.2	13.6	13.3	11.6	10.1	10.1	9.7	125.5
Number of new units required*	21.4	19.3	17.5	14.7	12.7	12.5	7.3	5.4	8.5	8.6	127.9
Total investment costs	4.2	3.9	3.5	2.9	2.5	2.5	1.5	1.0	1.7	1.7	25.4
Total operating costs	9.5	10.6	11.2	11.3	11.1	10.8	10.1	9.1	8.4	8.0	100.1
<i>Secondary Senior</i>											
Total education costs	2.4	3.2	3.2	3.5	5.1	7.1	9.2	5.7	5.3	5.7	50.4
Number of new units required*	2.6	3.7	3.0	3.3	6.0	8.8	10.9	1.8	2.4	3.7	46.2
Total investment costs	1.0	1.5	1.2	1.3	2.4	3.5	4.4	0.7	0.9	1.5	18.4
Total operating costs	1.4	1.7	2.0	2.2	2.7	3.6	4.8	5.0	4.4	4.2	32.0

Notes: ¹ In millions 1967 Jamaican \$; values applicable to five-year interval ending in year specified.

* Thousands

Table 8. Impact of Fertility Assumptions on Rural Educational Cost Requirements

(1967 J\$m.)

Year	PROJECTION 1			PROJECTION 2		
	Slowly Declining Fertility			Rapidly Declining Fertility		
	Investment Costs	Operating Costs	Total Costs	Investment Costs	Operating Costs	Total Costs
	(1)	(2)	(3)	(4)	(5)	(6)
1970	8.0	19.8	27.8	8.1	19.8	27.9
1975	8.0	21.4	29.4	7.9	21.3	29.2
1980	8.0	22.6	30.6	7.1	22.1	29.2
1985	9.0	24.2	33.2	6.6	22.3	28.9
1990	10.9	26.3	37.2	7.1	22.4	29.5
1995	13.1	29.0	42.1	7.7	22.5	30.2
2000	14.7	31.9	46.6	7.2	22.3	29.5
2005	10.1	33.2	43.3	3.4	20.9	24.3
2010	9.6	33.0	42.6	4.2	19.4	23.6
2015	9.5	32.7	42.2	4.5	18.4	22.9
Total Costs			375.0			275.2

indicate that in the terminal year of the projection period under conditions of rapidly declining fertility the number of units required and the educational cost components are between 40 and 60 per cent of what they would be for slowly declining fertility.

The total cost differential for the 50-year period between the slowly and rapidly declining fertility rates (Table 8) is over Jamaican \$100m. Thus a rise in fertility rates would appear to result in considerable savings in rural educational requirements.

The Rural Health Sector

Demographic trends also have implications for health service requirements in rural Jamaica. The rural population was weighted into *equivalent health consumers* to account for the varying health service requirements of different age/sex groups in the rural population.

Two kinds of health service were essentially dealt with, one was hospital beds and the other, out-patients unit. It was assumed that the 1965 service ratio of 2.85 hospital beds per 1,000 user population would increase slowly to 4.2 by 2015. This implies that hospital bed

Table 9. Rural Health Service Requirements and Costs¹

('000)

	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015
<i>PROJECTION 1</i>											
Rapid Population Growth:											
Equivalent health consumers	1129.7	1108.9	1122.4	1156.9	1192.8	1221.8	1249.0	1279.1	1310.4	1341.1	1365.8
Hospital beds	3.22	3.88	4.30	4.86	5.01	5.13	5.25	5.37	5.50	5.63	5.74
Out-patient service units	0.76	0.74	0.75	0.78	0.80	0.82	0.84	0.86	0.88	0.90	0.92
Health programme investment costs		19.63	17.78	23.88	15.81	15.44	15.55	16.14	16.58	16.83	16.52
Health programme operating costs		55.58	70.37	87.34	97.07	99.69	101.99	104.37	106.91	109.46	111.70
Total programme costs (including overhead)		75.20	88.15	111.22	112.88	115.12	117.54	120.51	123.49	126.29	128.21
<i>PROJECTION 2</i>											
Slow Population Growth:											
Equivalent health consumers	1129.7	1099.0	1087.3	1084.2	1069.7	1035.6	1006.1	992.0	977.0	958.6	934.8
Hospital beds	3.22	3.85	4.17	4.55	4.49	4.35	4.23	4.17	4.10	4.03	3.93
Out-patient service units	0.76	0.74	0.73	0.73	0.72	0.69	0.67	0.66	0.65	0.64	0.63
Health programme investment costs		18.92	15.47	19.36	9.64	7.39	7.53	8.88	8.64	8.12	7.34
Health programme operating costs		55.27	68.77	82.90	88.60	86.43	83.85	82.18	80.98	79.58	77.79
Total programme costs (including overhead)		74.19	84.24	102.29	98.24	93.81	91.38	91.06	89.62	87.69	85.13

