

by

Donald R. Drew
Professor of Systems Engineering
American University of Beirut

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ABSTRACT

Summary

This paper describes a pilot model, NRDM-2, developed through research conducted at the American University of Beirut sponsored by the Lebanese Government, the harbinger of a package of interactive national, regional, and sectoral models to be used to guide reconstruction and development in Lebanon.

Background

Whereas the immediate obligation of Government after Lebanon's 1975-76 Civil War was to provide emergency relief, it was recognized that national planning was essential if the problems of reconstruction and development were to be solved. The Council for Development and Reconstruction (CDR) was established with one of its responsibilities being to prepare a plan that would chart Lebanon's future. In 1977 the CDR began laying the ground-work for development planning by commissioning a series of Agenda Papers on the various sectors of the Lebanese economy and on specific topics of vital importance to strategic planning.

In November 1979 an interdisciplinary group of faculty at the American University of Beirut (AUB) prepared a proposal, "A Systems Approach to Guiding Reconstruction and Development in Lebanon," that outlines a procedure for using System Dynamics models to generate development scenarios for Lebanon as aids for national, regional and sectoral planning. The CDR formally endorsed the AUB proposal and the two organizations decided to involve teams of graduate students and their advisors, first in the development of, and then in experimentation with, a pilot model which would serve both as a training laboratory for them and as a benchmark for future research. The first team was formed in April 1980 and NRDM-1 was the result. The next team was formed at that time and the expanded version of the pilot model, referred to as NRDM-2, is now operational.

Description of NRDM-2

NRDM-2 is structured to accommodate three development orientations: 1) resource development, 2) regional development, and 3) sectoral development. Resource components include natural resources, land resources, water resources, and human resources (manpower). Regional development is organized on the basis of rural and urban in NRDM-2.

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Sectors represented in the model are agriculture, manufacturing, business, infrastructure and government. Obviously, the three orientations overlap. They are also tied together by two quantities most responsible for material growth: 1) population—including the effects of all economic and environmental factors that influence human birth, death, and migration rates, and 2) capital—including the means of producing industrial, service, and agricultural outputs. For the purpose of this paper, NRDM-2 is organized as follows:

- Manufacturing (Eqs. 1-36)
- Business (Eqs. 37-69)
- Infrastructure (Eqs. 70-105)
- Manpower (Eqs. 106-137)
- Government Service (Eqs. 138-171)
- Agriculture (Eqs. 172-217)
- Population (Eqs. 218-244)
- Utilities (Eqs. 245-254)
- Highways (Eqs. 255-261)
- Housing (Eqs. 262-277)
- Trade-Energy (Eqs. 278-292)
- Socio-Economic Indications (Eqs. 293-306)

These 12 model components correspond to the elements defined by the three rows and four columns in the accompanying causal diagram.

Uses of the Model

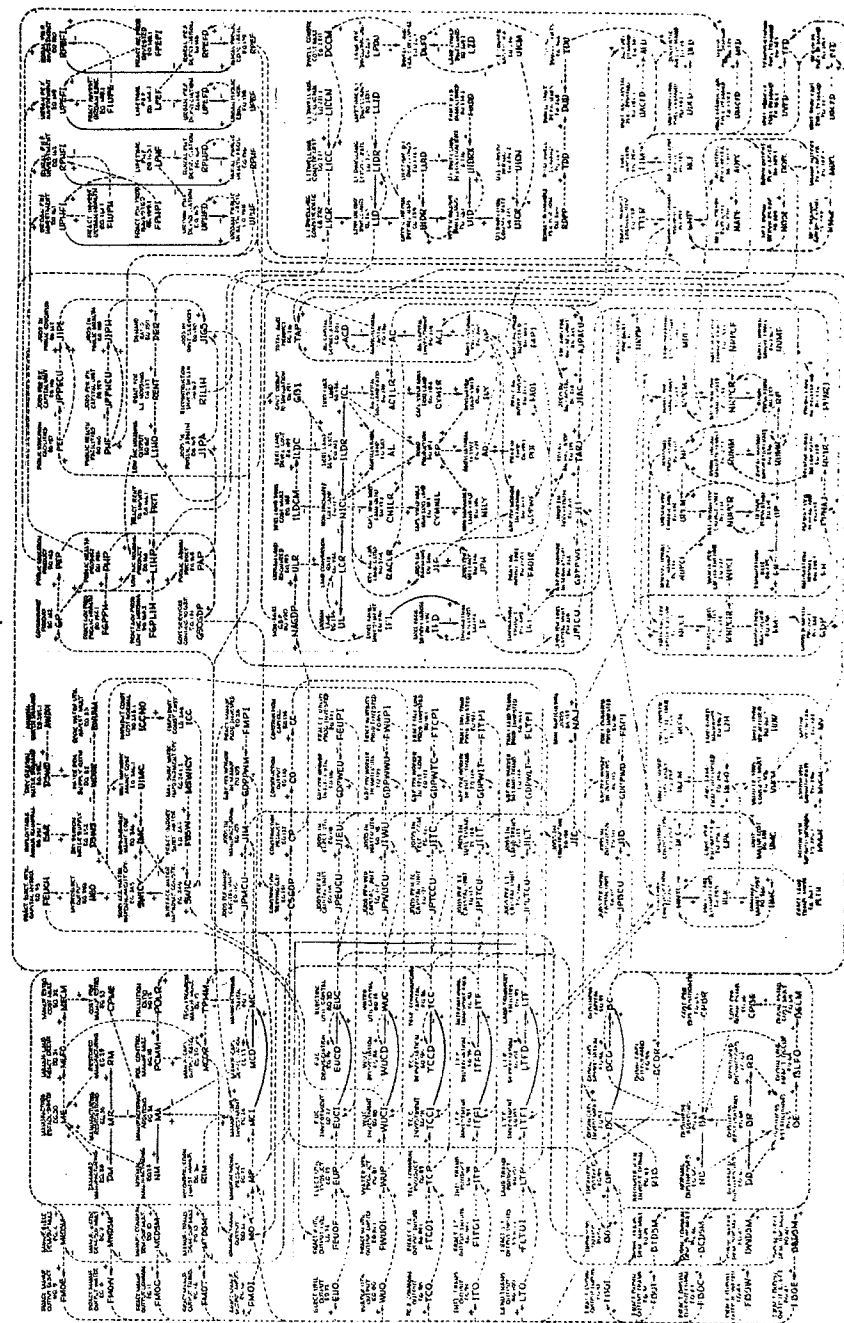
The structural and parametric assumptions inherent in NRDM-2 were distilled from the series of Agenda Papers obtained by the Council of Development and Reconstruction from many sources both in and out of Lebanese Government. Like NRDM-2, the Agenda Papers, taken collectively, is a model of Lebanon. Each of the Agenda Papers deal with goals involving certain variables and policy interventions involving other variables. To link the goal and policy variables, the authors of the Agenda Papers have implied an understanding of a complex set of intervening relationships, a system. Since the prose of the reports is the model representing the system, the Agenda Papers may be thought of as a verbal model. In contrast, the complex set of intervening relationships between variables in NRDM-2 are expressed by equations and it is referred to as a mathematical model. The verbal model of Lebanon contained in hundreds of pages of Agenda Papers spanning many disciplines can not promote communication and understanding leading to consensus and it is too fuzzy, static, incomplete and imprecise to be used for decision making. Thus, in the briefings, seminars and workshops that evolved in the modeling, system dynamics has become the language of communication.

The objective aspects of Lebanon's development are contained in the relationships between the variables. Using the values of the 435 parameters for 1980, the model calculates the values of the variables at consecutive years over a fifty year period. The subjective aspects of Lebanon's development are dealt with in the way the model is used

to generate scenarios. Four basic scenarios investigated are the following: 1) The "No-War" Reference Scenario, 2) The No Reconciliation - No Reconstruction Scenario, 3) The Reconstruction Without Reconciliation Scenario, and 4) The Reconstruction With Reconciliation Scenario. By "No-War" Reference Scenario we mean what could have been expected in Lebanon over the period 1980-2030 if the 1975-76 Civil War had not happened. The term "Reconciliation" refers to the restoration of the government's authority as opposed to the continuation of the present condition of neither peace nor war, but one of tension, intimidation, terror, violence and sporadic liquidations, fostered by militias and armed groups. "Reconstruction" refers to a plan unveiled by the CDR in 1979 that has been incorporated into NRDM-2. Private sector needs are reckoned at LL 9 billion (LL=\$.25), LL .8 billion per year for five years starting in 1980 to manufacturing and LL 1.0 billion per year for five years starting in 1980 to business. It includes LL 10 billion over five years in the public sector spread among telecommunications, ports and airports, highways, and low income housing.

Conclusions

Lebanon is faced with the challenges of national reconstruction, development, and reconciliation. The response to each is a search for funds, a search for facts, and a search for compromise, respectively. The premise upon which this study is based is that reconstruction, development, and reconciliation are not separate technological, economic, and political problems, but that reconstruction and reconciliation are aspects of a single development metaproblem, interpreted in its broadest sense. Funds, facts and compromise are necessary conditions for Lebanon's development; they are not sufficient conditions. Investing funds without impact-sensitive plans, amassing data unsupported by theories, and negotiating in the absence of precise communication can only provide illusions of progress. Overcoming physical deficiencies through reconstruction and reducing the institutional deficiencies as part of reconciliation can both be aided by eliminating the conceptual deficiencies inherent in the traditional approaches to development planning.



NATIONAL RECONSTRUCTION AND DEVELOPMENT MODEL OF LEBANON

by

Donald R. Drew

Visiting Professor of Systems Engineering and Systems Management
American University of Beirut

(on leave from Virginia Polytechnic Institute and State University)

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THE SITUATION

A certain hunter... came one day upon a cave in the mountains, where he found a hollow full of bees' honey. So he took somewhat thereof and carried it to the city, followed by a hunting dog which was dear to him. He stopped at the shop of an oilman and offered him the honey for sale... As he emptied it that he might see it, a drop fell to the ground, whereon flies flocked to it and a bird swooped down upon the flies... Now the oilman had a cat, which pounced upon the bird, and the hunter's dog sprang upon the cat and killed it; whereupon the oilman ran at the dog and killed it and the hunter in turn sprang upon the oilman and killed him... Now the oilman was of one village and the hunter of another; and when the people of the two villages heard what had passed, they took arms and rose on one another in anger, and the sword continued to play amongst them until many of the people died... None knows their number, save God Almighty.

Arabian Nights, Night 528

1.1. Introduction

Lebanon, the country is new; Lebanese society is ancient. Lebanon's current geographic frontiers and political institutions were defined in the Constitution of 1926 and, except for slight modifications introduced on the eve of Lebanon's independence in 1943, remain in effect. The social and cultural characteristics of Lebanese society have their origins in the Phoenician, Greco-Roman, Arab, and Ottoman civilizations. The Lebanese state, with an area of ten thousand square kilometers, and Lebanese society, with a resident population of three million persons (and almost an equal number of expatriates), have a significance in the Middle East and, indeed worldwide, out of proportion to their size, owing to their role as a vital link between East and West.

For half a century of statehood, from 1926 to 1975, Lebanon prospered. Lebanon became the banking and commercial center of the Middle East, providing services with an efficiency rare in the developing world. Fine restaurants and hotels welcomed international tourists and businessmen.

The country's per capita income, literacy rate, and health standards were among the highest in Afro-Asia. Even its democracy, based on a confessional formula in which the president was a Maronite Christian, the prime minister was a Sunni Moslem, and the chamber would consist of 56 Christians and 43 Moslems, seemed to work even though bearing increasingly less resemblance to the religious composition of the population.

Then in April 1975, a massacre of Palestinian refugees escalated into a civil war, a conflict between Maronites and Moslems, Maronites and other Christians, between right and left ideologies, and between the urban establishment and peasant immigrants. In 1976, Syrian forces invaded the country in order to control the conflict and later became legitimized as the Arab Deterrent Force. After a massive invasion of the south in 1978 by the Israeli army, a United Nations peace keeping force was stationed in the south. Thus, seemingly without warning, the liberal, democratic, pluralistic edifice of Lebanon was shattered.

Explanations for the sudden reversal of fortunes in Lebanon abound. They range from external conspiracy accusations placing the blame on regional and international forces beyond Lebanon's control to revelations of ideological and religious contradictions inherent in the system.

1.2. Civil Strife and Anarchy

The result of the chaos of the last five years has left 75,000 dead and 10,000 physically wounded. The commercial, economic, and social life of Lebanese society exists in the shadow of violence and political uncertainty. Real and potential financial losses to the year 1980 by the Beirut Chamber of Commerce and Industry's tabulation is placed at 21 billion L.L. In terms of psychological effects on the Lebanese people, the post war years have been

even more devastating than the two years of war. Lastly, and most disturbing of all, the current state of anarchy is becoming an accepted way of life.

Today there is not one Lebanon, nor even two, but a land divided into many zones of influence. The area from East Beirut north to Tripoli is dominated by the Falangist Party. From West Beirut south to the Litani River the Palestine Liberation Organization and its Lebanese leftist allies exert control. In Ras Beirut itself a conglomerate of parties friendly to Syria and to the PLO wields authority. South of the Litani River are two zones: a narrow one along the border with Israel is held by a force of Christian irregulars led by Major Saad Haddad. The area between this narrow strip and the Palestinians is inhabited largely by Shiite Moslems and protected by United Nations' troops. Southeast of Beirut, the Druze leader Walid Junblat, head of the Progressive Socialist, exercises influence within limits. The northern and western parts of the country are held by the Syrian Army which has remained since 1976.

In order to govern, the elected Lebanese administration must work with the Syrians, the Palestinians, the Falangists, UMIFIL, and dozens of other organizations. To further complicate things, many of these forces represent other national interests--Iraq, Iran, Saudi Arabia, Israel, as well as the United States and the Soviet Union.

1.3. Political Alternatives

The most serious impediment to sustained economic recovery and social development is the government's inability to restore its full authority. It appears that three alternatives face Lebanon: (1) perpetuation of the current situation, (2) partition of the country into two or more states, and (3) national reconciliation. The first option means the continuation of a condition of neither peace nor war, but one of tension, intimidation, terror,

violence and sporadic liquidations. Most Lebanese obviously oppose this, but they acquiesce. The absence of an effective central government forces them to rally to militias and armed groups.

The partition option has been strengthened by the political, economic and demographic developments created by the war and by the entrenched positions of the ideologically conflicting groups. This option of course has many variations depending upon the number of states formed and their boundaries. For example, one possibility would be the division of Lebanon into two states, one dominated by Maronites, and the other by Muslims. This would create problems for Christian minorities both within the new Maronite state and throughout the Middle East. The new Arab state could not satisfy both the radical socialist parties that have developed among the Lebanese Muslims and the national aspirations of the Palestinians who now live in Lebanon. The formation of three states so as to give the Palestinians a homeland and the national identity they are fighting for would rob Lebanese Muslims--Sunnis, Shiites and Druze alike--of a substantial portion of the political and economic power they now possess. It is doubtful that both Syria and Israel would agree to the same partition formula even if the fractions within Lebanon could.

The preferred option is to build a united, independent Lebanon. The obstacles to developing a formula for accommodating the interests of all the rival factions engaged in the present division of the country are formidable, indeed. The greatest asset that Lebanon possesses in overcoming these obstacles is its unique heritage as a melting pot of civilizations and, due to the diversity of its sects, a free field for the meeting place of ideas and beliefs in the exercise of tolerance, esteem, and progress.

THE APPROACH

Beyond Ghor there was a city. All its inhabitants were blind. A king with his entourage arrived nearby and with his army camped in the desert. He had a mighty elephant, which he used in attack and to increase the people's awe... The populace became anxious to learn about the elephant, and some among this blind community ran to find it. Since they did not know even the form or shape of the elephant, they groped slightlessly, gathering information by touching some part of it. Each thought that he knew something because he could feel a part... When they returned to their fellow-citizens, eager groups clustered around them, anxious, misguidedly, to learn the truth from those who were themselves astray. They asked about the form, the shape, and the size of the elephant, and they listened to all they were told... The man whose hand had reached an ear said, "It is a large, rough thing, wide and broad like a rug"... One who had felt the trunk said: "I have the real facts about it. It is like a straight and hollow pipe, awful and destructive". One who had felt its feet and legs said: "It is mighty and firm, like a pillar"... Each had felt one part out of many. Each had perceived the whole, wrongly.

Tales of the Dervishes.

2.1. Picking up the Pieces

Rebuilding after any war is a long and difficult undertaking. It is even more difficult when there is political uncertainty and physical insecurity. The first obligation of the Government was to provide emergency relief--feed those who were hungry, find temporary housing for the dispossessed, and treat the many who were sick and injured. As a massive emergency efforts ended, emphasis turned from problems of relief and rehabilitation to reconstruction and development.

Governmental response to the consequences of the 1975-76 war has taken two main forms: (1) an attempt to help settle various immediate economic issues such as creditor-debtor relationships and the provision of some funds for reconstruction purposes in the private sector, and (2) the establishment of the institutional framework considered necessary for future

socio-economic planning. Recognizing the long-range importance of the latter--forward planning--the Government quickly established its Council for Development and Reconstruction (CDR) in late January 1977, even before full scale relief efforts were underway. The responsibilities given the Council were extensive, but ranking above all others was the obligation to prepare an overall, comprehensive development plan that would chart the direction, scope, and composition of Lebanon's future.

2.2. The Agenda Papers

The CDR approached its post-war development planning task by commissioning a series of "Agenda Papers" on the various sectors of the Lebanese economy, and on specific topics of vital importance to strategic planning. Suggested Agenda Paper topics included the following: housing, telecommunications, transport, roads, potable water, Beirut city center, airport, seaport, agriculture, education, health, tourism, industry, repatriation of skills and capital, role of private sector, rural-urban balance, incomes policy, fiscal reform, delivery of social services, administrative reform, culture, energy, manpower, and the transfer of science and technology. The purposes, as expressed in an advisor's memorandum, were as follows: "They will form the framework for a position paper on the Government's planning objectives to be submitted to the Council of Ministers in June, 1978; they will provide a basis for systematic and more detailed studies; and they will assess, after discussions with representative groups the degree of consensus on policy goals".

The Agenda Papers were prepared and submitted to the CDR. The CDR had reason to be grateful for the serious effort put into most of the papers without compensation for the authors. However, while each author has presented a faithful perception of a part of the system we call Lebanon, the

overall picture formed is as misleading as the blindmen of Ghor's description of the elephant. Since the approach to development planning exemplified is not an illogical approach, not even an uncommon one for that matter, the metaphor is less a criticism of the CDR than it is an indictment of the development planning state of the art. What is needed is a way to synthesize many isolated, incomplete perceptions of national development into a complete picture.

2.3. Systems Approach

The reconstruction and development of Lebanon requires some form of "systems" approach. Even for simple interventions associated with small projects, the factors that will determine the outcome must be identified, their relationships must be established, and secondary effects anticipated. In Lebanon we are talking about a massive intervention of very large projects with consequences that can easily be overlooked because they are incidental to the projects themselves. The unfortunate experiences of the United States with low income housing and highway programs, and of many countries with irrigation projects and multi purpose dams are familiar examples. Systemic thought is needed.

In November 1979 an interdisciplinary group of faculty of the American University of Beirut (AUB) prepared a proposal, "A Systems Approach to Guiding Reconstruction and Development in Lebanon," that outlines a procedure for using computer simulation models to generate development scenarios for Lebanon as aids for national, regional and sectoral planning. The CDR has formally endorsed the AUB proposal and the two organizations are working together at the administrative level to obtain funding for this comprehensive modeling effort. While there is optimism that the necessary external support is forthcoming, it was recognized that the development of a

dynamic computer-based planning and decision-aiding instrumentality could not be deferred indefinitely in anticipation of donor funding. It was decided to involve teams of students, first in the development of, and then in the experimentation with, a pilot model which would serve both as a training laboratory for them and a benchmark for future research.

2.4. Research Contract

In the summer of 1980 an agreement was entered into whereby the Republic of Lebanon, acting through the CDR, would grant AUB a sum previously granted to the CDR by the U.S. Agency for International Development, to develop a pilot model, the harbinger of a proposed package of interactive national, regional, and sectoral computer models to be used for the reconstruction and rehabilitation of Lebanon. The following main guidelines set forth the overall plan of action agreed upon by the parties:

- Phase 1: The development of NRDM (National Reconstruction and Development Model), an operational computerized simulation model of Lebanon.
- Phase 2: The performance of sensitivity analysis and calibration of parameters for three basic scenarios, identified as follows:
(1) the "no War" Scenario, (2) the "Reconstruction Plan" Scenario, and (3) the "No Reconstruction Plan" Scenario.
- Phase 3: The preparation of the final report completely documenting the pilot model NRDM to serve as a training manual for CDR personnel and AUB students.

The calendar of program implementation was to be of a flexible nature with the general strategy, taken from the Grant's terms of reference, to include the following steps:

- Phase 1: Ending February 1981. The implementation of NRDM on the American University of Beirut IBM 370 Computer and the training of six AUB students in the use of the model who will be available to the CDR for hiring upon their graduation.

Phase 2: Ending May 1981. The training of an additional 6 to 12 students in the use of the model. These students will be graduate students who will use this project in partial fulfillment of their degree requirements at AUB.

Phase 3: Ending August 1981. The complete documentation of the model in a final report which can serve as a training manual for CDR personnel and AUB students interested in extending their research.

Seven students worked on Phase 1, the first version of the pilot model which came to be referred to as NRDM-1. Under Phase 2 it was possible not only to perform sensitivity and policy analyses but to extend the model, and this improved version is called NRDM-2. Twelve students participated on this phase in partial fulfillment of Master Degrees. Phase 3 is the Final Report which is summarized in this paper.

THE MODEL

He himself, Hermes said, would give Perseus a sword to attack Medusa with, which could not be broken by the Gorgon's scales. This was a wonderful gift and yet, thought Perseus to himself, what use was a sword when the creature to be stuck by it could turn the swordsman into stone before he was within striking distance. Then Athena took off the shield of polished bronze that covered her breast and held it out to him. "Look into this when you attack her", she said, "and you will be able to see her reflection, and so avoid her deadly power". With these, Perseus sped to the hall of the Gorgons. In silence set two of the sisters,--"

"But a third woman paced about the hall
And ever turned her head from wall to wall
And moaned aloud, and shrieked in her despair;
Because the golden tresses of her hair
Were moved by writhing snakes from side to side,
That in their writhing oftentimes would glide
On to her breast, or shuddering shoulders white;
Or, falling down, the hideous things would light
Upon her feet, and crawling then would twine
Their slimy folds about her ankles fine.
This was Medusa.

The Classic Myths

3.1. Need for a Model

Richard Mason described mankind's pressing problems as possessing a Medusan quality about them. This certainly applies to Lebanon's which are difficult to formulate, dangerous to embrace, and paralyzing to confront. Policy makers are, understandably, reluctant to face the issues head-on. They, as modern day Perseuses, also need shields. Models that cast realistic images of the real world can serve as those shields. A system dynamics model of Lebanon that can be used for guiding reconstruction and development will be described in this section.

3.2. Forms of the Model

NRDM-2 is a model of Lebanon. It was distilled from the Agenda Papers which, taken collectively, is also a model of Lebanon. Each of the Agenda Papers deal with goals involving certain variables and policy

interventions involving other variables. To link the goal and policy variables, the authors of the Agenda Papers have implied an understanding of a complex set of intervening relationships, a system. Since the prose of the reports is the model representing the system, the Agenda Papers may be thought of as a verbal model. In contrast, the complex set of intervening relationships between variables in NRDM-2 are expressed by equations and it is referred to as a mathematical model. The verbal model of Lebanon contained in hundreds of pages of Agenda papers spanning many disciplines can not promote communication and understanding leading to consensus and it is too fuzzy, static, incomplete and imprecise to be used for decision making. NRDM-2 can be represented on a single page in the form of a "causal diagram" displaying the intervening relationships between goal and policy variables (see Fig. 3.1).

The causal diagram in Fig. 3.1 not only facilitates writing the equations that permit one to perform the arithmetic tasks that will trace Lebanon's development through time (see Appendix A for the model equations and Appendix B for the identification of parameters), but portrays a gestalt-like statement of the Lebanese socio-economic National development system in its own right. The significance of this graphic gestalt in the modeling paradigm is that it takes us out of a communication cul-de-sac providing a common vocabulary and structure of reasoning between individuals, professions, specialists, administrators, and cultures. Because of the sense of fragmentation and isolation conveyed by the Agenda Papers prepared for the CDR, the communicative ability of NRDM-2 is as important as its scientific rigor.

3.3. Overview of the Model

NRDM-2 is structured to accommodate three development orientations: (1) resource development, (2) regional development, and (3) sectoral development. Resource components include natural resources, land resources, water resources, and human resources (manpower). Regional development is organized on the basis of rural and urban in NRDM-2. Sectors represented in the model are agriculture, manufacturing, business, infrastructure and government. Obviously, the three orientations overlap. They are also tied together by two quantities most responsible for material growth: (1) population—including the effects of all economic and environmental factors that influence human birth, death, and migration rates, and (2) capital—including the means of producing industrial, service, and agricultural outputs. For the purpose of this report, NRDM-2 is organized as follows:

- Manufacturing (Eqs. 1-36)
- Business (Eqs. 37-69)
- Infrastructure (Eqs. 70-105)
- Manpower (Eqs. 106-137)
- Government Services (Eqs. 138-171)
- Agriculture (Eqs. 172-217)
- Population (Eqs. 218-244)
- Utilities (Eqs. 245-254)
- Highways (Eqs. 255-261)
- Housing (Eqs. 262-277)
- Trade-Energy (Eqs. 278-292)
- Socio-Economic Indicators (Eqs. 293-306)

Many of the sectors in NRDM-2 can be thought of as elements in a national account. The national account is concerned with the measure of aggregate product originating within some geographical area, in this case Lebanon, so that a picture of economic performance can be gained.

The end result of economic activity is the production of goods and services and the distribution of those goods and services to the members of society. The most comprehensive measure of national output is the gross

national product, usually abbreviated GNP. It is the value of all goods and services produced annually in the nation. The task of estimating the GNP, however, is not merely adding up the value of all output because that would be double-counting. In NRDM-2 the "value-added" method is used because in a complex society like Lebanon, there are very few final outputs produced solely by one industry. The final value of any product is created by a large number of different industries; each firm buys materials or supplies from other firms, processes or transports them, and thus adds to their value.

There are four major components of GNP, each representing a final use of GNP: consumption, investment, government purchases, and net exports. Investment refers to that portion of the final output which takes the form of additions to or replacements of capital. Government purchases of goods and services are a second component of GNP. In addition, government makes other expenditures, "transfer payments", which do not represent the purchase of output and are consequently excluded from GNP. Consumption refers to the portion of nation's output devoted to meeting consumer wants. Net exports, exports minus imports of goods and services, are a final use of GNP and must be included in our total. In NRDM-2, three of the four major components are grouped under the heading of GDP for gross domestic product: consumption, investment, and government purchases. It is evident, then, that the GNP is the sum of the GDP plus net exports in the model.

