

# Assessing Interrelationships Between Population Policy, Social System and Demographic Behaviour in India : An Analytic Framework

## Purpose

**T**HE interactions of demographic, socio-economic and population variables are very complex and not, as yet, well understood. Analytical research remains to be done to determine the nature, strength and spatial-temporal patterns of these linkages in highly populous but underdeveloped countries.

In this context, the present paper aims to provide an analytical framework, a working model, which may enable us (i) to define the multi-dimensional relationships of demographic change and effects of population policies, with reference to inter-regional variations within India, and (ii) to analyse which population policies most influence demographic behaviour, taking into account the socio-cultural and economic systems in India. It presents a conceptual and analytical means to determine multivariate linkages between socio-cultural matrix and population policies, on the one hand and change in demographic behaviour on the other, in different parts of India. Emphasis here is on methodology and so, data and results are not presented.

## The Need for Research

On the occasion of the first World Population Conference in 1954, attention was called to the different gaps which still existed in the knowledge of demographic, economic, and social relationships (UN, 1955, p. 176). These included "the limited ability to predict demographic consequences of particular economic and social changes, even less ability to predict economic and social consequences of population change or to trace a sequence of inter-related demographic, economic and social changes. After 18 years, a 1973 UN study reports that these gaps in knowledge of 1950's are only partly filled and "imagination and vision have not yet penetrated into the intricate web of individual and socio-cultural behaviour to determine the basic nature of their interactions with the economic growth and social progress" (UN, 1973, pp. 7-9). It maintains that it has not been possible, for instance, "to determine the relative influence of different economic and social factors which contributed to the long-term decline of fertility in now industrialized countries. Nor have satisfactory explanations been found for the fact that fertility differences exist among the developing countries that do not appear to be related to the level of economic development" (*Ibid.*, P. 8).

It further states that "conditions conducive to fertility decline in developing countries are not known with sufficient precision. For example., what kind and how much education is required to initiate important changes in attitudes toward family size and motivation with respect to reproductive behavior. Can couples be successfully motivated to adopt small-family patterns in the absence of a significant measure of other social changes in the society"? (*Ibid.*, p. 8).

Many demographers recently have expressed doubts about the effectiveness of family planning programs alone for securing fertility decline. As Glass (1965), notes "direct programmes for spreading the use of birth control are only a small part of the action in which developing societies will require to engage. The largest part of the action will have to consist of planned economic and social development". A broader approach has thus emerged in recent years to the question of population control, which has been called "beyond family planning" (Berelson, 1969, pp. 533-543). Included here are measures like higher legal age of marriage, greater educational, recreational and employment opportunities for women, non-pregnancy bonus, tax incentives for not having children, tax penalties for too many children, abortion, sterilisation, etc.

**Shekhar Mukherji**

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Nevertheless, "support and encouragement of research on population policy other than family planning (sterilisation) is negligible. . . . The specific measures required for developing (attractive) substitutes are not easy to determine in the absence of research on the question." (Davis, 1967, pp. 730-32). There is lack of research on the relative effectiveness of different policies on the demographic processes, "Statistical tools and data for measuring, with reasonable accuracy, the effects of family planning programmes on fertility levels in the community or nation as a whole are as yet insufficiently developed." (UN, 1973, p. 656). However, some methodological work has been done, especially by Butz (1972) and Stillman (1974). But their methods either use simultaneous equations or simple correlation analysis, and thus, often are unable to isolate the effects of particular policies or programmes from that of socio-economic development. In this respect, the proposed analytical design, as it treats these factors as separate dimensions, is deemed to mark an advance.

### **The Social Field and Demographic Behaviour**

"To understand, explain and affect demographic variables require placing them within a complex web of social, political and cultural forces within which they operate, and untangling their complex and multi-dimensional relationships." (Rummel, 1974, p. 1). Seldom has the field of social processes and institutions been geared into demographic research and even less has comparison across communities been made. As a result, many population studies have accounted for a small variation and have produced unrealistic solutions. As Hauser (1962) puts it, "changes in fertility behavior cannot be produced through efforts to change attitudes, values or motivations, except in the context of changes in the social order."