Note: ¹ In thousands of Jamaican \$; costs applicable to five-year interval ending in year specified.

requirements for rural Jamaica would increase from 3,220 in 1965 to a total by 2015 of 5,740 for Projection 1 and 3,930 for Projection 2. Unit operating costs were assumed to increase from J\$2.58 thousand in 1965 to J\$3.5 thousand in 2015. The result, significantly different between Projection 1 and Projection 2, are displayed in Table 9. Similar calculations were made for rural outpatient service units.

The total costs for meeting the demands of the population for Projection 1 was \$75.2m. in 1970 and \$128m. in 2015. Under Projection 2, the increase was less - from \$74m. to \$85m. So again, slower population growth and higher fertility decline imply a substantial reduction in the requirement for hospital and health needs.

Rural Public Housing Requirements

To illustrate the impact of demographic trends upon rural public housing requirements, the following assumptions were made:

- (i) the proportion of the rural Jamaican population requiring public housing is about 14 per cent; and
- (ii) the desired average number of persons per public housing unit is four per 1,000 user population.

Projection 1, the total number of housing units required to shelter 14 percent of the rural population grows from about 41,000 in 1965 to 52,000 in 2015. In Projection 2, the total housing units required decreases from 41,000 in 1965 to 34,000 in 2015.

Projections are also made in Table 11 of the new housing units and the investment costs required to meet:

- (a) the current housing deficit;
- (b) to shelter additional population resulting from growth; and
- (c) to replace old dwellings.

The housing deficit in 1965 is assumed to be 41,000 dwelling unit, which will be constructed at an annual rate of 820 units over the projection period. An annual depreciation rate of 2 per cent is used to calculate the additional units required to replace old dwellings. Because rural population is decreasing in Projection 2, additional housing units required to shelter additions to the user population is negative. To calculate total investment costs, a unit investment cost of \$1,000 was used. In Projection 1, total investments costs over the 50-year period sum to J\$98.87m., whereas in Projection 2, they sum to only J\$73.40m. or about 26 per cent less.

Demographic Implications for Rural Economic Development

The potential implications of demographic trends of various aspects of rural development were considered: its impact upon rural density, food requirements, agricultural public expenditure requirements, savings, employment opportunities, income distribution, and per capita income.

Food Requirements

The low level of per capita food consumption and its concomitant effect on population health standards, which in turn influences the quality of the labour force and the educational achievement of the school-age population, is a cause of much concern in many developing countries. In

Table 10. Implications of Demographic Trends Upon Total Rural Housing Units Required

	('000)										
	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015
<i>PROJECTION 1</i>											
<u>Rapid Population Growth -</u> Slowly Declining Fertility:											
Rural population requiring public housing	163.81	162.90	167.07	174.41	182.11	189.21	195.17	200.00	203.90	206.91	208.94
Total number of rural dwelling units	40.95	40.72	41.77	43.60	45.53	47.30	48.79	50.00	50.98	51.73	52.24
<i>PROJECTION 2</i>											
<u>Slow Population Growth -</u> Rapidly Declining Fertility:											
Rural population requiring public housing	163.81	161.96	163.28	165.56	165.80	162.99	158.39	153.58	148.31	142.41	135.99
Total number of rural dwelling units	40.95	40.49	40.82	41.39	41.45	40.75	39.60	38.40	37.08	35.60	34.00