For purposes of national income analysis, GNP statistics are subdivided into mutually exclusive, collectively exhaustive categories. The most commonly used scheme for subdivision is that based on the International Standard Industrial Classification (ISIC). The nine major ISIC categories are listed in Table 3.1.

Table 3.1 International Standard Industrial Classification

<u>Code</u>	<u>Classification and Description</u>
1	Agriculture, hunting, forestry, and fishing
2	Mining and Quarrying
3	Manufacturing
4	Electricity, gas, and water
5	Construction
6	Wholesale and retail trade, restaurants, and hotels
7	Transport, storage, and communication
8	Financing, insurance, real estate, and business services
9	Community, social, and personal services

Each of the nine ISIC economic output divisions in Table 3.1 is associated with a particular capital stock in NRDM-2. In our model the agriculture sector provides most of the output in the first ISIC division. The NRDM-2 manufacturing capital stock provides the output in ISIC divisions 2 and 3. Business capital in the model is associated with the activities listed under ISIC divisions 6 and 8. The infrastructure sector in the model corresponds to ISIC divisions 4 and 7, and the government services sector to ISIC division 9.

THE SCENARIOS

"I don't understand you", said Alice. "it's dreadfully confusing!" "That's the effect of living backward," the Queen said kindly; "it always makes one a little giddy at first..."

"Living Backward?" Alice repeated in great astonishment. "I never heard of such a thing".

"...but there's one great advantage in it, that one's memory works both ways," the Queen continued, ignoring Alice's interruption.

"I'm sure mine only works one way," Alice remarked. "I can't remember things before they happen".

"It's a poor sort of memory that only works backward". the Queen concluded.

Through the Looking Glass

4.1. Introduction

Most development planners approach the task of designing the future with the naivete of Alice in Wonderland. As we study the dialogue between Alice and the White Queen, we begin to understand the Queen's lack of enthusiasm for a memory "that only works backward". No less an authority than Webster vindicates her in his definition of memory as "the power or process of reproducing what has been learned; the persistent modification of structure or behavior resulting from activity or experience". In this section we shall discuss the utilization of a technique called "scenario analysis" which permits one to "learn" and to gain "experience" from the future in much the same manner as one does from the past.

4.2. Generation of Scenarios

In the research we generate three variants of possible future configurations of Lebanese development activity, or three "scenarios".

Scenarios are attempts to describe future changes in the state or condition

of a social system--in this case, Lebanon. One of the scenarios has been dubbed the "No-War" Scenario. In this scenario the Lebanese economy is assumed to preserve in the future the pattern that existed in 1975 before the Civil War. The other two scenarios take conditions as they existed in 1980 as the initial state of the system with the difference between the two being whether or not there is a formal reconstruction effort. These are referred to as the "Reconstruction Plan" Scenario and the "No Reconstruction Plan" Scenario.

The three scenarios which cover a fifty year period starting from the present are expressed graphically to facilitate comparison. Specifically, the more than 300 variables of NRDM-2 have been weighted and condensed into 31 indicators representing fourteen socio-economic domains: human resources, wealth, distribution of wealth, government and politics, health, education, housing, land resources, agriculture and food, communications, transportation water resources, energy resources, and pollution. The 31 indicators, in turn, are weighted and combined linearly to produce an overall measure of the quality of life.

The development indicators selected for aiding in scenario analysis are summarized in Table 4.1. In Table 4.2 the values assigned to parameters in NRDM-2's equations in order to generate the three scenarios are given. For example, the values in the first column are based on the CDR five-year plan that was unveiled in 1979. This plan has been interpreted as follows. Private sector needs are reckoned at 9 billion Lebanese pounds, 0.8 billion per year for five years to manufacturing (Equation 26) and 1.0 billion per year for five years to business (Equation 59). It includes 10 billion Lebanese pounds over five years in the public sector spread among telecommunications (Equation 92), ports and airports (Equation 98), highways

TABLE 4.1 DEVELOPMENT INDICATORS FOR COMPARISON OF PRINCIPAL SCENARIOS

INDICATOR AND CATEGORY	VARIABLE	EQ. NO.	FIG. NO.
<u>HUMAN RESOURCES</u>			
1. National Population	NP	220	4.2
2. Percentage of Population Urban	POPU	370	4.3
3. Annual Natural Population Increase	ANPI	308	4.4
4. Percentage of Population of Working Age	PPWA	309	4.5
<u>WEALTH</u>			
5. Gross National Product	GNP	291	4.6
6. National Per Capita Income	NPCI	222	4.7
7. Population Density	POPDEN	310	4.8
8. Trade Balance Percentage of GNP	TBPGNP	311	4.9
<u>DISTRIBUTION OF WEALTH</u>			
9. Percentage Unemployment	PUNEM	312	4.10
10. Relative Rural Income	RRI	225	4.11
<u>GOVERNMENT AND POLITICS</u>			
11. Budget as Percentage of GNP	BPGNP	315	4.12
12. Govt. Transfer Payments as % of GNP	TPPGNP	316	4.13
<u>HEALTH</u>			
13. Population Per Physician	PPP	295	4.14
14. Percentage Health Subsidized	PHSUB	317	4.15
<u>EDUCATION</u>			
15. Adult Literacy	ALT	302	4.16
16. Percentage Education Subsidized	PESUB	319	4.17
<u>HOUSING</u>			
17. Average No. Rooms Per Person	ANRPP	300	4.18
18. Dwelling Unit Difficiency	DUD	268	4.19
<u>LAND RESOURCES</u>			
19. Urban Population Density	UPOPD	321	4.20
20. Average Farm Size	AFSIZ	322	4.21
<u>AGRICULTURE AND FOOD</u>			
21. Food Per Capita	FPCC	323	4.22
22. Percentage Ag. Land Irrigated	PALI	324	4.23
<u>COMMUNICATIONS</u>			
23. Television Sets Per Capita	TSPC	325	4.24
24. Cinema Attendance Per Capita	CAPC	326	4.25
<u>TRANSPORTATION</u>			
25. Motor Vehicles Per Capita	MVPC	297	4.26
26. Highway Density	HWYDEN	328	4.27
<u>WATER RESOURCES</u>			
27. Surface Water Impoundment Capacity Per	SWICPC	329	4.28
28. Water Demand Supply Ratio	WDSR	82	4.29
<u>ENERGY RESOURCES</u>			
29. Per Capita Energy Consumption	PCEC	296	4.30
30. Fuel Imports as Percentage of GNP	FIPGNP	330	4.31
<u>ENVIRONMENT</u>			
31. Pollution Ratio	POLR	17	4.32
32. Quality of Life	QOL	331	4.33

TABLE 4.2 PARAMETER SUMMARY FOR SCENARIO ANALYSIS

Eq.No.	Parameter	Parameter Values for Three Scenarios		
		Reconstruction Plan	No. Reconstruction Plan	No 1975-76 Civil War
1.2	MCN	4.8E9	4.8E9	8.0E9
25.1	FMPIX	.40	.20	.40
25.2	FMPIY	.45	.20	.40
25.3	RECPEF	5.	50.	0
26.1	RIMC	.8E9	0	0
27.2	NMN	3000	3000	6000
28.2	DMN	3000	3000	0
35.1	MRP	600	60	0
37.2	BCN	18.0E9	18.0E9	24.0E9
58.1	FBPIX	.35	.25	.35
58.2	FBPIY	.40	.25	.35
59.1	RIBC	1.0E9	0	0
60.2	NBN	20000	20000	30000
61.2	DBN	10000	10000	0
68.1	BRP	2000	200	0
70.2	EUCN	1.0E9	1.0E9	1.2E9
78.2	WJCN	1.0E9	1.0E9	1.2E9
86.2	TCCN	.5E9	.5E9	1.5E9
92.1	RITCC	.44E9	0	0
93.2	ITFN	1.0E9	1.0E9	1.5E9
98.1	RIITC	.1826E9	0	0
99.2	LTFN	3.0E9	3.0E9	4.5E9
104.1	RILTC	.485E9	0	0
108.1	FMPGX	.05	.03	.05
108.2	FMPGY	.05	.03	.05
112.1	FBPGX	.10	.05	.10
169.1	RILHC	.10	.05	.10
224.1	RNPCIN	.894E9	0	0
255.2	HLKN	3.6	3.6	4.8
258.1	HCCMT	1.2E4	1.2E4	1.8E4
262.2	UIDN	.9/.9/1/2/10/40	.9/.9/1/2/10/40	.9/.9/.9/1/8/25
263.2	LIDN	.75E6	.75E6	1.0E6
270.1	DCCMT	.7/.8/1.2/2.5/5/10	.7/.8/1.2/2.5/5/10	.7/.8/1/2/4/7
287.2	MYN	250000	250000	300000
36.1	FMOGC	.055	.05	.05
69.1	FBOGC	.105	.10	.10

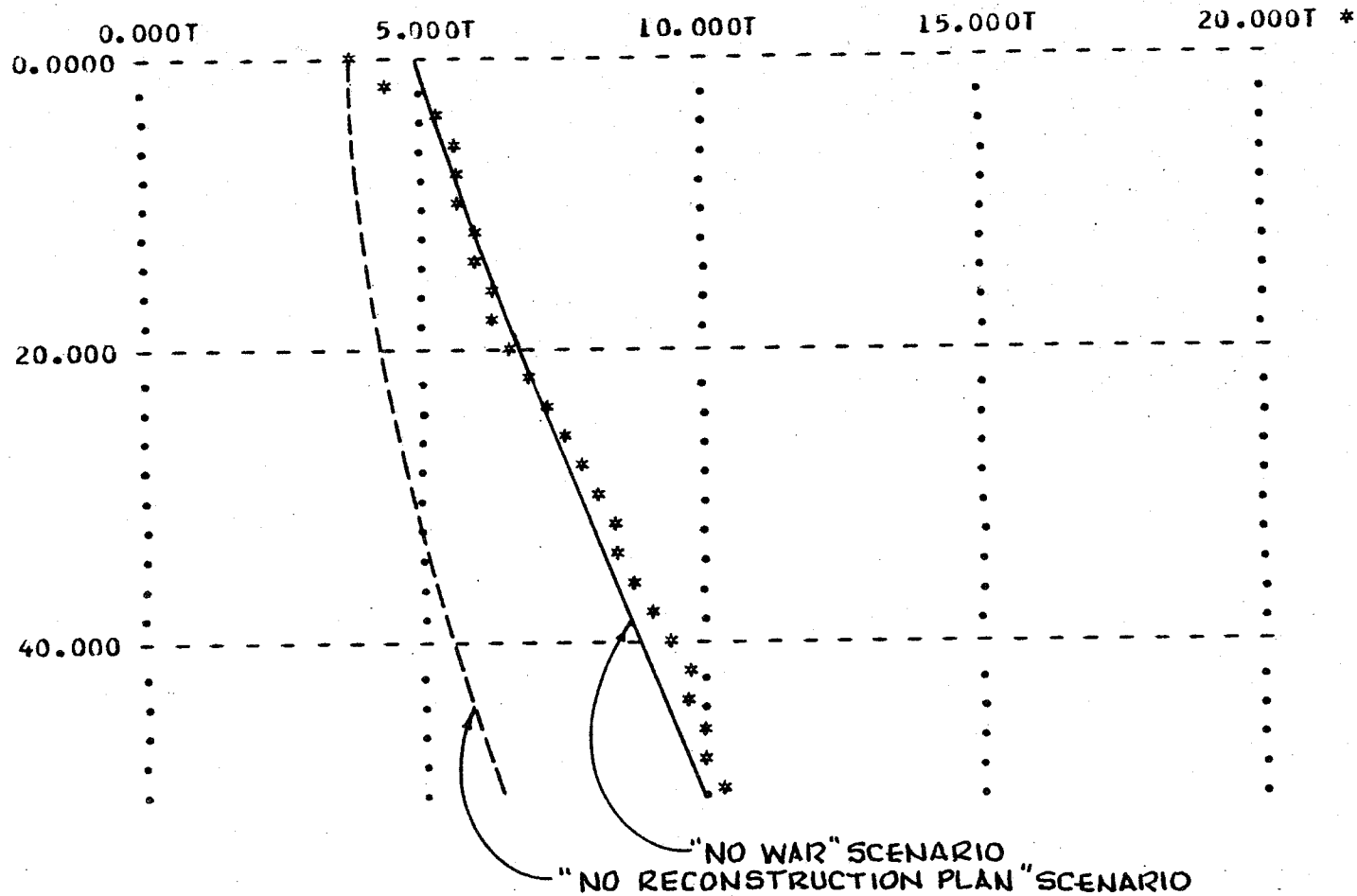
(Equation 1040, and low-income housing (Equation 169). For the purpose of this study it was assumed that private sector needs were supplied by loans which are repaid to Government (Equations 36 and 69) which in turn invests the money in irrigation (see Equation 217).

The manner in which the 3 futures can be compared using development indicators is illustrated in Figs. 4.7, 4.11, 4.32 and 4.33.

1. Population Growth	POP	370	4.3
2. Trade Balance Percentage of GDP	ISICM	308	4.9
3. Percentage of GDP			
4. Relative Total Income	YIM	312	4.10
5. Government and Social			
6. Budget as Percentage of GDP	BALG	315	4.12
7. Total Government Payments as % of GDP	PGM	318	4.15
8. Population per Hectare	POP	395	4.14
9. Population Density	POP	317	4.15
10. Total Income	YIM	312	4.10
11. Percentage of GDP	ISICM	308	4.17
12. Average H. Area Per Person	AREA	320	4.18
13. Available Land per Person	POP	363	4.19
14. Urban Population Growth	POP	370	4.20
15. Average Total Income	YIM	312	4.10
16. Percentage of GDP	ISICM	308	4.15
17. Total Per Capita	POP	370	4.18
18. Percentage of GDP	ISICM	308	4.15
19. Percentage of GDP	ISICM	308	4.15
20. Percentage of GDP	ISICM	308	4.15
21. Percentage of GDP	ISICM	308	4.15
22. Percentage of GDP	ISICM	308	4.15
23. Percentage of GDP	ISICM	308	4.15
24. Percentage of GDP	ISICM	308	4.15
25. Percentage of GDP	ISICM	308	4.15
26. Percentage of GDP	ISICM	308	4.15
27. Percentage of GDP	ISICM	308	4.15
28. Percentage of GDP	ISICM	308	4.15
29. Percentage of GDP	ISICM	308	4.15
30. Percentage of GDP	ISICM	308	4.15
31. Percentage of GDP	ISICM	308	4.15
32. Percentage of GDP	ISICM	308	4.15
33. Percentage of GDP	ISICM	308	4.15
34. Percentage of GDP	ISICM	308	4.15
35. Percentage of GDP	ISICM	308	4.15
36. Percentage of GDP	ISICM	308	4.15
37. Percentage of GDP	ISICM	308	4.15
38. Percentage of GDP	ISICM	308	4.15
39. Percentage of GDP	ISICM	308	4.15
40. Percentage of GDP	ISICM	308	4.15
41. Percentage of GDP	ISICM	308	4.15
42. Percentage of GDP	ISICM	308	4.15
43. Percentage of GDP	ISICM	308	4.15
44. Percentage of GDP	ISICM	308	4.15
45. Percentage of GDP	ISICM	308	4.15
46. Percentage of GDP	ISICM	308	4.15
47. Percentage of GDP	ISICM	308	4.15
48. Percentage of GDP	ISICM	308	4.15
49. Percentage of GDP	ISICM	308	4.15
50. Percentage of GDP	ISICM	308	4.15
51. Percentage of GDP	ISICM	308	4.15
52. Percentage of GDP	ISICM	308	4.15
53. Percentage of GDP	ISICM	308	4.15
54. Percentage of GDP	ISICM	308	4.15
55. Percentage of GDP	ISICM	308	4.15
56. Percentage of GDP	ISICM	308	4.15
57. Percentage of GDP	ISICM	308	4.15
58. Percentage of GDP	ISICM	308	4.15
59. Percentage of GDP	ISICM	308	4.15
60. Percentage of GDP	ISICM	308	4.15
61. Percentage of GDP	ISICM	308	4.15
62. Percentage of GDP	ISICM	308	4.15
63. Percentage of GDP	ISICM	308	4.15
64. Percentage of GDP	ISICM	308	4.15
65. Percentage of GDP	ISICM	308	4.15
66. Percentage of GDP	ISICM	308	4.15
67. Percentage of GDP	ISICM	308	4.15
68. Percentage of GDP	ISICM	308	4.15
69. Percentage of GDP	ISICM	308	4.15
70. Percentage of GDP	ISICM	308	4.15
71. Percentage of GDP	ISICM	308	4.15
72. Percentage of GDP	ISICM	308	4.15
73. Percentage of GDP	ISICM	308	4.15
74. Percentage of GDP	ISICM	308	4.15
75. Percentage of GDP	ISICM	308	4.15
76. Percentage of GDP	ISICM	308	4.15
77. Percentage of GDP	ISICM	308	4.15
78. Percentage of GDP	ISICM	308	4.15
79. Percentage of GDP	ISICM	308	4.15
80. Percentage of GDP	ISICM	308	4.15
81. Percentage of GDP	ISICM	308	4.15
82. Percentage of GDP	ISICM	308	4.15
83. Percentage of GDP	ISICM	308	4.15
84. Percentage of GDP	ISICM	308	4.15
85. Percentage of GDP	ISICM	308	4.15
86. Percentage of GDP	ISICM	308	4.15
87. Percentage of GDP	ISICM	308	4.15
88. Percentage of GDP	ISICM	308	4.15
89. Percentage of GDP	ISICM	308	4.15
90. Percentage of GDP	ISICM	308	4.15
91. Percentage of GDP	ISICM	308	4.15
92. Percentage of GDP	ISICM	308	4.15
93. Percentage of GDP	ISICM	308	4.15
94. Percentage of GDP	ISICM	308	4.15
95. Percentage of GDP	ISICM	308	4.15
96. Percentage of GDP	ISICM	308	4.15
97. Percentage of GDP	ISICM	308	4.15
98. Percentage of GDP	ISICM	308	4.15
99. Percentage of GDP	ISICM	308	4.15
100. Percentage of GDP	ISICM	308	4.15

NRDM-2 (CASE 4)

NPCI=* FOR "RECONSTRUCTION PLAN" SCENARIO

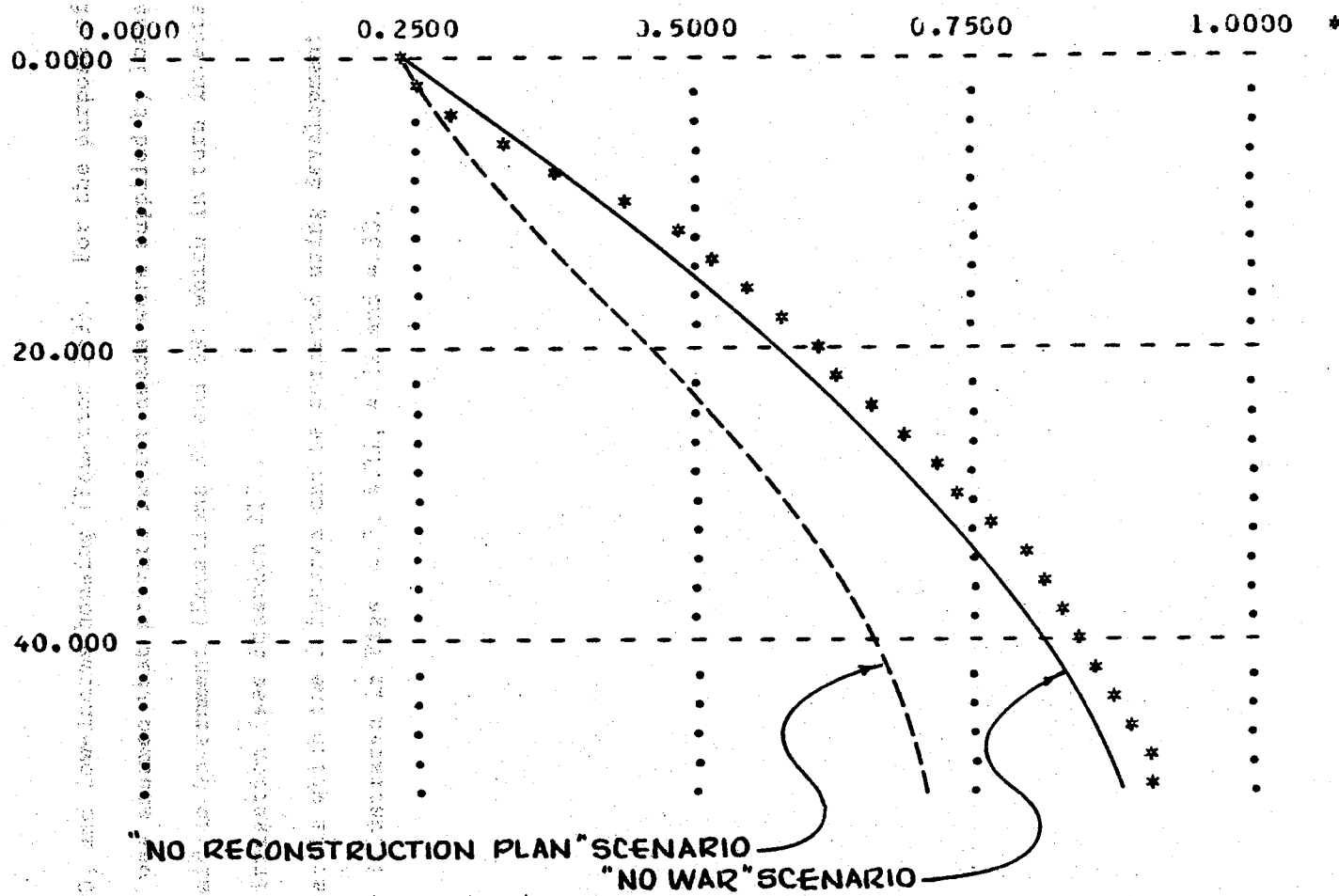


3 SCENARIOS IN TERMS OF NPCI-NATIONAL PER CAPITA INCOME

FIG. 4.7

NRDM-2 (CASE 4)

RRI=* FOR "RECONSTRUCTION PLAN" SCENARIO

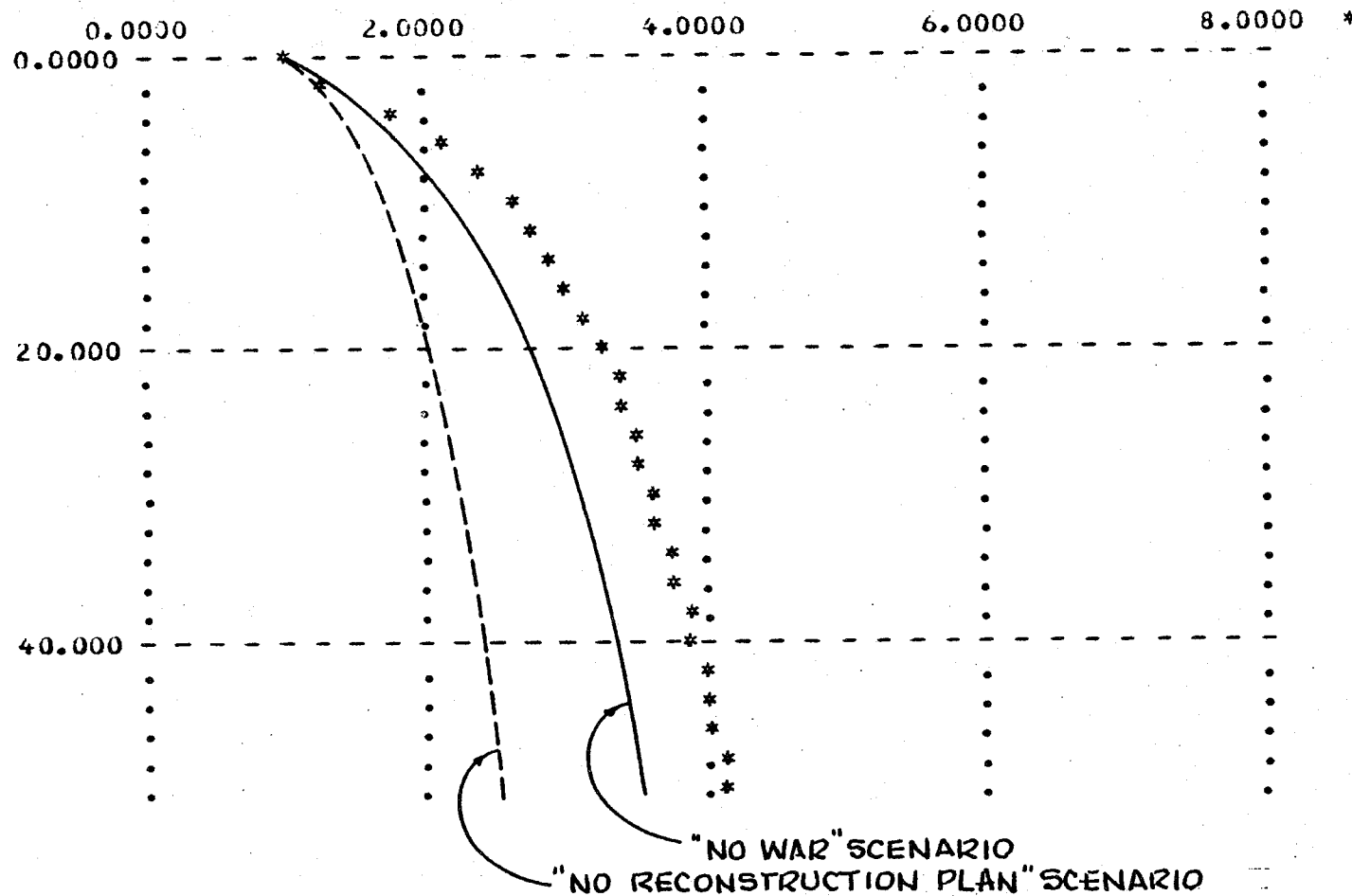


3 SCENARIOS IN TERMS OF RRI-RELATIVE RURAL INCOME

FIG.4.11

NRDM-2 (CASE 4)

POLR=* FOR "RECONSTRUCTION PLAN" SCENARIO

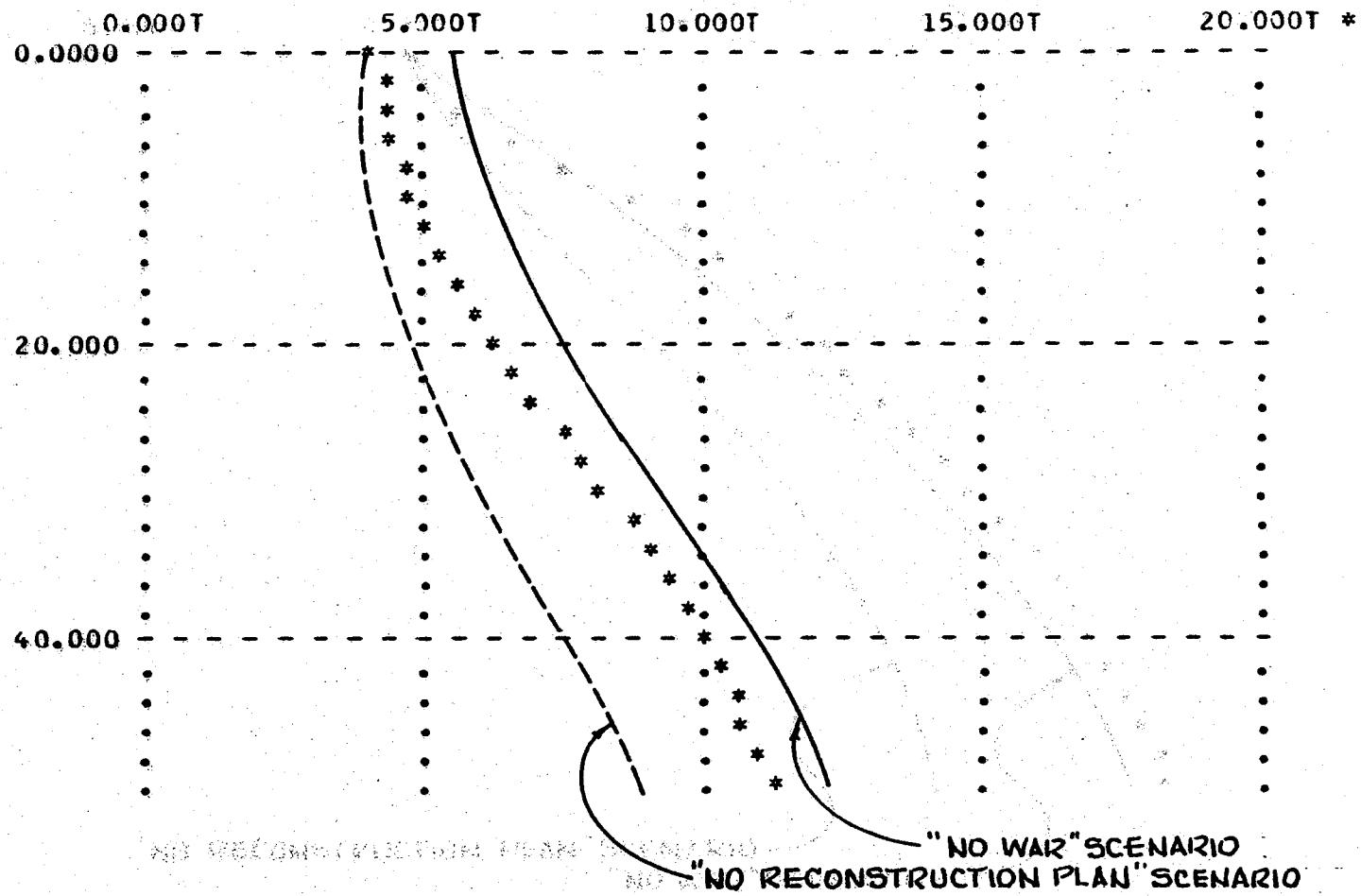


3 SCENARIOS IN TERMS OF POLR-POLLUTION RATIO

FIG. 4.32

NRDM-2 (CASE 4)

QOL = * FOR "RECONSTRUCTION PLAN" SCENARIO



3 SCENARIOS IN TERMS OF QOL-QUALITY OF LIFE INCOME

FIG. 4.33

THE POLICIES

I am not ignorant that many have been and are of the opinion that human affairs are so governed by fortune and God, that men cannot alter them by any prudence of theirs, and indeed have no remedy against them; and for their reason have come to think that it is worth while to labor much about anything, but that they must leave everything to be determined by chance.