While the need to imbed demographic variables in the social field has gained recognition in recent years, the methods for achieving this are not well known. To encompass society in its manifold aspects requires analysing scores of Variables and their interdependence, not only for one community but for many. And not only for one year, but for a series. Suitable methods for doing this are the multi-variatic, multi-dimensional techniques, which include component analysis, factor analysis, canonical analysis and multi-dimensional scaling. These are capable of dealing with traditional, tribal or modern communities; of defining the interrelationships between such variables as fertility, mortality and migration, within the socio-cultural-economic matrix; and of unravelling the social forces affecting demographic processes.

To fill in this gap between need and analysis, recent studies of Russett (1967), Adelman and Morris (1967, 1966) and Halt, *et al.* (1948) deal with cross-national societies and demographic change within the socio-cultural matrix. While these studies demonstrated the applicability of multi-dimensional techniques to cross-cultural data involving demographic change, they were cross-sectional and dealt mostly with the developed countries. To adequately deal with demographic change requires analysis of a time series.

These studies did not include policy variables, and therefore, could not determine the impact of population policies on demographic change. Yet, if demographic behaviour is to be influenced by policy-makers, we must know how policies in fact mix with the existing social situation and cultural norms and values to ultimately affect demographic behaviour. Population policies meant to achieve a social goal become, when implemented a part of the social fabric and operate within the limits of the society. Policies which are at variance with the social milieu and social forces stand little chance of success.

One of the purposes of the present exercise is to show ways of evaluating population policies in relation to many other social goals and interests; to enable us to see socio-economic and demographic reforms as a system of interrelationships. Inconsistencies often exist in governmental policies, as for instance, when family allowances and other benefits to mitigate the burdens of child-rearing are instituted for humanitarian reasons, but which also stimulate population growth. Again, raising simply the legal age of marriage for women, without an intensive programme for free and compulsory female education, at least up to high school standard, may not succeed to reduce the number of children born per woman in the Indian society, under the existing social conditions. This would be so primarily because, under widespread illiteracy among the Indian women, most of them achieve their average number of desired children of 6.6 at the mean age of 32-35 years, well ahead of termination of their reproductive period, at 45-49 years. Thus, simply increasing the legal age of marriage for women only, without concurrently providing female education and employment, would result in shifting their fertility schedules by a few years, but their completed fertility rates might remain still at high level of over 6 children. The difference would be that this size of the family is achieved at 35-38 years, instead of previous 32-35 years of age. Hence, the need to examine such inconsistencies in population and social policies, to examine their consequences upon demographic trends, and suggest policies in tune with the social mix, and thus, most likely to be effective in reducing fertility.

Thus, the objective of our model is two fold: first, to show means of analysing characteristics and changes in demographic behaviour and population policies within the socio-cultural-economic matrix by defining their dimensions of change across communities and over time; and second, to show ways to determine what population policies are most closely linked with specific demographic change (such as, decline in infant mortality or general fertility rates) over time and communities, holding constant the socio-cultural factors. This analytical design was first developed by Rummel (1974) and was further developed in Rummel and Mukherji (1976).

### **Analytical Design**

First, since study of population change requires a longitudinal analysis of all discreet communities, we propose to use time-series component analysis as a more suitable mode of investigation of demographic change within the socio-cultural matrix, than the usual cross-sectional analysis. Such a technique would permit us to delineate over time independent components of demographic behaviour and population policies across regions (states, or districts, or towns or villages) and for a number of years. This will facilitate a redefinition of demographic trends, social processes and policy changes, usually established only cross-sectionally in demographic studies.

Second, the effect of population policy upon demographic behaviour change may be determined through canonical (time-series) analysis. Given two sets of data matrices (policies and socio-cultural variables as the independent set and demographic variables as the dependent set) canonical analysis would enable a least square fit between the two time series and uncover causal policy-demographic linkages (Figure 1).

