POPULATION GROWTH IN SRI LANKA: A TREND PROJECTION ANALYSIS

S. Antony Norbert

S. Antony Norbert B. A. (Hons) Cey; M. Sc; M. Phil (Madras), is a Research Officer in the International Studies Division, Marga Institute.

This paper is about population growth in Sri Lanka. Population growth has been projected using five trend projection models, three exponential (direct, regression and modified) and two linear (direct and regression) models. The time period considered is that between 1871, the very first Census, and 2041. For the purposes of providing additional perspectives, a review of population projections on methods and studies have been attempted, including the use of the five models in this study. The trend models have been applied to population figures for the country as a whole, for the two broad agroclimatic divisions (wet and dry zones) and for the nine provinces separately. The application of the models has been accomplished using a specially developed computer software in BASIC language.

Population Projections: A Review

Population projection has been one of the most important contributions made in demography and related disciplines. Several international agencies have also been involved in such studies, the notable being the United Nations in the form of ESCAP country monograph series. Since 1947, the UN has contributed enormously as a pioneering and leading contributer to demographic estimates and projections. However, the member countries now tend to prepare their own estimates and, less often, projections. Methodological work under the UN auspices has led to some of the most important advances in demographic estimation methods and these constituted major contributions to demographic literature. In the early 1950s, the Population Division of the UN had prepared estimates of total population for the current dates for many countries which had no national sources for such estimates. These studies used 1950 as the base year and gave projections, by sex and by five-year age groups, for each country separately. An article published in 1951, in the first volume of the population bulletin of the United Nations, gave world population projections for the years 1950-1980. For the purpose of this study, the world was divided into three relatively homogeneous groups of countries as regards their demographic situation and prospects.

A similar study was presented in 1954 with projections for 1950-1980 to the World Population Conference. The approach of this study differed significantly from that of the earlier study. A more complex and innovative methodology was used in the 1957 projections for the period beyond 1980 to the year 2000. It was based on seven models of population growth, each representing a stage of transition in 1950. The projections also used the component method. By the mid-1960s, demand was already growing for more specialised types of demographic projections, particularly on urban/rural populations, labour force, school enrolment, and households and families. It was therefore necessary to collect available information on the methodologies, with a view to systematise the presentation for use by workers in specialised fields, particularly demographers dealing with deficient data. But by the time the 1968 revision was being made, computer facilities were made available and hence backward projections, starting from the base year 1965 and going back to 1950 were also prepared for each country.

In the 1970s, computer programs of software, which were until then the exclusive preserve of professional programmers, became available to demographers. The development of software for population projections meant easier computation and thus a greater number of variants came to be used for regional projections. Some of the software have now been designed and developed by the demographers themselves and hence they are very apt for application in population projections. Interestingly, geographers have also designed and developed such programs. The computer programmes written in BASIC for the five projection models have been extensively used on the study on the health care system of Thanjavur district in Tamil Nadu (Kumaran T. V. 1986) and the results have been as far as the study goes salutary. The same package has been used in the population analysis with respect of family welfare planning in the country and the State of Tamil Nadu and at least two studies have benefitted with the use of these models in population projection. But these studies have dealt extensively only with the economics of family welfare planning (Rajaram, 1987 and Madhuram, 1987).

The projections have been attempted in these studies with variants of linear models and three variants of exponential models. The linear models are linear direct and linear regression. It has been found that the two models are only moderately successful as they assume population to grow in a linear fashion while it has been known that it grows exponentially. The exponential models have been found to provide reasonable projections for the years for which population figures are reliably available. However, in these applications, the direct, regression and modified exponential models have been found to give reasonable estimate but not always in all contexts. Whereas direct model had proved to be effective in some cases, the other two have proved very reliable in most cases. Hence, the validity of these models applied to a country like Sri Lanka is beyond question.

Popolation Projections of Sri Lanka

Planners and policy makers are interested in knowing the future size and rate of growth of population for making realistic policies for economic and social development. Demographers who make population projections have often been criticised, since more often than not, their estimates have not turned out to be correct. Since the factors which determine the levels of fertility, mortality and migration have not been accurately assessed, the projections have not been correct. But this is to be expected in any attempt at projections for there are certain forces which operate with unknown strengths, intensity and consequenting the projections never turn out to be correct. This has happened in the case of projections for Sri Lanka, including the exercise for the years of known population. However, an approximation is seen only in certain methods.

