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A HIERARCHICAL SYSTEMS FORMULATION  
OF THE RURAL DEVELOPMENT PROCESS  
IN DEVELOPING COUNTRIES

by

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Abstract

A very urgent and significant set of problems facing developing countries arises in the area of rural development. The reasons for this are that the majority of the populations of these countries lives in the rural areas and the fact that the level of production in the rural areas has a major effect on the overall economy of the developing countries.

In this paper hierarchical systems theory is applied to rural development. The latter is complex in the sense that it is multi-dimensional, highly interacting and stochastic in nature, whilst reliable causal explanations of its socio-economic aspects in particular are commonly not available. Here a multilevel/hierarchical formulation of the rural development system is presented and analysed to provide an improved conceptual framework for the design, phasing and inter-connection of component management procedures which together comprise an effective rural development planning and control system.

This analysis has been applied to design an initial set of procedures which have been introduced and tested in six rural areas of Kenya. These provide at the first level a short cycle of one month for plan implementation and at the second level a medium cycle of one year for plan reformulation. These and further procedural components are being considered for replication in all rural areas of Kenya as an integral part of the introduction of district level development plans in the context of the third five year plan (1974-79).

Although the main benefits arising from the application of systems analysis to date have been at the level of procedural and institutional innovation, the multilevel/hierarchical formulation described in this paper now lays a foundation for a more quantitative approach based on systematic assembly of data describing the operation of the rural development system. Eventually, simulation studies using sophisticated planning models will enable a more efficient selection between alternative rural development strategies, projects and programmes.

## INTRODUCTION

### 1.1 The Rural Development System

The central importance of rural development in achieving the development objectives of the majority of less-developed countries (LDCs) is being increasingly recognised by international and national development agencies. Typically, the majority of the population resides in rural areas, so that both an objective assessment of human need and political pressures for the improvement of incomes and welfare are associated primarily with the rural population. Demographic trends currently reinforce this pattern, as the majority of the steadily increasing stream of new entrants to the labour force have to find their livelihood in the rural areas rather than in the small urban wage-labour sector. Also, as well as continuing the traditional functions of supplying food to the expanding urban population and earning foreign exchange from the export of primary products, recent experience with industrialization programmes in the LDCs has made it clear that success in this field depends to a considerable degree upon a continued expansion of the protected domestic market. This in turn requires rising productivity and incomes of the rural population which represents the potential mass consumer demand.

The term 'rural development' signifies a broader, more comprehensive approach than the various sectoral programmes, e.g. agricultural development, rural communications, rural education etc. which have tended in the past to be unduly fragmented, reducing the overall impact upon rural problems. The primary responsibility for introducing a more effective approach to rural development lies with the public sector. In the early stages of the development process the public sector is at least the vehicle for the injection of technical knowledge, production inputs and supporting physical infrastructure into the technically backward rural sectors which are typified by small-scale production and consumption units, e.g. the nuclear or extended family, clan or lineage group.

### 1.2 Traditional Planning of the Rural Development

The nature of the problems occurring in the traditional public sector approach to rural development can be illustrated more specifically from post-independence experience in East Africa. Some of the more obvious deficiencies have been:

(i) Where local-level officials and leaders have been involved in decentralized planning procedures, they have typically produced lengthy want lists (shopping lists), predominantly comprising social service capital works - schools, hospitals, etc. These are beyond the capability of national financial and manpower resources to implement, whilst they do little to enhance local productivity and incomes in the short run.

(ii) Where plans for rural areas (Districts or Regions) have received assistance from technical experts from the metropolis or in the form of external technical assistance, they usually contain a lengthy assemblage of descriptive material (natural resources data, infrastructure institutions) which is partly irrelevant to, and has partly not been related to, the actual local development options open to the planners. Nevertheless, the assembly of this material represents a considerable proportion of the man-months of expertise which were available to compile the plan.

(iii) the work of institutions engaged in activity relevant to development planning (natural resource appraisal, rural research and development, market research etc.), is rarely integrated into the planning process. To some extent this is unavoidable when search activity has not been an integral component previously and the plan must be compiled in the space of a few months. The search activity itself often needs to be redesigned, strengthened, etc, probably requiring a period of several years to complete. In the event, the planners often have to do in amateur fashion the work specialists could have done professionally had they received sufficient prior notice that specific information would be required by the planners.

(iv) radical change in the mix of development activities at the local level is not practicable in most settled rural areas (i.e. where big, new projects are not feasible). The most useful line of enquiry in that case is a careful evaluation of the efficiency and effectiveness of current activities in the public and private sectors. Unfortunately, in no case has this been incorporated into the planning process. Whilst regrettable, this is understandable, as ex post evaluation, if only of a simple type, had not been previously built into the annual implementation cycle of current activities. Consequently, the data required for accurate evaluation is not available to the planners, nor had the goals themselves been clearly specified against which actual performance could have been assessed, e.g. absence of implementation time tables, targets, etc.

(v) In the unfortunate tradition of much economic planning, whereby plan formulation has been divorced from plan implementation and inbuilt evaluation, District/Regional Plan documents have rarely included an agreed set of action proposals which can provide the starting point for further disaggregation into individual job specification, monthly work schedules, timetables and other common sense devices for improving the use of public sector personnel and funds on a day to day, month to month basis. Plans are usually written as policy guidelines, or even as recommendations only. In that case they are not necessarily accepted even as far as broad policy is concerned by executive ministries. Such policy plans are usually out-dated very quickly by events and play no further part in development decision-taking.

### 1.3 The Main Problem Areas in Rural Development Planning

This overall state of affairs reflects the tendency to view the objective of the planning process as the periodic production of a plan document, rather than viewing planning as process or series of activities designed to enhance management performance in the real production process in the rural areas.

In orientating the public sector agencies towards more effective rural development performance, four problem areas can be distinguished:

- (i) The need to achieve horizontal coordination at the local level between specialized development agencies in both plan formulation and implementation.
- (ii) The need to incorporate into public sector rural development activity a closed loop management system whereby implementation experience can be utilized to improve the specification of the subsequent plan. This, in turn, should be the basis for both the allocation of public resources and their action sequence over the next plan period.
- (iii) The need to take cognisance of local variations in both the production environment and in the aspirations of local communities to enhance the plan's accuracy and potential effectiveness. This necessitates the application of area-specific or 'regional' planning procedures to rural development.
- (iv) Problems concerned with the integration of a large number of local regional plans in a consistent and equitable manner into the overall framework of development plan.