The design involves two stages. Stage I primarily involves the basic evaluation and data collection of all relevant demographic variables, policy variables and socio-economic-cultural variables. In Figure 1, in the data stage, we have shown the three matrices: demographic behaviour matrix,  $D$  (of  $M$  number of variables, for  $n$  number of states/districts/towns, for  $/$  years), socio-cultural matrix,  $S$  (of  $Q$  number of variables,  $n$  observations, and  $/$  years), and population policy matrix,  $P$  (of  $R$  number of variables,  $n$  observations, and  $t$  years). These data would then have to be analysed to determine the dimensions (or factors or components) of demographic change, population policies and the socio-cultural matrix for the specified  $/$  year period (say, 1951-7J).

### METHOD OF ANALYZING POLICY-DEMOGRAPHIC LINKAGES

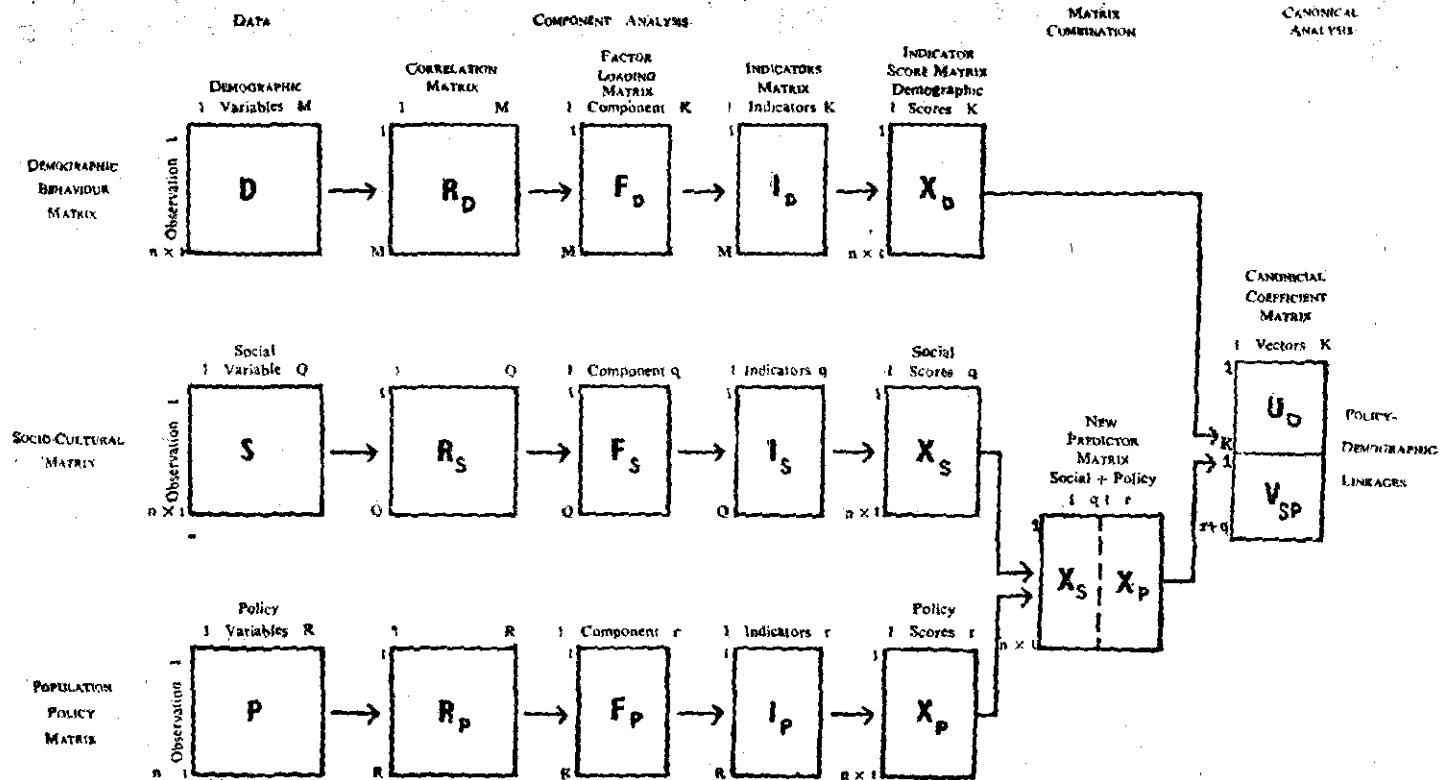


Fig. 1. Flow-charts of analysing population policy-demographic change linkages.