A number of projections have been made for Sri Lanka's population from time to time. Two sets of projections for the period 1951-1976 were prepared by Sarkar (1957). The first of these is a mathematical exercise and the second the component projection. The United Nations (1958) prepared three projections for the period 1955-80 with medium, low and very low growth changes. The Department of Census and Statistics (1957) has made two projections, with high and low growth changes, for the period 1955-70. Selvaratnam (1959) prepared three projections for the period 1956-81 at the request of the Planning Secretariat of Sri Lanka and these were probably the first detailed projection to be used in development planning in the country. Though the projections have overestimated the total population, these have nevertheless been used in a substantial manner in policy making for the country. In 1970, Selvaratnam, Wright and Jones (1970) together prepared a set of three projections for the period 1968-98, merely as an academic exercise.

It was in 1974 that the Department of census and Statistics prepared a set of three projections covering 1971-2000 with high, medium and low growth changes and using the component method on the basis of three different fertility assumptions combined with a single assumption of future mortality trend. Srivatsava and Abeykoon (1974) have made four population projections in which international migration has been taken into consideration. The four different projections dealt with the demographic situation in Sri Lanka. On the other hand Frejka (1973) has computed five different population estimates for the period 1970-2150. The population projections in Sri Lanka have been mainly attempted in relation to planning and policy formulation. At least two purposes have been indicated in the documents available for perusal. The future estimates of population have been taken into consideration in setting various development targets and the size of the probable future population and its implications have led to formulation of policies for moderating the rate of population growth. The housing needs, health, social services and manpower have been and are being estimated on the basis of population increase seen through these projections. Thus population projection forms one of the basic items of data. The planning authorities in the country have fully realised the potential of the projections in terms of policy and planning for age specific population (health, education), urbanisation and investment in industries and other activities, most notably services.

Population Growth in Sri Lanka

The first census was enumerated in Sri Lanka in the year 1871 and according to this census there were 2.4 million people. The census in the following years came to be enumerated every ten years until 1931. However, after this enumeration was done in 1946, 1953 and 1963 but only to revert back to the old practice from the next census. So the successive censuses were conducted in 1971 and 1981. The reason for the break in the 1940s was the Second World War. The first census after independence was in 1953 and the second, ten years later in 1963. The trend of population growth since 1871 indicates that the population of Sri Lanka has been growing rapidly after 1946. Population rose from 2.4 million in 1871 to about 6.7 million in 1946 and in 1981 this more than doubled to become 14.85 million. The addition to the population during the period 1871-1946 was 4.2 million whereas during 1946-81 was of the order of 8.12 million. In the period between 1946 and 1963, the increase was 3.93 million. In the 80 years since 1901, the population increment has been to the tune of 11.28 million. The growth of population since 1871 has been very uneven and this trend can also be seen in the percentage of increase in population as well as in the average annual rates of growth. The rate of increase during 1881-91 was 8.98 per cent and during 1911-21 9.53 per cent and these were relatively small when compared to the rate of increase in the following periods, 25.44 per cent during 1931-46 and 30.67 during 1953-63.

Since the interval between the successive censuses has been different, the annual average rate of growth points to the nature of growth. On the basis of this indicator, we can see at least four basic growth periods: In the first phase of 1871-1901, the natural increase in population was high and the international migration was also relatively high: 1.3 per cent a year and 0.52 per cent respectively. The contribution in the growth of population by internal migration has been estimated to be of the order of 58 per cent. The second phase (1901-46) on the other hand showed still greater growth but the death rate has already shown particularly significant decline. The annual growth rate during the period amounted to 1.4 per cent, a slight increase over the first phase. However, it is in this period that natural increase became more dominant in determining the growth of population of Sri Lanka. As the birth rates began to soar, the death rate began to fall rapidly. The natural increase during this phase accounted for nearly 85 per cent of increase.