### 1.4 The Systems Analysis Approach

National Governments and international aid organizations are providing large sums of money and scarce personnel for the development of rural areas. However, it appears that very little effort has been put into a systematic analysis of the dynamics of the rural development system. A probable reason for that is the large number of branches of science and engineering which are involved and the lack of communication and coordination between the various disciplines. The lack of a systematic analytical framework has, in our view, undoubtedly contributed to the disappointing performance of public sector planning for the rural economies in the LDCs, referred to above.

The aim of the present paper is to utilise hierarchical systems theory in conceptualizing the control issues which are involved in designing an effective rural development planning machinery. In recent years hierarchical systems theory has been widely applied to planning and control systems in such fields as industrial processes, corporate business and management systems, urban and regional physical planning and traffic and transport management. Examples

of these application studies are: Mitter and Dy-Liacco <sup>1</sup>, Miller <sup>2</sup>, Rakic <sup>3</sup>, Wismer and Larson <sup>4</sup>, David <sup>5</sup>, Mesarovic et al. <sup>6</sup> and Lasdon <sup>7</sup>. In these applications the common feature has been that the system is composed of a large number of interconnected subsystems. Hierarchical systems theory provides a natural conceptual structure for the system as it exists in practice. A benefit of this formulation is that it not only provides an insight into the dynamics of the system but it also enables critical path analysis of information collection and processing activities, and appraisal of alternative planning and control policies. The systems formulation leads to the clear specification of a closed-loop management oriented system as opposed to the existing open-loop "top-down" administrative style approach to rural development, thereby enabling a significant increase in the efficiency of the overall system.

Although the hierarchical formulation described in this paper has been developed in the context of the actual rural development system in Kenya, it has been generalized sufficiently to enable adaptation to rural development problems in a wide range of less-developed countries.

#### HIERARCHICAL FORMULATION OF THE RURAL DEVELOPMENT SYSTEM

The rural development system is very complex in the sense that it is multi-dimensional, strongly interacting and stochastic in nature. Further, predictively reliable causal explanations of its socio-economic aspects in particular are not available.

1. Mitter, S.K. and Dy-Liacco, T.E. "Multi-level Approach to the Control of Interconnected Power Systems", IFAC Conference on Computer Control, Menton, France, 1967.
2. Miller, A. "Automation in the Steel Industry", Automation, pp. 7-14 November 1966.
3. Rakic, M.V. "A Multi-level Approach to Steady State Control of a Multi-product, Multi-factor Firm", Session on Industrial Management Systems, 5th World Congress of IFAC, Paris, 1972.
4. Wismer, D.A. and Larson, R.E. "A Hierarchical Systems Formulation for Urban Systems Engineering", Session on National Regional and Urban Systems, 5th World Congress of IFAC, Paris, 1972.
5. David, Y. "Present Situation and Prospects of Automation in Transportation", Survey Session, 5th World Congress of IFAC, Paris, 1972.
6. Mesarovic, M.D. et al. "Theory of Hierarchical, Multi-level Systems", Mathematics in Science and Engineering, Vol. 68, Academic Press, New York, 1970.
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In modelling the rural development system and designing a suitable set of procedures for rural development planning and control, the configuration of the overall system is not self-evident. Therefore, the design of the planning and control procedures includes specifications regarding the structure of the system and the way the different parts of the system are interconnected. This includes the location of the different decision levels and their attendant communication links. Many possible configurations of the system are possible, and the problem is to design the one most appropriate for the planning process. Selection of a poor system configuration may obscure the workings of the system, may prevent its smooth operation and may also make future extensions and alterations of the system model very difficult.

### 2.1. Basic Sub-systems of the Rural Development System

The rural development system essentially consists of three main subsystems; the public sector process, the private sector process and the relevant government planning machinery. This is illustrated in Fig. 1. The three subsystems are all strongly interacting through information and resource flows as indicated in the figure.

The allocation of available resources in the public sector is partially determined by the development plans produced by the government planning machinery and partially by historical patterns or ad hoc factors operating upon the public sector; the most important of these is intervention from the national political process. The private sector process is not under government control to the same degree as the public sector process, but government policy will of course influence the private sector process through, for instance, taxation, pricing, public sector investment, etc. Further, the public sector process and the private sector process are interacting through flows of resources and services.

In less developed countries the public sector process typically plays a major role in the overall rural economy. The developmental role of the public sector is to achieve an acceleration of the private sector process. Its activities must usually be viewed as means to assist the private sector rather than as often occurs in practice as ends in themselves. Within the government planning machinery there should be established procedures through which the implementation of the plans can be controlled, and the performance of the public and private processes evaluated and compared to the targets which had been set. This information, when fed back into the planning machinery, can then be used in short and long term updating and reformulation of existing plans. In this way a closed-loop, dynamic planning system is established.

## 2.2 Hierarchical Structure of the Rural Development System

In order to arrive at a planning and control system which fulfills the above requirements, it is necessary to decompose the basic subsystem structure into a hierarchy of subsystem whose individual design and implementation are relatively simple. In addition, the design of the planning system must be such that it allows the coordination of the individual parts in order to achieve the overall objectives specified for the total rural development system.

It is useful to decompose the rural development planning and control system into a hierarchical or multilevel structure as shown in Figure 2. Here the hierarchy of operational levels has been chosen as the main feature determining the subdivision of the overall system. In Figure 2 three such levels are indicated, namely, the national level, the district level and the activity level. At the national level at the top of the hierarchy, the overall national rural development plan is formulated. This can in turn be disaggregated into district plans which will also contain targets for smaller areas within them. The district plans can be further partitioned into activity programmes which form subsystems on the next level. In this way we arrive at a multilevel hierarchical planning and control system formulation for the rural development system.

## 2.3 A Hierarchical Planning and Control Formulation of the Rural Development System

In the design of a planning and control system within this hierarchical structure, it is important to retain the existing structures of government agencies and civil service administration as far as possible. Figure 3 shows a possible formulation of the planning and control machinery in relation to the rural processes. "National Planning System" at the top of the planning hierarchy produces the overall guidelines for national development in terms of national development plans. Through these plans the available public resources (taxation, international aid, loans) are allocated to the different sectors of the national economy. The national development plans usually cover a medium-term period (e.g. 5 year plans), whilst in addition there is the set of development projects and programmes based on the annual allocation of resources through the national budget.

Consistent with the framework of the national development plans, the different district plans are formulated. In Figure 3 for simplicity only one district is indicated but the figure shows the general lay-out of the hierarchical formulation.

The district plan represents the overall objectives for rural development in the district within the planning period. The "District Control" governs the implementation of the district plan and takes action in order to fulfil the objectives.