In regard to each matrix, actual computation involved in the principal components factor analysis are as follows (Figure 1): (1) transformation of an  $n \times t$  observation by  $M$ -behaviour variable data matrix  $D$  into a standard score matrix  $Z$  (not shown); (2) calculation from  $Z$  of an ( $M$  by  $M$ ) simple correlation coefficient matrix  $RD$ ; (3) resolution of  $RD$  into an ( $M$  by  $K''$ ) factor loading matrix  $AD$  (not shown), where  $K''$  equals the number of principal components or basic dimensions in descending order of magnitude of eigen values and predictability; (4) rotation of  $AD$  to normal varimax position, to approximate an ( $M$  by  $k'$ ) simple structure matrix  $FD$ , where  $k'$  equals the number of significant factors or dimensions with eigen values greater than unity (or any other criterion chosen); (5) computation of an ( $n \times t$  by  $k'$ ) matrix  $XD'$  (similar to matrix  $XD$  but not shown) of normalized factor scores for the observations. The above discussion refers only to demographic behaviour matrix, but the same steps are also involved in factors analysing the social-cultural matrix and population policy matrix.

Instead of analysing separately, when the three matrices (of demographic, social and policy variables) are analysed jointly in the same manner as above, then we may achieve fulfilment of step one of the design. This is shown in Figure 2. Here, the diagram shows that from innumerable number of data on/social, demographic, and policy variables across different communities or regions, we can generate a multi-dimensional composite space which is defined and delineated by a finite number of general space-time components, each describing multi-variate inter-relationships between the social variables, demographic behaviour, and population policy variables. In this space, each region (or community or population) can be projected as a vector (with length and direction) to represent a region's specific location, relative to all others. Thus, both the general characteristics of the Indian society and of individual region (or community) can be untangled in this manner. Analysis upto this stage will achieve fulfilment of purpose I, as outlined in the beginning.

Stage II (purpose II) will require to focus on further refinement of dimensions and indicators for policy purposes, specifically involving collection of more refined data, hopefully to capture the essence of change in the three matrices on the basis of refined indicators ensued from reiterative analysis. It could be that the initially selected indicators lose their value in the light of the more complete and continuous time-series data. Therefore, the indicators should be reanalysed, and this step involves going back and forth between data collection and reana-



canonical (regression) analysis between demographic behaviour indicator matrix  $X_D$  and the new predictor matrix (of policy and social indicators). Canonical analysis, developed by Hotelling (1936), basically elicits the maximum correlation between linear functions of the two (or more) sets of variables describing the same subjects.

Given the two sets of data on demographic behavior and social-policy variables, canonical analysis permits us to answer to two related basic research question : (i) what is the overall general relationship between individual region's (community) socio-cultural-cum-policy variables and demographic behaviour change; and (ii) given this overall relationship, what are the underlying causal relationships between specific combinations of demographic behaviour variables and population policy variables within the context of the socio-cultural-economic system?

The first is shown by the trace correlation—indicating overall goodness of fit between policy and demographic linkages, between demographic behaviour matrix and socio-cultural-cum-policy matrix. The second kind of relationships are shown by canonical loading, or canonical coefficients, corresponding to specific variables on both sides of the equation, which measure the degree of interdependence or association between each matched pair of variates (from both demographic set and policy-social set). The latter kind of equations show causal relationships between population policy-demographic behaviour variables, in the context of socio-cultural system of India.