In the third phase (1946-71) the growth population in Sri Lanka was more rapid than ever before and the natural increase was 2.4 per cent. Interestingly, internal migration during this phase touched a low, even negative after 1953 and as such the natural increase became very dominant. In the fourth phase (1971-81) the growth rate fell further, to below 2 per cent, essentially as a result of fertility reduction. International migration however showed an upswing, mainly as a result of accelerated repatriation of Indian estate labour and the departure of a large number of Sri Lankans to West Asia and Africa for employment.

Growth of Population by Agroclimatic Zone

Although there are some microclimatic differences in the district regions, we have taken the traditional division of Sri Lanka into agroclimatic zones: the wet and the dry. The Wet zone consists of Colombo, Kalutara, Kandy, Nuwara-Eliya, Galle, Matara, Ratnapura, Kegalle and Gampaha districts while the Dry zone consists of Matale, Hambantota, Jaffna, Mannar, Vavuniya, Batticaloa, Trincomalee, Kurunegala, Puttalam, Anuradhapura, Amparai, Polonnaruwa, Badulla, Monaragala and Mullaitivu districts of Sri Lanka. In all, the dry zone has 15 districts and the wet zone 9 districts. On the contrary, the geographical area of the wet zone is 23 per cent of the total geographical area of the country and the rest is being that of the dry zone (Figure 1).

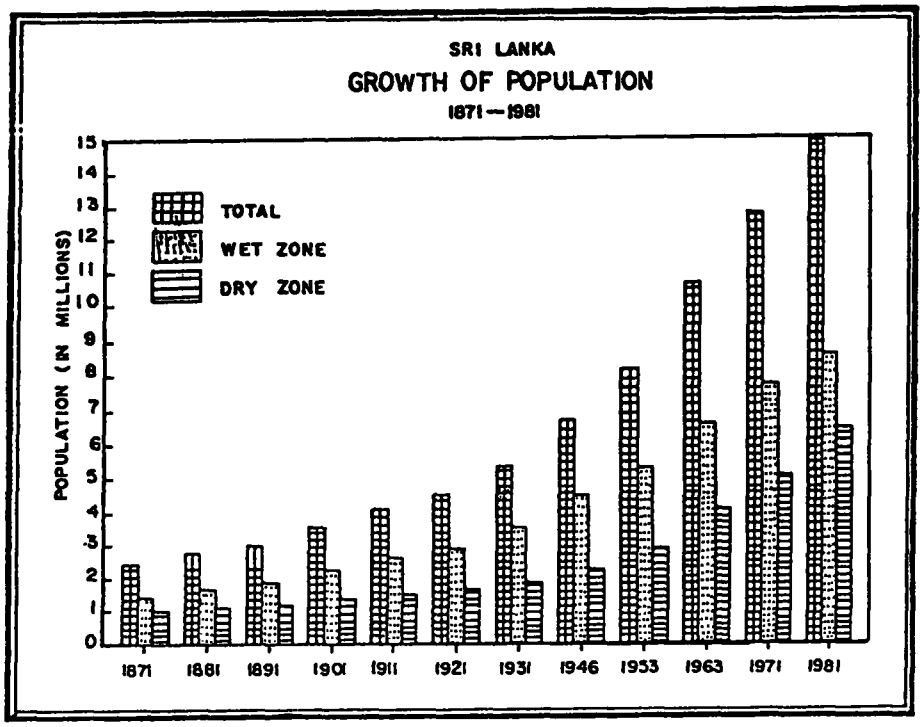

Figure 1

Today the wet zone accounts for 57.25 percent of the Sri Lankan population while the dry zone for 42.75 per cent. In the year 1871, the population of the wet zone was 58 per cent while the dry zone was 42 per cent of the total. It would therefore appear that the balance between the two zones has been intact. For instance, in 1946, the wet zone had 66.3 per cent and the dry zone 33.7 per cent. It is after 1946 that the dry zone began attracting people. As a result, the share of the population of the wet zone began declining, with 64.57 per cent in 1953, 60.5 per cent in 1971 and 57.25 in 1981. The comparable figures for the dry zone is: 35.43 per cent in 1953, 39.5 per cent in 1971 and 42.75 per cent in 1981 (Figure 2). The shape of the curves after 1946 indicate graphically the downsing of population percentage of the wet zone against the upswing of the same of the dry zone. The indications are that these opposite trends may intensify further and thus there would be further decline in the percentage of the population of the wet zone.