The district plan can further be divided into a set of separate activities. In Figure 3 two such activities are indicated. These activities may be plans for different areas within the district or specific projects within the district (a hospital, farmers training centre, agricultural research station, etc.). The programme for each activity will have a set of targets to be met, and the executive official in charge of implementation of the programme for each activity is termed the "Activity Control".

In this way a multi-level control system is obtained. The lowest level controllers will be the "Activity Controls" which control the different activities on a day-to-day, week-to-week basis. The decisions taken by the Activity Control are based on a monitoring of the real process in order to assess the results of previous decisions. Based on this feedback from the process the activity targets should be reviewed and some targets and task settings may be altered. Further, new decisions are taken regarding the operation of the process in the next time-period in order to achieve the set targets for that particular activity.

As shown in Figure 3, only the public sector aspects of an activity are directly controlled. The private sector process is not under director control as is indicated by the dashed line from "Activity Control" to the "Social Control". To clarify this point, let us consider a programme to introduce a new crop into a district. The success of such a programme depends on many things; information and education given to local farmers, demonstration plots, subsidized seed programme, etc. However, there is no direct control action which can force the farmers to start growing the new crop. Only when the advantages of changing to the new crop are accepted by the individual farmers will the programme work. Very often this depends on some influential people in the local society realizing the advantages, and thus influencing the rest of the farmers through their position and prestige.

Above the Activity Control we find the District Control. The main task of this higher level controller is the coordination of the different activities within the district in order to fulfil the overall objectives of the district plan in the best possible way. The control cycle of the District Control will be longer than that of the Activity Control, perhaps a month rather than days or weeks. The action taken by the District Control will be based on feedbacks from the different activities, usually through regular reports (e.g. monthly) on the progress of the different activities.

In addition the District Level Control may be responsible for testing the results of independent search procedures. These consist primarily of appraisal of the natural environment, research and development work on rural production activities and market research. Based on these different feedbacks an annual evaluation of the performance of the district activities can be done and from this a set of new directives is formulated and sent to the different activity control systems for next year's implementation. These directives will change the local targets at the activity level in order to optimize the overall performance of the total district plan.

The "National Planning System" receives information about the progress of the different district plans through reports from the districts. Based on this information and additional information from independent search procedures, the new rural development plan is formulated. The control cycle for decisions on this top level will probably be longer than one year, but should not exceed two or three years because of the increasing inaccuracy of the original plan over time.

The National Planning System will also be influenced by the National Political Process as indicated in Figure 3. This operates upon the planning machinery by injecting additional political considerations into the decisions concerning the allocation of national resources and incomes. It is in turn responsive to those local interests in rural areas which have been able to obtain political influence at the centre. Planning decisions derived from political considerations are not based on any consistent criterion and hence decisions resulting from these may lead to a deterioration in the performance of the rural development system. For example political decisions may be based on emotions and incomprehensive information. In the absence of an effective and comprehensive plan management

system, the majority of key decisions affecting the rural areas will be taken on the basis of information flows in this external political system which can be viewed as embracing both the social control and the national political process at the centre. On the other hand a comprehensive planning and control management system derived in a systematic manner (Figure 3) will lead to an increase in efficiency and consistent performance of the Rural Development System.

#### 2.4 Disaggregation of the District Plan by Activity Category and Geographical Area

In the previous section the general lay-out of the rural development planning and control system was considered. In practice a further decomposition of the system formulation must be done in order to perform the necessary analysis and formulate the plans and work-schedules for the different activities. This further detailing often reveals that a particular subsystem of Figure 3 like one activity is a hierarchical system in itself such that the structure of Figure 3 is carried on into another yet lower level.

A typical feature of the system is a decision structure as shown in more detail in Figure 4 for the District Level. The decision making body is the District Control which has to coordinate the different activities within the district. The activities can be usefully grouped into three main categories, direct production activities, production infrastructure activities and social infrastructure activities. The different activities may be specific for a certain planning area within the district or may be overhead district activities. In Figure 4, examples of both types of activities are given. The direct production activities shown, i.e. the cotton and tobacco development programmes, are specific for different planning areas within the district, i.e. there exist separate programmes for say, cotton production for area 1 and area 2. On the other hand an activity like the production infrastructure activity "Farmers Training Centre" is a district activity common to the whole geographical district.

The District Control receives reports from the various offices and agencies running the different activities. It is also the function of the District Control to ensure that lateral communication exists between the different agencies where this is important. Planning which takes into account the interactions between the individual activities will not usually be done unless a coordinating agent such as the District Control is set up.

This same decision-making structure will usually exist at all levels in the system, for example at the activity level. The decision-making authority for, say, a cotton-programme will be concentrated in one office and receives

reports from the component features of the cotton production programme. Thus, this hierarchical decision-making structure will usually be apparent at all levels of the rural development system.

### DESIGN TRIALS WITH RURAL PLANNING PROCEDURES IN KENYA, 1971-72

#### 3.1 Special Rural Development Programme

The hierarchical systems formulation described above has been used to help identify the needed procedural innovations required for a comprehensive closed-loop management system capable of embracing all agencies and personnel working in the rural development system. The initial procedures were introduced into five of the six Special Rural Development Programme (SRDP) areas in Kenya at the beginning of the 1971/72 financial year, and they are now in their second year of operation. The SRDP areas are administrative divisions or sub-units in six different districts, embracing a deliberately chosen variety of ecological, social and rural economic conditions. They essentially provide a test-bed in which pilot programmes and experimental procedures can be tested realistically without disturbing the ongoing development programmes operating in the rest of the country. Once they have been successfully tested, however, the new components can be replicated in national programmes of larger scale and wider coverage, Nellis<sup>8</sup>.

In this section the major procedural components of the experimental rural planning and control system which have been introduced to date are first briefly described. Secondly, the extent to which those procedures fulfil the conditions of the hierarchical systems formulation is assessed.

Two procedures have been introduced into the SRDP areas which are designed to apply simplified network analysis to the operations of any rural development programme over the forthcoming financial year. The first, termed the Annual Phasing Form (APF), is a simple work sheet to assist in identifying the component operations and their sequence over time.

The second, termed the Annual Programming Chart (APC), portrays in bar-chart form the information collected by the previous procedure; an example is shown in Figure 5. The upper bar represents the initial planned target in terms of timing and key output indicators; the lower bar records at monthly intervals the progress actually made in the course of practical implementation. In the figure a right-dashed line is used to record performance of time and achieving output targets, whilst a left-dashed line is used to portray a shortfall in either

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8. Nellis, J.R. "The Administration of Rural Development in Kenya", *East Africa Journal*, Vol. 9, No. 3, 1972.

respect. The chart also provides a continuous record, of course, of the pattern of implementation which actually occurred over the implementation period.