I think it may be the case that Fortune is the mistress of one half our actions and yet leaves the control of the other half, or a little less, to ourselves. And I would liken her to one of those wild torrents which, when angry, overflow the plains, sweep away trees and houses, and carry off soil from one bank to throw it down upon the other. Every one flees before them, and yields to their fury without the least power to resist. And yet, though this be their nature, it does not follow that in seasons of fair weather, men cannot, by constructing weirs and moles, take such precautions as will cause them when again in flood to pass off by some artificial channel, or at least prevent their course from being so uncontrolled and destructive.

The Prince

5.1. Introduction

On April 28, 1981 Israeli jet fighters shot down two Syrian helicopters over Lebanon. In response Syria brought up lethal Soviet-made SA-6 surface-to-air missiles to counter the threat. As Syria and Israel braced for a violent showdown that could bring war to the region once again--and one, moreover, that conceivably could drag in the superpowers--the U.S. and the Soviet Union moved swiftly to restrain their respective allies. Caught in the middle, as always, battered Lebanon anxiously waited for others to settle its fate. Nothing could underscore more dramatically the flimsiness of Lebanon's grip on its own destiny.

We have introduced this section with one of Niccolo Machiavelli's admonitions to his Prince. The message is clear: Fortune helps those who help themselves. Dr. Salim El-Hoss as Prince Minister of Lebanon echoed this

sentiment in an eloquent, inspiring address at the 110th Commencement of the American University of Beirut:

"...we should not cajole ourselves into believing that a conspiracy was the sole cause of our crisis, and be blinded by it to the existence of other factors. If we were to do this, we would deserve the accusation of those who say that the Lebanese crisis has produced many lessons, but it has failed to produce those who can heed them. Let us then pause a while and give a little thought to our affairs. In the days when we were at the apogee of our fortune we were not superior to other, any more than today, in our decline, we are more abject than others. Yesterday, the intoxication of success prevented us from perceiving our shortcomings and from foreseeing the pitfalls that were lying in wait for us; today, the humiliation of our decline should not similarly prevent us from seeing those virtues that are ours and from striving to regain our health and well-being."

5.2. Knowledge and Development

Of all the problems of human affairs, those associated with national development are the most perplexing. The evolution of theories of socio-economic development is a fascinating story of intellectual inventiveness and ideological self-delusion. Why is it that there aren't significant correlations between development and mild climatic environments or between development and a abundance of natural resources? It is evident that some countries have "played their cards" better than others.

Development is a metaproblem--one that crosses disciplines, is value-ridden, and requires trade-offs between competitive ends. In combating the development metproblem, there is no weapon more potent than knowledge, no

panacea more effective than the understanding that knowledge can bring. But what kind of knowledge?

Consider the evolution of civilization: In primitive societies, the existing systems were these arising in nature and their characteristics were accepted as divine and as beyond man's comprehensive and control. As industrial societies emerged, socio-economic systems became so complex and their behavior so confusing that they were attributed to random, irrational causes. Development was a matter of luck, and luck was looked on as a loving mother with too many children to attend. Gradually over the past century it has become clear that a barrier to achieving development is the fragmentation of knowledge and our inability to structure it.

Whereas there has been exponential growth in fundamental knowledge of the environment and society, there is a scarcity of knowledge concerning the design and operation of the systems using this knowledge. While human capacities to shape the environment and society are rapidly increasing, policymaking capabilities to use these capacities are not. For example, we can create a gene in a test tube reflecting our understanding of the basic secrets of the life process, while at the same time we cannot handle the population explosion, a manifestation of the most primitive biological urge. It is the growing gulf between the capacity to control the environment and society, on one hand, and the knowledge of how to design and operate our societal meta-control systems so they can use these capacities, on the other hand, which constitutes the major obstacle to development.

5.3. Policy Experiments

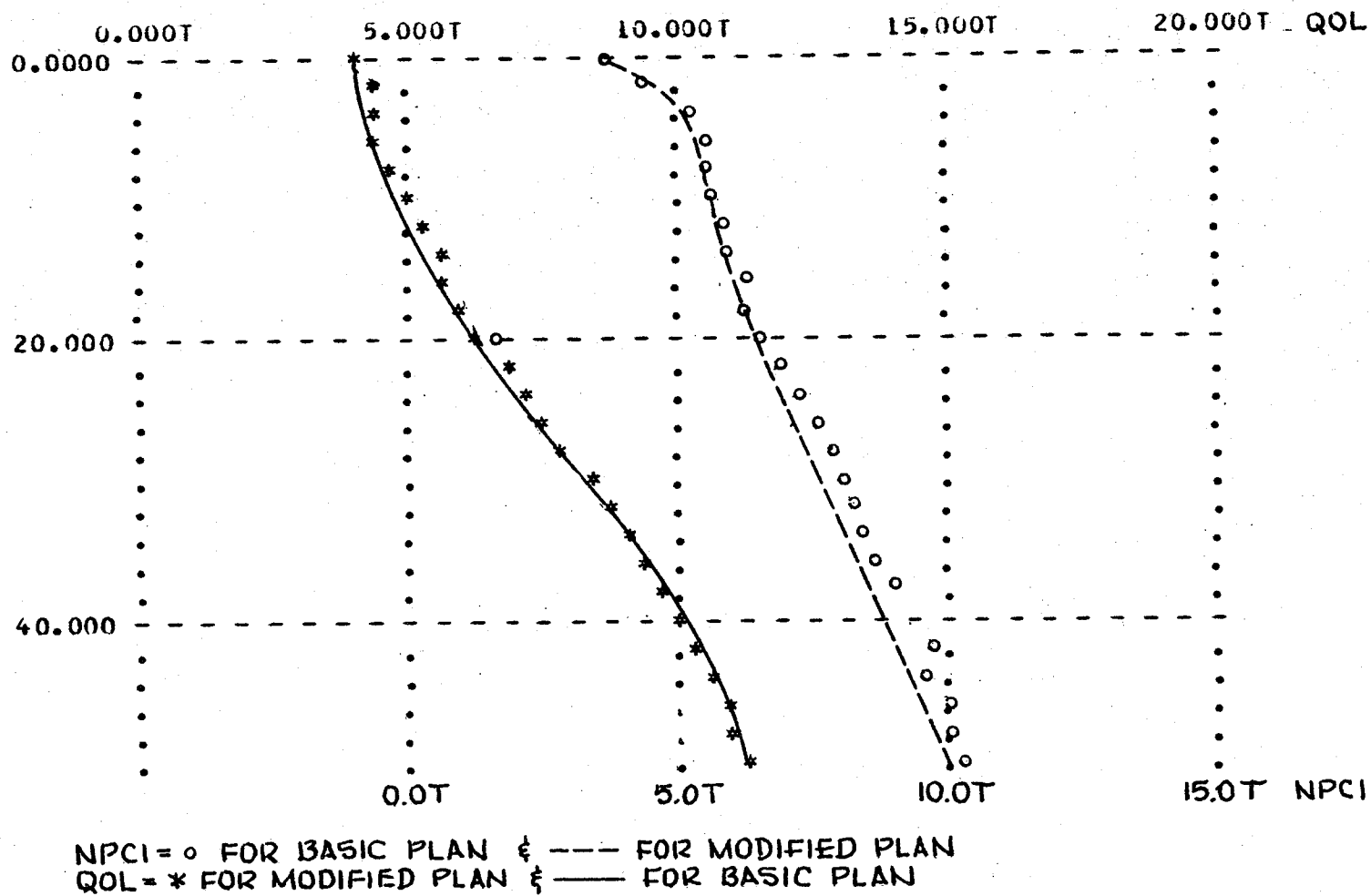
Armed with the knowledge that we have in NRDM-2 the capability to observe the time paths of hundreds of socio-economic variables over the next 50 years of Lebanon's future, we are about to do what all development

planners would like to be able to do: to see what the next 50 years would look like if any of several variations in the Reconstruction Plan Scenario are substituted. This will be illustrated by testing two hypothetical policies identified as a Taxation Policy and a Zoning Policy.

Taxation Policy. Traditionally Lebanon has tended to pursue a policy favorable to private interests--laissez faire. But if social justice is to accompany physical and economic reconstruction, it is doubtful that needed social programs in the future can be undertaken without a budget fueled by taxes. To show how we use NRDM-2 to experiment with various tax policies, two computer cards were changed and a simulation run was made. Specifically, the parameter FM PGX, the Fraction of Manufacturing Product to Government after Reconstruction which is Equation 108.1, was made equal to .10, and the parameter FB PGX, the Fraction of Business Product to Government after Reconstruction which is Equation 112.1, was made equal to .15. Recall from Table 4.2 that under the basic Reconstruction Plan Scenario the values used for these two parameters were FM PGX = .05 and FB PGX = .10. Referring to Table 4.2, note that the two fractions during the period of reconstruction would remain .05 and .10 respectively. Thus, the tax increase would take effect after the formal reconstruction period. One result of this computer run is presented in Figure 5.1. To facilitate evaluation and comparison to the basic Reconstruction Plan Scenario of this modified plan, some of the same development indicators employed for comparison of the three principal scenarios in Table 4.1 are used.

Zoning Policy. Zoning decisions determine the supply of land available for various socio-economic activities. In Lebanon zoning is an unexploited policy instrument. The amount of land and its use influence such

NRDM-2 (CASE 4A)



MODIFIED RECONSTRUCTION PLAN SCENARIO BASED ON TAXATION POLICY

FIG. 5.1

things as the present and future housing market, population mix, economic growth, employment conditions, and environmental quality. Since a country must live with its zoning decisions for decades, local decisions affecting land use should be made in the context of the total national system. Land zoning policy tests afford a basis for accomplishing this. To illustrate this capability, four parameters in the model were changed as indicated below:

Parameter Name	Description	Equation	Normal Value (ha)	Present Value (ha)
LZM	Land Zoned for Manufacturing	31.2	4500	6000
LZB	Land Zoned for Business	64.2	8000	10000
LZH	Land Zoned for Highways	256.2	1500	2000
LZD	Land Zoned for Dwellings	269.2	10000	12000

The impacts of the present policy values on selected development indicators are shown in Figure 5.2.

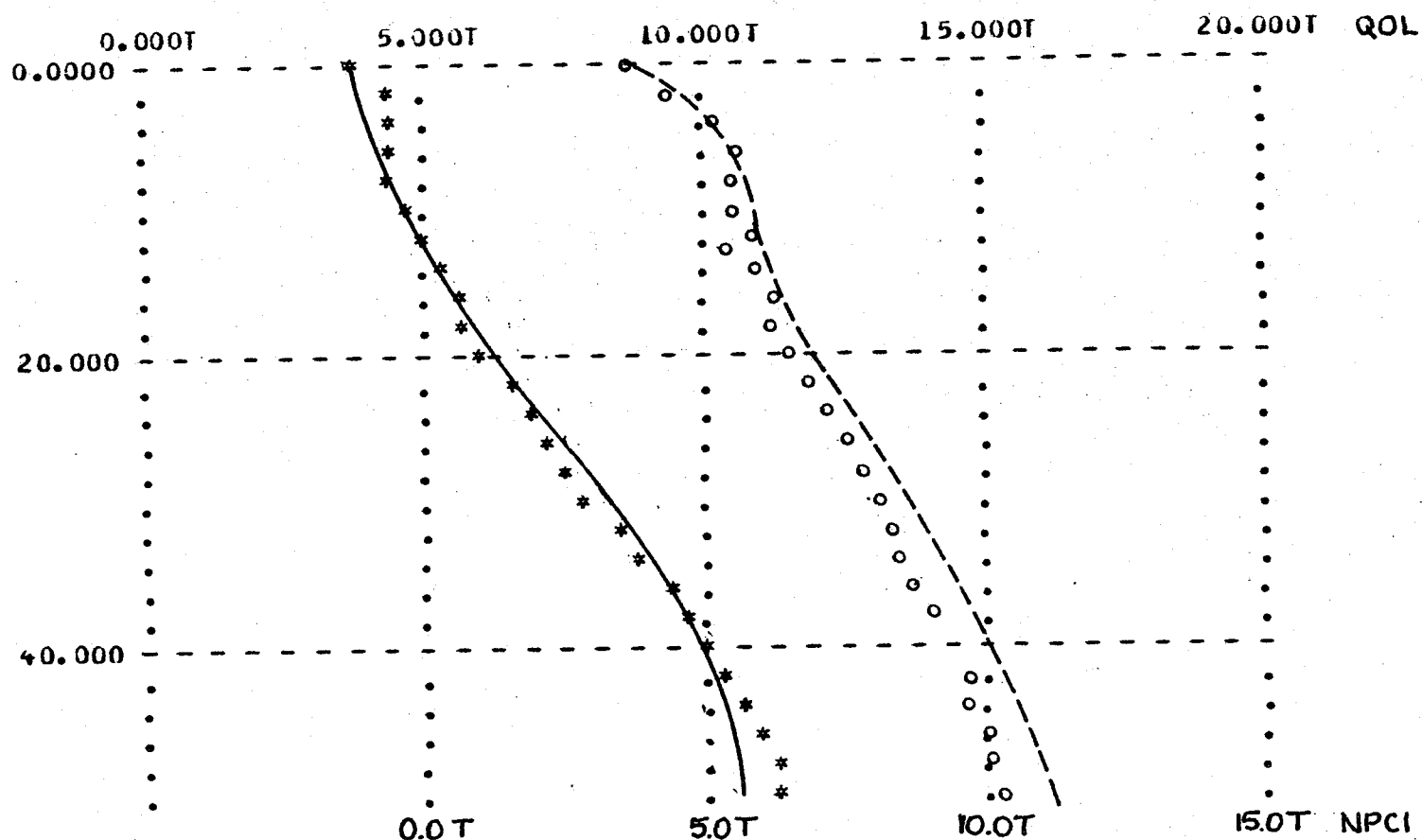
5.4 Sensitivity to Exogenous Factors

In addition to policy experiments, additional experiments can be performed with NRDM-2 to try to ascertain the potential effects of factors such as fuel costs and world economic development that are beyond Lebanon's control.

National Cost of Fuel, NCF. This variable in NRDM-2 is defined in Eqs. 285 and 285.1. Translating the equations from mathematics to English: the present cost of fuel in Lebanon is taken as 750 LL per TOE (Ton-Oil-Equivalents) and that it increases steadily to 2500 LL/TOE in the year 2030. How good is this assumption? How critical is it?

NRDM-2 (CASE 40)

NPCI=0 FOR BASIC PLAN & --- FOR MODIFIED PLAN
 QOL=* FOR MODIFIED PLAN & — FOR BASIC PLAN



MODIFIED RECONSTRUCTION PLAN SCENARIO BASED ON ZONING POLICY

FIG. 5.2

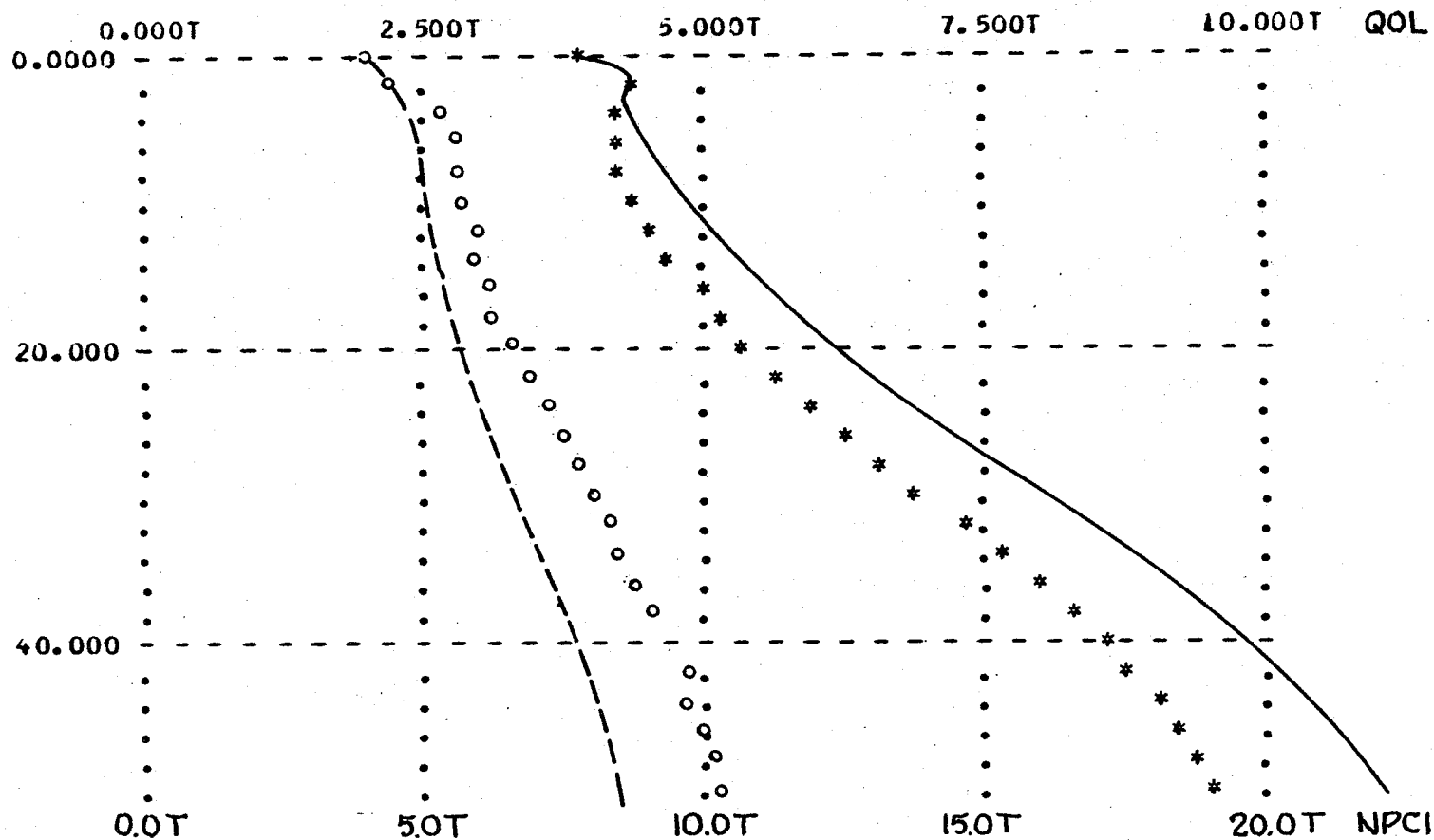
Fortunately it is not the task of this research or any research to forecast the values of its exogenous variables, but only to understand the effects of varying forecasts on important national development indicators. The effects of a steady state value in 50 years for the exogenous variable NCF that is twice that assumed originally in NRDM-2 is shown in Figure 5.9 for selected development indicators.

World Per Capita Income, WPCI. As in the case of NCF, above, WPCI is treated as a time-dependent exogenous variable. It is defined in Eq. 221. The significance of WPCI in the model is that it is a principal determinant of the Emigration Rate, ER (Eq. 235). The higher world per capita income with respect to the national per capita income in Lebanon, the greater the number of Lebanese that will leave each year, according to the assumptions in the model.

If we accept a recent report, "Global 2000", our projection for WPCI is NRDM-2 is too low. An experiment was designed based on almost doubling WPCI so that it reached 2300 LL/yr. in 50 years. A comparison of the outputs based on the two alternative forecasts for WPCI is summarized in Figure 5.11.

NRDM-2 (CASE 4B)

NPCI = 0 FOR BASIC ASSUMPTION & --- FOR MODIFIED ASSUMPTION
 QOL = * FOR MODIFIED ASSUMPTION & — FOR BASIC ASSUMPTION

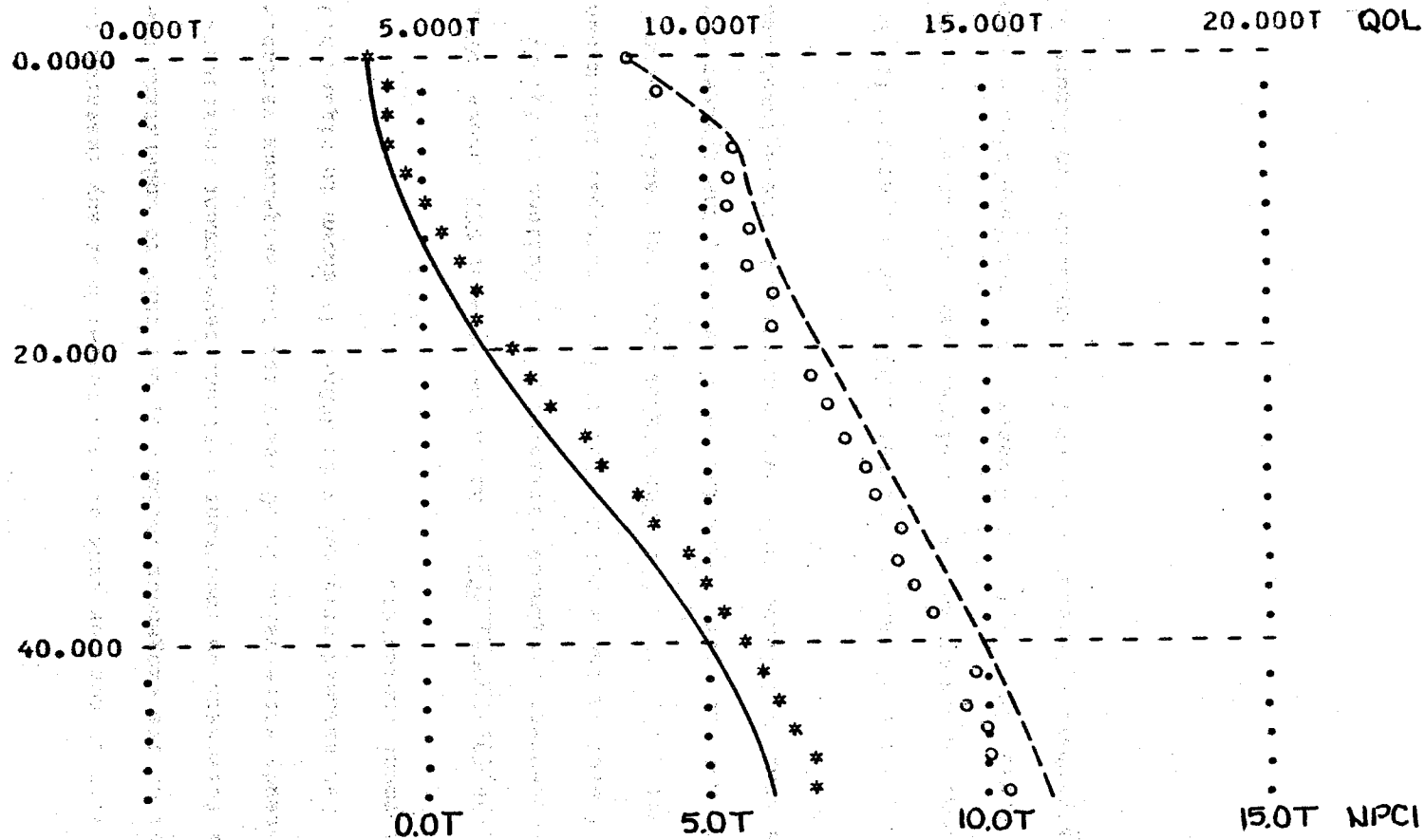


EFFECT ON LEIBANON OF NCF-NATIONAL COST OF FUEL

FIG. 5.9

NRDM-2 (CASE 4C)

NPCI = 0 FOR BASIC ASSUMPTION & FOR MODIFIED ASSUMPTION ---
 QOL = * FOR MODIFIED ASSUMPTION & FOR BASIC ASSUMPTION ---



EFFECT ON LEBANON OF WPCI-WORLD PER CAPITA INCOME

FIG. 5.11

THE SKEPTICS

Things being thus ordered, he would defer the execution of his designs no longer, being spurred on the more vehemently by the want which he esteemed his delays wrought in the world, according to the wrongs that he resolved to right, the harms he meant to redress, the excesses he would amend, the abuses that he would better, and the debts he would satisfy. And therefore, without acquainting any living creature with his intentions, he, unseen of any, upon a certain morning, somewhat before the day, armed himself cap-a-pie, mounted on Rozisante, laced on his ill-contrived helmet, embraced his target, took his lance, and by a postern door of his base-court issued out to the field, marvellous jocund and content to see with what facility he had commenced his good desires.