In actual numbers, the 1981 census indicates that the wet zone had a population of 8.5 million while the dry zone a total of 6.3 million. The increment over the period 1946-71 to the population has been of the order of 3.2 million for the wet zone and 2.8 million for the dry zone. The population being larger in the wet zone than the dry may be explained by the fact that this has traditionally been the administrative, educational, social and cultural focal point of the island. Also this area has been connected with the other parts of the country by transport lines. And most importantly, nearly 80 per cent of the industrial activities are found concentrated in this zone. The concentration of a sizeable population in this zone can be attributed mainly to these factors. But since independence, owing to efforts at improving agriculture in the dry zone and the overall improvement in production and also due to government sponsored colonisation of the dry zone, population in the dry zone began to increase.

During 1946-53, the wet zone districts with the exception of Colombo have shown decline in population and this decline has been exceptionally large in the case of the Matara and Kandy districts. On the other hand, the dry zone districts of Mannar, Batticaloa, Anuradhapura and Vavuniya gained greatly. The gain in Polonnaruva and Anuradhapura have shown greater nets from in and out migration: 28 persons per 1000 population. The inmigration rate for the district of Vavuniya for the period 1953-63 was 29.7 per 1000. In these years, the wet zone districts have shown only decline (Abeyasekara, 1986). In the years 1971-81, the outward movement of population from Colombo resulted in the enormous growth of suburban areas. The data indicate that during 1963-71 the population of the fringe areas increased by 96 per cent but that on the other hand, the increase in the population of Colombo amounted to 35 per cent only. The main reasons may be the growth of industries and the development of the free trade zone.

It was during 1946-63 that the agriculture of the dry zone improved both in area under cultivation and in levels of production. A sample of this growth is the 68 per cent

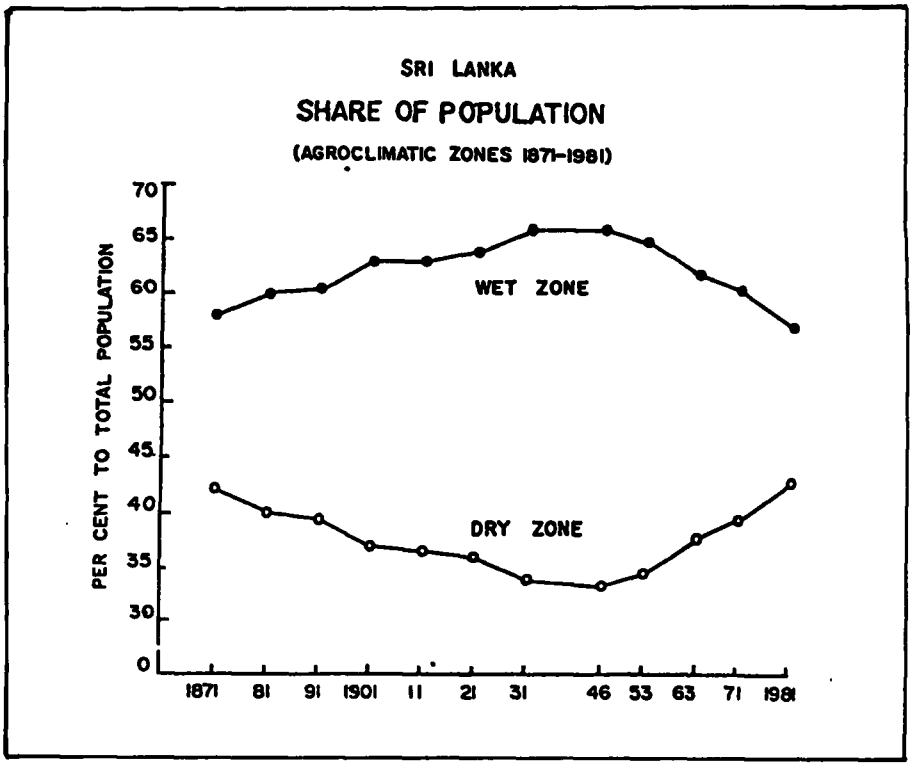

Figure 2

growth in the area under cultivation in Anuradhapura district and the 118 per cent growth of the same in Monaragala district (Gunawardena,1985). The major reason for the spectacular increase in population in the years since 1946 in the dry zone may also be attributed to the eradication of malaria, as a result of which deaths declined while fertility and immigration increased.