The nature of canonical correlation analysis probably can be best explained through the algebraic model of a set of simultaneous equations :

$$\begin{aligned} \beta_1 Y_1 + \beta_2 Y_2 + \beta_3 Y_3 &= \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 \\ \beta_1^* Y_1 + \beta_2^* Y_2 + \beta_3^* Y_3 &= \alpha_1^* X_1 + \alpha_2^* X_2 + \alpha_3^* X_3 + \alpha_4^* X_4 \\ \beta_1^{**} Y_1 + \beta_2^{**} Y_2 + \beta_3^{**} Y_3 &= \alpha_1^{**} X_1 + \alpha_2^{**} X_2 + \alpha_3^{**} X_3 + \alpha_4^{**} X_4 \end{aligned}$$

where the beta and alpha coefficients, analogous to regression co-efficients, weighting  $Y$  and  $X$  sets of variables in two data matrices. Here, the  $Y$ 's represent three behaviour variables and the  $X$ 's represent four policy-cum-social variables. The asterisks indicate that the coefficients assume different values in the three

equations. The canonical analysis, then, simply attempts to maximise the correlations between pairs of weighted combination of A's and T's. Within each equation weighted combination of F's is termed as the new vector,  $U$ , and that of the A's as the new vector,  $V$ . Within each equation, these new pair of vectors  $U$  and  $V$  (called canonical variates) are matched in a way such that the correlations between them is maximised (see Figure 1).

Canonical analysis gives mainly four kinds of statistics for assessing the statistical significance of the relationships. First is the trace correlation, already described, which indicates the statistical overlap between demographic-policy sets. The second is the canonical correlation, corresponding to each matched pair of variates, showing the degree of association between the independent set (*policy-social variables*) and the dependent set (*demographic variables*). The square of canonical correlation times 100 indicates the amount of variance explained in the variate of dependent set by the variate of independent set. The third feature is the Chi-square statistic. This indicates the statistical significance of these canonical correlations between each matched pair of variates or linear combinations of variables. The fourth feature is the canonical co-efficients which relate each input variable to a canonical variate. Examination of such co-efficients permit precise interpretation of a canonical variate in terms of those input variables (here indicators) which constitute that specific variate and indicate high loadings. In other words, precisely these canonical co-efficients enable us to indicate the causal Policy-Demographic linkages, with reference to socio-cultural system. And, these coefficients identify which policy-social variables are less or more important in determining fertility behaviour, or mortality decline, or migration-urbanisation rate. Precisely, in this sense, the present design helps to identify those socio-economic mechanisms which need more emphasis in order to bring fertility decline, apart from on-going family planning programs and population policies purported to do so. This also permits to isolate the separate effects of policies on the demographic behaviour change, controlling the effects of socio-economic forces.

### Suggested List of Variables

The demographic variables which may be tentatively suggested include :

1. infant mortality rate;
2. crude birth rate;
3. population growth rate;

4. intrinsic growth rate;
5. net reproduction rate;
6. percent of population in cities of more than 20,000 population;
7. proportion of expenditure on food;
8. tuberculosis death rate;
9. heart disease death rate;
10. typhoid death rate;
11. calories consumed to required;
12. life expectancy at birth;
13. general fertility rate;
14. total fertility rate;
15. male/female ratio;
16. labour force population;
17. dependency ratio;
18. females in the labour force;
19. mean birth interval;
20. net migration rate for males;
21. net migration rate for females.

The population policies to be analysed may include :

1. population control policy;
2. abortion (extent of practice);
3. family planning assistance;
4. scope of family planning assistance;
5. population policy campaign;
6. child support;
7. unemployment compensation;
8. welfare measures, if any;
9. old age security policy (if any);
10. medical support;
11. population research support;
12. in-migration restriction, if any;
13. out-migration restriction, if any;
14. promotion of female equality;
15. effective age at marriage for women;
16. freedom to divorce;
17. widow remarriage practices, if any;

18. tax exemption policy;
19. voluntary family planning organisations, if any;
20. funding for urban versus rural development support.

On the other hand, the socio-cultural-economic matrix may include a multitude of variables defining a region's (districts/states/towns/villages/communities) level of economic development, energy consumption and production, size, culture stability, ethnic, linguistic, religious groups, level of literacy, family structure, female labour force, per capita income, consumption expenditure, and so forth. The above lists are however not exhaustive. The details of their measurement are given in Rummel and Mukherji (1976).

### **Usefulness of the Analytical Model**

At the outset, the model should have important methodological and policy outcomes. First, it provides a framework for dealing with the whole communities and the role of various societal forces (levels of living, organised versus informal labour sector) as they bear upon fertility, mortality and migration and also upon their over-time changes and processes.