The monthly check on progress is made during a monthly area team meeting attended by all programme executive heads; any rescheduling required because of delays or new circumstances, including the interacting effects of one programme upon another, can be discussed and agreed shortly after the cause for an adjustment in the original schedule has become apparent. Delays may be caused at the local level but frequently the cause of the delay occurs at higher levels in the public sector hierarchy. The SRDP official in charge (equivalent to District Control in Figures 3 and 4) produces a monthly report based on 'management by exception' principles which identifies the bottleneck and requests appropriate action. This report is circulated to all levels of Government concerned with the implementation of rural development programmes.

These four procedures, i.e. the APF, the APC, the monthly meeting and the monthly report, together comprise an operational control system for improving the actual implementation of programmes on the ground. The system is described in detail in Belshaw and Chambers,<sup>9</sup>. An independent evaluation was carried out on the working of the system in the six SRDP areas which concluded that it was suitable for replication to national level in association with the introduction of district planning across the country, commencing in 1973, Ascroft et al.,<sup>10</sup>.

Where the implementation of a rural programme depends on the independent and only partially supervised activities of a large cadre of field staff, as is the case with agricultural extension and community development programmes, it has been found useful to introduce a lower-level control system, also operating on a monthly cycle. The design of this system has embodied the major principles of the 'management by objectives' (MBO) approach including the concept of joint work assignment by discussion by junior and senior officials together. This lower-level system has been briefly described by Chambers,<sup>11</sup>.

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9. Belshaw, D.G.R. and Chambers, R.J.H. "Programming, Operational Control and Evaluation for Rural Development Programmes", Institute for Development Studies, Nairobi, Kenya. Staff Paper 111, 1971.

10. Ascroft, J. et al. "The Overall Evaluation of the Special Rural Development Programme", Institute for Development Studies, Nairobi, Kenya, 1972.

11. Chambers, R.J.H. "Management by Objectives and Rural Development", East African Staff College, Nairobi, Kenya, 1972.



The sequence of monthly control system activities takes place within a longer annual cycle. Operating plans, financial estimates and manpower budgets operate on this time cycle. Procedures have been introduced into SRDP practice designed to provide feedback from the previous period's experience with both the implementation of public sector programmes and their impact on the private sector process. This feedback mechanism is intended to improve the quality of the ex ante decision-taking relating to the ensuing year's implementation and planning activities. The relevant procedures are three functional reviews which are timed to feed in at critical times in the higher-level decision processes, Belshaw and Chambers, <sup>12</sup>.

The first of these, the Annual Implementation Review, is prepared towards the end of the operating year. It summarises the lessons learned in the course of implementation with a view to assembling these for the programming decisions for next sequence of operations in each programme, Belshaw <sup>13</sup>. This is followed by the Annual Evaluation Review which is prepared in September/October to immediately precede the annual estimates exercise carried out by each Ministry in the Government. The review is designed to elicit information required to compile cost-effectiveness and cost-benefit indices of programme performance, which in turn provide the justification for changes in public sector resources allocated for the ensuing financial year, Belshaw and Chambers, <sup>14</sup>. A final review is prepared at the end of the calendar year; this feeds into the present Government reporting system which is primarily of a descriptive nature, providing information on public and private sector performance to members of Parliament and other informed members of the public, as well as to officials in Government itself.

This annual cycle of activity in turn operates within the longer-term context of the national development plan which has a five-year plan period in Kenya. However, the national plan is in essence a broad policy summary rather than an action document for executive agencies, especially after the first year or two of the plan period when the initial assumptions have been superceded. In the light of SRDP experience, rural development plans will need revision every two-to-three

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12. Belshaw D.G.R. and Chambers, R.J.H. "A Functional Review Sequence for Rural Development Programmes: A Procedure for Recurrent Resource Management", Institute for Development Studies, Nairobi, Kenya, Working Paper 24, 1972.

13. Belshaw, D.G.R. "The Annual Implementation Review: Objectives, Structure and Content" Special Rural Development Programme, Nairobi, Kenya, 1972.

14. Belshaw, D.G.R. and Chambers, R.J.H. "The Annual Evaluation Review", Special Rural Development Programme, Nairobi, Kenya, 1972.

years if they are to provide a reasonably accurate framework of objectives and output targets to which the annual implementation and financial resource allocation procedures can be tied. It is likely that such a plan will be written at an early stage in the introduction of the planning and control system, without the full benefit of the feedback from the implementation and evaluation reviews. Subsequent revisions of the plan, however, would be able to benefit from the enhanced flow of information which these parts of the management system provide.

A provisional manual setting out a sequence of procedures for formulating a development plan for a rural area has been prepared, Belshaw et al.<sup>15</sup>. At the present time this is in the course of revision along simplified lines, Belshaw,<sup>16</sup>. An essential feature of the plan formulation sequence is the nature of the programme selection criteria to be used. Considerable emphasis has been placed in Kenya on an awareness of the social equity implications of economic decisions. In consequence, procedures are included which bring explicit cognisance of this aspect into the decision-making analysis, Belshaw<sup>17, 18</sup>. Other features of the plan formulation procedure are an emphasis on a systematic search for income-generating opportunities and close scrutiny of production infrastructure investments which must be in close support of directly productive activities.

Finally, exploratory work has been done on means of integrating rural Research and Development activities, especially natural resource appraisal, agricultural production research and market research within the framework of rural plan formulation and revision. At present, these activities are performed largely independently of economic planning activity. An important requirement is the cycling of research findings through the implementation-cum-evaluation cycle the form of pilot projects, farm-level trials, trial marketings, etc. - in order to test these results under realistic production conditions, Belshaw and Hall<sup>19</sup>.

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15. Belshaw, D.G.R., Chambers, R.J.H. Bedi, M. and Hungate, F., "Rural Planning Manual", Institute for Development Studies, Nairobi, Kenya, 1971.

16. Belshaw, D.G.R. "An Outline of Procedures for District Development Planning in Kenya", Institute for Development Studies, Nairobi, Kenya, 1972.

17. Belshaw, D.G.R. "Criteria for Selecting Rural Development Programme," Institute for Development Studies, Nairobi, Kenya, 1971.

18. Belshaw, D.G.R. "Dynamic and Operational Aspects of the Equity Objectives in Rural Development Planning in East Africa", E. Afri. Agric. Econ. Soc. Conf., Makerere University, Kampala, Uganda, 1972.

19. Belshaw, D.G.R. and Hall, M., "The Analysis and Use of Agricultural Experimental Data in Tropical Africa.", E. Afr. J. Rural Development, Vol. 1, 1972.