Population Growth in Sri Lanka by Provinces

During 1871-1981 the Western Province has registered a high growth of population. Even initially, in 1871 it had a high population of 575,721 persons (Figure 3). The population has grown to be 920,683 at the beginning of this century and by 1981 this has more than quadrupled to become 3.92 million. The lowest initial population was in the North Central Province (63,743 in 1871) and this rose to 79,110 persons in 1901 and this increased more than ten-fold in the eight decades. The provinces all have gained population in the last eighty years in the following pattern: a little more than three-fold in the Central and Nothern, nearly three-fold in the Southern, nearly five-fold in the North Western. In terms of absolute numbers no province has shown any decline, although there were interchanges between the Provinces on a larger scale, which in some instances were large and in others small. The Central and Uva provinces have shown slightly subdued increments in the last decade (1971-81) as is seen from the graph while the province of Sabaragamuva has shown clear low profile growth after 1953.

Population Projections for 1871-2041

The projected populations using the five trend projection time series linear and regression models have been computed for the country as a whole, for the two agroclimatic zones and for the nine provinces, which together make up twelve runs of the package. A cursory glance through the projections will indicate to the reader that the projections computed by the exponential direct model in most cases have been approximating the actual census population (for 1941,1951 and 1961 in all cases, the actual population has been recomputed for the purpose of providing evenly spaced-data and such figures as computed have been compared with various sources for reliability) more so than others.

The trend projection models yielded results for the country as a whole and the agroclimatic zones presented are only for the selected years: 1991,2001,2021 and 2041. It may be seen that the projections from the