Table 11. New Housing Units Required

	('000)									
	1965- 1970	1970- 1975	1975- 1980	1980- 1985	1985- 1990	1990- 1995	1995- 2000	2000- 2005	2005- 2010	2010- 2015
<i>PROJECTION 1</i>										
<u>Rapid Population Growth</u>										
Additions to meet current housing deficit	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10
Additions to meet population growth	-0.23	1.04	1.83	1.92	1.78	1.49	1.21	0.98	0.75	0.51
Additions to meet replacement of old dwellings	4.09	4.11	4.25	4.44	4.62	4.79	4.93	5.04	5.13	5.19
Total new housing units	7.96	9.26	10.18	10.46	10.50	10.38	10.24	10.11	9.98	9.80
Total investment costs ¹	7.96	9.26	10.18	10.46	10.50	10.38	10.24	10.11	0.08	9.80
<i>PROJECTION 2</i>										
<u>Slow Population Growth</u>										
Additions to meet current housing deficit	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10
Additions to meet population growth	-0.46	0.33	0.57	0.06	-0.70	-1.15	-1.20	-1.32	-1.47	-1.61
Additions to meet replacement of old dwellings	4.08	4.06	4.10	4.14	4.12	4.03	3.91	3.79	3.65	3.50
Total new housing units	7.71	8.49	8.77	8.30	7.51	6.98	6.81	6.57	6.27	5.99
Total investment costs ¹	7.71	8.49	8.77	8.30	7.51	6.98	6.81	6.57	6.27	5.99

Note: ¹In millions of 1967 J\$.

addition, increases in domestic food requirements invariably necessitate increased investment expenditures. Further compounding the food problem is the size of the food import bill and the foreign exchange requirements necessary to support these imports. Since foreign exchange must also be used for capital imports, increases in the food import bill may severely infringe upon the rate of capital formation. For these reasons, the impact of population growth through increasing the requirements for food may constrain the rate of development in developing countries.

To project food requirements for rural Jamaica, the rural population was weighted to reflect food consumption differences by age groups. To capture the impact of population growth on food requirements it was assumed that the daily intake per *equivalent adult consumer* was 2280 calories (Table 12). Total rural population daily requirements for high population growth Projection 1 increased 31 per cent over the projection period from 2.6 to 3.4 billion calories. For slow population Projection 2, requirements increased to 2.6 billion in 1990 and then declined to 2.2 billion by 2015. Hence, the slow rate of population growth in Projection 2, resulted in a reduction of total calorie requirements of approximately 33 per cent over Projection 1.

Rural Density

The impact of rural population growth on the demand for rural land can be gauged by density within the sector. In rural Jamaica, under conditions of the rapid growing population Projection 1, the number of people per acre of agricultural land increases from 0.94 in 1965 to 1.20 in year 2015 (Table 13, Figure 3). For the slow population growth Projection 2, the decrease in rural density is from 0.94 in 1965 to 0.78 in year 2015. The percentage increase in density over the entire projection period in Projection 1 is approximately 28 per cent, and in Projection 2 approximately 17 per cent. For the entire projection period this represents a 45 per cent difference between Projections 1 and 2.

For rapid population Projection 1, density with respect to the rural labour force increases steadily over the projection period, from 0.34 to 0.54 (Table 13, Figure 3) while under conditions of rapid declining fertility and slow population growth Projection 2, it increases to 0.43 in 2005 and then decreases to 0.40 in 2015.

While these magnitudes may be subject to some error, the results would seem to indicate that a substantial difference in rural densities exist between Projections 1 and 2, both with respect to the rural population as a whole and the rural labour force, resulting in a lower density for the slow population growth Projection 2.

Employment Opportunities

The rate of rural population growth has a long-term effect upon the growth of the rural labour force. In Projection 1 (Table 14) the size of Jamaica's rural labour force increases from 412,600 in 1965 to 646,500 in 2015. In Projection 2 the increase is less rapid in the late 1980's, reaching only 482,000 by 2015. In both Projections 1 and 2 the average annual rate of growth of the rural labour force was about 0.7 per cent between 1965 and 1980. However, from 1980 to 2015, the rate of increase is 1 per cent for Projection 1 and 0.2 per cent for Projection 2. The lagged impact is due to the fact that a fertility decline only begins to influence the size of the work-age population after about 15 years.