Preliminary work on control procedures for rural search activity is in progress in one SRDP area, utilizing a multi-disciplinary committee embracing the complete range of expertise required to design, test and implement a viable commercial production activity. This committee is focussing on the question of crop diversification policy for a marginal low-income agricultural area, Belshaw<sup>20</sup>.

The set of management subsystems briefly described above are currently being implemented in all six SRDP areas. Overall evaluation and ensuing revision of the complete sequence has not yet occurred, so that they must be viewed as still in the experimental stage. The implementation subsystem, however, has been independently recommended for adoption throughout the Kenya Government rural administrative system on the grounds that the effectiveness of programme implementation and coordination has been visibly enhanced. The procedures for field staff cadres have also been recommended for wider adoption by the Ministry of Agriculture, and the Ministry of Social Services has requested the design of a modified system for community development field workers. Finally, plan formulation procedures derived from SRDP experience are being incorporated into a planning manual for District Development Officers, who will introduce district development plans during Kenya's third five-year plan period (1974-79). The experience with a management systems approach to rural development is thus being transmitted to wider areas in the national economy than the original SRDP areas, although these still have their experimental lives to run until 1976.

### 3.2 Additional Problem Areas in the Application of the Hierarchical Formulation to the S.R.D.P.

In terms of Figure 3, the major subsystems and their associated linkages have been accounted for by the SRDP procedures described above. However, two areas have yet to receive specific attention in terms of procedural designs tested under realistic operational conditions.

The first is the relationship between the executive officials in charge of programmes (Activity Controls) and the rural community (Social Controls). There are a range of possible institutional arrangements - joint committees, public meetings, the use of literature and the mass media which may improve the image of the public sector agencies, explain the intentions of the public sector programmes and, thereby increase the commitment of the local population to support and utilize the programmes initiated in the public sector.

Perhaps more important, the selection and design of the

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20. Belshaw, D.G.R., "A Note on Research Possibilities for Crop Diversification Policy with Special Reference to Mbere Division of Embu District and Similar Areas", Institute for Development Studies, Nairobi, Kenya, 1972.

programmes themselves could often benefit from examination in the light of the experience and preferences of the local community. Much discussion has centred around the concept of "local participation in planning and development mobilisation" but unfortunately no systematic operational procedures have yet been designed for testing and evaluation in the field.

Secondly, the linkage between the national planning system and the district plans should ideally be a two-way, iterative procedure. District planning should add new dimensions to the accuracy and capability of the overall planning process, so that additional proposals not included in the national plan or modifications of existing national programmes should emanate from district planning activity. The sum of district plan proposals must in turn, however, be made consistent with the constraints operative upon the overall national plan. This requires the introduction of a simple, two-level optimization procedure, where many relevant coefficients have not been quantified. Unfortunately, no progress has been made to date in tackling this problem.

#### CONCLUSIONS

The design of a rural development planning and control system according to the scheme presented in Figures 3 and 4 can be viewed as a multilevel optimization problem. The system is characterized by a set of lower level optimization problems with their associated local performance functions. The tasks of the lower level controllers are to take the actions necessary to maximize the different local performance functions. In addition there exists a global performance function for the overall system. The tasks of the higher level controllers are to intervene in the local optimization procedures on the next lower level by changing the local performance functions in such a way that the overall global performance function is maximized.

A quantitative solution of this problem requires a mathematical formulation of the performance functions, both the local ones and the global one. Further, the dynamics of the total rural development system must be known and describable in terms of a mathematical model.

The reality is very far from this ideal picture. The rural development system is very complex, and reliable causal explanations of its socio-economic aspects are not available. Further, many aspects of rural development planning are not amenable to analytical treatment. Social and political constraints involving value judgements are examples of this. Such factors cannot easily be quantified, and are therefore not suited for mathematical modelling.

Nevertheless, it is felt that the formulation of the rural development planning and control problem within the structure of hierarchical systems theory is very useful. This approach has the advantage that the emphasis is placed on the rural system itself, rather than on the planning documents as has been the tendency in rural development planning of the past. In the formulation of the Special Rural Development Programme in Kenya an attempt has been made to place the emphasis on the real rural production processes. Thus in the design of the different planning and control procedures of the SRDP effort was made to obtain a closed-loop management planning and control system whereby experience from the plan implementation stage can be utilized to improve the ensuing development plans. It is the belief of the authors that the conceptual framework offered by the hierarchical systems formulation of the overall planning and control problems has been an aid towards obtaining these ends. An important contribution of the hierarchical formulation is that it enables the planners to appreciate the relationship between the control inputs (plan implementation procedures) at all levels of the hierarchy and the performance of the subsystems as well as the performance of the overall rural system. This helps the planners in the identification of the crucial information channels and levels on the one hand and the necessary data collection and processing for efficient decision making on the other. In this way critical paths and bottle-necks can be identified and a comprehensive treatment of interactions between the various activities of the rural system can be achieved.

Also the hierarchical systems formulation makes it possible to apply systems analysis methods to those parts of the system which can be quantified in terms of mathematical models. It therefore enables a more analytical treatment of the rural development system. This, however, requires further development of conceptual and mathematical models of the different subsystems of the rural development system. Work along these lines ought to be given a high priority in the future since the existence of reliable models for the rural development system (or parts of it) would add a hitherto unknown dimension to rural development planning in most developing countries. A reliable model would make simulation studies possible whereby different planning and control strategies could be tried out and the performance of the different strategies compared. Further, by simulation the crucial variables in the process could be identified, such that suitable search and information collection procedures could be designed in order to determine these crucial variables with a higher degree of accuracy.

This paper presents a first attempt to apply hierarchical systems theory to the problem of rural development planning and control. It is hoped that the

contribution of this paper will lead to closer cooperation between planners, economists, rural experts and systems analysts and thereby lead to more efficient solutions to the problems of rural development in developing countries.