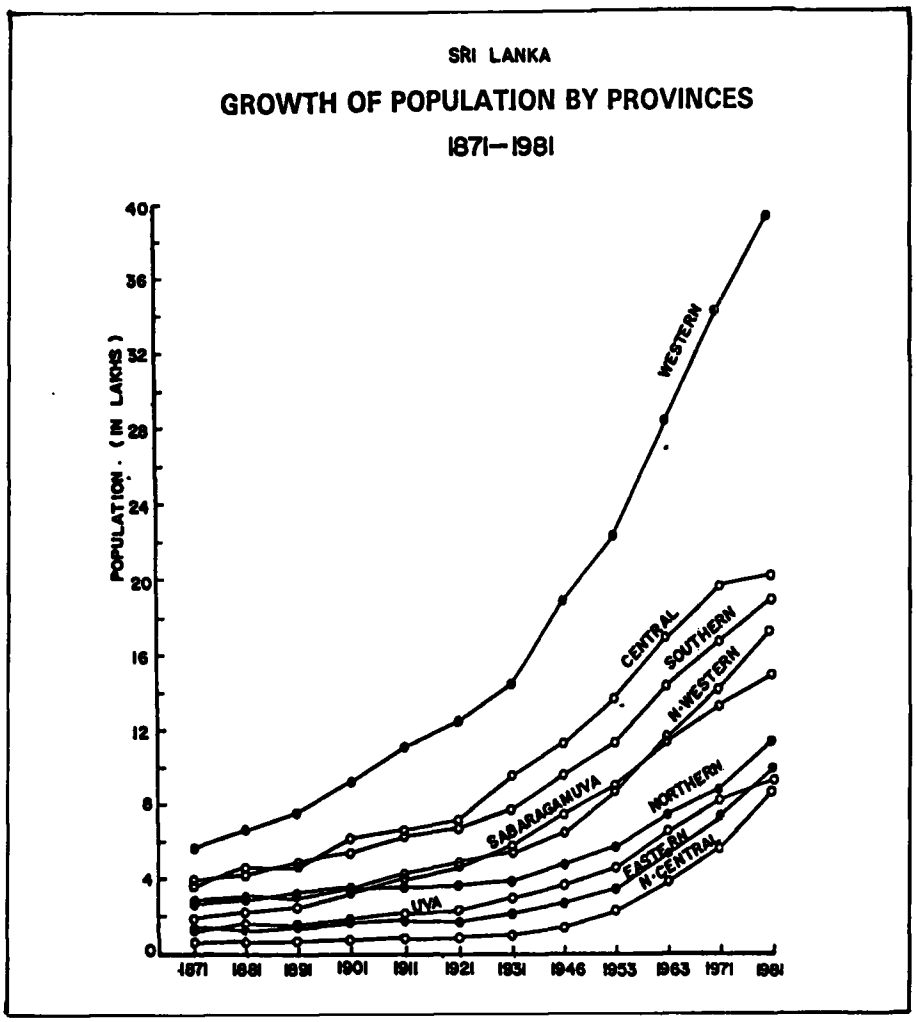

Figure 3

time series exponential direct method provide near approximations for the populations of the known years 1871-1981. So it follows from above that the projections from all other methods, including those of the linear models, since they do not approximate and some cases far bigger than the known populations, either over-or under estimate the actual population and therefore not very reliable as population estimates of the future.

The population of Sri Lanka is likely to be in the order of 17.55 million in 1991, 20.74 million in 2001, 28.97 million in 2021 and little more than 40 million in 2041. This approximates the projection of Frejka (1973) as quoted in ESCAP report of 1976,(especially projection 3, p.201).

If we consider that the same option of direct exponential model projections apply equally well with the agroclimatic zones, then the Wet Zone will have a population of 10 million by 1991, 11.8 million by 2001, 16.44 million by 2021 and nearly 23 million by 2041. This would amount to nearly 53 to 54 per cent of the total population at that time in the country. On the other hand, the Dry Zone will have 7.5 million by 1991, nearly 9 million by 2001, 12.6 million by 2021 and 17.8 million by 2041 (Figure 4). Note that the other methods, as may be seen either overestimate or underestimate the population for the future years. In some cases, they even look untrue and therefore unreliable as estimates. An important particular piece of information that we perceive from the application is that Sri Lanka's population will have rate of change per period of 18.2 per cent (direct exponential) or nearly 18 per cent (regression exponential). However, in the case of dry zone, the rate per period is 18.77 per cent by direct exponential and 17.55 per cent by regression exponential. The other significant information that gain from the projections is that in exponential regression projection the population trend expresses a positive increase over time and this is stronger (r=0.9973) than that yielded by the linear regression, (r=0.9569). This particular inference can also be drawn from the projections for both the wet and dry zones.

Table 1

Population Projections by Trend Models: 1991-2041

(in million)

year	Exponential Models			Linear Models	
	Direct	*Regression*	*Modified*	*Direct*	*Regression*
Sri Lanka					
1991	17.55	15.85	15.73	15.98	13.28
2001	20.74	18.70	16.57	17.11	14.34
2011	24.51	22.07	17.38	18.25	15.39
2021	28.97	26.05	18.16	19.38	16.45
2031	34.24	30.74	18.91	20.51	17.51
2041	40.46	36.27	19.63	21.64	18.56
Wet Zone					
1991	10.03	9.99	9.02	9.15	8.12
2001	11.82	11.82	9.52	9.79	8.76
2011	13.94	13.97	10.00	10.44	9.40
2021	16.44	16.58	10.47	11.08	10.04
2031	19.39	19.54	10.94	11.73	10.68
2041	22.86	23.11	11.63	12.37	11.31
Dry Zone					
1991	7.54	5.82	6.71	6.84	5.16
2001	8.96	6.84	7.06	7.32	5.58
2011	10.64	8.05	7.99	7.81	5.99
2021	12.63	9.46	7.70	8.29	6.41
2031	15.01	11.12	8.01	8.78	6.85
2041	17.82	13.07	8.30	9.27	7.25

Source: Computer results of Trend Projection Models.