DON QUIXOTE

6.1 Introduction

We are at the dawn of a new era--an information systems age that will change forever the way the world works, plays, travels, and even thinks. Just as the industrial revolution dramatically expanded the strength of man's muscles and the reach of his hand, so the computer revolution will magnify the power of his brain. But unlike the industrial revolution, which depends on finite material and energy resources, the new information systems age will be fired by a limitless resource--knowledge.

The driving force behind the revolution lies in fundamental developments in computer technology--ranging from silicon chips etched with powerful circuitry on the hardware side to interactive problem-oriented languages on the software side. The result is a problem-solving aid of enormous potential. Because of these developments, systems analysts have begun to approach the public decision makers with computer models to permit him to understand the future implications of present decisions and policies. It would appear logical that any such tool which could add rigor and scope to analysis and understanding would be wholeheartedly embraced. The question

is: Why is the systems approach in general and computer models in particular not so avidly espoused? The answers range from skepticism that such grand endeavors are quixotic to deeply seated psychological and intellectual prejudices.

6.2 Enemies of the Systems Approach

In order to understand why the world's leaders have not more rapidly responded to computer modeling as tools for development planning, we must first appreciate the fact that they're not "in" the systems approach but rather live and decide "outside" it. Churchman has gone so far as to coin the idea of the "enemies" on the systems approach--approaches to human life that are not comprehensive, holistic, or rational. His sword falls on the humanities as he singles out politics, morality, and aesthetics as entities that have in common a tendency of rejecting the reality of the whole system in lieu of single-minded; short-sighted, piecemeal approaches.

Far more formidable than the humanities as foes of the system approach and their offspring, large-scale interdisciplinary computer models, are the management and academic establishments. While politics, morality and aesthetics are merely implausible enemies, modern management and education are implacable adversaries.

One of the paradoxes of the "traditional approach" to problem solving is that in spite of the rapid pace of technological change and growth in fundamental knowledge, solving contemporary problems using the traditional approach has not become easier. The reason is overspecialization--the tendency for professionals to narrow their focus and for scientists to compartmentalize their knowledge. The results were inevitable: (1) within disciplines, there is needless replication of research and duplication of effort; (2) between disciplines, we find authors tending to differentiate

their findings with contrived superficiality rather than contributing to the unity of science; and (3) throughout the professions and the scientific disciplines, there is a lack of social concern simply because the social need rarely expresses itself in a form to which the specialists' knowledge is simply and directly applicable.

The traditional approach to problem solving is inadequate because it is based on a philosophy that is knowledge-oriented, rather than problem-oriented. Problems are framed intellectually as philosophical questions and pragmatically as merely technological deficiencies. As to the latter, the myth of the technological fix was exposed during the energy crisis of 1974 when it dawned on humanity that the world and its resources were finite. As to the former, the scientific philosophy underlying the traditional approach aimed only at understanding the world, not improving it. While proclaiming itself as the science of the general, its essence as thus conceived was analysis, not synthesis. The approach was the division of traditional problems into a number of separate and less baffling questions. The maxim of success was: "Divide and conquer". The ultimate end was the conceptualization of the world as a whole and the unity of science. But one does not accomplish either through reconstruction of the pieces into which they have been disassembled.

The traditional approach to problem solving is wrong because it assumes that the structure of the environment and of society are isomorphic with the structure of physical science and social science, respectively. Traditionally, in order to understand what appeared to him to be diverse aspects of reality, man has developed different scientific disciplines: engineering, medicine, law, management, physics, chemistry, biology, mathematics, philosophy, sociology, geography, history, economics, etc. And

in solving different problems man has relied on experience and expertise in relevant disciplines. But our academic disciplines have proven to be more convenient ways of organizing our knowledge than applying it because the environment and society and the problems and the phenomena they present are transdisciplinary.

Development is more than a physical or economic concept. It is both a desired state of a system and the process by which that state is achieved. National development is a measure of a country's vulnerability to externalities and of the extent that it is in control of its own destiny. It can be furthered by a set of possible change; technological (projects), socio-economic (policies and programs) and cultural (education). Lastly, development is a complex multigoaled metaproblem--one that entails variables from many academic disciplines, involves the necessity to impose some sort of balance between several apparently competitive ends, and requires ethical interpretation. Metaproblems, in general, and the development metaproblem, in particular, rarely receive rational scientific attention because they remain outside any traditional problem solving discipline and are seldom shared with the new systems scientists, for reasons succinctly articulated by Sutherland. First of all, administrators tend to limit the use of their interpretation of systems analysis to the tactical sub-problems framed to match disciplinary expertise while tackling the critical strategic functions, that should have included the definition and partitioning of the problem as well as the synthesis of solutions, with casual deduction and raw speculation. The partners in crimes of omission and commission are the traditional physical and social scientists who restrict their inputs in the traditional problem solving process to their well-tended little plots of specialized knowledge of the environment and of society, respectively. A

metaproblem, itself, never receives their attention because of the inadequacy of their techniques and the irrelevancy of their philosophy. Neither the traditional approaches in the soft sciences nor the hard sciences suffice for solving metaproblems--the former are verbal, qualitative and do not permit manipulation; the latter are wrapped obscurely in the mathematics of calculus and are only useful for simpler sub-problems. Then there is the disclaimer that value-ridden issues are not the proper province of science anyway--a self-serving excuse for avoiding complicated, intractable problems so as to concentrate on simpler questions that guarantee quick completion experiences.

Finally, society absolves the most critical issue affecting it--the development metaproblem--from true systems analysis because of bureaucratic arrogance and technocratic apprehension. A bureaucracy is a government characterized by specialization of functions with strict adherence to a rigid formal routine. A technocracy is government by technical experts. In the former the development metaproblem and its issues, such as energy and the environment, rural and urban, economic growth and social justice, guns and butter, inflation and unemployment, are framed as examples of irresolvable differences to be accommodated in accordance with the relative weights of the various constituencies; in the latter, as alternatives to be analyzed through the performance of quasi-optimal trade-offs. For the bureaucrat, there are no social problems--only political pressures.

6.3. The Promise of the Systems Approach

We have come to the conclusion that society is a system which is being dragged down by its own inefficiency. The system operates through a set of institutions which worked well enough in a more leisurely age. But now its relaxation times no longer match the rate of perturbations and our

systems at all levels of government are actually designed to have wastable outputs. A systems approach to the future is needed.

When development--the control of our density--is considered in systems terms, some of the bewildering complexity of our world and its cities and its regions disappears. The broad, subjective goals of development seem to find meaning in the concept of entropy. While development in this context is maximization of negentropy, this is not an application of a law of physics, but merely a method of reasoning that helps to show us what must be done. We must redesign our institutions because requisite variety for running the world, a nation, or even a great city does not exist in any man's head, whether he is a premier, president, party secretary, governor, mayor, congressman, economist, engineer, or clergyman.

While it is possible for experts to understand portions of development systems fairly well, but to put together more than a few of these relationships in an internally consistent manner without a formal technique is impossible. Development systems are composed of many feedback loops with delays, nonlinearities, and noise in the information channels and their behavior cannot be anticipated by studying isolated portions sequentially. The difficulty multiplies when considerations of policy formation and their impacts are needed. It is well within the state-of-the-art for us to improve our mental models for policy analysis and planning through the development and use of computer simulation models such as NRDM-2.

Simulation of a socio-economic system like a region involves building and operating a model designed to represent those features of the system which are deemed to be significant in view of the objectives behind the simulation. Some of the more obvious benefits of simulation include: (1) forecasting of macro behavior; (2) predicting consequences of government

actions and refusal to act; (3) conducting sensitivity analysis to establish research and data gathering priorities; and (4) providing aids to communication among specialists and in the achievement of understanding.

It is known that the construction of computer simulation models help free development planners from a mechanistic, deterministic view of a region, and provide them with a more dynamic and comprehensive tool for influencing change. Specific potential uses of URDM-2 include: (1) providing a means for implementing a systems capability, (2) monitoring progress during policy implementation, (3) comparing strategic alternatives, and (4) as a pedagogical tool aiding in the training of a cadre of development planners.

6.4. Summary and Conclusions

During the last two decades, Lebanon has witnessed rather sudden prosperity which not even the Civil War could suppress. It has also engaged in a rat-race for procuring the largest share of the bonanza with the least expenditure of effort in the shortest time possible--illegitimately if necessary. The intensity for the need for success has resulted in the bending of the interpretation of such words as professionalism, scholarship, honor, and equity. Illegitimate means, before the war, gradually became justifiable, and justifiable means, during the worst period of the war in 1975-76, have become laudable by many--described as "guile" and even "genius" as long as it succeeds.

Post-war Lebanon is like post-war U.S.A. in many respects, where ills are attributed to changes beyond control and variously to lack of will, moral decay, selfishness, and the scattering of community responsibility. While these are factors, the key is that these nations want everything without considering--what in systems terms is called--the trade-offs. You can't stress freedom as well as order, individual liberty as well as equality,

security as well as profits from risks taken, and material wealth along with spiritual worth. These are conflicting values. Lastly, you can't have anything without taxation and conscription.

Most people do not worry about the Lebanese people because of their resourcefulness and propensity to move to countries where there are opportunities when the times are right: they worry about Lebanon. The experiment with alternate forecasts of world per capita income in Section 5 as an exogenous input to NRDM-2 dramatizes the necessity of taking a world view in approaching the problems of Lebanon's reconstruction and development.

Therefore, the purpose of this section is twofold: (1) to incorporate a world view into this research and (2) to try to diffuse anxieties regarding the study's approach ("systems") and its instrument ("NRDM-2"). In responding to this purpose we have ranged far and wide because we believe that the old fashioned problem-solving remedies that nations have used no longer suffice. There is a world wide malaise, a sense of diminished vision in facing development problems. Unlike previous times of difficulty in which good and evil could be sharply perceived, today there is a feeling that the real problems of nations are so complex that the traditional way to running things is inadequate.

One real danger is that the world will sit back and hope for leadership in the belief that great issues summon great men. And when the man in the street thinks of this type of leadership, he generally means "charisma." The question is whether the world really needs more of the charismatic, individualistic leaders that have dominated our century. Henry Kissinger is reported to have ventured the opinion that "A society that must produce a great man in each generation to maintain its domestic or international position will doom itself." A second danger is that those

skeptical of the systems approach will--with no scientific basis for their reticence, with only a gut feeling for the realities of the policy area, and because of some deep psychological repulsion--merely condemn endeavors such as this study. No engineered system--Polaris, Apollo, Columbia--costing billions and affecting millions would be designed without making a model. Yet, national development systems are continually planned, designed and operated based on policies that have never been tested as to possible consequences. Institutions for evaluating experimental "software" such as policies must be established, just as we have laboratories for testing hardware.

Humanity is now approaching the transition from world wide growth to equilibrium. It has already started in most of the countries of the world including Lebanon. We can show it through computer printouts of model variables. We can show it mathematically using steady state analysis. What we can not do is chart the course of our human voyage through this transition. However, we suggest that the systems approach will provide the ship and computer modeling will serve as the instrument of navigation.

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*      NRO4-2 (CASE 1)
NOTE   MANUFACTURING SECTOR
L      MC.K=MC.J+(DT)*(MCI.JK-MCD.JK)                      (1)
C      MC=MCN                                              (1.1)
NOTE   MC-MANUFACTURING CAPITAL(BIL LL)
C      MCN=8.0E9                                           (1.2)
NOTE   MCN-MANUFACTURING CAPITAL INITIAL(BIL LL)
A      MCP.K=MC.K/MCJ                                     (2)
NOTE   MCP-MANUFACTURING CAPITAL PATT(DIMENSIONLESS)
A      MEUCR.K=MCP.K/EUCR.K                               (3)
NOTE   MEUCR-MANUF ELECT UTIL CAPITAL RATIO (DIMENSIONLESS)
A      MEDSM.K=TABLE(MEDSMT,MEUCR.K,0.3,1)                 (4)
T      MEDSMT=0/1/3/6                                     (4.1)
NOTE   MEDSM-MANUF ELECT DEMAND SUPPLY MULTIPLIER(DIMENSIONLESS)
A      FMEC.K=FMDEN*MEDSM.K                               (5)
NOTE   FMEC-FRACT MANUF OUTPUT TO ELECT (DIMENSIONLESS)
C      FMDEN=.03                                           (5.1)
NOTE   FMDEN-FRACT MANUF OUTPUT TO ELECT NORMAL (DIMENSIONLESS)
A      MWUCR.K=MCP.K/WUCR.K                               (6)
NOTE   MWUCR-MANUF WATER UTIL CAPITAL RATIO (DIMENSIONLESS)
A      MWDSM.K=TABLE(MWDSMT,MWUCR.K,0.3,1)                 (7)
T      MWDSMT=0/1/3/6                                     (7.1)
NOTE   MWDSM-MANUF WATER DEMAND SUPPLY MULTIPLIER (DIMENSIONLESS)
A      FMDW.K=FMDWN*MWDSM.K                               (8)
NOTE   FMDW-FRACT MANUF OUTPUT TO WATER (DIMENSIONLESS)
C      FMDWN=.01                                           (8.1)
NOTE   FMDWN-FRACT MANUF OUTPUT TO WATER NORMAL (DIMENSIONLESS)
A      MTCCR.K=MCP.K/TCR.K                                 (9)
NOTE   MTCCR-MANUF TELE-COM CAPITAL RATIO (DIMENSIONLESS)
A      MCDSM.K=TABLE(MCDSMT,MTCCR.K,0.3,1)                 (10)
T      MCDSMT=0/1/3/6                                     (10.1)
NOTE   MCDSM-MANUF COMMON DEMAND SUPPLY MULTIPLIER (DIMENSIONLESS)
A      FMCC.K=FMDCN*MCDSM.K                               (11)
NOTE   FMCC-FRACT MANUF OUTPUT TO COMMUNICATIONS (DIMENSIONLESS)
C      FMDCN=.02                                           (11.1)
NOTE   FMDCN-FRACT MANUF OUTPUT TO COMMUN NORMAL (DIMENSIONLESS)
A      MTECR.K=MCP.K/TECR.K                               (12)
NOTE   MTECR-MANUF TRANS FACIL CAPITAL RATIO (DIMENSIONLESS)
A      MTDSM.K=TABLE(MTDSMT,MTECR.K,0.3,1)                 (13)
T      MTDSMT=0/1/3/6                                     (13.1)
NOTE   MTDSM-MANUF TRANS DEMAND SUPPLY MULTIPLIER (DIMENSIONLESS)
A      FMOT.K=FMDTN*MTDSM.K                               (14)
NOTE   FMOT-FRACT MANUF OUTPUT TO TRANSPORTATION (DIMENSIONLESS)
C      FMDTN=.04                                           (14.1)
NOTE   FMDTN-FRACT MANUF OUTPUT TO TRANS NORMAL (DIMENSIONLESS)
A      FMDF.K=FMEC.K+FMDW.K+FMCC.K+FMOT.K                 (15)
NOTE   FMDF-FRACT MANUF OUTPUT TO INFRASTRUCTURE (DIMENSIONLESS)
A      FMDI.K=FMDF.K+FMOM+FMUG.K                           (16)
NOTE   FMDI-FRACT MANUF OUTPUT TO INPUTS (DIMENSIONLESS)
C      FMOM=.35                                           (16.1)
NOTE   FMOM-FRACT MANUF OUTPUT TO MATERIALS (DIMENSIONLESS)
A      POLR.K=MAX(LOGN(MCR.K*VPWF*MV.K/1VN),1)             (17)
C      VPWF=2
NOTE   POLR-POLLUTION RATIO (DIMENSIONLESS)
A      PCMT.K=TABLE(PCMTT,POLR.K,0.10,2)                  (18)
T      PCMTT=.8/1.2/2/3.6/5.3/13                         (18.1)
NOTE   PCMT-POLLUTION CONTROL MANUF MULT (DIMENSIONLESS)

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A $TPMM.K = \text{TABLE}(TPMNT, MCP.K, 0.20, 2)$ (19)
 T $TPMNT = 1.05/.95/.85/.73/.71/.65/.60/.56/.53/.51/.5$ (19.1)
 NOTE TPM-TECHNOLOGICAL PROGRESS MANUF MULT (DIMENSIONLESS)
 A $MCDK.K = MCDRN * PCMM.K * TPMM.K * \text{TABLE}(MLAMT, MLFD.K, 0.1, 2)$ (20)
 C $MCDRN = 1.6$ (20.1)
 T $MLAMT = 1/1/1.03/1.1/1.25/1.5$ (20.2)
 NOTE MCDR-MANUF CAPITAL OUTPUT RATIO (YEARS)
 NOTE MCDRN-MANUF CAPITAL OUTPUT RATIO NORMAL (YEARS)
 NOTE MLAM-MANUF LAND AVAILABILITY MULT (DIM)
 A $MO.K = MC.K / MCDK.K$ (21)
 NOTE MO-MANUF OUTPUT (BIL LL PER YR)
 A $MP.K = MO.K * (1 - FMPI.K)$ (22)
 NOTE MP-MANUF PRODUCT (BIL LL PER YR)
 R $MCD.KL = MC.K / LMC$ (23)
 NOTE MCD-MANUF CAPITAL DEPRECIATION (BIL LL PER YR)
 C $LMC = 20$ (23.1)
 NOTE LMC-LIFETIME MANUF CAPITAL (YEARS)
 R $MCI.KL = MP.K * FMPI.K * RIM.JK$ (24)
 NOTE MCI-MANUF CAPITAL INVESTMENT (BIL LL PER YR)
 A $FMPI.K = \text{CLIP}(FMPIX, FMPIY, \text{TIME.K}, \text{RECPER})$ (25)
 C $FMPIX = .4$ (25.1)
 C $FMPIY = .4$ (25.2)
 C $RECPER = 0$ (25.3)
 NOTE FMPI-FRACT MANUF PRODUCT INVESTED (DIMENSIONLESS)
 NOTE RECPER-RECONSTRUCTION PERIOD (YEARS)
 R $RIM.KL = \text{CLIP}(0, RIMC, \text{TIME.K}, 5)$ (26)
 C $RIMC = 0$ (26.1)
 NOTE RIM-RECONSTRUCTION INVESTMENT IN MANUF (BIL LL PER YR)
 L $NM.K = NM.J + (DT)(MA.JK)$ (27)
 N $NM = NAN$ (27.1)
 NOTE NM-NORMAL MANUFACTURING (ESTABLISHMENTS)
 C $NMN = 6000$ (27.2)
 NOTE NMN-NORMAL MANUFACTURING INITIALLY (ESTABLISHMENTS)
 L $DM.K = DM.J - (DT)(MR.JK)$ (28)
 N $DM = DMN$ (28.1)
 NOTE DM-DAMAGED MANUFACTURING (ESTABLISHMENTS)
 C $DMN = 0$ (28.2)
 NOTE DMN-DAMAGED MANUFACTURING INITIALLY (ESTABLISHMENTS)
 L $RM.K = RM.J + (DT)(MR.JK)$ (29)
 N $RM = RMN$ (29.1)
 NOTE RM-RESTORED MANUF (ESTABLISHMENTS)
 C $RMN = 0$ (29.2)
 NOTE RMN-RESTORED MANUF INITIALLY (ESTABLISHMENTS)
 A $ME.K = NM.K + DM.K + RM.K$ (30)
 NOTE ME-MANUFACTURING ESTABLISHMENTS
 A $MLFD.K = ME.K * LPME / LZM$ (31)
 NOTE MLFD-MANUF LAND FRACT OCCUPIED (DIMENSIONLESS)
 C $LPME = .15$ (31.1)
 C $LZM = 4500$ (31.2)
 NOTE LPME-LAND PER MANUF ESTABLISHMENT (HECT PER ESTAB)
 NOTE LZM-LAND ZONED FOR MANUF (HECTARES)
 A $MECM.K = \text{TABLE}(MECMT, MLFD.K, 0.1, 2)$ (32)
 T $MECMT = .2/.5/1.0/2.0/4.0/10.0$ (32.1)
 NOTE MECM-MANUF ESTABLISHMENT COST MULT (DIMENSIONLESS)
 A $CPME.K = CPMEV * MECM.K$ (33)
 NOTE CPME-COST PER MANUF ESTABLISHMENT (MIL LL PER ESTAB)
 C $CPMEV = 1.35E6$ (33.1)

NOTE CPME-COST PER MANUF ESTABLISHMENT NORMAL (MIL LL PER ESTAB)
 R MA.KL=(MCI.JK-MCE.JK-MR.JK*CPME)/CPME.K (34)
 C CPMR=400000 (34.1)
 NOTE MA-MANUF ADDITIONS (ESTAB PER YR)
 R MR.KL=CLIP(0,MRP,TIME.K,KECPER) (35)
 C MRP=0.0 (35.1)
 NOTE MR-MANUF RESTORATIONS (ESTAB PER YR)
 NOTE MRP-MONIE RESTORATIONS PROGRAMMED (ESTAB PER YR)
 A FMGC.K=CLIP(FMGC,0,TIME.K,5) (36)
 C FMGC=.05 (36.1)
 NOTE FMGC-FRACT MANUF OUTPUT TO GOVT (DIMENSIONLESS)
 NOTE BUSINESS SECTOR
 L BC.K=BC.J+(DT)*(BCI.JK-BCD.JK) (37)
 N BC=BCN (37.1)
 NOTE BC-BUSINESS CAPITAL
 C BCN=24E9 (37.2)
 NOTE BCI-BUSINESS CAPITAL INITIAL (BIL LL)
 A BCR.K=BC.K/BCN (38)
 NOTE BCR-BUSINESS CAPITAL RATIO(DIMENSIONLESS)
 A BEUCR.K=BCR.K/BUCR.K (39)
 NOTE BEUCR-BUSIN ELECT UTIL CAPITAL RATIO (DIMENSIONLESS)
 A BEDSM.K=TABLE(BEDSMT,BEUCR.K,0,3,1) (40)
 T BEDSMT=0/1/3/0 (40.1)
 NOTE BEDSM-BUSIN ELECT DEMAND SUPPLY MULT (DIMENSIONLESS)
 A FBJE.K=FBJEN*BEDSM.K (41)
 NOTE FBJE-FRACT BUSIN OUTPUT TO ELECT (DIMENSIONLESS)
 C FBJEN=.025 (41.1)
 NOTE FBJEN-FRACT BUSIN OUTPUT TO ELECT NORMAL (DIMENSIONLESS)
 A BWUCR.K=BCR.K/WUCR.K (42)
 NOTE BWUCR-BUSIN WATER UTIL CAPITAL RATIO (DIMENSIONLESS)
 A BWDSM.K=TABLE(BWDSMT,BWUCR.K,0,3,1) (43)
 T BWDSMT=0/1/3/6 (43.1)
 NOTE BWDSM-BUSIN WATER DEMAND SUPPLY RATIO (DIMENSIONLESS)
 A FBOW.K=FBOWN*BWDSM.K (44)
 NOTE FBOW-FRACT BUSIN OUTPUT TO WATER (DIMENSIONLESS)
 C FBOWN=.01 (44.1)
 NOTE FBOWN-FRACT BUSIN OUTPUT TO WATER (DIMENSIONLESS)
 A BTCCR.K=BCR.K/TCR.K (45)
 NOTE BTCCR-BUSIN TELE-COM CAPITAL RATIO (DIMENSIONLESS)
 A BCDSM.K=TABLE(BCDSMT,BTCCR.K,0,3,1) (46)
 T BCDSMT=0/1/3/0 (46.1)
 NOTE BCDSM-BUSIN COMMUN DEMAND SUPPLY MULT (DIMENSIONLESS)
 A FBCC.K=FBCCN*BCDSM.K (47)
 NOTE FBCC-FRACT BUSIN OUTPUT TO COMMUNICATIONS (DIMENSIONLESS)
 C FBCCN=.025 (47.1)
 NOTE FBCCN-FRACT BUSIN OUTPUT TO COMMUN NORMAL (DIMENSIONLESS)
 A BTFCR.K=BCR.K/TCR.K (48)
 NOTE BTFCR-BUSIN TRANS FACIL CAPITAL RATIO (DIMENSIONLESS)
 A BTDSM.K=TABLE(BTDSMT,BTFCR.K,0,3,1) (49)
 T BTDSMT=0/1/3/5 (49.1)
 NOTE BTDSM-BUSIN TRANS DEMAND SUPPLY MULT (DIMENSIONLESS)
 A FBOT.K=FBOTN*BTDSM.K (50)
 NOTE FBOT-FRACT BUSIN OUTPUT TO TRANSPORTATION (DIMENSIONLESS)
 C FBOTN=.04 (50.1)
 NOTE FBOTN-FRACT BUSIN OUTPUT TO TRANS NORMAL (DIMENSIONLESS)
 A FBDF.K=FBJE.K+FBOW.K+FBCC.K+FBOT.K (51)
 NOTE FBDF-FRACT BUSIN OUTPUT TO INFRASTRUCTURE (DIMENSIONLESS)