Second, it provides a powerful methodology capable of connecting this framework to empirical measurements of the socio-cultural matrix and forces. This methodology is especially useful for population research, since it enables us to analyse and disentangle the complex of social, economic, and political forces with which fertility and mortality variables operate and demographic changes occur.

And, thirdly, this analytical model enables us to indicate whether existing population policies work along or contrary to the major aligned social trends and what policy alternatives must be sought in the future.

At more substantial level, the model is capable of generating fourfold outcomes, listed as follows:

- I. Definition of general space-time components of demographic, population policy and economic-social-cultural changes in all regions of India (or any country) over a long period of time (if data are available). This design is capable of delineating independent, component time series, and

untangle complex multivariate relationships between the social matrix, demographic change and population policy.

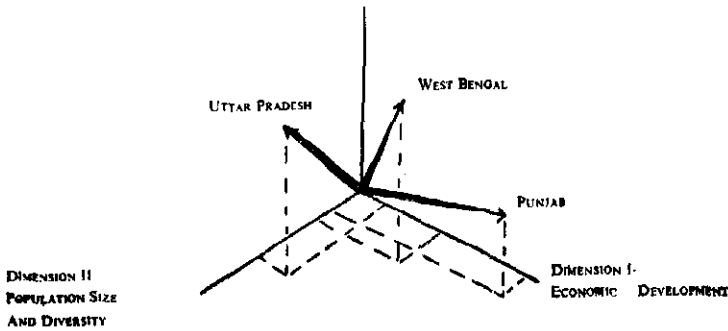
2. Delineation of time-series components separately for social, demographic and policy indicators. These components/indicators may define empirical inter-relationships within each set and thereby identify the major lines of forces operating in social system, population dynamics, and policy formulation.
3. Isolation of indicators of social, demographic and policy dimensions which are capable of empirically defining independent trends in social change, demographic transition, and policy inputs (see Figures 3A, 3B, 3C). Analyses of such indicators of behavioural trends are of great significance in social sciences and policy analysis.
4. Assessment of multivariate policy-demographic linkages, within the socio-cultural field. Such linkages, if determined, may shed light on many important issues, such as, economic implications of rapid population growth, interactions between social norms, the belief-value matrix and fertility behavior; effect of female education and employment on fertility levels; and relative effectiveness of different policies upon fertility/mortality.

An example will bring the point home. In Figure 3 (A, B, C), hypothetical indicators of social, population policy and demographic dimensions are shown, respectively. In Figure 3A, the dimensions are economic development, population size and diversity, and joint-versus-nuclear family structure and cultural diversity. These are clusters of inter-related variables, which are called dimensions or factors (or components). On this multi-dimensional space, three regions (here three states are shown, but districts can also be taken) Uttar Pradesh, West Bengal and Punjab states are shown to have their own specific locations, relative to all others. Each are represented by a vector (with length and direction). Each of these vectors share a specific combination of the dimensions which span the space. The vectors' shares of the general dimensions are shown by projections on the axes, which represent the dimensions. Thus, for instance, again hypothetically speaking, the state of Punjab shows more economic development and less population size and less cultural diversity than the state of Uttar Pradesh which is characterised by a larger population size and diversity and more people in joint family and relatively less economic development. Position of West Bengal can similarly be explained. Thus, these figures (3B and 3C) represent

(Hypothetical Examples)