ACKNOWLEDGEMENTS

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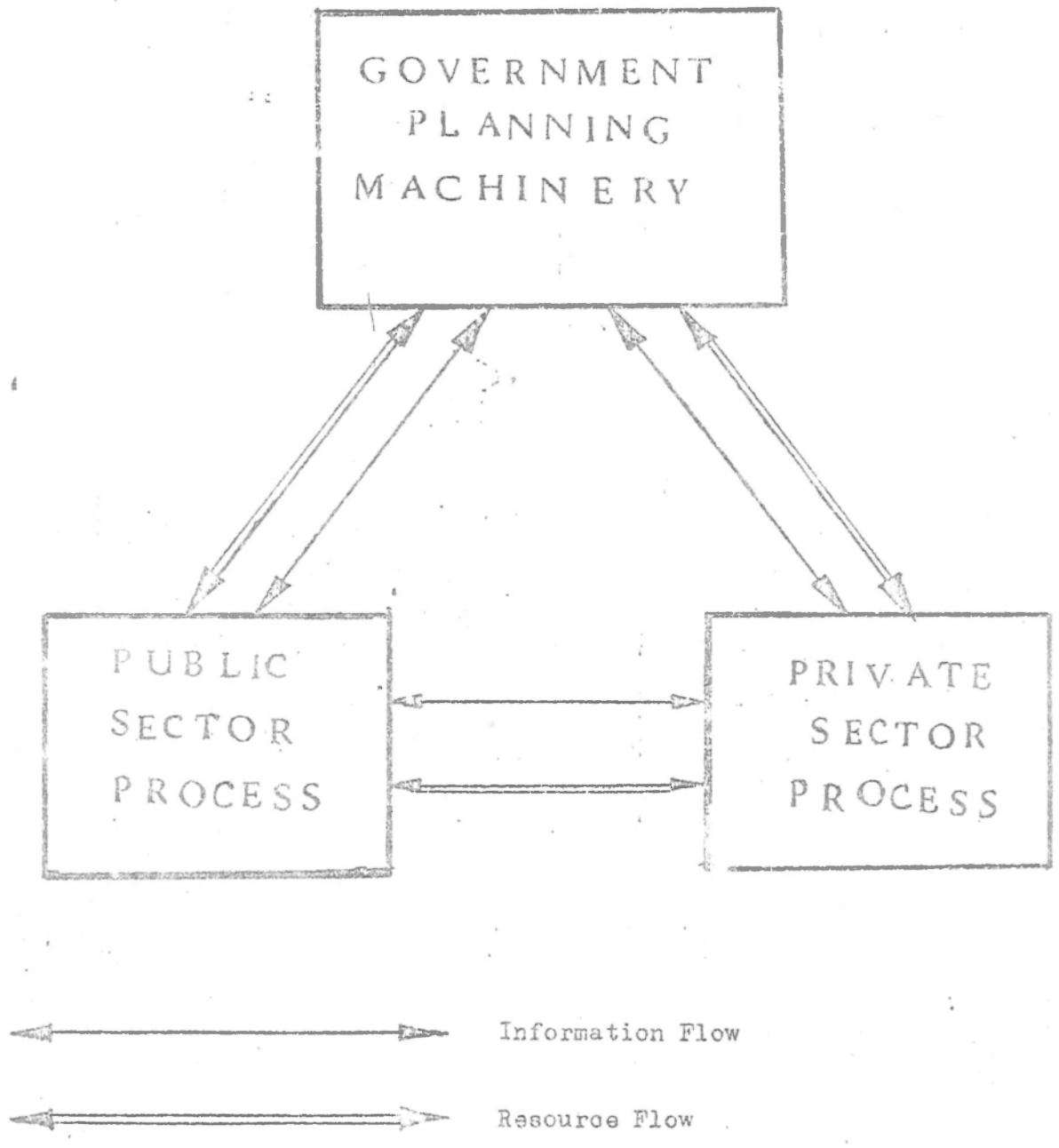