A $FB01.K = FB01F.K + FB0M + FB0G.K$ (52)
 NOTE $FB01$ -FRACT BUSIN OUTPUT TO INPUTS (DIMENSIONLESS)
 C $FB0M = .13$ (52.1)
 A $BCOR.K = TABLE(BLAMT, BLFO.K, 0, 1..2) * BCORN$ (53)
 T $BLAMT = 1.5/1/1.2/1.5/1.9/2.5$ (53.1)
 C $BCORN = 2.0$ (53.2)
 NOTE $BCOR$ -BUSINESS CAPITAL OUTPUT RATIO (YEARS)
 A $BC.K = BC.K / BCOR.K$ (54)
 NOTE BC -BUSINESS OUTPUT (BIL LL PER YR)
 A $BP.K = BC.K * (1 - FB01.K)$ (55)
 NOTE BP -BUSINESS PRODUCT (BIL LL PER YR)
 R $BOD.KL = BC.K / LBC$ (56)
 NOTE BOD -BUSIN CAPITAL DEPRECIATION (BIL LL PER YR)
 C $LBC = 25$ (56.1)
 NOTE LBC -LIFETIME BUSINESS CAPITAL (YEARS)
 R $BCI.KL = BP.K * FBPI.K + RIB.JK$ (57)
 NOTE BCI -BUSIN CAPITAL INVESTMENT (BIL LL PER YR)
 A $FBPI.K = CLIP(FBPIX, FBPIY, TIME.K, RECPK)$ (58)
 C $FBPIX = .35$ (58.1)
 C $FBPIY = .35$ (58.2)
 NOTE $FBPI$ -FRACT BUSIN PRODUCT INVESTED (DIMENSIONLESS)
 R $RIB.KL = CLIP(0, RIBC, TIME.K, 5)$ (59)
 C $RIBC = 0$ (59.1)
 NOTE RIB -RECONSTRUCTION INVESTMENT IN BUSINESS
 L $NB.K = NB.J + (DT)(BA.JK)$ (60)
 N $NB = NBN$ (60.1)
 NOTE NB -NORMAL BUSINESS (ESTABLISHMENTS)
 C $NBN = 30000$ (60.2)
 NOTE NBN -NORMAL BUSINESS INITIALLY (ESTABLISHMENTS)
 L $DB.K = DB.J - (DT)(BR.JK)$ (61)
 N $DB = DBN$ (61.1)
 NOTE DB -DAMAGED BUSINESS (ESTABLISHMENTS)
 C $DBN = 0$ (61.2)
 NOTE DBN -DAMAGED BUSINESS INITIALLY (ESTABLISHMENTS)
 L $RB.K = RB.J + (DT)(BR.JK)$ (62)
 N $RB = RBN$ (62.1)
 NOTE RB -RESTORED BUSINESS (ESTABLISHMENTS)
 C $RBN = 0$ (62.2)
 NOTE RBN -RESTORED BUSINESS (ESTABLISHMENTS)
 A $BE.K = NB.K + DB.K + RB.K$ (63)
 NOTE BE -BUSINESS ESTABLISHMENTS
 A $BLFO.K = BE.K * LPBE / LZB$ (64)
 NOTE $BLFO$ -BUSINESS LAND FRACTION OCCUPIED (DIMENSIONLESS)
 NOTE $LPBE$ -LAND PER BUSINESS ESTABLISHMENT (HECT PER ESTAB)
 C $LPBE = .05$ (64.1)
 C $LZB = 3000$ (64.2)
 NOTE LZB -LAND ZONED PER BUSINESS (HECTARES)
 A $BECM.K = TABLE(BECMT, BLFO.K, 0, 1..2)$ (65)
 T $BECMT = .2/.5/1/2/4/1$ (65.1)
 NOTE $BECM$ -BUSIN ESTAB COST MULT (DIMENSIONLESS)
 A $CPBE.K = CPBEN * BECM.K$ (66)
 NOTE $CPBE$ -COST PER BUSIN ESTAB (MIL LL PER ESTAB)
 C $CPBEN = .850$ (66.1)
 NOTE $CPBEN$ -COST PER BUSIN ESTAB NORMAL (MIL LL PER ESTAB)
 R $BA.KL = (BP.K * FBPI.K - BC.K / LBC) / CPBE.K$ (67)
 NOTE BA -BUSINESS ADDITIONS (ESTAB PER YR)
 R $BR.KL = CLIP(0, BRP, TIME.K, RECPK)$ (68)

P- 5 RUN- MODEL NAME = NROM - 1 (CASE 1)

C BRP=0 (88.1)
 NOTE BR-BUSIN RESTORATIONS (ESTAB PER YR)
 NOTE BRP-BUSIN RESTORATIONS PROGRAMMED (ESTAB PER YR)
 A FBUSG.K=CLIP(FBGGC,.1,TIME.K,5) (89)
 C FBGGC=.10 (89.1)
 NOTE FBGG-FRACT BUSIN OUTPUT TO GOVT (DIMENSIONLESS)
 NOTE INFRASTRUCTURE SECTOR
 L EUC.K=EUC.J+(DT)*(EUCI.JK-EUCD.JK) (70)
 N EUC=EUCN (70.1)
 NOTE EUC-ELECTRIC UTILITY CAPITAL (BIL LL)
 C EUCN=1.2E9 (70.2)
 NOTE EUCN-ELECTRIC UTIL CAPITAL INITIAL (BIL LL)
 A EUCR.K=EUC.K/EUCN (71)
 NOTE EUCR-ELECTRIC UTIL CAPITAL RATIO (DIMENSIONLESS)
 A EUJ.K=MO.K*F4JE.K+BO.K*FBOE.K (72)
 NOTE EUJ-ELECTRIC UTIL OUTPUT (BIL LL PER YR)
 A FEUCH.K=HEG.K/TEG.K (73)
 NOTE FEUCH-FRACT ELECT UTIL CAPL HYDROELECTRIC (DIMEN)
 A FEUJF.K=TABLE(FEUJFT,FEUCH.K,0,1,.5) (74)
 T FEUJFT=.67,4/0 (74.1)
 NOTE FEUJF-FRACT ELECT UTIL OUTPUT TO FUEL (DIMEN)
 A EUP.K=EUC.K*(1-FEUCF.K) (75)
 NOTE EUP-ELECTRIC UTIL PRODUCT (BIL LL PER YR)
 R EUCD.KL=EUC.K/LFUC (76)
 NOTE EUCD-ELECT UTIL CAPITAL DEPRECIATION (BIL LL PER YR)
 C LEUC=40 (76.1)
 NOTE LEUC-LIFETIME ELECT UTIL CAPITAL (YEARS)
 R EUCI.KL=EUP.K*FEUPI (77)
 NOTE EUCI-ELECT UTIL CAPITAL INVESTMENT (BIL LL PER YR)
 C FEUPI=.4 (77.1)
 NOTE FEUPI-FRACT ELECT UTIL PRODUCT INVESTED (DIMEN)
 L WUC.K=WUC.J+(DT)*(WUCI.JK-WUCD.JK) (78)
 N WUC=WUCN (78.1)
 NOTE WUC-WATER UTIL CAPITAL (BIL LL)
 C WUCN=1.2E9 (78.2)
 NOTE WUCN-WATER UTIL CAPITAL INITIAL (BIL LL)
 A WUCR.K=WUC.K/WUCN (79)
 NOTE WUCR-WATER UTIL CAPITAL RATIO (DIMEN)
 A WUJ.K=MO.K*F4WJ.K+BO.K*FBOW.K (80)
 NOTE WUJ-WATER UTIL OUTPUT (BIL LL PER YR)
 A WUPI.K=WUJ.K*(1-FWUCI) (81)
 NOTE WUP-WATER UTIL PRODUCT (BIL LL PER YR)
 C FWUCI=.05 (81.1)
 NOTE FWUCI-FRACT WATER UTIL OUTPUT TO INPUTS (DIMEN)
 A WDSR.K=DSWC.K/DSWS.K (82)
 NOTE WDSR-WATER DEMAND SUPPLY RATIO (DIMEN)
 A EWUIM.K=TABLE(EWUIMT,WDSR.K,0,4,.4) (83)
 T EWUIMT=1/1/.97/.75/.55/.3/.1/.05/.02/.01/.01 (83.1)
 NOTE EWUIM-EFFICIENCY WATER UTIL INVESTMENT MULT (DIMEN)
 R WUCD.KL=WUC.K/LWUC (84)
 NOTE WUCD-WATER UTIL CAPITAL DEPRECIATION (BIL LL PER YR)
 C LWUC=50 (84.1)
 NOTE LWUC-LIFETIME WATER UTIL CAPITAL (YEARS)
 R WUCI.KL=WUP.K*FWUPI*EWUIM.K (85)
 NOTE WUCI-WATER UTIL CAPITAL INVESTMENT (BIL LL PER YR)
 C FWUPI=.4 (85.1)
 NOTE FWUPI-FRACT WATER UTIL PRODUCT INVESTED (DIMEN)

L $TCC.K = TCC.J + (DT)(TCCI.JK - TCCD.JK)$ (86)
 N $TCC = TCCN$ (86.1)
 NOTE TCC-TELE-COMMUNICATIONS CAPITAL (BIL LL)
 C $TCCN = 1.5E9$ (86.2)
 NOTE TCCN-TELE-COMMUN CAPITAL INITIAL (BIL LL)
 A $TCCR.K = TCC.K / TCCN$ (37)
 NOTE TCCR-TELE-COMMUN CAPITAL RATIO (DIMEN)
 A $TCD.K = MC.K * FMDC.K + BD.K * FBDC.K$ (88)
 NOTE TCD-TELE-COMMUN OUTPUT (BIL LL PER YR)
 A $TCP.K = TCD.K * (1 - FTCOI)$ (89)
 NOTE TCP-TELE-COMMUN PRODUCT (BIL LL PER YR)
 C $FTCOI = .3$ (89.1)
 NOTE FTCOI-FRACT TELE-COMMUN OUTPUT TO INPUTS (DIMEN)
 R $TCCD.KL = TCC.K / LTCC$ (90)
 NOTE TCCD-TELE-COMMUN CAPITAL DEPRECIATION (BIL LL PER YR)
 C $LTCC = 30$ (90.1)
 NOTE LTCC-LIFETIME TELE-COMMUN CAPITAL (YEARS)
 R $TCCI.KL = TCP.K * FTCPI + FITC.JK$ (91)
 NOTE TCCI-YELECTCOMMUN CAPITAL INVESTMENT (BIL LL PER YR)
 C $FTCPI = .4$ (91.1)
 NOTE FTCPI-FRACT TELECOMMUN PRODUCT INVESTED (DIMEN)
 R $FITC.KL = CLIP(0, FITC.TIME.K, 5)$ (92)
 C $RIITC = 0$ (92.1)
 NOTE FITC-RECONSTRUCTION INVESTMENT IN TELECOMMUN (BIL LL PER YR)
 L $ITF.K = ITF.J + (DT)(ITFI.JK - ITFD.JK)$ (93)
 N $ITF = ITFN$ (93.1)
 NOTE ITF-INTERNATIONAL TRANSPORT FACILITIES (BIL LL)
 C $ITFN = 1.5E9$ (93.2)
 NOTE ITFN-INTL TRANSPORT FACIL INITIAL (BIL LL)
 A $ITD.K = (MC.K * FMOT.K + BD.K * FBOT.K) * FIT$ (94)
 NOTE ITD-INTL TRANSPORT OUTPUT (BIL LL)
 C $FIT = .5$ (94.1)
 NOTE FIT-FRACT IN INTL TRANSPORT (DIMEN)
 A $ITP.K = ITD.K * (1 - FITCI)$ (95)
 NOTE ITP-INTL TRANSPORT PRODUCT (BIL LL PER YR)
 C $FITCI = .2$ (95.1)
 NOTE FITCI-FRACT INTL TRANSPORT OUTPUT TO INPUTS
 R $ITFD.KL = ITF.K / LITF$ (96)
 NOTE ITFD-INTL TRANSPORT FACIL DEPRECIATION (BIL LL PER YR)
 C $LITF = 25$ (96.1)
 NOTE LITF-LIFETIME INTL TRANSPORT FACIL (YEARS)
 R $ITFI.KL = ITP.K * FITPI + RIIT.JK$ (97)
 NOTE ITFI-INTERNATIONAL TRANS FACIL INVESTMENT (BIL LL PER YR)
 C $FITPI = .4$ (97.1)
 NOTE FITPI-FRACT INTL TRANSPORT PRODUCT INVESTED
 R $RIIT.KL = CLIP(0, RIITC.TIME.K, 5)$ (98)
 C $RIITC = 0$ (98.1)
 NOTE RIIT-RECONSTRUCTION INVESTMENT IN INTL TRANSPORT (BIL LL PER YR)
 L $LTF.K = LTF.J + (DT)(LTFI.JK - LTFD.JK)$ (99)
 N $LTF = LTFN$ (99.1)
 NOTE LTF-LAND TRANSPORT FACILITIES (BIL LL)
 C $LTFN = 4.5E9$ (99.2)
 NOTE LTFN-LAND TRANSPORT FACIL INITIAL (BIL LL)
 A $LTD.K = (MC.K * FMOT.K + BD.K * FBOT.K) * FLT$ (100)
 NOTE LTD-LAND TRANSPORT OUTPUT (BIL LL PER YR)
 C $FLT = .5$ (100.1)
 NOTE FLT-FRACT IN LAND TRANSPORT (DIMEN)

A LTP.K=LTO.K*(1-FLT01) (101)
 NOTE LTP-LAND TRANSPORT PRODUCT (BIL LL PER YR)
 C FLT01=.5 (101.1)
 NOTE FLT01-FRACT LAND TRANSPORT OUTPUT TO INPUTS (DIMEN)
 R LTFD.K=LTF.K/LLTF (102)
 NOTE LTFD-LAND TRANSPORT FACIL DEPRECIATION (BIL LL PER YR)
 C LLTF=75 (102.1)
 NOTE LLTF-LIFETIME LAND TRANSPORT FACIL (YEARS)
 R LTFI.K=LTP.K*FLTPI+ILT.JK (103)
 NOTE LTFI-LAND TRANSPORT FACIL INVESTMENT (BIL LL PER YR)
 C FLTPI=.4 (103.1)
 NOTE FLIFI-FRACT LAND TRANSPORT FACIL INVESTED (DIMEN)
 R RILT.K=CLIP(0,RILTC.TIME.K,5) (104)
 C RILTC=0 (104.1)
 NOTE RILT-RECONSTRUCTION INVESTMENT IN LAND TRANSPORT (BIL LL PER YR)
 A TFCR.K=(ITF.K+LTF.K)/(ITFN+LTFN) (105)
 NOTE TFCR-TRANS FACIL CAPITAL RATIO (DIMEN)
 NOTE MANPOWER SECTOR
 A JPMCU.K=TABLE(JPMOUT,MCR.K,0,20,2) (106)
 T JPMOUT=.28/.22/.17/.13/.10/.08/.07/.065/.062/.06/.06 (106.1)
 NOTE JPMCU-JOBS PER MANUF. CAPITAL UNIT (PERSONS/LL E4)
 A JIM.K=JPMCU.K*MC.K/10000 (107)
 NOTE JIM-JOBS IN MANUFACTURING (PERSONS)
 A FMPGTP.K=CLIP(FMPGX,FMPGY,TIME.K,RECPK) (108)
 C FMPGX=.05 (108.1)
 C FMPGY=.05 (108.2)
 NOTE FMPGTP-FRACT. MANUF. PRODUCT GOVT. TRANSFER PAYMENT (DIM.)
 A GPPWM.K=MP.K*(1-FMPI.K-FMPGTP.K)/JIM.K (109)
 NOTE GPPWM-G.O.P. PER WORKER IN MANUF (LL/YR-PERSON)
 A JPBCU.K=TABLE(JPBOUT,BCR.K,0,20,2) (110)
 T JPBOUT=.225/.175/.135/.105/.085/.075/.07/.07/.07/.07 (110.1)
 NOTE JPBCU-JOBS PER BUSINESS CAPITAL UNIT (PERSONS/LL E4)
 A JIB.K=JPBCU.K*BC.K/10000 (111)
 NOTE JIB-JOBS IN BUSINESS (PERSONS)
 A FBPGTP.K=CLIP(FBPGX,FBPGY,TIME.K,RECPK) (112)
 C FBPGX=.1 (112.1)
 C FBPGY=.1 (112.2)
 NOTE FBPGTP-FRACT. BUSIN. PRODUCT GOVT. TRANSFER PAYMENT (DIM.)
 A GPPWB.K=BP.K*(1-FBPI.K-FBPGTP.K)/JIB.K (113)
 NOTE GPPWB-G.O.P. PER WORKER IN BUSIN. (LL/YR-PERSON)
 A JPEUCU.K=TABLE(JEUCUT,EUCR.K,0,20,4) (114)
 T JEUCUT=.75/.55/.45/.4/.37/.35 (114.1)
 NOTE JPEUCU-JOBS PER ELECT UTIL CAPITAL UNIT (PERSONS/LL E5)
 A JIEU.K=JPEUCU.K*EUC.K/100000 (115)
 NOTE JIEU-JOBS IN ELECTRIC UTILITIES (PERSONS)
 A GDPWEU.K=EUP.K*(1-FEUPI)/JIEU.K (116)
 NOTE GDPWEU-G.O.P. PER WORKER IN ELECT UTIL (LL/YR-PERSON)
 NOTE FEUPI-FRACT ELECT UTIL PROD. INVESTED (DIM)
 A JPWUCU.K=TABLE(JWUCUT,WUCR.K,0,20,4) (117)
 T JWUCUT=.46/.38/.32/.28/.26/.25 (117.1)
 NOTE JPWUCU-JOBS PER WATER UTIL CAPITAL UNIT (PERSONS/LL E5)
 A JIWU.K=JPWUCU.K*WUC.K/100000 (118)
 NOTE JIWU-JOBS IN WATER UTILITIES (PERSONS)
 A GDPWU.K=WUP.K*(1-FWUPI)/JIWU.K (119)
 NOTE GDPWU-G.O.P. PER WORKER IN WATER UTIL (LL/YR-PERSON)
 A JTCCU.K=TABLE(JTCCUT,TCCR.K,0,20,4) (120)
 T JTCCUT=1.05/.85/.77/.67/.55/.5 (120.1)

NOTE JPTCCU-JOBS PER TELE-COM CAPITAL UNIT (PERSONS/LL E5)
 A $JITC.K = JPTCCU.K * TCC.K / 100000$ (121)
 NOTE JITC-JOBS IN TELE-COMMUNICATIONS (PERSONS)
 A $GDPWTC.K = TCC.K * (1 - FTCPI) / JITC.K$ (122)
 NOTE GDPWTC-G.D.P. PER WORKER IN TELE-COM(LL/YR-PERSON)
 A $JPTCCU.K = TABLE(JITCUT, ITF.K / ITFN, 0, 20, 4)$ (123)
 T $JITCUT = .75 / .55 / .45 / .4 / .37 / .35$ (123.1)
 NOTE JPITCU-JOBS PER INTL TRANS CAPITAL UNIT (PERSONS/LL E5)
 A $JITF.K = JPITCU.K * ITF.K / 100000$ (124)
 NOTE JITF-JOBS IN INTL TRANS FACILITIES (PERSONS)
 A $GDPWIT.K = ITP.K * (1 - FITPI) / JITF.K$ (125)
 NOTE GDPWIT-G.D.P. PER WORKER IN INTL TRANS (LL/YR-PERSON)
 A $JPLTCU.K = TABLE(JLTCUT, LTF.K / LTFN, 0, 20, 4)$ (126)
 T $JLTCUT = .21 / .17 / .14 / .12 / .11 / .1$ (126.1)
 NOTE JPLTCU-JOBS PER LAND TRANSPORT CAPITAL UNIT (PERSONS/LL E5)
 A $JLTF.K = JPLTCU.K * LTF.K / 100000$ (127)
 NOTE JLTF-JOBS IN LAND TRANS FACILITIES (PERSONS)
 A $GDPWLT.K = LTP.K * (1 - FLTPI) / JLTF.K$ (128)
 NOTE GDPWLT-G.D.P. PER WORKER IN LAND TRANS (LL/YR-PERSON)
 A $UCGDP.K = FUP.K + WUP.K$ (129)
 NOTE UCGDP-UTILITIES CONTRIBUTION TO G.D.P. (BIL LL PER YR)
 A $IFCGDP.K = TCC.K + ITP.K + LTP.K$ (130)
 NOTE IFCGDP-INFRASTRUCTURE CONTRIB TO G.D.P. (BIL LL PER YR)
 A $CSGDP.K = MP.K + JP.K + UCGDP.K + IFCGDP.K + GSCGDP.K$ (131)
 NOTE CSGDP-CONSTRUCTION SERVING G.D.P. (BIL LL PER YR)
 A $CP.K = CSGDP.K * AFPI * AFIP * (1 - FCOI)$ (132)
 C $AFPI = .4$ (132.1)
 C $AFIP = .4$ (132.2)
 C $FCOI = .5$ (132.3)
 NOTE CP-CONSTRUCTION PRODUCT (BIL LL PER)
 NOTE AFPI-AVER FRACT PRODUCT INVESTED (DIM)
 NOTE AFIP-AVER FRACT INVESTMENT IN PLANT (DIM)
 NOTE FCOI-FRACT CONSTRUCTION OUTPUT TO INPUTS (DIM)
 A $CO.K = CP.K / (1 - FCOI)$ (133)
 NOTE CO-CONSTRUCTION OUTPUT (BIL LL PER YR)
 A $CC.K = CO.K * CCCR$ (134)
 C $CCOR = 1.0$ (134.1)
 NOTE CC-CONSTRUCTION CAPITAL (BIL LL)
 NOTE CCCR-CONSTRUCTION CAPITAL OUTPUT RATIO (YEARS)
 A $JIC.K = CC.K * JPCCU$ (135)
 C $JPCCU = .3E-5$ (135.1)
 NOTE JIC-JOBS IN CONSTRUCTION (PERSONS)
 NOTE JPCCU-JOBS PER CONSTRUCTION CAPITAL UNIT (PERSONS/LL E5)
 A $GDPJIC.K = CP.K * (1 - FCOI) / JIC.K$ (136)
 C $FCOI = .4$ (136.1)
 NOTE GDPJIC-G.D.P. PER WORKER IN CONSTR (LL/YR-PERSON)
 NOTE FCOI-FRACT CONSTRUCTION PROD INVESTED (DIM)
 A $NAJ.K = JIM.K + JIB.K + JIEU.K + JIWU.K + JITC.K + JITF.K + JLTF.K + JIGS.K + JIC.K$
 NOTE NAJ-NON-AGRICULTURAL JOBS (PERSONS)
 NOTE GOVERNMENT SERVICES SECTOR
 L $UPEF.K = UPEF.J + (DT) (UPEFI.JK - UPEFD.JK)$ (138)
 N $UPEF = UPEFN$ (138.1)
 C $UPEFN = .8E9$ (138.2)
 NOTE UPEF-URBAN PUBLIC EDUC FACIL (LL)
 L $RPEF.K = RPEF.J + (DT) (RPEFI.JK - RPEFD.JK)$ (139)
 N $RPEF = RPEFN$ (139.1)
 C $RPEFN = .2E9$ (139.2)

NOTE RPEF=RURAL PUBLIC EDUC FACIL (LL)
 A $PEO.K = PEF.K / \text{TABLE}(PECURT, PEF.K / PEFN, 0, 20, 2)$ (140)
 T $PECURT = 3.5/4.5/4.6/5/5.2/5.5/6/7/8.5/10/12$ (140.1)
 C $PEFN = 1.0E9$ (140.2)
 NOTE PECOR=PUBLIC EDUC CAPITAL OUTPUT RATIO (YEARS)
 NOTE PEFN=PUBLIC EDUCATION FACIL INITIAL (BIL LL)
 S $FPES.K = PEP.K / PEO.K$ (141)
 NOTE FPES=FRACT PUBLIC EDUC SUBSIDIZED
 NOTE PEO=PUBLIC EDUC OUTPUT (BIL LL PER YR)
 A $GP.K = MO.K * FMJG.K + BC.K * FBJG.K$ (142)
 NOTE GP=GOVERNMENT PRODUCT (BIL LL PER YR)
 A $PEP.K = GP.K * FGPPE$ (143)
 C $FGPPE = .15$ (143.1)
 NOTE PEP=PUBLIC EDUCATION PRODUCT (BIL LL PER YR)
 NOTE FGPPE=FRACT GOVT PRODUCT TO PUBLIC EDUCATION (DIM)
 R $UPEF.KL = UPEF.K / LPEF$ (144)
 C $LPEF = 25$ (144.1)
 NOTE UPEF=URBAN PUBLIC EDUC FACIL DEPRECIATION (LL/YR)
 NOTE LPEF=LIFETIME PUBLIC EDUC FACIL (YR)
 R $RPEF.KL = RPEF.K / LPEF$ (145)
 NOTE LPEF=LIFETIME PUBLIC EDUC FACIL (YEARS)
 A $JPPECU.K = \text{TABLE}(JPFCUT, PEF.K / PEFN, 0, 20, 4)$ (146)
 T $JPFCUT = 1.02/.34/.68/.84/.82/.3$ (146.1)
 NOTE JPPECU=JOBS PER PUBLIC EDUC CAPITAL UNIT (PERSONS/LL ES)
 A $JIPE.K = JPPECU.K * PEF.K / 100000$ (147)
 NOTE JIPE=JOBS IN PUBLIC EDUCATION (PERSONS)
 A $GDPWPU.K = PEP.K * (1 - FPEPI) / JIPE.K$ (148)
 C $FPEPI = .4$ (148.1)
 NOTE GDPWPU=G.D.P. PER WORKER PUBLIC EDUC (LL/YR-PERSON)
 NOTE FPEPI=FRACT PUBLIC EDUC PRODUCT INVESTED (DIM)
 R $UPEFI.KL = PEP.K * FPEPI * FIUPE$ (149)
 C $FIUPE = .8$ (149.1)
 NOTE UPEFI=URBAN PUBLIC EDUC FACIL INVESTMENT (LL/YR)
 NOTE FIUPE=FRACT INVESTMENT URBAN PUBLIC EDUC (DIM)
 R $RPEFI.KL = PEP.K * FPEPI * (1 - FIUPE)$ (150)
 NOTE RPEFI=RURAL PUBLIC EDUC FACIL INVESTMENT (LL/YR)
 A $PEF.K = UPEF.K + RPEF.K$ (151)
 NOTE PEF=PUBLIC EDUCATION FACILITIES (BIL LL)
 A $PHO.K = PHF.K / \text{TABLE}(PHCORT, PHF.K / PHFN, 0, 20, 2)$ (152)
 T $PHCORT = 2.5/3.5/4.1/4.5/4.9/5.5/6/7/8.5/10/12$ (152.1)
 C $PHFN = 1.0E9$ (152.2)
 NOTE PHCOR=PUBLIC HEALTH CAPITAL OUTPUT RATIO (YEARS)
 NOTE PHFN=PUBLIC HEALTH FACIL INITIAL (BIL LL)
 S $FPHS.K = PHP.K / PHO.K$ (153)
 NOTE FPHS=FRACT PUBLIC HEALTH SUBSIDIZED
 NOTE PHO=PUBLIC HEALTH OUTPUT (BIL LL PER YR)
 A $PHP.K = GP.K * FGPPH$ (154)
 C $FGPPH = .2$ (154.1)
 NOTE PHP=PUBLIC HEALTH PRODUCT (BIL LL PER YR)
 NOTE FGPPH=FRACT GOVT PRODUCT TO PUBLIC HEALTH (DIM)
 L $UPHF.K = UPHF.J + (DT) (UPHF1.JK - UPHF0.JK)$ (155)
 N $UPHF = UPHFN$ (155.1)
 C $UPHFN = .8E9$ (155.2)
 NOTE UPHF=URBAN PUBLIC HEALTH FACIL (LL)
 L $RPHF.K = RPHF.J + (DT) (RPHF1.JK - RPHF0.JK)$ (156)
 N $RPHF = RPHFN$ (156.1)
 C $RPHFN = .259$ (156.2)