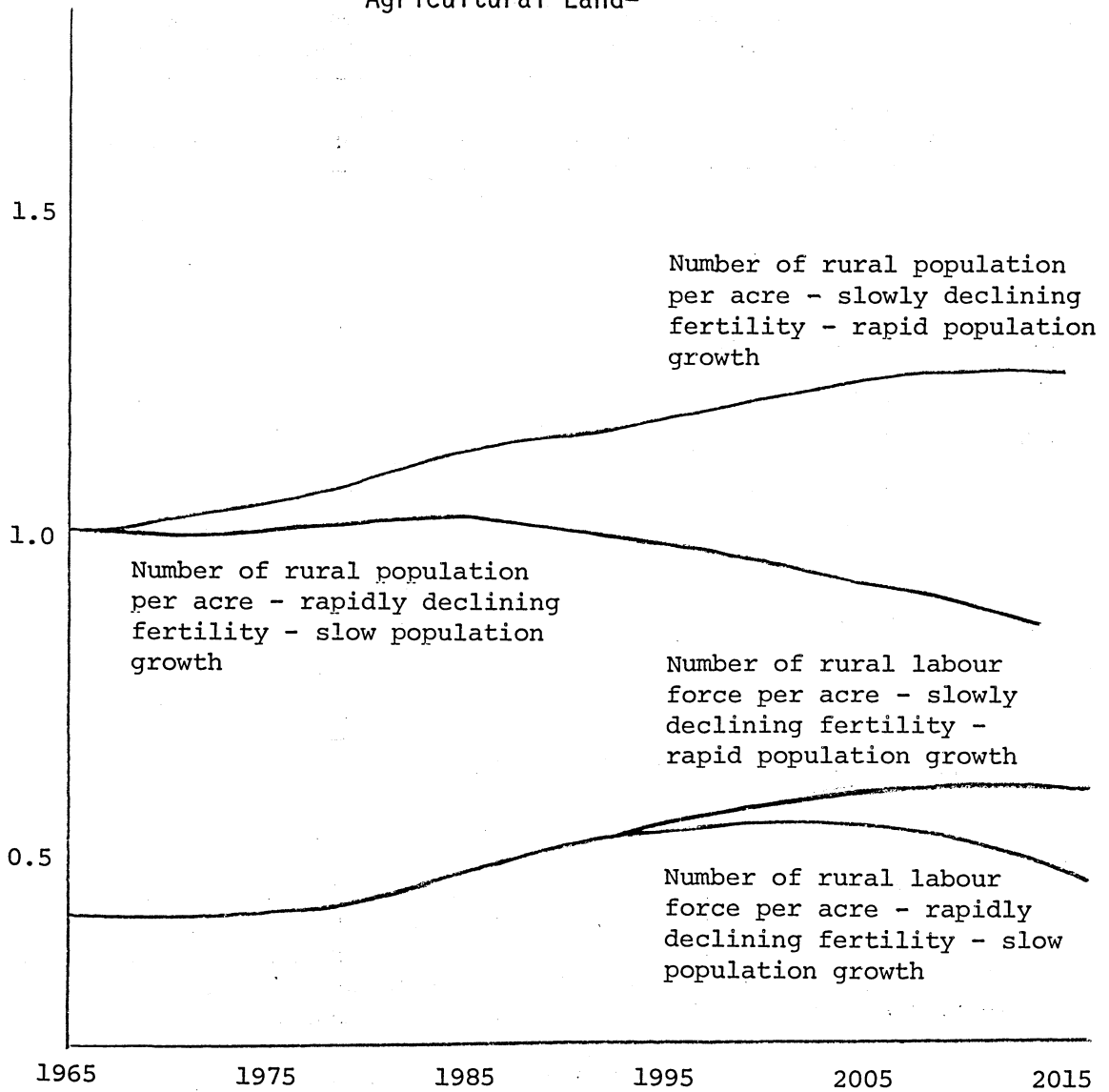
Table 12. Rural Daily Food Consumption Requirements¹

Year	Rural Economic Consumer Population ² (thousands)		Total Daily Calorie Requirements (billions)	
	Projection 1 - Slow Fertility Decline - Rapid Population Growth	Projection 2 - Rapid Fertility Decline - Slow Population Growth	Projection 1	Projection 2
1965	1129.7	1129.7	2.576	2.576
1970	1126.1	1114.3	2.567	2.541
1975	1148.7	1126.1	2.619	2.567
1980	1199.4	1146.4	2.735	2.614
1985	1254.6	1155.5	2.860	2.634
1990	1307.1	1144.4	2.980	2.609
1995	1355.7	1122.5	3.090	2.559
2000	1398.2	1097.0	3.188	2.501
2005	1433.6	1063.5	3.269	2.425
2010	1504.4	1021.6	3.430	2.329
2015	1474.3	974.1	3.361	2.221

Notes: ¹ Based on 2280 calories per person per day.