FIG. 1 : Basic Subsystems of the Rural Development System



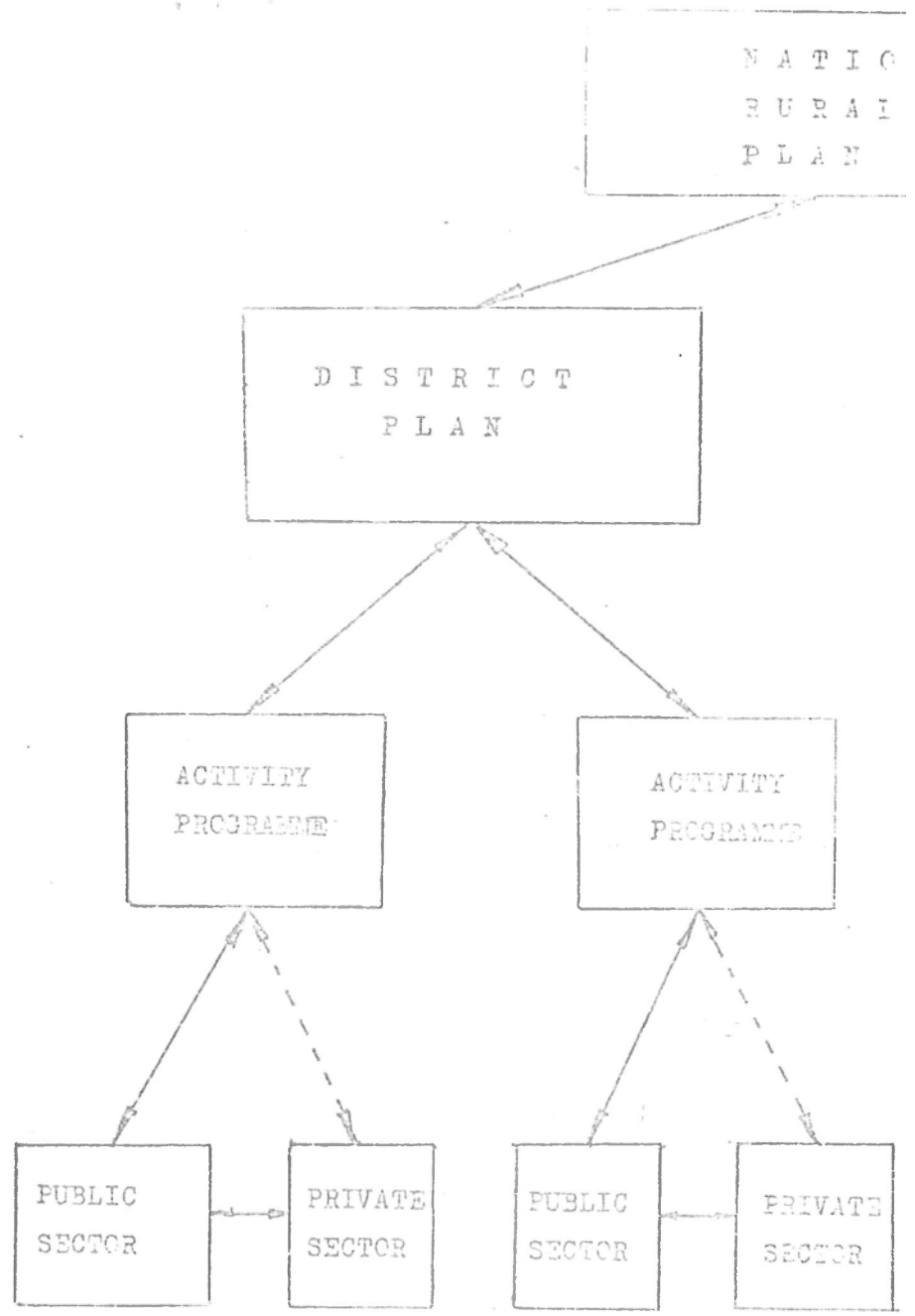
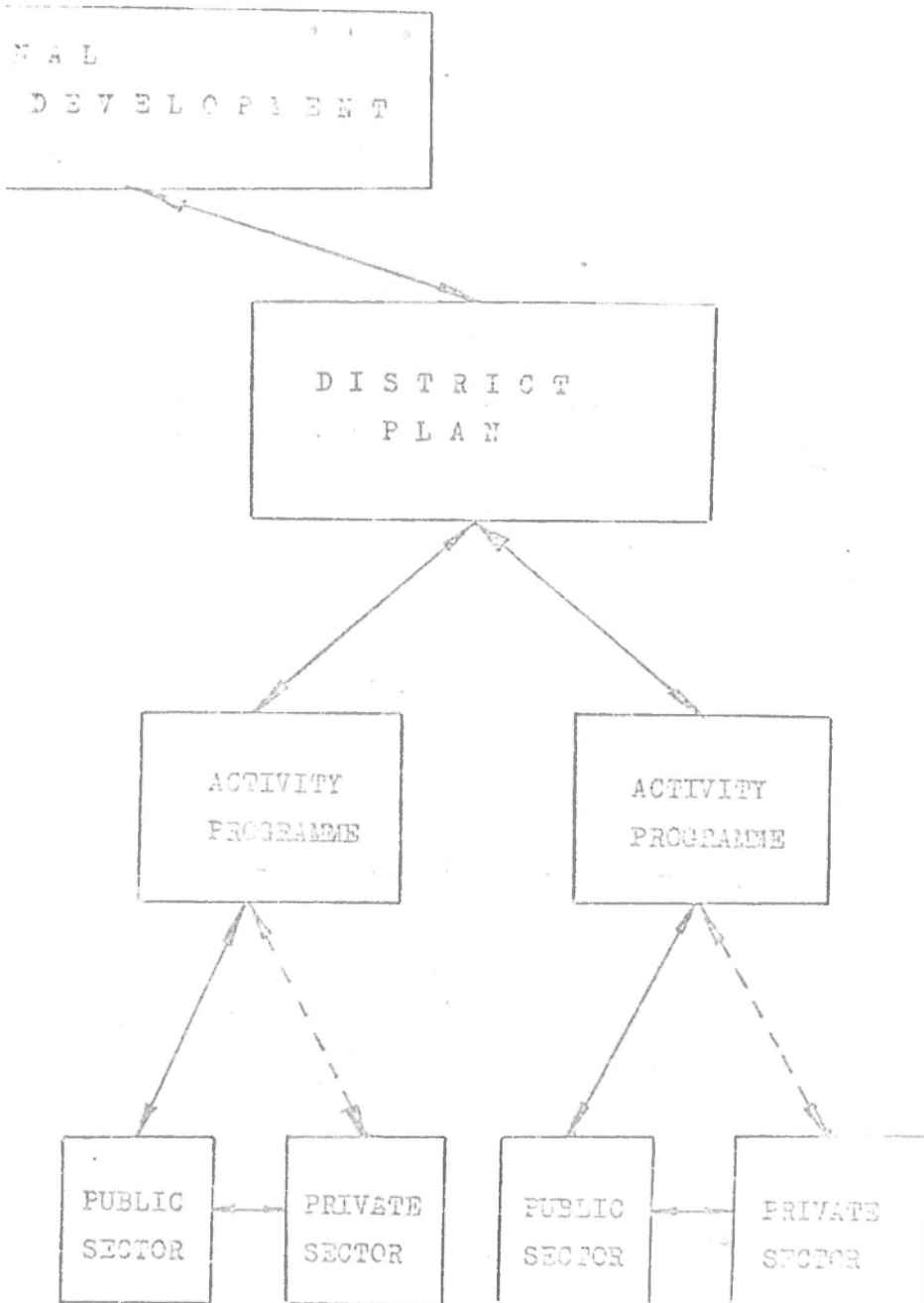