NOTE RPHF-RURAL PUBLIC HEALTH FACIL (LL)
 A $JPPHCU.K = TABLE(JPHCUT.PHF.K/PHFN.D.ZD.+)$ (157)
 T $JPHCUT = 1.02/.94/.88/.84/.82/.8$ (157.1)
 NOTE JPPHCU-JOBS PER PUBLIC HEALTH CAPITAL UNIT (PERSON/LL E5)
 A $JIPH.K = JPPHCU.K * PHF.K / 10000$ (158)
 NOTE JIPH-JOBS IN PUBLIC HEALTH (PERSONS)
 A $GDPWPH.K = PHP.K * (1 - FPHPI) / JIPH.K$ (159)
 C $FPHPI = .4$ (159.1)
 NOTE $GDPWPH - G.D.P. PER WORKER IN PUBLIC HEALTH (LL/YR-PERSON)$
 NOTE FPHPI-FRACT PUBLIC HEALTH PRODUCT INVESTED (DIM)
 A $PHF.K = UPHF.K + RPHF.K$ (160)
 NOTE RPHF-PUBLIC HEALTH FACIL (LL)
 R $JPHFI.KL = PHP.K * FPHPI * FIUPH$ (161)
 C $FIUPH = .8$ (161.1)
 NOTE UPHEI-URBAN PUBLIC HEALTH FACIL INVESTMENT (LL/YR)
 NOTE FIUPH-FRACT INVESTMENT URBAN PUBLIC
 R $RPHFI.KL = PHP.K * FPHPI * (1 - FIUPH)$ (162)
 NOTE RPHFI-RURAL PUBLIC HEALTH FACIL INVESTED (LL/YR)
 R $UPHFI.KL = UPHF.K / LPHF$ (163)
 C $LPHF = 15$ (163.1)
 NOTE UPHFI-URBAN PUBLIC HEALTH FACIL DEPRECIATION
 NOTE LPHF-LIFETIME PUBLIC HEALTH FACILITIES (YR)
 R $RPHFI.KL = RPHF.K / LPHF$ (164)
 NOTE RPHFI-RURAL PUBLIC HEALTH FACIL DEPRECIATION
 NOTE LPHF-LIFETIME PUBLIC HEALTH FACIL (YEARS)
 A $LIHQ.K = LIC.K * RENT.K$ (165)
 NOTE LIHQ-LOW INCOME HOUSING OUTPUT (BIL LL PER YR)
 A $LIHP.K = GP.K * FGPLIH + LIHQ.K * (1 - FRTI)$ (166)
 C $FRTI = .5$ (166.1)
 C $FGPLIH = .2$ (166.2)
 NOTE LIHP-LOW INCOME HOUSING PRODUCT (BIL LL PER YR)
 NOTE FRTI-FRACT RENT TO INPUTS
 NOTE FGPLIH-FRACT GOVT PROD INVESTED IN LOW INCOME HOUSING (DIM)
 R $RILIH.KL = CLIP(0, RILIH.TIME.K, 5)$ (167)
 C $RILIH = 0$ (167.1)
 NOTE RILIH-RECONSTRUCTION INVESTMENT IN LOW INCOME HOUSING (BIL LL PER
 A $PAP.K = GP.K * FGPPA$ (168)
 C $FGPPA = .45$ (168.1)
 NOTE PAP-PUBLIC ADMINISTRATION PRODUCT (BIL LL PER YR)
 NOTE FGPPA-FRACT GOVT PROD TO PUBLIC ADMIN (DIM)
 A $JIPA.K = GP.K * JPGPCU$ (169)
 C $JPGPCU = 1.0E-5$ (169.1)
 NOTE JIPA-JOBS IN PUBLIC ADMINISTRATION (PERSONS)
 NOTE JPGPCU-JOBS PER GOVT PROD CAPITAL UNIT (PERSONS/LL E5)
 A $JIGS.K = JIPE.K + JIPH.K + JIPA.K$ (170)
 NOTE JIGS-JOBS IN GOVT SERVICES (PERSONS)
 A $GSCGDP.K = PEP.K + PHP.K + LIHP.K + PAP.K$ (171)
 NOTE GSCGDP-GOVT. SERVICE CONTRIB TO G.D.P. (BIL LL PER YR)
 NOTE AGRICULTURAL SECTOR
 L $IF.K = IF.J + (DT) (IFI.JK - IFD.JK)$ (172)
 A $IF = IFN$ (172.1)
 NOTE IF-IRRIGATION FACILITIES (BIL LL)
 C $IFN = .7E9$ (172.2)
 NOTE IFN-IRRIGATION FACILITIES INITIAL (BIL LL)
 L $NICL.K = NICL.J - (DT) (ILDR.JK + LCR.JK)$ (173)
 N $NICL = NICLN$ (173.1)
 NOTE NICL-NON-IRRIGATED CULTIVATABLE LAND (HECTARES)

C NICLN=270000 (173.2)
 NOTE NICLN=NON-IRRI CULTIVATABLE LAND INITIAL (HECTARES)
 L $ICL.K=ICL.J+(DT)(ILDR.JK)$ (174)
 N ICL=ICLN (174.1)
 NOTE ICL=IRRIGATED CULTIVATABLE LAND (HECTARES)
 C ICLN=90000 (174.2)
 NOTE ICLN=IPRIGATED CULTIVATABLE LAND INITIAL (HECTARES)
 L $UL.K=UL.J+(DT)(ILCCR.JK)$ (175)
 N UL=ULN (175.1)
 NOTE UL=URBAN LAND (HECTARES)
 C ULN=10000 (175.2)
 NOTE ULN=UPBAN LAND INITIAL (HECTARES)
 L $AC.K=AC.J+(DT)(ACI.JK-ACD.JK)$ (176)
 N AC=ACN (176.1)
 NOTE AC=AGRICULTURAL CAPITAL (BIL LL)
 C ACN=1.4E9 (176.2)
 NOTE ACN=AGRICULTURAL CAPITAL INITIAL (BIL LL)
 A $CNILR.K=AC.K/(NICL.K+RWIL*ICL.K)$ (177)
 C RWIL=2 (177.1)
 NOTE CNILR=CAPITAL NON-IRRI LAND RATIO (LL PER HECT)
 NOTE RWIL=RELATIVE WIEGHT OF IRRI LAND (DIM)
 A $ACILR.K=AC.K/(ICL.K+NICL.K/RWIL)$ (178)
 NOTE ACILR=AG CAPITAL IRRI LAND RATIO (LL PER HECT)
 A $FNICLR.K=NICL.K/(NICLN+ICLN)$ (179)
 NOTE FNICLR=FRACT NON-IRRI CULT LAND REMAINING (DIM)
 A $CILR.K=ACILR.K+IFLN$ (180)
 C IFLN=7778 (180.1)
 NOTE CILR=CAPITAL IRRI LAND RATIO (LL PER HECT)
 NOTE IFLN=IRRI FACILITIES PER LAND INITIAL (LL PER HECT)
 A $RCNILR.K=CNILR.K/CNILRN$ (181)
 C CNILRN=3111 (181.1)
 NOTE RCNILR=RELATIVE CAPL NON-IRRI LAND RATIO (DIM)
 NOTE CNILRN=CAPITAL NON-IRRI LAND RATIO INITIAL (LL PER HECT)
 A $RCILR.K=CILR.K/CILRN$ (182)
 C CILRN=14000 (182.1)
 NOTE RCILR=RELATIVE CAPITAL IRRI LAND RATIO (DIM)
 NOTE CILRN=CAPITAL IRRI LAND RATIO INITIAL (LL PER HECT)
 A $CYMNIL.K=TABLE(YMNILT,RCNILR.K,0,10,2)$ (183)
 T YMNILT=0/2/2.5/2.9/3/3 (183.1)
 NOTE CYMNIL=CAPL YIELD MULTIPLIER NON-IRRI LAND (DIM)
 A $CYMIL.K=TABLE(CYMILT,RCILR.K,0,10,2)$ (184)
 T CYMILT=0/2/3.5/4.5/5/5 (184.1)
 NOTE CYMIL=CAPL YIELD MULTIPLIER IRRIGATED LAND (DIM)
 A $NILY.K=NILYN*CYMNIL.K$ (185)
 C NILYN=1.0 (185.1)
 NOTE NILYN=NON IRRI LAND YIELD NORMAL (VEG EQUIV TONS/HECT-YR)
 A $ILY.K=ILYN*CYMIL.K$ (186)
 C ILYN=6.0 (186.1)
 NOTE ILYN=IRRIGATED LAND YIELD NORMAL (VEG EQUIV TONS/HECT-YR)
 A $FP.K=NILY.K*NICL.K+ILY.K*ICL.K$ (187)
 NOTE FP=FOOD PRODUCTION (THOUSAND VEG EQUIV TONS/HECT-YR)
 A $ILDCM.K=TABLE(ILDCMT,FNICLR.K,0,1,.25)$ (188)
 T ILDCMT=20/5/2/1/.5 (188.1)
 NOTE ILDCM=IRRI LAND DEVELOPMENT COST MULT (DIM)
 A $ILDC.K=(IFLN+ICCN)*ILDCM.K$ (189)
 C ICCN=7778 (189.1)
 NOTE ILDC=IRRI LAND DEVELOPMENT COSTS (LL PER HECT)

NOTE ICCN-IPRI CONSTRUCTION COSTS INITIAL (LL PER HECT) (190)
 A $NAGDP.K = CSGDP.K + CP.K$
 NOTE NAGDP-NON AGRICULTURE G.D.P. (BIL LL PER YR) (190)
 A $GBI.K = GTP.K * FGTPIM.K * FGTPIN + FPI.K$ (191.2)
 C $FGTPIN = .08$
 NOTE GBI-GOVT BUDGET TO IRRIGATION (BIL LL PER YR)
 NOTE FGTPIN-FRAC GOVT TRANSFER PAYMENTS TO IRRI NORMAL (DIM) (192)
 R $ILDR.KL = GBI.K / ILDC.K$
 NOTE ILDR-IRRI LAND DEVELOPMENT RATE (HECT PER YR) (193)
 A $ULR.K = TABLE(ULPT, NAGDP.K, 0.150E9, 15E9)$
 T $ULPT = 0/16000/24000/28000/30000/31000/31000/31000/31000/31000$
 NOTE ULR-URBAN LAND REQUIRED (THOUSANDS OF HECTARES) (194)
 R $LCCR.KL = DELAY1(LCP, JK, ULDT)$ (194.1)
 R $LCP.KL = (ULR.K - UL.K) * FLPPY$ (194.2)
 C $FLPPY = .25$ (194.3)
 C $ULDT = 4$
 NOTE LCCR-LAND CONVERSION COMPLETION RATE (HA/YR)
 NOTE LCR-LAND CONVERSION RATE (HA/YR)
 NOTE FLPPY-FRAC LAND PROGRAMMED PER YEAR (1/YR)
 NOTE ULDT-URBAN LAND DEVELOPMENT TIME (YEARS)
 NOTE LCR-LAND CONVERSION RATE (HECT PER YR)
 NOTE ULDT-URBAN LAND DEVELOPMENT TIME (YEARS)
 R $IFD.KL = IF.K / LIF$ (195)
 C $LIF = 35$ (195.1)
 NOTE IFD-IRRI FACILITIES DEPRECIATION (BIL LL PER YR)
 NOTE LIF-LIFETIME IRRI FACILITIES (YEARS)
 R $IFI.KL = GBI.K$ (196)
 NOTE IFI-IRRI FACILITIES INVESTMENT (BIL LL PER YR) (197)
 A $FPC.K = FP.K / NP.K$
 NOTE FPC-FOOD PER CAPITA (THOUS VEG EQUIV TONS / YR-PERSON) (198)
 A $FGTPIM.K = TABLE(FGPTM, FPC.K / FPCN, 0.4, 1)$ (198.1)
 T $FGPTM = 2/1.5/1/.6/.5$ (198.2)
 C $FPCN = .27$
 NOTE FGTPIM-FRAC GOVT TRANSFER PAYMENTS TO IRRI MULT (DIM) (199)
 A $AU.K = FP.K * PDF$ (199.1)
 C $PDF = 1000$
 NOTE AD-AGRICULTURAL OUTPUT (BIL LL PER YR)
 NOTE PDF-PRICE OF FOOD (LL PER TON)
 A $AP.K = AU.K * (1 - FAOI)$ (200)
 C $FAOI = .3$ (200.1)
 NOTE AP-AGRICULTURAL PRODUCT (BIL LL PER YR)
 NOTE FAOI-FRAC AG OUTPUT TO INPUTS (DIM)
 R $ACD.KL = AC.K / LAC$ (201)
 C $LAC = 20$ (201.1)
 NOTE ACD-AG CAPITAL DEPRECIATION (BIL LL PER YR)
 NOTE LAC-LIFETIME AG CAPITAL (YEARS)
 R $ACI.KL = AP.K * FAPI$ (202)
 C $FAPI = .2$ (202.1)
 NOTE ACI-AG CAPITAL INVESTMENT (BIL LL PER YR)
 NOTE FAPI-FRAC AG PRODUCT INVESTED (DIM) (203)
 A $AL.K = NICL.K + ICL.K$
 NOTE AL-AGRICULTURAL LAND (HECTARES) (204)
 A $RACLR.K = (AC.K / ALN) / (AL.K / ALN)$ (204.1)
 C $ALN = 360000$
 NOTE RACLR-RELATIVE AG CAPL LAND RATIO (DIM)
 NOTE ALN-AG LAND INITIAL (HECTARES)
 A $UPH.K = TABLE(UPHT, RACLR.K, 0.10, 2)$ (205)

T JPH_T= $.45/.35/.3/.27/.25/.25$ (205.1)
 NOTE JPH-JOBS PER HECTARE
 A JIF_K=JPH_K*AL_K (206)
 NOTE JIF-JOBS IN FARMING
 A GDPWF_K=AP_K*(1-FAPI)/JIF_K (207)
 NOTE GDPWF-G.D.P. PER WORKER IN FARMING (LL/YR-PERSON)
 NOTE POPULATION SECTOR
 A IRP_K=AC_K*FACIR (209)
 C FAJIR=.1 (209.1)
 NOTE IRP-IRRIGATION PRODUCT (BIL LL PER YR)
 NOTE FAJIR-FRAC AG OUTPUT TO IRRIGATION (DIM)
 A JPICU_K=TABLE(JPICUT,IF_K/IFN,0,0,4) (210)
 T JPICUT= $.37/.25/.21/.18/.15/.13/.115/.105/.1/.1/.1$ (210.1)
 NOTE JPICU-JOBS PER IRRIGATION CAPITAL UNIT (PERSONS/LL E5)
 A JII_K=JPICU_K*IF_K/100000 (211)
 NOTE JII-JOBS IN IRRIGATION (PERSONS)
 A GOPPWI_K=IRP_K/JII_K (212)
 NOTE GOPPWI-G.D.P. PER WORKER IN IRRIGATION (LL PER YR PER PERSON)
 A AJPACU_K=TABLE(AJACUT,AC_K/ACN,0,10,2) (213)
 T AJACUT= $.2/.15/.13/.11/.1/.1$ (213.1)
 NOTE AJPACU-ADDITIONAL JOBS PER AG CAPITAL UNIT (PERSONS/LL E5)
 A JIAC_K=AJPACU_K*AC_K/100000 (214)
 NOTE JIAC-JOBS IN AG CAPITAL (PERSONS)
 A TARJ_K=JIF_K+JII_K+JIAC_K (215)
 NOTE TARJ-TOTAL AG RELATED JOBS (PERSONS)
 A TAP_K=AP_K+IRP_K (216)
 NOTE TAP-TOTAL AGRICULTURAL PRODUCT (BIL LL PER YR)
 A RPI_K=(MD_K+BC_K)*(FCF_K-SCF_K) (217)
 A FCF_K=CLIP(FMDGC+FBDGC-.15,0,TIME_K,5) (217.1)
 A SCF_K=CLIP(FMDGC+FBDGC-.15,0,TIME_K,45) (217.2)
 L UP_K=UP_J+(DT)(NUPCR_J-ER_J+RUMR_J) (218)
 N UP=UPN (218.1)
 NOTE UP-URBAN POPULATION (PERSONS)
 C UPN=1.8E6 (218.2)
 NOTE UPN-URBAN POPULATION INITIAL (PERSONS)
 L RP_K=RP_J+(DT)(NRPCR_J-RUMR_J) (219)
 N RP=RPN (219.1)
 NOTE RPN-RURAL POPULATION INITIAL (PERSONS)
 C RPN=1.2E6 (219.2)
 NOTE RP-RURAL POPULATION (PERSONS)
 A NP_K=UP_K+RP_K (220)
 NOTE NP-NATIONAL POPULATION (PERSONS)
 A WPCI_K=TABLE(WPCIT,TIME_K,0,100,10) (221)
 T WPCIT=1000/1200/1350/1450/1525/1575/1600/1620/1655/1645/1650
 NOTE WPCI-WORLD PER CAPITA INCOME (LL PER PERSON PER YR)
 NOTE WPCIN-WORLD PER CAPITA INC INITIAL (LL PER PERSON PER YR)
 A NPCI_K=GNP_K/NP_K (222)
 NOTE NPCI-NATIONAL PER CAPITA INCOME (LL PER PERSON PER YR)
 A RNPCI_K=NPCI_K/WPCI_K (223)
 NOTE RNPCI-RELATIVE NATIONAL PER CAPITA INCOME (DIM)
 A RNPCR_K=RNPCI_K/RNPICIN (224)
 C RNPICIN=4.8 (224.1)
 NOTE RNPCR-RELATIVE NATL PER CAPITA INCOME RATIO (DIM)
 NOTE RNPICIN-RELATIVE NATL PER CAPITA INCOME NORMAL (DIM)
 A RRI_K=TABLE(RRIT,PPARJ_K/PPNAJ_K,0,2,.5) (225)
 T RRIT=0/.5/.8/1/1.1 (225.1)
 NOTE RRI-RELATIVE RURAL INCOME (DIM)

A PPARJ.K=TAP.K/TARJ.K (226)
 NOTE PPARJ-PRODUCT PER AG-RELATED JOB (LL PER PERSON PER YR)
 A PPNAJ.K=NAGDP.K/NAJ.K (227)
 NOTE PPNAJ-PRODUCT PER NON-AG JOB (LL PER PERSON PER YR)
 A RRIR.K=ERI.K/RRIN (228)
 C RRIN=.25 (228.1)
 NOTE RRIR-RELATIVE RURAL INCOME RATIO (DIM)
 NOTE RRIN-RELATIVE RURAL INCOME NORMAL (DIM)
 A RUMM.K=TABLE(RUMMT,REIR.K,0,6,1) (229)
 T RUMMT=.05/0/- .03/- .04/- .05/- .06/- .07 (229.1)
 NOTE RUMM-RURAL TO URBAN MIGRATION MULT (FRACT/YR)
 A RUMMR.K=DLINF3(RUMM.K,RLZT) (230)
 C RLZT=3 (230.1)
 NOTE RUMMR-RURAL TO URBAN MIGRATION MULT REALIZED (FRACT/YR)
 NOTE RLZT-REALIZATION TIME (YEARS)
 A MUPM.K=TABLE(MUPMT,UP.K/NP.K,0,1,.2) (231)
 T MUPMT=.02/.02/.015/0/- .03/- .045 (231.1)
 NOTE MUPM-MODERNIZATION OF URBAN POPULATION MULT (1/YR)
 A POLPM.K=TABLE(POLPMT,POLR.K,0,10,2) (232)
 T POLPMT=0/- .001/- .002/- .003/- .005/- .01 (232.1)
 NOTE POLPM-POLLUTION POPULATION MULT (FRACT/YR)
 A POLPMR.K=DLINF3(POLPM.K,PED) (233)
 C PED=5 (233.1)
 NOTE PED-POLLUTION EFFECT DELAY (YEARS)
 R NUPCR.KL=UP.K*(UPCM.K+NUPCF) (234)
 C NUPCF=.03 (234.1)
 NOTE NUPCR-NATURAL URBAN POP CHANGE RATE (PERSONS/YR)
 NOTE NUPCF-NATURAL URBAN POP CHANGE FACTOR (FRACT/YR)
 R ER.KL=UP.K*(EM.K+EF) (235)
 C EF=.0167 (235.1)
 NOTE ER-EMIGRATION RATE (PERSONS/YR)
 NOTE EF-EMIGRATION FACTOR (FRACT/YR)
 R RUMR.KL=RP.K*(RUMMR.K+RUMF) (236)
 C RUMF=.05 (236.1)
 NOTE RUMR-RURAL TO URBANMIGRATION RATE (PERSONS/YR)
 NOTE RUMF-RURAL TO URBAN MIGRATION FACTOR (FRACT/YR)
 R NRPCR.KL=RP.K*(RPCM.K+NRPCF) (237)
 C NRPCF=.033 (237.1)
 NOTE NRPCR-NATURAL RURAL POP CHANGE RATE (PERSONS/YR)
 NOTE NRPCF-NATURAL RURAL POP CHANGE FACTOR (FRACT/YR)
 A EM.K=TABLE(EMT,RNPCIR.K,0,3,.5) (238)
 T EMT=.1/.02/0/- .0167/- .03/- .03/- .03 (238.1)
 NOTE EM-EMIGRATION MULTIPLIER (FRACT/YR)
 A MRPM.K=DLINF3(MUPM.K,MDT.K) (239)
 NOTE MRPM-MODERNIZATION OF RURAL POPULATION MULT (1/YR)
 A MDT.K=MDTN*TABLE(REFRMT,(RPEF.K/RP.K)/(UPEFN/UPN),0,8,.8) (240)
 T REFRMT=1.5/.5/.3/.2/.2/.2/.2/.2/.2/.2 (240.2)
 C MDTN=10 (240.1)
 NOTE MDT-MODERNIZATION DISSEMINATION TIME (YEARS)
 NOTE REFRMT-RELATIVE EDUC FACIL RURAL MULT (DIM)
 A HRP.M.K=TABLE(HRPMT,(RPHF.K/RP.K)/(RPHFN/RPN),0,16,2,1,8) (241)
 T HRPMT=-.009/.0045/.005/.005/.005/.005/.005/.005/.005 (241.1)
 NOTE HRP.M-HEALTH RURAL POPULATION MULT (1/YR)
 A UPCM.K=MUPM.K+POLPMR.K (242)
 A RPCM.K=MRPM.K+HRPM.K (243)
 A GDP.K=NAGDP.K+TAP.K (244)
 NOTE GDP-GROSS DOMESTIC PRODUCT (BIL LL PER YR)

25 L SWICY.K=SWICY.J+(DT)*(SWIC.JK) (245)
 N SWICY=SWICYN (245.1)
 C SWICYN=480E6 (245.2)
 NOTE SWICY-SURFACE WATER IMPOUNDMENT CAPACITY (CU METERS)
 A IMC.K=SWICY.K*UIMC (246)
 C UIMC=.02 (246.1)
 NOTE IMC-IMPOUNDMENT MAINTENANCE COST (LL/YR)
 NOTE UIMC-UNIT IMPOUNDMENT MAINT COST (LL/M3-YR)
 A FBSW.K=CLIP(C,FBSWN,SWICY.K,MSWICY) (247)
 C FBSWN=.8 (247.1)
 C MSWICY=1000E6 (247.2)
 35 NOTE FBSW-FRACT BUDGET TO SURF WATER (DIM)
 37 NOTE MSWICY-MAX SURF WATER IMPDMT CAP (M3) (248)
 A ICC.K=ICCN*SWICY.K/SWICYN (248.1)
 C ICCN=1.0
 39 NOTE ICC-IMPDMT CONSTRUCTION COSTS (LL/M3) (ICCN=WUCN*.4/SWICYN)
 41 R SWIC.KL=MAX(0,((WUCI.JK-WUCD.JK)*FBSW.K-IMC.K)/ICC.K) (249)
 NOTE SWIC-SURF WATER IMPDMT CONSTRUCTION (M3/YR)
 43 A DER.K=(MC.K+BC.K+AC.K)/(MCN+BCN+ACN) (250)
 NOTE DER-DEMAND RATIO
 45 A DSWD.K=DER.K*AWDN*DDS (251)
 C AWDN=825E6 (251.1)
 C DDS=.67 (251.2)
 47 NOTE DSWD-DRY SEASON WATER DEMAND (M3)
 49 NOTE AWDN-ANNUAL WATER DEMAND (M3/YR)
 NOTE DDS-DURATION DRY SEASON (YR)
 51 A DSW.S.K=EAR*FFDS+MIN(SWICY.K,EAR*(1-FFDS)) (252)
 C EAR=4800E6 (252.1)
 C FFDS=.1 (252.2)
 53 NOTE DSW.S-DRY SEASON WATER SUPPLY (M3)
 55 NOTE EAR-EXPLOITABLE ANNUAL RAINFALL (M3)
 NOTE FFDS-FRACT FALLING IN DRY SEASON (DIM)
 57 A HED.K=SWICY.K*KHPMPY (253)
 C KHPMPY=2.5 (253.1)
 59 NOTE HED-HYDROELECTRIC OUTPUT (KWH/YR)
 NOTE KHPMPY-KWH PER CU METER PER YR (KWH/M3-YR)
 61 A TED.K=DER.K*EDN (254)
 C EDN=2000E6 (254.1)
 63 NOTE TED-TOTAL ELECTRICITY DEMAND (KWH/YR)
 NOTE EDN-ELECTRICITY DEMAND NORMAL (KWH/YR)
 NOTE PHYSICAL INFRASTRUCTURE - HIGHWAYS
 L HLK.K=HLK.J+(DT)*(HWYC.JK) (255)
 1 N HLK=HLKN (255.1)
 C HLKN=1.8E4
 3 NOTE HLK-HWY LANE KILOMETERS (LANE-KM)
 A HLFO.K=HLK.K*LPK/LZH (256)
 5 C LPK=.05 (256.1)
 C LZH=1500 (256.2)
 7 NOTE HLFO-HWY LAND FRACTION OCCUPIED (DIM)
 NOTE LPK-LAND PER KILOMETER (HA/KM-LAND)
 9 NOTE LZH-LAND ZONED HWYS (HA)
 A HCC.K=HCCN*HCCM.K (257)
 11 C HCCN=212500 (257.1)
 NOTE HCC-HWY CONSTRUCTION COST (LL/KM-LANE)
 13 A HCCM.K=TABLE(HCCMT,HLFO.K,C,1..2) (258)
 T HCCMT=.9/.9/.9/1/8/25 (258.1)
 15 NOTE HCCM-HWY CONSTR COST MULT (DIM)

21 P- 17 RUN- MODEL NAME = NRDM - 1 (CASE 1)

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25 A $UMC.K = UMCN * NCF.K / NCFN$ (259)

NOTE UMC-UNIT MAINTENANCE COST (LL/LANE-KM-YR)

27 C $NCFN = 750$ (259.1)

C $UMCN = 3333$ (259.2)

29 A $HMC.K = HLK.K * UMC.K$ (260)

R $HWYC.KL = (FLTH * (LTFI.JK - LTFO.JK) + MV.K * HUR - HMC.K) / HCC.K$ (261)

31 C $FLTH = .85$ (261.1)

C $HUR = 300$ (261.2)

33 NOTE HWYC-HWY CONSTRUCTION (LANE-KM/YR)

NOTE FLTH-FRACT LAND TRANS IN HWYS (DIM)

35 NOTE HUR-HIGHWAY USER REVENUES (LL/YR)

NOTE HOUSING SECTOR

37 L $UID.K = UID.J + (DT) * (UICR.JK - UIDR.JK - UIDRX.JK)$ (262)

N $UID = UIDN$ (262.1)

39 C $UIDN = 1.0E6$ (262.2)

NOTE UID-UPPER INCOME DWELLINGS (ROOMS)

41 L $LID.K = LID.J + (DT) * (UIDR.JK + LICR.JK - LIDR.JK)$ (263)

N $LID = LIDN$ (263.1)

