AN EVALUATION OF THE SPATIAL PLANNING INPUT IN THE NINGI DEVELOPMENT AREA OF THE BAUCHI STATE INTEGRATED RURAL DEVELOPMENT PROGRAMME (BASIRDP)

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DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented before in any previous application for a higher degree. All literature cited are specifically acknowledged by means of references.

ADAMU AHMED

11 · 11 · 2000

Date

CERTIFICATION

This thesis entitled "AN EVALUATION OF THE SPATIAL PLANNING INPUT IN THE NINGI DEVELOPMENT AREA OF THE BAUCHI STATE INTEGRATED RURAL DEVELOPMENT PROGRAMME (BASIRDP)" by ADAMU AHMED meets the regulations governing the degree of Doctor of Philosophy of Ahmadu Bello University, Zaria, and is approved for its contributions to scientific knowledge and literary presentation.

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DEDICATION

This work is dedicated to the memory of my late father

Alhaji Ahmed Adamu

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ABSTRACT

Spatial Planning has received more emphasis in 1RD design relating to rural service delivery. However there are limitations in knowledge of the implications associated with the pattern of implementation of the spatial input in IRD design and use of the information to improve IRD policy formulation and implementation strategy.

To fill the gap in knowledge, therefore, the aspect of the spatial input in the design of the service delivery system in the World Bank supported Bauchi State Integrated Rural Development Programme (BASIRDP) was investigated. The focus was on the evaluation of the spatial efficiency of FSCs in BASIRDP. The assessment was based on the application of a model of evaluation using computer Programme, as an improvement over the techniques of social evaluation in use.

The outcome of the study showed that the location of FSCs in BASIRDP are spatially inefficient. This has imposed travel distances (35%) greater than the 12km considered reasonable for farm journeys to and from FSCs. The pattern was shown as a negation of the project design principle and implied loss of productive labour time, resources and energy that wouid otherwise be useful in farm activities. The number of FSCs capable of achieving the desired spatial objective in BASIRDP was also determined using the principles of the model.

Based on the research findings, some policy recommendations have been made for BASIRDP and for use in the planning and design of IRD projects. in

particular, the usefulness of computer based models in spatiai analysis to support decision making has been shown from the pattern of results obtained in the study.

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CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND OF THE STUDY

Spatial planning is a process of guiding the efficient use of space. At the urban level, it is useful in guiding locational decisions and in managing physical growth and development. The concern at the regional level is with organization of rural land use, settlement systems (pattern and hierarchy) and physical linkages, as well as guiding rural locational decisions of infrastructure, facilities and services in development projects.

In Nigeria, spatial planning has been limited to urban physical plans and policies. Its influence in guiding rural resource use and service delivery at the regional level has been very limited. Rural development schemes have therefore been designed and implemented with minimal consideration paid to rural spatial structures and processes, even though they are area-based, and therefore constitute elements in regional development requiring locational decisions and design of physical linkage networks (Kaltho, 1990).

Aspects of limitations associated with weaknesses in spatial planning at the regional level have been widely reported. They include effects on labour input, productivity, yields and total production. They are associated with inefficiencies in locational decisions in the planning of rural landuse (O'keefe and Wisner, 1977); settlement systems (Hoskins, 1980; Tadesse, 1982); physical linkages and the siting of rural facilities and services (McCall, 1985).

The World Bank, in the design of its assisted Integrated Rural Development (IRD) programmes in Nigeria, gave recognition of this limitation by emphasising the inclusion of spatial planning in the design and implementation of its activities. The focus of the spatial planning input is primarily on the aspect of locational decisions for Farm Service Centres (FSCs) as the physical support systems for programme implementation, but specifically for the delivery of input supply and agricultural extension.

In the River Basin Development Authorities (RBDA's), spatial planning is used to guide the distribution of facilities, rural resource management and the planning and design of rural resettlement schemes. Other examples are the planning of rural health schemes under the Nigeria Primary Health Care Project and of rural transport infrastructure.

For many of these programmes, the assessment of their performance has led to concerns with social issues covering aspects of equity considerations (Mabogunje and Gana, 1981); effects of programme inputs on settlement systems (Saba, 1984; Balarabe, 1988; and Masau, 1983). Others focus on land distribution problems (Bird, 1984); compensation, resettlement and occupational disruptions (Sano, 1983; Wallace 1980 and 1981; Oculi, 1981; and Beckman, 1986), etc.