² Projected population weighted by differential age group consumption.

Figure 3. Rural Labour Force and Total Rural Population Per Acre of Agricultural Land¹



Note: ¹ Based on 1.2 million acres of agricultural land.

Table 13. Rural Labour Force and Total Rural Population Per Acre of Arable Land*

Year	PROJECTION 1		PROJECTION 2	
	Rapid Population Growth Number of People Per Acre		Slow Population Growth Number of People Per Acre	
	Rural Labour Force	Rural Population	Rural Labour Force	Rural Population
1965	0.34	0.94	0.34	0.94
1970	0.34	0.94	0.34	0.93
1975	0.36	0.96	0.36	0.94
1980	0.38	1.00	0.38	0.95
1985	0.40	1.05	0.40	0.95
1990	0.42	1.09	0.41	0.94
1995	0.45	1.12	0.42	0.91
2000	0.47	1.15	0.43	0.88
2005	0.50	1.17	0.43	0.85
2010	0.52	1.23	0.41	0.82
2015	0.54	1.20	0.40	0.78

*Based on 1.2m. acres of agricultural land.

Under the demographic projections, which reflect rapid urbanization, the urban labour force increases rapidly from 232,100 in 1965 to 2,317,400 in 2015 in Projection 1, and to 1,727,700 in Projection 2, a difference of 589,700. The annual rate of growth for the urban labour force is 4.7 per cent in Projection 1 and 4.1 per cent in Projection 2.

In summary, in the rapid population growth Projection 1, rural labour force grows at an average annual rate of 0.9 per cent, while the urban labour force grows at 4.7 per cent over the projection period. In the slow population growth Projection 2, the rural labour force grows over the projection period at an average annual rate of about 0.3 per cent while the urban labour force grows at an annual rate of 4.1 per cent. Thus, demographic trends have important implications for the magnitude of job creation requirements needed to provide the labour force with adequate employment opportunities.

Rural Incomes

Table 15 summarizes the impact of population growth projections on rural per capita incomes. Estimated levels of rural income over the projected period was derived by assuming a 4 per cent annual growth rate

Table 14. The Impact of Demographic Trends on Size of the Labour Force Projections, 1965-2015