43 C $LIDN = 1.0E6$ (263.2)

NOTE LID-LOW INCOME DWELLINGS (ROOMS)

45 A $TDU.K = UID.K + LID.K$ (264)

NOTE TDU-TOTAL DWELLING UNITS (ROOMS)

47 A $RDPPM.K = TABLE(RDPPMT, DEK.K * NPN / N^2.K, 0.8, 1)$ (265)

T $RDPPMT = 0/1/1.2/1.33/1.42/1.48/1.5/1.5/1.5$ (265.1)

49 C $NPN = 3E6$ (265.2)

NOTE RDPPM-ROOMS DESIRED PER PERSON MULT (DIM)

51 R $UIDRX.KL = (UID.K / LUID) * FUIDD$ (266)

NOTE UIDRX-UPPER INCOME DWELLING DEMOLITION RATE (ROOMS/YR)

53 C $RDPPN = .75$ (266.1)

NOTE RDPP-ROOMS DESIRED PER PERSON MULT (DIM)

55 A $TDD.K = NP.K * RDPPN * RDPPM.K$ (267)

S $DUD.K = TDD.K - TDU.K$ (268)

57 NOTE DUD-DWELLING UNIT DEFICIENCY (ROOMS)

NOTE TDD-TOTAL DWELLING DEMAND (ROOMS)

59 A $DLFO.K = TDU.K * LPDU / LZD$ (269)

C $LPDU = 200$ (269.1)

61 C $LZD = 10000E5$ (269.2)

NOTE DLFO-DWELLING LAND FRACT OCCUPIED (DIM)

63 NOTE LPDU-LAND PER DWELLING UNIT (SQ METERS/ROOM)

NOTE LZD-LAND ZONED FOR DWELLINGS (M2)

A $DCCM.K = TABLE(DCCMT, DLFO.K, 0.1, .2)$ (270)

T $DCCMT = .7/.8/1/2/4/7$ (270.1)

NOTE DCCM-DWELLING CONSTRUCTION COST MULT (DIM)

1 A $LICC.K = LICCN * DCCM.K$ (271)

3 C $LICCN = 20000$ (271.1)

NOTE LICC-LOW INCOME (DWELLING) CONSTR COST (LL/ROOM)

5 NOTE LICR-LOW INCOME CONSTR RATE (ROOMS/YR)

R $LICR.KL = (LIHP.K + RILIH.JK) / LICC.K$ (272)

7 R $LIDR.KL = LID.K / LLID$ (273)

C $LLID = 50$ (273.1)

9 NOTE LIDR-LOW INCOME DWELLING DETERIORATION RATE (ROOMS/YR)

NOTE LLID-LIFETIME LOW INCOME DWELLINGS (YR)

11 R $UIDR.KL = (UID.K / LUID) * (1 - FUIDD)$ (274)

C $LUID = 30$ (274.1)

13 C $FUIDD = .2$ (274.2)

NOTE UIDR-UPPER INCOME DWELLING DETERIORATION RATE (ROOMS/YR)

15 NOTE LUID-LIFETIME UPPER INCOME DWELLINGS (YR)

25 NOTE FUIDD-FRACT UPPER INCOME D.U. DEMOLISHED (DIM)
 R $UICR.K = UID.K * UICN * UICM.K$ (275)
 NOTE UICR-UPPER INCOME DWELLING CONSTR. RATE (ROOMS/YR)
 A $UICM.K = TABLE(UICMT, DLFO.K, 0.1, .2)$ (276)
 T $UICMT = 1/1/1/.8/.67/.6$ (276.1)
 NOTE UICM-UPPER INCOME CONSTRUCTION MULT (DIM)
 C $UICN = .03$ (276.2)
 A $RENT.K = RENTN * DER.K$ (277)
 C $RENTN = 500$ (277.1)
 NOTE RENT PER DWELLING (LL/YR-ROOM)
 25 NOTE TRADE-ENERGY SECTOR
 A $TTLR.K = (ITF.K / ITFN) * TTLRN$ (278)
 C $TTLRN = 1.0E9$ (278.1)
 37 NOTE TTLR-TARIFF-TRANSIT-LOADING REVENUES (LL/YR)
 A $MFD.K = MC.K * UMCFD * ETEM.K$ (279)
 39 C $UMCFD = .075E-3$ (279.1)
 NOTE MFD-MANUF FUEL DEMAND (TON OIL EQUIVALENTS PER YR)
 41 NOTE UMCFD-UNIT MANUF CAPITAL FUEL DEMAND (TOE/YR-LL)
 A $SFD.K = (BC.K + WUC.K + TCC.K + ITF.K + PEF.K + PHF.K) * USCFD * ETEM.K$ (280)
 43 C $USCFD = .025E-3$ (280.1)
 NOTE SFD-SERVICE SECTOR FUEL DEMAND (TOE/YR)
 45 NOTE USCFD-UNIT SERVICE CAPITAL FUEL DEMAND (TOE/YR-LL)
 A $AFD.K = AC.K * UACFD * ETEM.K$ (281)
 47 C $UACFD = .075E-3$ (281.1)
 NOTE AFD-AGRICULTURE FUEL DEMAND (TOE/YR-LL)
 49 NOTE UACFD-UNIT AGRI CAPITAL FUEL DEMAND (TOE/YR-LL)
 A $DFD.K = TDU.K * UDFD * ETEM.K$ (282)
 51 C $UDFD = .3$ (282.1)
 NOTE DFD-DOMESTIC FUEL DEMAND (TOE/YR)
 53 NOTE UDFD-UNIT DWELLING UNIT FUEL DEMAND (TOE/YR-ROOM)
 A $TFD.K = MV.K * UVFD * ETEM.K$ (283)
 55 C $UVFD = 2.5$ (283.1)
 NOTE TFD-TRANSPORTATION FUEL DEMAND (TOE/YR)
 57 NOTE UVFD-UNIT VEHICLE FUEL DEMAND (TOE/YR-VEH)
 A $FIM.K = (MFD.K + SFD.K + AFD.K + DFD.K + TFD.K) * NCF.K + (EUD.K * FEUDF.K)$ (284)
 59 NOTE FIM-FUEL IMPORTS (LL/YR)
 A $NCF.K = TABLE(NCFT, TIME.K, 0.50, 10)$ (285)
 61 T $NCFT = 750/1500/2000/2500/2450/2500$ (285.1)
 63 NOTE NCF-NATIONAL COST OF FUEL (LL/TOE)
 R $MVGR.KL = MV.K * MVGN * VHGM.K$ (286)
 C $MVGN = .08$ (286.1)
 NOTE MVGR-MOTOR VEH GROWTH RATE (VEH/YR)
 1 NOTE MVGN-MOTOR VEH GROWTH NORMAL (1/YR)
 L $MV.K = MV.J + (DT) (MVGR.JK)$ (287)
 3 N $MV = MVN$ (287.1)
 C $MVN = 300000$ (287.2)
 5 NOTE MV-MOTOR VEHICLES (VEH)
 A $NMGE.K = NMGEN * (MO.K / NP.K) / MOPCN$ (288)
 7 C $MOPCN = 1667$ (288.1)
 C $NMGEN = .25E9$ (288.2)
 9 NOTE NMGE-NET MANUF GOODS EXPORTED (LL/YR)
 NOTE MOPCN-MANUF OUTPUT PER CAPITA NORMAL (LL/YR-PERSON)
 11 A $NBSE.K = NBSEN * (BO.K / NP.K) / BOPCN$ (289)
 C $BOPCN = 4000$ (289.1)
 13 C $NBSEN = .6E9$ (289.2)
 NOTE NBSE-NET BUSINESS SERVICES EXPORTED (LL/YR)
 15 NOTE BOPCN-BUSINESS OUTPUT PER CAPITA NORMAL (LL/YR-PERSON)

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P- 19 RUN-

MODEL NAME = NRDM - 1 (CASE 1)

A NAPE.K=NAPEN*(AO.K/NP.K)/AOPCN (290)
 C AOPCN=270 (290.2)
 C NAPEN=.15E9 (290.3)
 NOTE NAPE-NET AGRI PRODUCTS EXPORTED (LL/YR)
 NOTE AOPCN-AGRI OUTPUT PER CAPITA NORMAL (LL/YR-PERSON)
 A GNP.K=GDP.K+TTLR.K+NMGE.K+NbSE.K+NAPE.K-FIM.K (291)
 NOTE GNP-GROSS NATIONAL PRODUCT (LL/YR)
 A ETEM.K=TABLE(ETEM,DER.K,0,10,2) (292)
 T ETEM=1.15/.85/.65/.5/.4/.35 (292.1)
 NOTE ETEM-ENERGY EFFICIENCY TECHNOLOGY MULTIPLIER (DIM)
 A GTP.K=MP.K*FAPGTP.K+BP.K*FBPGTP.K (293)
 NOTE GTP-GOVT TRANSFER PAYMENTS (LL/YR)
 S GB.K=GP.K+GTP.K+TTLR.K*FTTLRB+FIM.K*FTAX (294)
 C FTTLRB=1.0 (294.1)
 C FTAX=.2 (294.2)
 NOTE GB-GOVT BUDGET (LL/YR-VEH)
 NOTE FTTLRG-FRACT TTL REVENUES TO BUDGET (DIM)
 NOTE FTAX-FUEL TAX (DIM)
 S PPP.K=NP.K/(JIPH.K*FWPHY.K) (295)
 A FWPHY.K=TABLE(FWPHY,T,JIPH.K,0,100000,10000) (295.1)
 T FWPHY=1/.2/.16/.14/.13/.122/.115/.109/.104/.101/.10 (295.2)
 NOTE PPP-POP PER PHYSICIAN (DIM)
 NOTE FWPHY-FRACT WORKERS PHYSICIANS (DIM)
 S PCEC.K=TED.K/NP.K (296)
 NOTE PCEC-PER CAPITA ENERGY CONSUMPTION (TOE/YR-PERSON)
 S MVPC.K=MV.K/NP.K (297)
 NOTE MVPC-MOTOR VEHICLES PER CAPITA (VEH/PERSON)
 A FPWA.K=TABLE(FPWAT,ANPI.K,-2,4,1) (298)
 T FPWAT=.42/.41/.4/.38/.35/.32/.3 (298.1)
 NOTE FPWA-FRACT POP OF WORKING AGE (DIM)
 S FEIF=JIF.K/(NAJ.K+TARJ.K) (299)
 NOTE FWIF-FRACT WORKERS EMPLOYED IN FARMING (DIM)
 S ANRPP.K=(UID.K+LID.K)/NP.K (300)
 NOTE ARMPP-AVER NO ROOMS PER PERSON (ROOMS/PERSON)
 S FALI.K=ICL.K/(ICL.K+NICL.K) (301)
 NOTE FALI-FRACT AG LAND IRRIGATED (DIM)
 S ALT.K=ALTN+DLINF3(ALM.K,ALRT) (302)
 C ALTN=.7 (302.1)
 C ALRT=10 (302.2)
 NOTE ALT-ADULT LITERACY (FRACT)
 NOTE ALRT-ADULT LITERACY REALIZATION TIME (YEARS)
 A ALM.K=TABLE(ALMT,UPEPCR.K+RPEPCR.K,0,24,2) (303)
 T ALMT=-.7/0/.12/.18/.21/.23/.245/.255/.262/.267/.27/.27/.27 (303.1)
 A UPEPCR.K=(UPEF.K/UP.K)/(UPEFN/UPN) (304)
 NOTE UPEPCR-URBAN PUBLIC ED PER CAPITA RATIO
 A RPEPCR.K=(RPEF.K/RP.K)/(RPEFN/RPN) (305)
 NOTE RPEPCR-RURAL PUBLIC ED PER CAPITA RATIO
 A VHCM.K=TABLE(VHCMT,(MV.K/HLK.K)/(MVN/HLKN),0,4,1) (306)
 T VHCMT=3/1/0/-.01/-.04 (306.1)
 NOTE VHCM-VEH HWY CONGESTION MULT (DIM)
 S POPU.K=(100)(UP.K/NP.K) (307)
 NOTE POPU-PERCENTAGE OF POPULATION URBAN
 A ANPI.K=(100)(NUPCR.K+NRPCR.K)/NP.K (308)
 NOTE ANPI-ANNUAL NATURAL POPULATION INCREASE
 S PPWA.K=100*FPWA.K (309)
 NOTE PPWA-PERCENTAGE OF POPULATION OF WORKING AGE
 S POPDEN.K=NP.K/AREA (310)

25 NOTE POPDEN-POPULATION DENSITY (PERSONS / SQ KM) (310.1)
 C AREA=10400 (311)
 S TBPGNP.K=(GNP.K-GDP.K)/GNP.K (311)
 NOTE TBPGNP-TRADE BALANCE PERCENTAGE OF GNP (312)
 A PUNEM.K=TABLE(PUNEMT,(TLFD.K-JOBS.K)/TLFD.K,-.5,.5,.5) (312.1)
 T PUNEMT=-20/0/30 (312.1)
 NOTE PUNEM-PERCENTAGE UNEMPLOYMENT (313)
 A JOBS.K=TARJ.K+NAJ.K (313)
 A TLFD.K=NP.K*FPWA.K (314)
 NOTE TLFD-TOTAL LABOR FORCE (315)
 S BPGNP.K=(100)(GB.K/GNP.K) (315)
 NOTE BPGNP-BUDGET AS PERCENTAGE OF GNP (316)
 S TPPGNP.K=(100)(GTP.K/GNP.K) (316)
 NOTE TPPGNP-TRANSFER PAYMENTS AS PERCENTAGE OF GNP (317)
 S PHSUB.K=FPS.K*(100-PHPS.K) (317)
 NOTE PHSUB-PERCENTAGE HEALTH SUBSIDIZED (318)
 A PHPS.K=TABLE(PHPST,(PHF.K/NP.K)/(PHEN/NPN),0.5,1) (318)
 T PHPST=90/80/70/60/50/40 (318.1)
 NOTE PHPS-PERCENTAGE HEALTH IN PRIVATE SECTOR (319)
 S PESUB.K=FPES.K*(100-PEPS.K) (319)
 NOTE PESUB-PERCENTAGE EDUCATION SUBSIDIZED (320)
 A PEPS.K=TABLE(PEPST,(PEF.K/NP.K)/(PEFN/NPN),0.5,1) (320)
 T PEPST=60/50/40/30/20/10 (320.1)
 NOTE PEPS-PERCENTAGE EDUCATION IN PRIVATE SECTOR (321)
 S UPOPD.K=UP.K/UL.K (321)
 NOTE UPOPD-URBAN POPULATION DENSITY (PERSONS/HECTARE) (322)
 S AFSIZ.K=AL.K/JIF.K (322)
 NOTE AFSIZ-AVER FARM SIZE (HECT / FARM) (323)
 S FPCC.K=FPC.K*10000 (323)
 NOTE FPCC-FOOD PER CAPITA (KILCCALORIES / PERSON-DAY) (324)
 S PALI.K=(ICL.K/AL.K)*100 (324)
 NOTE PALI-PERCENTAGE AGRI LAND IRRIGATED (325)
 S TSPC.K=TSPCN*TSPCM.K (325)
 C TSPCN=.05 (325.1)
 A TSPCM.K=TABLE(TSPCMT,TCCR.K,0.9,1) (325.2)
 T TSPCMT=0/2/3.8/5.5/7/8.3/9.5/10.5/11.2/12 (325.3)
 NOTE TSPC-T.V. SETS PER CAPITA (326)
 S CAPC.K=CAPCN*CAPCM.K (326)
 C CAPCN=10 (326.1)
 A CAPCM.K=TABLE(CAPCMT,TCCR.K,0.9,1) (326.2)
 T CAPCMT=2/1.2/.8/.6/.5/.5/.5/.5/.5 (326.3)
 NOTE CAPC-CINEMA ATTENDANCE PER CAPITA (TRIPS/PERSON-YR) (328)
 S HWYDEN.K=HLK.K/AREA (328)
 NOTE HWYDEN-HIGHWAY DENSITY (LANE-KMS/SQ KM) (329)
 S SWICPC.K=SWICY.K/NP.K (329)
 NOTE SWICPC-SURF WATER IMPDMT CAPACITY PER CAPITA (M3/PER) (330)
 S FIPGNP.K=(FIM.K/GNP.K)*100 (330)
 NOTE FIPGNP-FUEL IMPORTS AS PERCENT OF GNP (331)
 S QOL.K=NPCI.K+(10000*RR1)-(2000*POLR.K) (331)
 NOTE QOL-QUALITY OF LIFE (331)
 NOTE CONTROL (331)
 PRINT PUNEM,NPCI,RR1 (331)
 PRINT QOL (331)
 PLOT MC=C,MO=O,MP=P (331)
 PLOT FEUCH=H/WDSR=W (331)
 PLOT NB=N,DB=D,RB=R,BE=E (331)
 PLOT GNP=N,GDP=D,FIM=F (331)

APPENDIX B

DEFINITIONS OF PARAMETERS

* NRDM-2

NOTE AC-AGRICULTURAL CAPITAL (BIL LL)
 NOTE ACN-AGRICULTURAL CAPITAL INITIAL (BIL LL)
 NOTE ACILR-AG CAPITAL IRRI LAND RATIO (LL PER HECT)
 NOTE AO-AGRICULTURAL OUTPUT (BIL LL PER YR)
 NOTE AP-AGRICULTURAL PRODUCT (BIL LL PER YR)
 NOTE ACD-AG CAPITAL DEPRECIATION (BIL LL PER YR)
 NOTE ACI-AG CAPITAL INVESTMENT (BIL LL PER YR)
 NOTE AL-AGRICULTURAL LAND (HECTARES)
 NOTE ALN-AG LAND INITIAL (HECTARES)
 NOTE AJPACU-ADDITIONAL JOBS PER AG CAPITAL UNIT (PERSONS/LL E5)
 NOTE AWDN-ANNUAL WATER DEMAND (M3/YR)
 NOTE AFD-AGRICULTURE FUEL DEMAND (TOE/YR-LL)
 NOTE AOPCN-AGRI OUTPUT PER CAPITA NORMAL (LL/YR-PERSON)
 NOTE ARMPP-AVER NO ROOMS PER PERSON (ROOMS/PERSON)
 NOTE ALT-ADULT LITERACY (FRACT)
 NOTE ALRT-ADULT LITERACY REALIZATION TIME (YEARS)
 NOTE ANPI-ANNUAL NATURAL POPULATION INCREASE
 NOTE AFSIZ-AVER FARM SIZE (HECT / FARM)
 NOTE AFPI-AVER FRACT PRODUCT INVESTED (DIM)
 NOTE AFIP-AVER FRACT INVESTMENT IN PLANT (DIM)
 NOTE BOPCN-BUSINESS OUTPUT PER CAPITA NORMAL (LL/YR-PERSON)
 NOTE BPGNP-BUDGET AS PERCENTAGE OF GNP
 NOTE BC-BUSINESS CAPITAL
 NOTE BCN-BUSINESS CAPITAL INITIAL (BIL LL)
 NOTE BCR-BUSINESS CAPITAL RATIO (DIMENSIONLESS)
 NOTE BEUCR-BUSIN ELECT UTIL CAPITAL RATIO (DIMENSIONLESS)
 NOTE BEDSM-BUSIN ELECT DEMAND SUPPLY MULT (DIMENSIONLESS)
 NOTE BWUCR-BUSIN WATER UTIL CAPITAL RATIO (DIMENSIONLESS)
 NOTE BWDSM-BUSIN WATER DEMAND SUPPLY RATIO (DIMENSIONLESS)
 NOTE BTCCR-BUSIN TELE-COM CAPITAL RATIO (DIMENSIONLESS)
 NOTE BCDSM-BUSIN COMMUN DEMAND SUPPLY MULT (DIMENSIONLESS)
 NOTE BTFCR-BUSIN TRANS FACIL CAPITAL RATIO (DIMENSIONLESS)
 NOTE BTDSM-BUSIN TRANS DEMAND SUPPLY MULT (DIMENSIONLESS)
 NOTE BCOR-BUSINESS CAPITAL OUTPUT RATIO (YEARS)
 NOTE BO-BUSINESS OUTPUT (BIL LL PER YR)
 NOTE BP-BUSINESS PRODUCT (BIL LL PER YR)
 NOTE BCD-BUSIN CAPITAL DEPRECIATION (BIL LL PER YR)
 NOTE BCI-BUSIN CAPITAL INVESTMENT (BIL LL PER YR)
 NOTE BE-BUSINESS ESTABLISHMENTS
 NOTE BLFO-BUSINESS LAND FRACTION OCCUPIED (DIMENSIONLESS)
 NOTE BECM-BUSIN ESTAB COST MULT (DIMENSIONLESS)
 NOTE BA-BUSINESS ADDITIONS (ESTAB PER YR)
 NOTE BR-BUSIN RESTORATIONS (ESTAB PER YR)
 NOTE BRP-BUSIN RESTORATIONS PROGRAMMED (ESTAB PER YR)
 NOTE CNILR-CAPITAL NON-IRRI LAND RATIO (LL PER HECT)
 NOTE CILR-CAPITAL IRRI LAND RATIO (LL PER HECT)
 NOTE CNILRN-CAPITAL NON-IRRI LAND RATIO INITIAL (LL PER HECT)
 NOTE CILRN-CAPITAL IRRI LAND RATIO INITIAL (LL PER HECT)
 NOTE CYMIL-CAPL YIELD MULTIPLIER NON-IRRI LAND (DIM)
 NOTE CYMIL-CAPL YIELD MULTIPLIER IRRIGATED LAND (DIM)
 NOTE CAPC-CINEMA ATTENDANCE PER CAPITA (TRIPS/PERSON-YR)
 NOTE CPME-COST PER MANUF ESTABLISHMENT (MIL LL PER ESTAB)
 NOTE CPMEN-COST PER MANUF ESTABLISHMENT NORMAL (MIL LL PER ESTAB)
 NOTE CPBE-COST PER BUSIN ESTAB (MIL LL PER ESTAB)
 NOTE CPBEN-COST PER BUSIN ESTAB NORMAL (MIL LL PER ESTAB)
 NOTE CSGDP-CONSTRUCTION SERVING G.D.P. (BIL LL PER YR)

NOTE CP-CONSTRUCTION PRODUCT (BIL LL PER)
 NOTE CO-CONSTRUCTION OUTPUT (BIL LL PER YR)
 NOTE CC-CONSTRUCTION CAPITAL (BIL LL)
 NOTE CCOR-CONSTRUCTION CAPITAL OUTPUT RATIO (YEARS)
 NOTE DER-DEMAND RATIO
 NOTE DSWD-DRY SEASON WATER DEMAND (M3)
 NOTE DDS-DURATION DRY SEASON (YR)
 NOTE DSW-DRY SEASON WATER SUPPLY (M3)
 NOTE DUD-DWELLING UNIT DEFICIENCY (ROOMS)
 NOTE DLFO-DWELLING LAND FRACT OCCUPIED (DIM)
 NOTE DFD-DOMESTIC FUEL DEMAND (TOE/YR)
 NOTE DM-DAMAGED MANUFACTURING (ESTABLISHMENTS)
 NOTE DMN-DAMAGED MANUFACTURING INITIALLY (ESTABLISHMENTS)
 NOTE DB-DAMAGED BUSINESS (ESTABLISHMENTS)
 NOTE DBN-DAMAGED BUSINESS INITIALLY (ESTABLISHMENTS)
 NOTE ER-EMIGRATION RATE (PERSONS/YR)
 NOTE EF-EMIGRATION FACTOR (FRACT/YR)
 NOTE EM-EMIGRATION MULTIPLIER (FRACT/YR)
 NOTE EAR-EXPLOITABLE ANNUAL RAINFALL (M3)
 NOTE EDN-ELECTRICITY DEMAND NORMAL (KWH/YR)
 NOTE ETEM-ENERGY EFFICIENCY TECHNOLOGY MULTIPLIER (DIM)
 NOTE EUC-ELECTRIC UTILITY CAPITAL (BIL LL)
 NOTE EUCN-ELECTRIC UTIL CAPITAL INITIAL (BIL LL)
 NOTE EUCR-ELECTRIC UTIL CAPITAL RATIO (DIMENSIONLESS)
 NOTE EUO-ELECTRIC UTIL OUTPUT (BIL LL PER YR)
 NOTE EUP-ELECTRIC UTIL PRODUCT (BIL LL PER YR)
 NOTE EUCD-ELECT UTIL CAPITAL DEPRECIATION (BIL LL PER YR)
 NOTE EUCI-ELECT UTIL CAPITAL INVESTMENT (BIL LL PER YR)
 NOTE EWUIM-EFFICIENCY WATER UTIL INVESTMENT MULT (DIMEN)
 NOTE FGPPA-FRACT GOVT PROD TO PUBLIC ADMIN (DIM)
 NOTE FNICLR-FRACT NON-IRRI CULT LAND REMAINING (DIM)
 NOTE FP-FOOD PRODUCTION (THOUSAND VEG EQUIV TONS/HECT-YR)
 NOTE FGTPIN-FRACT GOVT TRANSFER PAYMENTS TO IRRI NORMAL (DIM)
 NOTE FLPPY-FRACT LAND PROGRAMMED PER YEAR (1/YR)
 NOTE FPC-FOOD PER CAPITA (THOUS VEG EQUIV TONS / YR-PERSON)
 NOTE FGTPIM-FRACT GOVT TRANSFER PAYMENTS TO IRRI MULT (DIM)
 NOTE FAOI-FRACT AG OUTPUT TO INPUTS (DIM)
 NOTE FAPI-FRACT AG PRODUCT INVESTED (DIM)
 NOTE FAOIR-FRACT AG OUTPUT TO IRRIGATION (DIM)
 NOTE FBSW-FRACT BUDGET TO SURF WATER (DIM)
 NOTE FFDS-FRACT FALLING IN DRY SEASON (DIM)
 NOTE FLTH-FRACT LAND TRANS IN HWYS (DIM)
 NOTE FUIOD-FRACT UPPER INCOME D.U. DEMOLISHED (DIM)
 NOTE FIM-FUEL IMPORTS (LL/YR)
 NOTE FTTLRG-FRACT TTL REVENUES TO BUDGET (DIM)
 NOTE FTAX-FUEL TAX (DIM)
 NOTE FWPHY-FRACT WORKERS PHYSICIANS (DIM)
 NOTE FPWA-FRACT POP OF WORKING AGE (DIM)
 NOTE FWIF-FRACT WORKERS EMPLOYED IN FARMING (DIM)
 NOTE FALI-FRACT AG LAND IRRIGATED (DIM)
 NOTE FPCC-FOOD PER CAPITA (KILOCALORIES / PERSON-DAY)
 NOTE FIPGNP-FUEL IMPORTS AS PERCENT OF GNP
 NOTE FMOG-FRACT MANUF OUTPUT TO GOVT (DIMENSIONLESS)
 NOTE FBOE-FRACT BUSIN OUTPUT TO ELECT (DIMENSIONLESS)
 NOTE FBOEN-FRACT BUSIN OUTPUT TO ELECT NORMAL (DIMENSIONLESS)
 NOTE FBOW-FRACT BUSIN OUTPUT TO WATER (DIMENSIONLESS)
 NOTE FBOWN-FRACT BUSIN OUTPUT TO WATER (DIMENSIONLESS)