FIG 2 : Flowchart



Structure of the Rural Development Plan

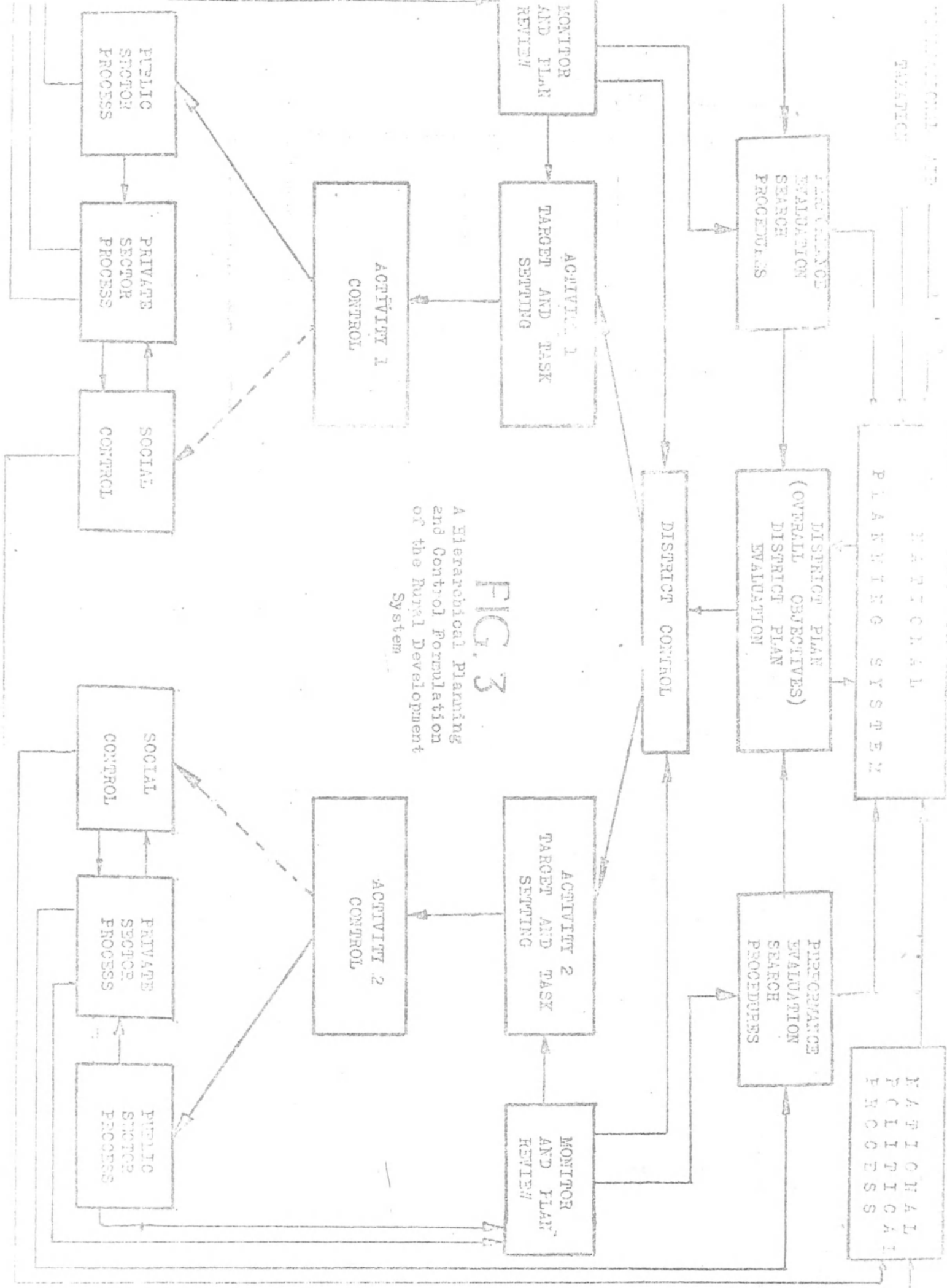


FIG. 3  
 A Hierarchical Planning and Control Formulation of the Rural Development System

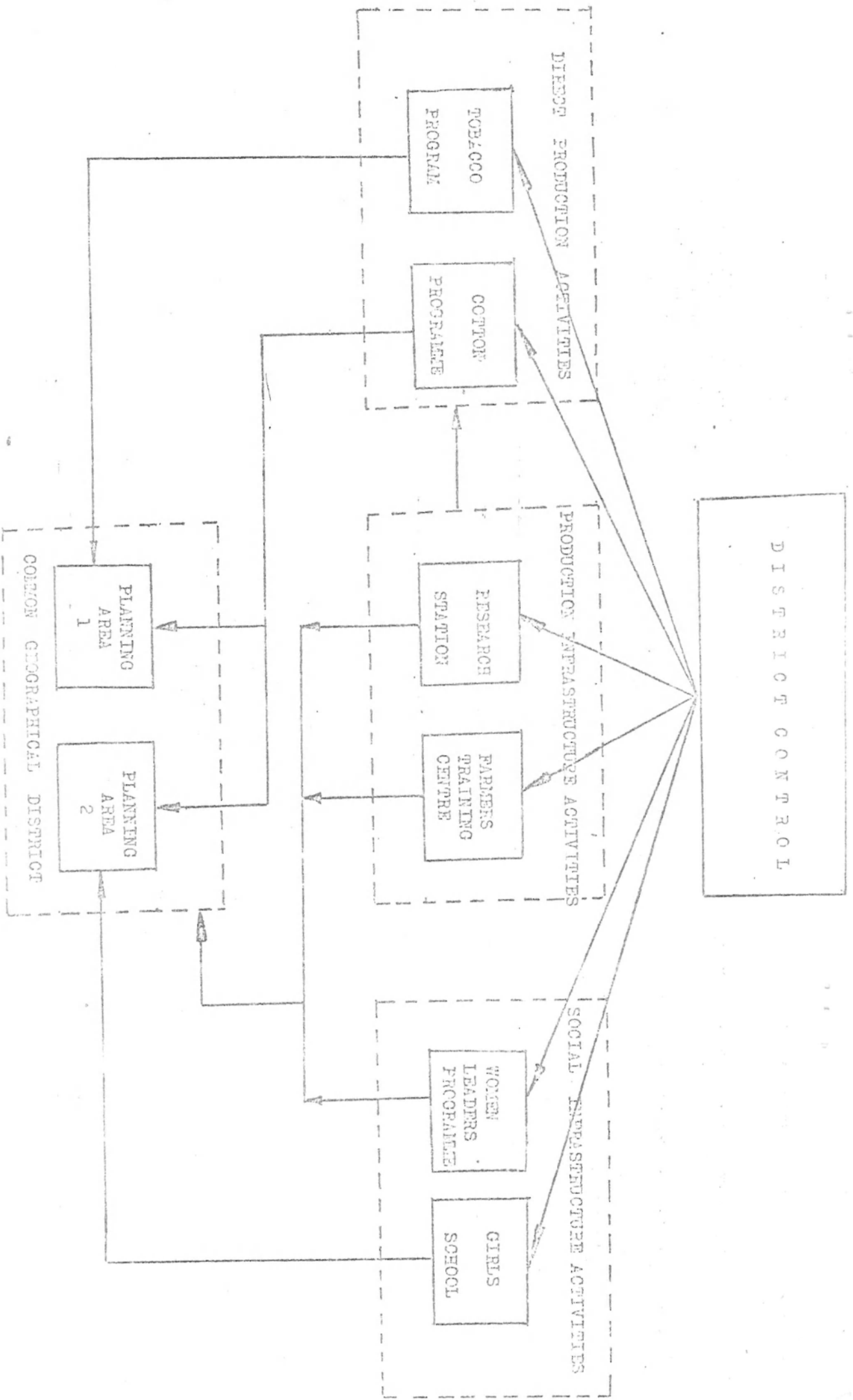


FIG. 4

: Disaggregation of the District Plan by Activity Category and Geographical Area

# FIG. 5

Program Chart for one Rural Activity

PROGRAMMING CHART SUB-PROGRAMME Mexican 142 Pea Beans PLANNING AREA Where SEP 1971/72



OPERATION	7	8	10	11	12	1	2	3	4	5	6	7	8	9	COMPLETION INDICATOR	
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
Targets set for Short Rains 1971																Targets issued to location, Ams
Seed supply to KPA and where																100 bags via KPA Ebnu to Stockists
Check seed at stockists																All stockists supplied
Select demonstration plots etc.																15 x 1 acre demonstrations
Farm Visits land prep. & planting																a) 150-200 farms x 1 visit b) 400 acres planted
Demonstrations a) Planting																15 demonstrations held
b) Preharvest																15 demonstrations held
Farm Visits Preharvest; Farm Selling																a) 150-200 farms x 1 b) 1600 bags harvested