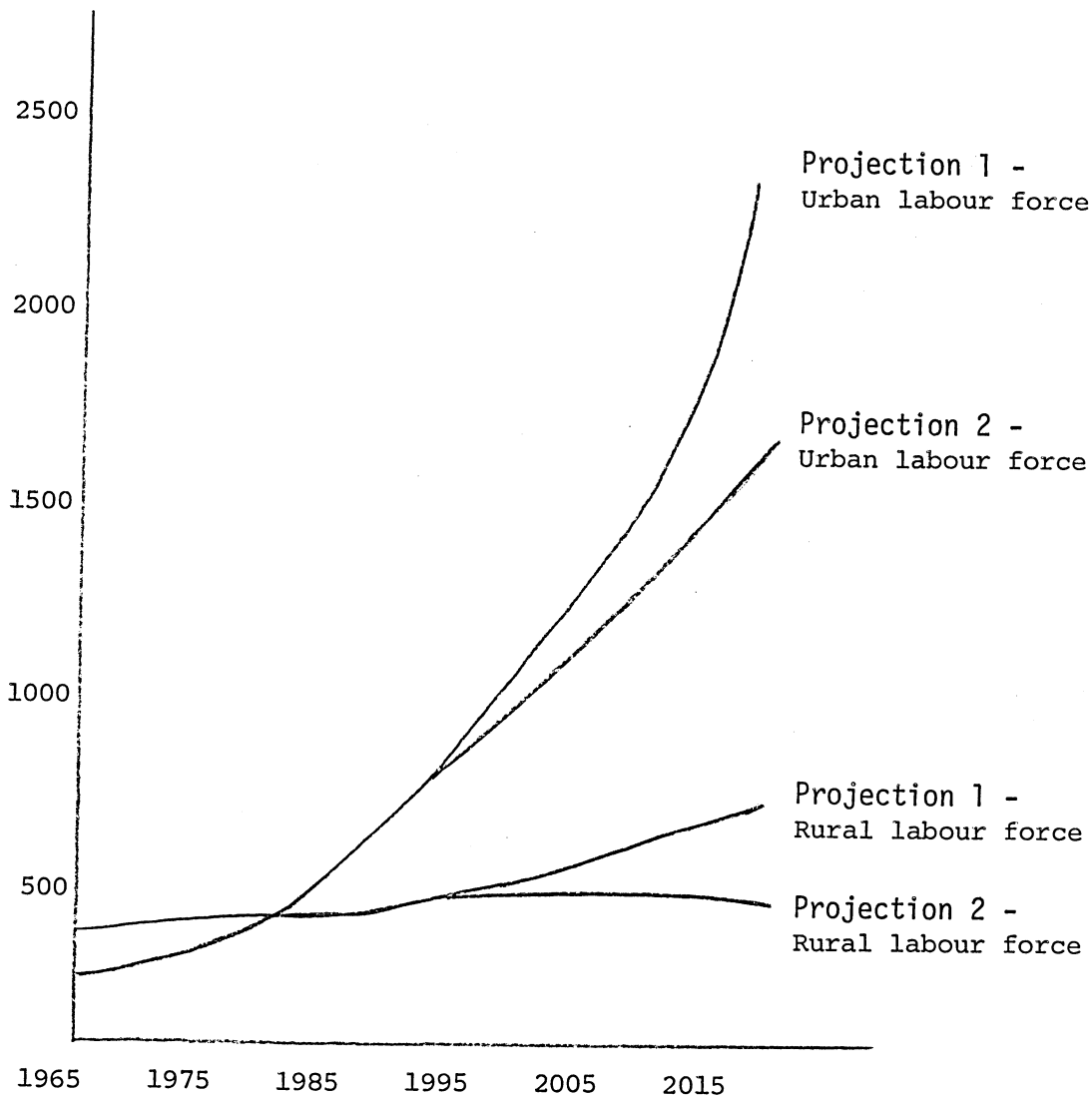
	('000)			
	Total Labour Supply	Rural Labour Supply	Urban Labour Supply	Year
<i>PROJECTION 1 -</i>				
Rapid Population Growth - Slowly Declining Fertility	644.7	412.6	232.1	1965
	701.7	410.8	290.9	1970
	798.9	430.3	368.6	1975
	929.6	456.9	472.7	1980
	1,084.1	482.4	601.7	1985
	1,269.7	507.9	761.8	1990
	1,502.5	536.8	965.7	1995
	1,791.0	568.4	1,222.6	2000
	2,133.8	599.1	1,534.7	2005
	2,525.4	625.4	1,900.0	2010
	2,963.9	646.5	2,317.4	2015
<i>PROJECTION 2 -</i>				
Slow Population Growth - Rapidly Declining Fertility	644.7	412.6	232.1	1965
	701.7	410.8	290.9	1970
	798.9	430.3	368.6	1975
	929.5	456.8	472.6	1980
	1,077.7	479.6	598.1	1985
	1,240.2	496.1	744.1	1990
	1,422.8	508.3	914.5	1995
	1,622.5	514.9	1,107.5	2000
	1,823.7	512.0	1,311.7	2005
	2,016.5	499.4	1,517.1	2010
	2,209.7	482.0	1,727.7	2015

of agricultural production.¹ Over the period 1965-2015 rural per capita income increases by over 450 per cent and 750 per cent in rapid population Projection 1, and slow population Projection 2, respectively. This represents an average annual growth of 4.4 per cent for Projection 1 as compared to 3.5 per cent of Projection 2. This represents 54 per cent per capita income differential in the terminal year of the projection period (i.e., J\$442 compared to J\$289). In spite of the potential increases in rural incomes resulting from a slower rate of population growth and the assumption relating to growth in agricultural output, per capita rural income will still remain substantially below the national average.²

¹ It is assumed that rural incomes are wholly derived from agriculture and all agricultural income goes to the rural sector.