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NOTE FBOC-FRACT BUSIN OUTPUT TO COMMUNICATIONS (DIMENSIONLESS)
 NOTE FBOCN-FRACT BUSIN OUTPUT TO COMMUN NORMAL (DIMENSIONLESS)
 NOTE FBOT-FRACT BUSIN OUTPUT TO TRANSPORTATION (DIMENSIONLESS)
 NOTE FBOTN-FRACT BUSIN OUTPUT TO TRANS NORMAL (DIMENSIONLESS)
 NOTE FBOIF-FRACT BUSIN OUTPUT TO INFRASTRUCTURE (DIMENSIONLESS)
 NOTE FBOI-FRACT BUSIN OUTPUT TO INPUTS (DIMENSIONLESS)
 NOTE FBPI-FRACT BUSIN PRODUCT INVESTED (DIMENSIONLESS)
 NOTE FBOG-FRACT BUSIN OUTPUT TO GOVT (DIMENSIONLESS)
 NOTE FEUCH-FRACT ELECT UTIL CAPL HYDROELECTRIC (DIMEN)
 NOTE FEUOF-FRACT ELECT UTIL OUTPUT TO FUEL (DIMEN)
 NOTE FEUPI-FRACT ELECT UTIL PRODUCT INVESTED (DIMEN)
 NOTE FWUOI-FRACT WATER UTIL OUTPUT TO INPUTS (DIMEN)
 NOTE FWUPI-FRACT WATER UTIL PRODUCT INVESTED (DIMEN)
 NOTE FMOM-FRACT MANUF OUTPUT TO MATERIALS (DIMENSIONLESS)
 NOTE FMOI-FRACT MANUF OUTPUT TO INPUTS (DIMENSIONLESS)
 NOTE FMOIF-FRACT MANUF OUTPUT TO INFRASTRUCTURE (DIMENSIONLESS)
 NOTE FMOTN-FRACT MANUF OUTPUT TO TRANS NORMAL (DIMENSIONLESS)
 NOTE FMOT-FRACT MANUF OUTPUT TO TRANSPORTATION (DIMENSIONLESS)
 NOTE FTCOI-FRACT TELE-COMMUN OUTPUT TO INPUTS (DIMEN)
 NOTE FTCPI-FRACT TELECOMMUN PRODUCT INVESTED (DIMEN)
 NOTE FIT-FRACT IN INTL TRANSPORT (DIMEN)
 NOTE FITOI-FRACT INTL TRANSPORT OUTPUT TO INPUTS
 NOTE FITPI-FRACT INTL TRANSPORT PRODUCT INVESTED
 NOTE FLT-FRACT IN LAND TRANSPORT (DIMEN)
 NOTE FLTOI-FRACT LAND TRANSPORT OUTPUT TO INPUTS (DIMEN)
 NOTE FLTFI-FRACT LAND TRANSPORT FACIL INVESTED (DIMEN)
 NOTE FMPGTP-FRACT. MANUF. PRODUCT GOVT. TRANSFER PAYMENT (DIM.)
 NOTE FBPGTP-FRACT. BUSIN. PRODUCT GOVT. TRANSFER PAYMENT (DIM.)
 NOTE FMOCN-FRACT MANUF OUTPUT TO COMMUN NORMAL (DIMENSIONLESS)
 NOTE FMOC-FRACT MANUF OUTPUT TO COMMUNICATIONS (DIMENSIONLESS)
 NOTE FMOWN-FRACT MANUF OUTPUT TO WATER NORMAL (DIMENSIONLESS)
 NOTE FMOW-FRACT MANUF OUTPUT TO WATER (DIMENSIONLESS)
 NOTE FMOEN-FRACT MANUF OUTPUT TO ELECT NORMAL (DIMENSIONLESS)
 NOTE FMOE-FRACT MANUF OUTPUT TO ELECT (DIMENSIONLESS)
 NOTE FEUPI-FRACT ELECT UTIL PROD INVESTED (DIM)
 NOTE FCOI-FRACT CONSTRUCTION OUTPUT TO INPUTS (DIM)
 NOTE FCPI-FRACT CONSTRUCTION PROD INVESTED (DIM)
 NOTE FPES-FRACT PUBLIC EDUC SUBSIDIZED
 NOTE FGPPE-FRACT GOVT PRODUCT TO PUBLIC EDUCATION (DIM)
 NOTE FPEPI-FRACT PUBLIC EDUC PRODUCT INVESTED (DIM)
 NOTE FIUPE-FRACT INVESTMENT URBAN PUBLIC EDUC (DIM)
 NOTE FPHS-FRACT PUBLIC HEALTH SUBSIDIZED
 NOTE FPHPI-FRACT PUBLIC HEALTH PRODUCT INVESTED (DIM)
 NOTE FGPPH-FRACT GOVT PRODUCT TO PUBLIC HEALTH (DIM)
 NOTE FIUPH-FRACT INVESTMENT URBAN PUBLIC
 NOTE FRTI-FRACT RENT TO INPUTS
 NOTE FOPLH-FRACT GOVT PROD INVESTED IN LOW INCOME HOUSING (DIM)
 NOTE GSCGDP-GOVT. SERVICE CONTRIB TO G.D.P. (BIL LL PER YR)
 NOTE GBI-GOVT BUDGET TO IRRIGATION (BIL LL PER YR)
 NOTE GDPWF-G.D.P. PER WORKER IN FARMING (LL/YR-PERSON)
 NOTE GDPPWI-G.D.P. PER WORKER IN IRRIGATION (LL PER YR PER PERSON)
 NOTE NGTE GDP-GROSS DOMESTIC PRODUCT (BIL LL PER YR)
 NOTE GNP-GROSS NATIONAL PRODUCT (LL/YR)
 NOTE GTP-GOVT TRANSFER PAYMENTS (LL/YR)
 NOTE GB-GOVT BUDGET (LL/YR-VEH)
 NOTE GDPPWM-G.D.P. PER WORKER IN MANUF (LL/YR-PERSON)
 NOTE GDPPWB-G.D.P. PER WORKER IN BUSIN. (LL/YR-PERSON)

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NOTE GDPWEU-G.D.P. PER WORKER IN ELECT UTIL (LL/YR-PERSON)

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NOTE GDPWU-G.D.P. PER WORKER IN WATER UTIL (LL/YR-PERSON)

NOTE GDPWTC-G.D.P. PER WORKER IN TELE-COM(LL/YR-PERSON)

27

NOTE GDPWIT-G.D.P. PER WORKER IN INTL TRANS (LL/YR-PERSON)

NOTE GDPWLT-G.D.P. PER WORKER IN LAND TRANS (LL/YR-PERSON)

29

NOTE GDPPWC-G.D.P. PER WORKER IN CONSTR (LL/YR-PERSON)

NOTE GP-GOVERNMENT PRODUCT (BIL LL PER YR)

31

NOTE GDPWPU-G.D.P. PER WORKER PUBLIC EDUC (LL/YR-PERSON)

NOTE GDPWPH-G.D.P. PER WORKER IN PUBLIC HEALTH (LL/YR-PERSON)

33

NOTE HRPm-HEALTH RURAL POPULATION MULT (1/YR)

NOTE HEO-HYDROELECTRIC OUTPUT (KWH/YR)

35

NOTE HLK-HWY LANE KILOMETERS (LANE-KM)

NOTE HLFO-HWY LAND FRACTION OCCUPIED (DIM)

37

NOTE HCC-HWY CONSTRUCTION COST (LL/KM-LANE)

NOTE HCCM-HWY CONSTR COST MULT (DIM)

39

NOTE HWYC-HWY CONSTRUCTION (LANE-KM/YR)

NOTE HUR-HIGHWAY USER REVENUES (LL/YR)

41

NOTE HWYDEN-HIGHWAY DENSITY (LANE-KMS/SQ KM)

NOTE IF-IRRIGATION FACILITIES (BIL LL)

43

NOTE IFN-IRRIGATION FACILITIES INITIAL (BIL LL)

NOTE ICL-IRRIGATED CULTIVATABLE LAND (HECTARES)

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NOTE ICLN-IRRIGATED CULTIVATABLE LAND INITIAL (HECTARES)

NOTE IFLN-IRRI FACILITIES PER LAND INITIAL (LL PER HECT)

47

NOTE ILYN-IRRIGATED LAND YIELD NORMAL (VEG EQUIV TONS/HECT-YR)

NOTE ILDCM-IRRI LAND DEVELOPMENT COST MULT (DIM)

49

NOTE ILDC-IRRI LAND DEVELOPMENT COSTS (LL PER HECT)

NOTE ICCN-IRRI CONSTRUCTION COSTS INITIAL (LL PER HECT)

51

NOTE ILDR-IRRI LAND DEVELOPMENT RATE (HECT PER YR)

NOTE IFD-IRRI FACILITIES DEPRECIATION (BIL LL PER YR)

53

NOTE IFI-IRRI FACILITIES INVESTMENT (BIL LL PER YR)

NOTE IRP-IRRIGATION PRODUCT (BIL LL PER YR)

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NOTE IMC-IMPOUNDMENT MAINTENANCE COST (LL/YR)

NOTE ICC-IMPDMT CONSTRUCTION COSTS (LL/M3) (ICCN=WUCN*.4/SWICYN)

57

NOTE ITF-INTERNATIONAL TRANSPORT FACILITIES (BIL LL)

NOTE ITFN-INTL TRANSPORT FACIL INITIAL (BIL LL)

59

NOTE ITO-INTL TRANSPORT OUTPUT (BIL LL)

NOTE ITP-INTL TRANSPORT PRODUCT (BIL LL PER YR)

61

NOTE ITFD-INTL TRANSPORT FACIL DEPRECIATION (BIL LL PER YR)

NOTE ITFI-INTERNATIONAL TRANS FACIL INVESTMENT (BIL LL PER YR)

63

NOTE IFCGDP-INFRASTRUCTURE CONTRIB TO G.D.P. (BIL LL PER YR)

NOTE JIPA-JOBS IN PUBLIC ADMINISTRATION (PERSONS)

NOTE JPGPCU-JOBS PER GOVT PROD CAPITAL UNIT (PERSONS/LL E5)

NOTE JIGS-JOBS IN GOVT SERVICES (PERSONS)

1

NOTE JPH-JOBS PER HECTARE

NOTE JIF-JOBS IN FARMING

3

NOTE JPICU-JOBS PER IRRIGATION CAPITAL UNIT (PERSONS/LL E5)

NOTE JII-JOBS IN IRRIGATION (PERSONS)

5

NOTE JIAC-JOBS IN AG CAPITAL (PERSONS)

NOTE JPMCU-JOBS PER MANUF. CAPITAL UNIT (PERSONS/LL E4)

7

NOTE JIM-JOBS IN MANUFACTURING (PERSONS)

NOTE JPBCU-JOBS PER BUSINESS CAPITAL UNIT (PERSONS/LL E4)

9

NOTE JIB-JOBS IN BUSINESS (PERSONS)

NOTE JPEUCU-JOBS PER ELECT UTIL CAPITAL UNIT (PERSONS/LL E5)

11

NOTE JIEU-JOBS IN ELECTRIC UTILITIES (PERSONS)

NOTE JPWUCU-JOBS PER WATER UTIL CAPITAL UNIT (PERSONS/LL E5)

13

NOTE JIWW-JOBS IN WATER UTILITIES (PERSONS)

NOTE JPTCCU-JOBS PER TELE-COM CAPITAL UNIT (PERSONS/LL E5)

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NOTE JITC-JOBS IN TELE-COMMUNICATIONS (PERSONS)
 NOTE JPITCU-JOBS PER INTL TRANS CAPITAL UNIT (PERSONS/LL E5)
 NOTE JITF-JOBS IN INTL TRANS FACILITIES (PERSONS)
 NOTE JPLTCU-JOBS PER LAND TRANSPORT CAPITAL UNIT (PERSONS/LL E5)
 NOTE JLTF-JOBS IN LAND TRANS FACILITIES (PERSONS)
 NOTE JIC-JOBS IN CONSTRUCTION (PERSONS)
 NOTE JPCCU-JOBS PER CONSTRUCTION CAPITAL UNIT (PERSONS/LL E5)
 NOTE JPPECU-JOBS PER PUBLIC EDUC CAPITAL UNIT (PERSONS/LL E5)
 NOTE JIPE-JOBS IN PUBLIC EDUCATION (PERSONS)
 NOTE JPPHCU-JOBS PER PUBLIC HEALTH CAPITAL UNIT (PERSON/LL E5)
 NOTE JIPH-JOBS IN PUBLIC HEALTH (PERSONS)
 NOTE KHPMPY-KWH PER CU METER PER YR (KWH/M3-YR)
 NOTE LCCR-LAND CONVERSION COMPLETION RATE (HA/YR)
 NOTE LCR-LAND CONVERSION RATE (HA/YR)
 NOTE LCR-LAND CONVERSION RATE (HECT PER YR)
 NOTE LIF-LIFETIME IRRF FACILITIES (YEARS)
 NOTE LAC-LIFETIME AG CAPITAL (YEARS)
 NOTE LPK-LAND PER KILOMETER (HA/KM-LAND)
 NOTE LZH-LAND ZONED HWYS (HA)
 NOTE LID-LOW INCOME DWELLINGS (ROOMS)
 NOTE LPDU-LAND PER DWELLING UNIT (SQ METERS/ROOM)
 NOTE LZD-LAND ZONED FOR DWELLINGS (M2)
 NOTE LICC-LOW INCOME (DWELLING) CONSTR COST (LL/ROOM)
 NOTE LICR-LOW INCOME CONSTR RATE (ROOMS/YR)
 NOTE LIDR-LOW INCOME DWELLING DETERIORATION RATE (ROOMS/YR)
 NOTE LLID-LIFETIME LOW INCOME DWELLINGS (YR)
 NOTE LUID-LIFETIME UPPER INCOME DWELLINGS (YR)
 NOTE LMC-LIFETIME MANUF CAPITAL (YEARS)
 NOTE LPME-LAND PER MANUF ESTABLISHMENT (HECT PER ESTAB)
 NOTE LZM-LAND ZONED FOR MANUF (HECTARES)
 NOTE LBC-LIFETIME BUSINESS CAPITAL (YEARS)
 NOTE LPBE-LAND PER BUSINESS ESTABLISHMENT (HECT PER ESTAB)
 NOTE LZB-LAND ZONED PER BUSINESS (HECTARES)
 NOTE LEUC-LIFETIME ELECT UTIL CAPITAL (YEARS)
 NOTE LWUC-LIFETIME WATER UTIL CAPITAL (YEARS)
 NOTE LTCC-LIFETIME TELE-COMMUN CAPITAL (YEARS)
 NOTE LITF-LIFETIME INTL TRANSPORT FACIL (YEARS)
 NOTE LTF-LAND TRANSPORT FACILITIES (BIL LL)
 NOTE LTFN-LAND TRANSPORT FACIL INITIAL (BIL LL)
 NOTE LTO-LAND TRANSPORT OUTPUT (BIL LL PER YR)
 NOTE LTP-LAND TRANSPORT PRODUCT (BIL LL PER YR)
 NOTE LTFO-LAND TRANSPORT FACIL DEPRECIATION (BIL LL PER YR)
 NOTE LLTF-LIFETIME LAND TRANSPORT FACIL (YEARS)
 NOTE LTFI-LAND TRANSPORT FACIL INVESTMENT (BIL LL PER YR)
 NOTE LPEF-LIFETIME PUBLIC EDUC FACIL (YR)
 NOTE LPEF-LIFETIME PUBLIC EDUC FACIL (YEARS)
 NOTE LPHF-LIFETIME PUBLIC HEALTH FACILITIES (YR)
 NOTE LPHF-LIFETIME PUBLIC HEALTH FACIL (YEARS)
 NOTE LIHO-LOW INCOME HOUSING OUTPUT (BIL LL PER YR)
 NOTE LIHP-LOW INCOME HOUSING PRODUCT (BIL LL PER YR)
 NOTE MUPM-MODERNIZATION OF URBAN POPULATION MULT (1/YR)
 NOTE MRPM-MODERNIZATION OF RURAL POPULATION MULT (1/YR)
 NOTE MDT-MODERNIZATION DISSEMINATION TIME (YEARS)
 NOTE MSWICY-MAX SURF WATER IMPDMT CAP (M3)
 NOTE MFD-MANUF FUEL DEMAND (TON OIL EQUIVALENTS PER YR)
 NOTE MVGR-MOTOR VEH GROWTH RATE (VEH/YR)
 NOTE MVGN-MOTOR VEH GROWTH NORMAL (1/YR)

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MODEL NAME = NRDM

NOTE MV-MOTOR VEHICLES (VEH)
 NOTE MOPCN-MANUF OUTPUT PER CAPITA NORMAL (LL/YR-PERSON)
 NOTE MVPC-MOTOR VEHICLES PER CAPITA (VEH/PERSON)
 NOTE MCOR-MANUF CAPITAL OUTPUT RATIO (YEARS)
 NOTE MCORN-MANUF CAPITAL OUTPUT RATIO NORMAL (YEARS)
 NOTE MLAM-MANUF LAND AVAILABILITY MULT (DIM)
 NOTE MO-MANUF OUTPUT (BIL LL PER YR)
 NOTE MP-MANUF PRODUCT (BIL LL PER YR)
 NOTE MCD-MANUF CAPITAL DEPRECIATION (BIL LL PER YR)
 NOTE MCI-MANUF CAPITAL INVESTMENT (BIL LL PER YR)
 NOTE ME-MANUFACTURING ESTABLISHMENTS
 NOTE MLFO-MANUF LAND FRACT OCCUPIED (DIMENSIONLESS)
 NOTE MECM-MANUF ESTABLISHMENT COST MULT (DIMENSIONLESS)
 NOTE MA-MANUF ADDITIONS (ESTAB PER YR)
 NOTE MR-MANUF RESTORATIONS (ESTAB PER YR)
 NOTE MRP-MANUF RESTORATIONS PROGRAMMED (ESTAB PER YR)
 NOTE MTDSM-MANUF TRANS DEMAND SUPPLY MULTIPLIER (DIMENSIONLESS)
 NOTE MTFCR-MANUF TRANS FACIL CAPITAL RATIO (DIMENSIONLESS)
 NOTE MCDSM-MANUF COMMUN DEMAND SUPPLY MULTIPLIER (DIMENSIONLESS)
 NOTE MTCCR-MANUF TELE-COM CAPITAL RATIO (DIMENSIONLESS)
 NOTE MWDSM-MANUF WATER DEMAND SUPPLY MULTIPLIER (DIMENSIONLESS)
 NOTE MWUCR-MANUF WATER UTIL CAPITAL RATIO (DIMENSIONLESS)
 NOTE MEDSM-MANUF ELECT DEMAND SUPPLY MULTIPLIER (DIMENSIONLESS)
 NOTE MEUCR-MANUF ELECT UTIL CAPITAL RATIO (DIMENSIONLESS)
 NOTE MCR-MANUFACTURING CAPITAL RATIO (DIMENSIONLESS)
 NOTE MCN-MANUFACTURING CAPITAL INITIAL (BIL LL)
 NOTE MC-MANUFACTURING CAPITAL (BIL LL)
 NOTE NICL-NON-IRRIGATED CULTIVATABLE LAND (HECTARES)
 NOTE NICLN-NON-IRRI CULTIVATABLE LAND INITIAL (HECTARES)
 NOTE NILYN-NON IRRI LAND YIELD NORMAL (VEG EQUIV TONS/HECT-YR)
 NOTE NAGDP-NON AGRICULTURE G.D.P. (BIL LL PER YR)
 NOTE NP-NATIONAL POPULATION (PERSONS)
 NOTE NPCI-NATIONAL PER CAPITA INCOME (LL PER PERSON PER YR)
 NOTE NUPCR-NATURAL URBAN POP CHANGE RATE (PERSONS/YR)
 NOTE NUPCF-NATURAL URBAN POP CHANGE FACTOR (FRACT/YR)
 NOTE NRPCR-NATURAL RURAL POP CHANGE RATE (PERSONS/YR)
 NOTE NRPCF-NATURAL RURAL POP CHANGE FACTOR (FRACT/YR)
 NOTE NCF-NATIONAL COST OF FUEL (LL/TOE)
 NOTE NMGE-NET MANUF GOODS EXPORTED (LL/YR)
 NOTE NBSE-NET BUSINESS SERVICES EXPORTED (LL/YR)
 NOTE NAPE-NET AGRI PRODUCTS EXPORTED (LL/YR)
 NOTE NM-NORMAL MANUFACTURING (ESTABLISHMENTS)
 NOTE NMN-NORMAL MANUFACTURING INITIALLY (ESTABLISHMENTS)
 NOTE NB-NORMAL BUSINESS (ESTABLISHMENTS)
 NOTE NBN-NORMAL BUSINESS INITIALLY (ESTABLISHMENTS)
 NOTE NAJ-NON-AGRICULTURAL JOBS (PERSONS)
 NOTE PAP-PUBLIC ADMINISTRATION PRODUCT (BIL LL PER YR)
 NOTE POF-PRICE OF FOOD (LL PER TON)
 NOTE PPARJ-PRODUCT PER AG-RELATED JOB (LL PER PERSON PER YR)
 NOTE PPNAJ-PRODUCT PER NON-AG JOB (LL PER PERSON PER YR)
 NOTE POLPM-POLLUTION POPULATION MULT (FRACT/YR)
 NOTE PED-POLLUTION EFFECT DELAY (YEARS)
 NOTE PPP-POP PER PHYSICIAN (DIM)
 NOTE PCEC-PER CAPITA ENERGY CONSUMPTION (TOE/YR-PERSON)
 NOTE POPU-PERCENTAGE OF POPULATION URBAN
 NOTE PPWA-PERCENTAGE OF POPULATION OF WORKING AGE
 NOTE POPDEN-POPULATION DENSITY (PERSONS / SQ KM)

MODEL NAME = NRDM

NOTE PUNEM-PERCENTAGE UNEMPLOYMENT
 NOTE PHSUB-PERCENTAGE HEALTH SUBSIDIZED
 NOTE PHPS-PERCENTAGE HEALTH IN PRIVATE SECTOR
 NOTE PESUB-PERCENTAGE EDUCATION SUBSIDIZED
 NOTE PEPS-PERCENTAGE EDUCATION IN PRIVATE SECTOR
 NOTE PALI-PERCENTAGE AGRI LAND IRRIGATED
 NOTE PCMM-POLLUTION CONTROL MANUF MULT (DIMENSIONLESS)
 NOTE POLR-POLLUTION RATIO (DIMENSIONLESS)
 NOTE PECOR-PUBLIC EDUC CAPITAL OUTPUT RATIO (YEARS)
 NOTE PEFN-PUBLIC EDUCATION FACIL INITIAL (BIL LL)
 NOTE PEO-PUBLIC EDUC OUTPUT (BIL LL PER YR)
 NOTE PEP-PUBLIC EDUCATION PRODUCT (BIL LL PER YR)
 NOTE PEF-PUBLIC EDUCATION FACILITIES (BIL LL)
 NOTE PHCOR-PUBLIC HEALTH CAPITAL OUTPUT RATIO (YEARS)
 NOTE PHFA-PUBLIC HEALTH FACIL INITIAL (BIL LL)
 NOTE PHO-PUBLIC HEALTH OUTPUT (BIL LL PER YR)
 NOTE PHP-PUBLIC HEALTH PRODUCT (BIL LL PER YR)
 NOTE PHF-PUBLIC HEALTH FACIL (LL)
 NOTE QOL-QUALITY OF LIFE
 NOTE RILIH-RECONSTRUCTION INVESTMENT IN LOW INCOME HOUSING (BIL LL PER
 NOTE RWIL-RELATIVE WIEGHT OF IRRI LAND (DIM)
 NOTE RCNILR-RELATIVE CAPL NON-IRRI LAND RATIO (DIM)
 NOTE RCILR-RELATIVE CAPITAL IRRI LAND RATIO (DIM)
 NOTE RACLR-RELATIVE AG CAPL LAND RATIO (DIM)
 NOTE RPN-RURAL POPULATION INITIAL (PERSONS)
 NOTE RP-RURAL POPULATION (PERSONS)
 NOTE RNPCI-RELATIVE NATIONAL PER CAPITA INCOME (DIM)
 NOTE RNPCIR-RELATIVE NATL PER CAPITA INCOME RATIO (DIM)
 NOTE RBN-RESTORED BUSINESS (ESTABLISHMENTS)
 NOTE RB-RESTORED BUSINESS (ESTABLISHMENTS)
 NOTE RNPCIN-RELATIVE NATL PER CAPITA INCOME NORMAL (DIM)
 NOTE RRI-RELATIVE RURAL INCOME (DIM)
 NOTE RRIR-RELATIVE RURAL INCOME RATIO (DIM)
 NOTE RRIN-RELATIVE RURAL INCOME NORMAL (DIM)
 NOTE RUMM-RURAL TO URBAN MIGRATION MULT (FRACT/YR)
 NOTE RUMMR-RURAL TO URBAN MIGRATION MULT REALIZED (FRACT/YR)
 NOTE RLZT-REALIZATION TIME (YEARS)
 NOTE RUMR-RURAL TO URBANMIGRATION RATE(PERSONS/YR)
 NOTE RUMF-RURAL TO URBAN MIGRATION FACTOR (FRACT/YR)
 NOTE REFRMT-RELATIVE EDUC FACIL RURAL MULT (DIM)
 NOTE RDPP-ROOMS DESIRED PER PERSON MULT (DIM)
 NOTE RENT PER DWELLING (LL/YR-ROOM)
 NOTE RPEPCR-RURAL PUBLIC ED PER CAPITA RATIO
 NOTE RPHE-RURAL PUBLIC HEALTH FACIL (LL)
 NOTE RIM-RECONSTRUCTION INVESTMENT IN MANUF (BIL LL PER YR)
 NOTE RM-RESTORED MANUF (ESTABLISHMENTS)
 NOTE RMN-RESTORED MANUF INITIALLY (ESTABLISHMENTS)
 NOTE RIB-RECONSTRUCTION INVESTMENT IN BUSINESS
 NOTE RITC-RECONSTRUCTION INVESTMENT IN TELECOMMUN (BIL LL PER YR)
 NOTE RIIT-RECONSTRUCTION INVESTMENT IN INTL TRANSPORT (BIL LL PER YR)
 NOTE RILT-RECONSTRUCTION INVESTMENT IN LAND TRANSPORT (BIL LL PER YR)
 NOTE RPEF-RURAL PUBLIC EDUC FACIL (LL)
 NOTE RPEFI-RURAL PUBLIC EDUC FACIL INVESTMENT (LL/YR)
 NOTE RPHFI-RURAL PUBLIC HEALTH FACIL INVESTED (LL/YR)
 NOTE RPHFD-RURAL PUBLIC HEALTH FACIL DEPRECIATION
 NOTE SWICY-SURFACE WATER IMPOUNDMENT CAPACTY (CU METERS)
 NOTE SWIC-SURF WATER IMPDMT CONSTRUCTION (M3/YR)