Table 2

Population Projections for the Provinces of Sri Lanka by Time Series Direct Exponential Model

Provinces	1991	2001	2011	2021	2031	2041	Rate
Western	4.66	5.56	6.62	7.88	9.39	11.19	19.11
Central	2.35	2.76	3.24	3.79	4.45	5.22	17.27
Southern	2.17	2.50	2.89	3.33	3.84	4.42	15.28
Nothern	1.26	1.44	1.63	1.85	2.11	2.40	13.65
Eastern	1.20	1.47	1.79	2.20	2.69	3.30	22.51
North Western	2.02	2.39	2.83	3.35	3.96	4.69	18.35
North Central	1.10	1.43	1.85	2.41	3.12	4.05	29.70
Uva	1.11	1.34	1.61	1.94	2.34	2.82	20.47
Sabaragamuva	1.78	2.14	2.57	3.09	3.71	4.46	20.21

Source: Computer results from trend Projection Models. The population figures are in million and the rate is the rate of change per period.

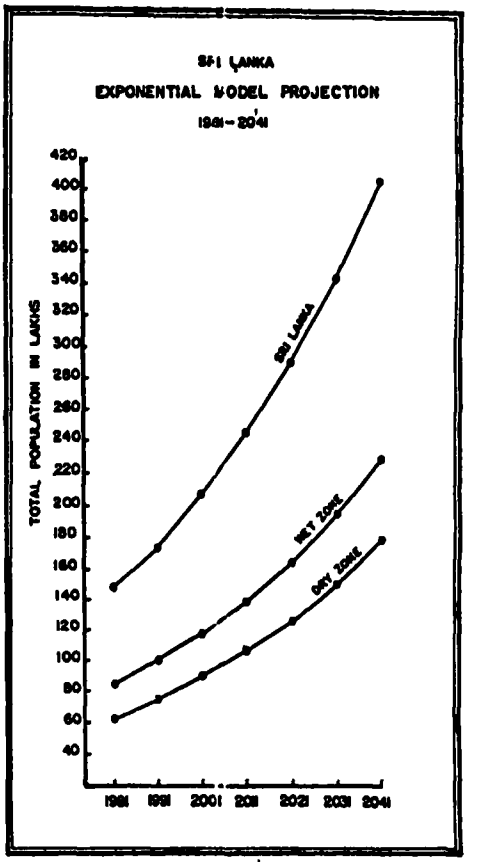

Figure 4

The projections for the nine provinces also indicate that projections from the direct exponential are more approximate than those from other methods, although in some cases, for instance in the case of Western Province the projected figures from the regression exponential also more or less approximate the populations of the known years. The projections indicate that the population of the provinces for the years 1991-2041 would be as follows:

A very significant inference is that the provinces will have uneven distribution of population and that the Northern province will have the lowest ever population change rate registered per period (13.65 per cent). This is also an indication that the population in the Northern Province has a slower rate of growth than elsewhere in the past years and that it will continue to be more so in the future. On the contrary, the Eastern province shows a high rate of change per period of 22.51 percent. This may be due to colonisation sponsored by the government in this province more than elsewhere. The rates of change per period as revealed by the table differ for different provinces, the highest being for the North Central (29.71 percent). The enormous increase in population expected in the Western Province is essentially because of the