² The ratio of rural per capita income to national per capita G.D.P. was calculated under the assumption that G.D.P. will flow at an annual average rate of 7 per cent between 1970 and 2015. The gap was estimated to be 75 and 80.

Figure 4. Impact of Demographic Trends Upon Labour Force



Public Sector Expenditures in Agriculture

In Jamaica, capital expenditure on agricultural infrastructure is of crucial importance. A high population growth rate and high dependency ratio tend to adversely affect savings and investment, through the impact on household consumption and the reduction in the female labour force. The level of savings for the economy as a whole, which tends to be relatively low, combined with the difficulty of attracting foreign investment to the agricultural sector tends to place the burden of capital formation on government.

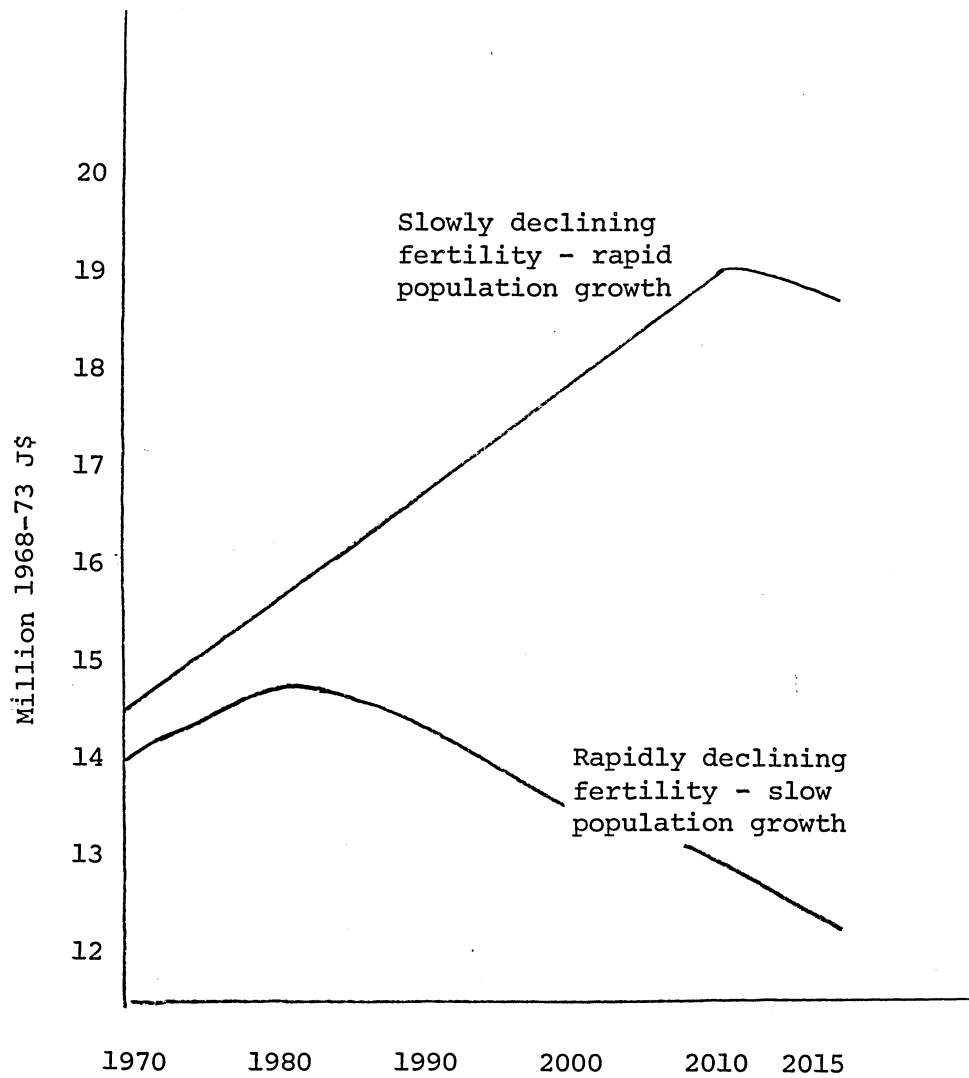
Investment requirements necessary to maintain rural public agricultural expenditure at its 1968-1970 level of \$12.9 per person in the rural population was calculated for both rapid and slow population growth projections (Table 16, Figure 9). For rapid population growth Projection 1, public expenditure requirements increase from J\$14.54m. in 1970 to J\$18.65m. 2015, whereas for slow population growth Projection