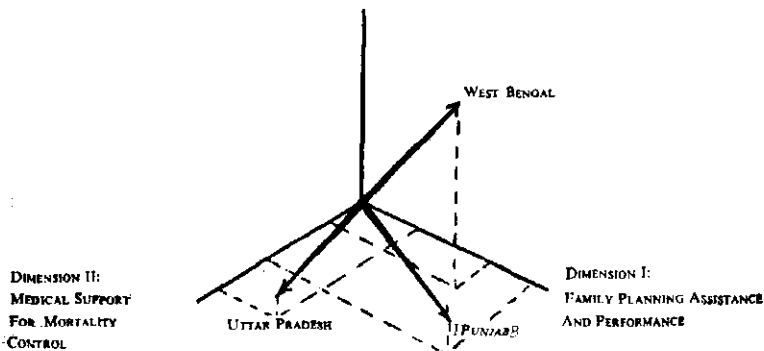
**A. SOCIO-CULTURAL SPACE**

**DIMENSION III  
JOINT VERSUS NUCLEAR FAMILY,  
CULTURAL DIVERSITY**



**B. POPULATION POLICY INDICATORS  
C. DEMOGRAPHIC BEHAVIOUR SPACE**

**DIMENSION III  
(PRO-URBAN DEVELOPMENT POLICY)**



**DIMENSION III  
HIGH GROWTH TENDENCY  
(High infant mortality, high fertility)**

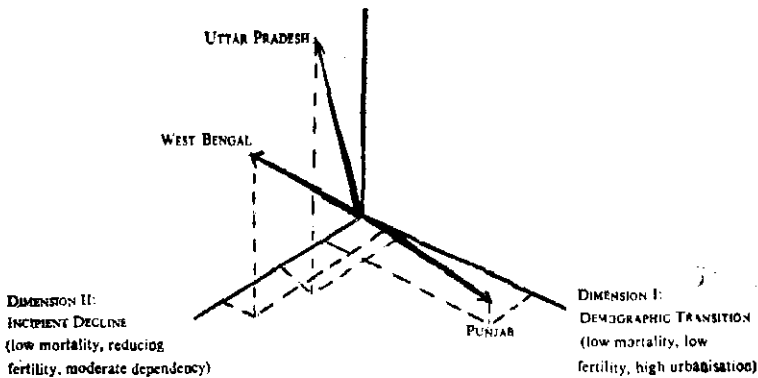


Fig. 3. Step Two— Method of Assessing three sets of Indicators (and Policy demographic linkages).

TABLE 1—HYPOTHETICAL CANONICAL RELATIONSHIPS BETWEEN POLICY-DEMOGRAPHIC VARIABLES,  
WITHIN THE SOCIO-CULTURAL FIELD

State/ Distt/ Township/ Vill.	Demographic Behaviour					Socio-Cultural System						Population Policies						
	Tot. fert. rate	Mort. rate	Inf. mort. rate	Growth rate	Urbanisation rate	Per cap. incm.	Size of Pop.	% in agri. activity	Fem. Edn.	Pop. div. ersity	Eco. dev.	Fam. struc- ture	Age at mar- riage	Ex- tent of abor- tion	Steri- liza- tion	Oth- er Fam. Plan.	Dea- th con- trol	Old age secu- rity
Uttar Pradesh	may remain high	dec.	high	at same high level	low	very low	large	large	low	large	little	Joint family	low	slight	lately stressed	part- ly effective	part- ly	no
West Bengal	may slightly dec.	dec. further	still high	quite high	partly	low	sub- stan- tial	quite large	some	large	mo- derate	joint family	low	some	part- ly	part- ly	yes	no
Punjab	may dec.	dec. further	may dec.	may reduce	partly inc.	high	small	less	some	less	rel high ar	nucle- ar	high	some	yes	emp- has- ised	yes	no

NOTE : If  $D_1, D_2, \dots, D_k$  are demographic behaviour indicators and  $\beta_1, \beta_2, \dots$  are corresponding canonical co-efficients, and if  $S_1, S_2, \dots, S_q$  and  $P_1, P_2, \dots, P_r$  are respectively socio-cultural indicators and population policy indicators, with  $\alpha_1, \alpha_2, \dots, \alpha_q$  and  $\alpha_1^*, \alpha_2^*, \dots, \alpha_r^*$  as their corresponding canonical coefficients, then the canonical (policy-demographic) linkages within the socio-cultural system are given by

$$\beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \dots + \beta_k D_k = \alpha_1 S_1 + \alpha_2 S_2 + \dots + \alpha_q S_q + \alpha_1^* P_1 + \alpha_2^* P_2 + \dots + \alpha_r^* P_r$$

e.g. Co-eff. (total fertility rate) + ... = Co-eff. (per capita income) + Co-eff. (fem. edn.) + ... + Co-eff. (lower age at marriage) + Co-eff. (Fam. plan. assistance) + residuals.

both general space-time components and region-specific social, policy, and demographic characteristics. Although these are purely hypothetical examples of demographic, population policy, and socio-cultural indicators and state-specific characteristics with reference to India, such characterisation may accrue out of the empirical investigation on the basis of the model.