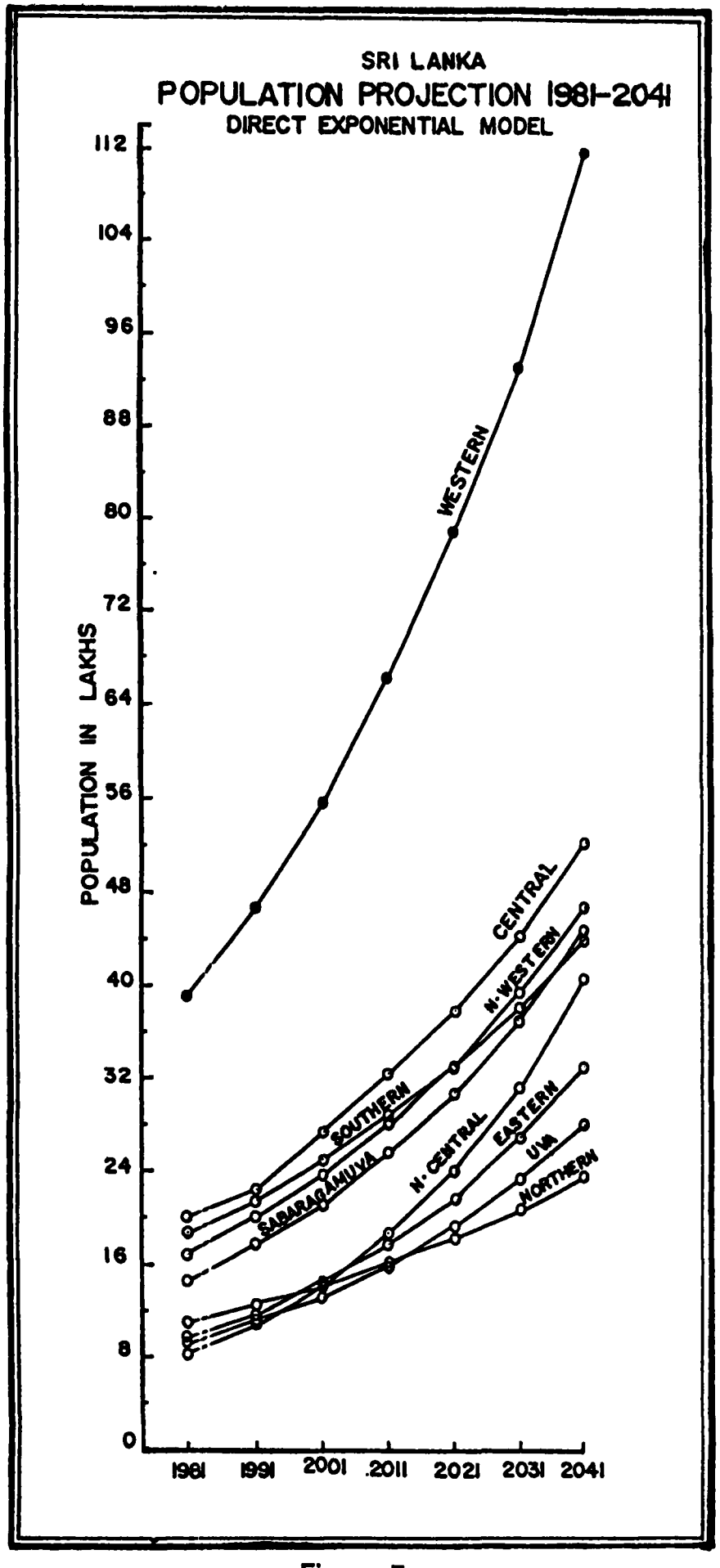

Figure 5

location of Colombo within it; the population will gravitate more towards it in the future as it did in the past. However, the rate of change will remain comparatively low (19.11 per cent) (Figure 5).

The projected population for the island, the wet and dry zone from the time series direct model and the population as is evident is likely to grow very steeply for the entire country, whereas it will more subdued in the dry zone than in the wet zone. The projections from the same model for the provinces are presented graphically and the graph indicates that the Western province will have far greater growth in population in the future than any other and that the Northern province will register the lowest growth possible among the provinces. The Eastern province will however register medium growth when compared to other provinces.

The Reprise

The paper has presented the population projections attempted with the help of a BASIC computer program package of Time Series Trend Projections Models. The results have been very salutary in that they have been able to give us some idea of the sizes of population likely to be till 2041-not only with respect to the country as a whole, but also in terms of agroclimatic zones and the provinces. It has been seen that the time series direct exponential model has provided approximations better than other models for the populations of known years and therefore the results yielded from it may be more reliable than those computed from other models, for they have either overestimated or underestimated the populations even for the known years (1871-1981). As this exercise provides for an understanding of the likely levels of population in the various administrative units, zones and the country, as a whole it is very significant. The projections can be utilized for planning population programmes, either for controlling growth or dispersing population for a balanced distribution. However, the projections are only as good as the data upon on which they are based and have not however assessed the factors for population growth, except by taking the trends of the population deducible by the trend models themselves.

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