Table 15. Rural Per Capita Agricultural Production for Different Fertility Assumptions

Year	Rural Population (thousands)		Agricultural Production ¹ (1960 J\$m.)	Rural Per Capita Agricultural Production (1960 J\$)	
	Rapid Population Growth Slow Fertility Decline	Slow Population Growth Rapid Fertility Decline		Slow Fertility Decline	Rapid Fertility Decline
1965	1,129.7	1,129.7	58.4	51.7	51.7
1970	1,123.4	1,117.0	71.0	63.2	63.6
1975	1,152.2	1,126.1	86.4	75.0	76.7
1980	1,202.8	1,141.8	105.1	87.4	92.0
1985	1,255.9	1,143.4	127.9	101.8	111.8
1990	1,304.9	1,124.1	155.6	119.2	138.4
1995	1,346.0	1,092.3	189.3	140.6	173.3
2000	1,379.3	1,059.2	230.3	166.9	217.4
2005	1,406.2	1,022.8	280.2	199.3	273.9
2010	1,427.0	982.2	340.9	238.9	347.1
2015	1,441.0	937.9	414.7	287.8	442.1

Note: ¹ Assuming a 4% growth rate.

Figure 5. Rural Per Capita Public Sector Agricultural Expenditure Requirements



2, requirements decrease from J\$14.54m. in 1970 to J\$12.41m. in 2015. In addition, total investment for the 45 year period, 1970-2015, which amounts to J\$169.33m. for rapid population growth, is substantially higher than that required for slow population growth of \$139.10m., a difference of over \$30m. or 43 per cent.

Table 16. Rural Per Capita Public Sector Agriculture¹ Capital Expenditures Requirements² Under Different Fertility and Population Growth Assumptions

(1968-70 J\$m.)

Year	Agricultural Capital Requirements	
	Slowly Declining Fertility Rapid Population Growth	Rapidly Declining Fertility Slow Population Growth
1970	14.54	14.46
1975	14.91	14.57
1980	15.57	14.79
1985	16.25	14.80
1990	16.89	14.54
1995	17.42	14.41
2000	17.85	13.71
2005	18.20	13.24
2010	19.05	12.71
1015	18.65	12.14
Total	169.33	139.10

¹Public sector agricultural investment includes capital expenditures on agricultural equipment, watershed protection, loans to various marketing boards, subsidies to farmers and research.

²Expenditures necessary to maintain rural per capita public sector investment at the 1968-70 level of \$12.9 per person in the rural population.

Conclusion

The illustrative application of LRPM2 to the rural sector in Jamaica, while only indicative of the general trends of the variables considered, would seem to justify the conclusion that rapid sector population growth can seriously affect development of the rural sector through its impact on food requirements, government agricultural and social service expenditure requirements, densities, employment possibilities and worsening rural-urban income differences. This implies that government should give serious consideration to policies directly affecting demographic variables such as fertility and internal and international migration.

In conclusion, in this paper we have attempted to present a framework in which the interaction between demographic, social and economic variables can be integrated and used for rural development planning.¹ The need for a systematic approach to rural sectoral planning cannot be over-emphasized since the key to economic progress of the less developed countries may well depend on what happens in the rural sector. If the rural sector is to become a *growing point* in the economic landscape of underdeveloped countries, concentrated efforts must be made to change the structure of the rural economy. Reducing the pressures of population would lessen this burden. The problem is that people cannot always wait for the long-term prospect of a reduction in fertility. *History teaches us that men do not always starve quietly.* (3)

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¹ While the impact of demographic variables is significant for rural development, other factors such as land reform, access to capital markets, extension services, marketing facilities and improved agricultural technology may be equally important in rural transformation. Treatment of these issues is left for another time.