As elaborated earlier, the second major objective function of the model is to generate causal linkages between combined policy and social indicators and demographic behaviour indicators. Thus, multivariate policy-demographic linkages are to be determined with the context of the socio-cultural field of India. For this, for instance, consider Uttar Pradesh, which shows in Figure 3A relatively less economic development but more population diversity and size (and more joint family). When such social characteristics of Uttar Pradesh are combined with relatively more medical support for only mortality control and less emphasis on fertility control (until very recent months) (in Figure 3B), may give rise to high growth tendency (with high fertility level and large dependency from surviving children) and less incipient demographic decline or transition (Figure 3C). Though these are simply hypothetical examples, such multivariate linkages between policy and demographic behaviour may show up in the actual analysis

Similar examples can be easily multiplied, as may be revealed from Figure 3(A, B, C) and Table 1. Table I shows a pseudo-canonical model and hypothetical examples of such linkages. The relevance of the design may be at once apparent from the canonical relationships shown between the social matrix and policy matrix (in one hand) and demographic matrix (on the other). For example, for Punjab the table shows (hypothetically speaking) that given emphasis both on mortality control and family planning assistance, the fertility rate may decline in the state, especially under favourable economic condition and high per capita income, relative to other states in India. However, for West Bengal, the situation may not be that much conducive. Low age for marriage for women, more emphasis on mortality control than family planning programs in West Bengal may, for the present, maintain fertility at quite a high level as now, or may decline slightly. This may be partly also due to the fact that general poverty and large proportion of population in traditional agricultural sector in West Bengal may maintain a condition in which large size family is still considered economically rational. The alternative must be to raise the general standard of living of course, along with the existing sterilisation programmes.

## References

1. Adelman, Irma and Cynthia, Morris, 1966, A quantitative study of social and political determinants of fertility, *Economic Development and Cultural Change*, XIV, 129-157.
2. \_\_\_\_\_, 1967, *Society, Politics and Economic Development*, Baltimore: John Hopkins Press.
3. Berelson, Bernard, 1969, Beyond family planning, *Science*, 163, 533-543.
4. Butz, W. P., 1972, *Research and Information Strategies to Improve Population Policies in Less Developed Countries*. A.I.D. Rand Corporation, 11-30.
5. Davis, Kingsley, 1967, Population policy : Will current program succeed ? *Science*, 158, 730-739.
6. Glass, D. V., 1965, *Population Growth and Population Policy*, p. 23.
7. Hatt, P. et al., 1948, Types of population balance, *American Sociological Review*, XX, 36-43.
8. Hauser, Philip M., 1962, On design for experiment and research in fertility control. In: *Research in Family Planning*, Clyde V. Kiser (ed.), Princeton : Princeton University Press.
9. Hotelling, H., 1936, Relation between two sets of Variates, *Biometrika*, XV.
10. Rummel, R. J., 1974. Population policies and demographic change : Dimensions, projections and linkages, *Paper, Path Institute*, Honolulu, 1-56.
11. Rummel, R. J. and Shekhar Mukherji, 1976, *Analyzing Population Policy and Demographic Change*, Beverly Hills : Sage and Halsted, forthcoming, Ch. X.
12. Russett, Bruce, et al., 1969, *World Handbook for Political and Social Indicators*, New Haven : Yale University Press.
13. Stillman, D. V., 1974, *Population Related Policy : A Framework Analysis with Examination of Two Cases (Togo and Ghana)*, Chapel Hill : Carolina Population Centre, pp. 41-75.
14. United Nations, 1955, *Economic and Social Implications of Rapid Population Growth*, (New York : U. N.) p. 176.
15. United Nations, 1973, *The Determinants and Consequences of Population Trends, New Summary of Findings on Interactions of Demographic, Economic and Social Factors*, New York : U. N.).