Often the spatial planning component is considered secondary, and therefore not fully investigated. Studies that fall in this category include those on spatial equity considerations by Mabogunje and Gana (1981); effects of changes in policies on programme sustainability by Kaltho (1990) and the effects of programme design on outcomes by Ahmed, (1990), etc. The studies are based on techniques of social evaluation, using the impact evaluation model. The analysis is carried out manually, enriched with data from questionnaire application techniques, with the result used in explaining the spatial pattern of variation of programme outcomes rather than in systematically evaluating the influence of the spatial input in programme design and implementation. Therefore, the procedure in the analysis is cumbersome and subjective, and the results deficient in explaining the influence of the spatial planning input in the design of IRD projects as they affect programme implementation and outcomes.

The gap in knowledge about the consequences of the limited spatial planning input in IRD project design needs to be filled through research that takes cognisance of limitations in the scope of, practice and methods employed in assessing the spatial component in IRD programme design and implementation. That is, it is necessary to answer the question: What pattern of implications are associated with the absence of spatial planning input in IRD design? This, therefore, is the main issue addressed in this study with particular reference to the Bauchi State Integrated Rural Development Programme (BASIRDP). The BASIRDP has been the major initiative to develop the rural areas of Bauchi State (Fig. 1.1) and is based on the World Bank technical and financial assistance. It was started in 1976 as the enclave Gombe Agricultural Development Project (GADP). It expanded to cover the whole state in 1981 as the Bauchi State Agricultural Development Project

(BSADP) and transformed later into the Bauchi State Integrated Rural Development Programme (BASIRDP) in 1985.

The objective of BASIRDP (as with the BSADP and GADP) is to improve farmer productivity through the sustained delivery of farm inputs and extension advice using a network of Farm Service Centres (FSCs). The choice of locations for the centres constitute the level where the spatial planning input is most visible. The principle is to locate the centres within a walking distance of 6km of farm villages to ensure effective delivery of programme services and minimize the cost in journeys to FSCs for purchases. It is considered a motivational compliment for inducing farmers to adopt new inputs and improved farming practices as basis for enhancing their productivity.

Numerous indications however suggest that the spatial input of BASIRDP during implementation was inconsistent with programme design provisions. Therefore, the question in BASIRDP needing answer is: How has the spatial input in BASIRDP been implemented, and with what pattern of implications?

This question is investigated in this study through the use of enhanced analytical methods and procedures as improvement over conventional techniques of evaluation in practice. The findings are useful in providing insights into the constraints imposed by the spatial input in BASIRDP during implementation, as useful indicator for improving the planning, design and implementation of IRD projects. There is also the advantage that the results will provide indications of the limitations of conventional methods and procedures used in the evaluation of the spatial input in IRD project design.

1.21 STRUCTURE OF THE THESIS REPORT

The thesis is organized in six chapters. The spatial input in IRD design is examined in the background sections of the report as Chapter Two, alongside the nature of spatial problems in rural areas and their effects on rural productivity. The various techniques and procedures of evaluating the spatial input in IRD design are the subject of review in Chapter Three. The aspects reviewed are the concept and purpose of evaluation and the limitations of conventional techniques of evaluation in common use.

The research parameters discussed in Chapter Four, cover the main issues investigated in the study based on the gap in knowledge identified in Chapter Two. The objectives of the research and the methodology of investigation covering details of the research model adopted are also discussed in the chapter. In Chapter Five, the results of data analysis are given as "Pattern of Distances Imposed by the spatial input in BASIRDP". The results are discussed in four sections as: the efficiency of service centres; average distances to Farm Service Centres; maximum distances to Farm Service Centres; and profile of distances of villages to Farm Service Centres.

The summary of research findings and inferences drawn are discussed in Chapter Six. Details of the implications of the findings are given for BASIRDP and also for the planning of area-based IRD projects. A critique of the spatial input in BASIRDP provides the basis for the recommendations given in the later part of the chapter. The closing section of the chapter is given as conclusions where issues for further investigation are identified.

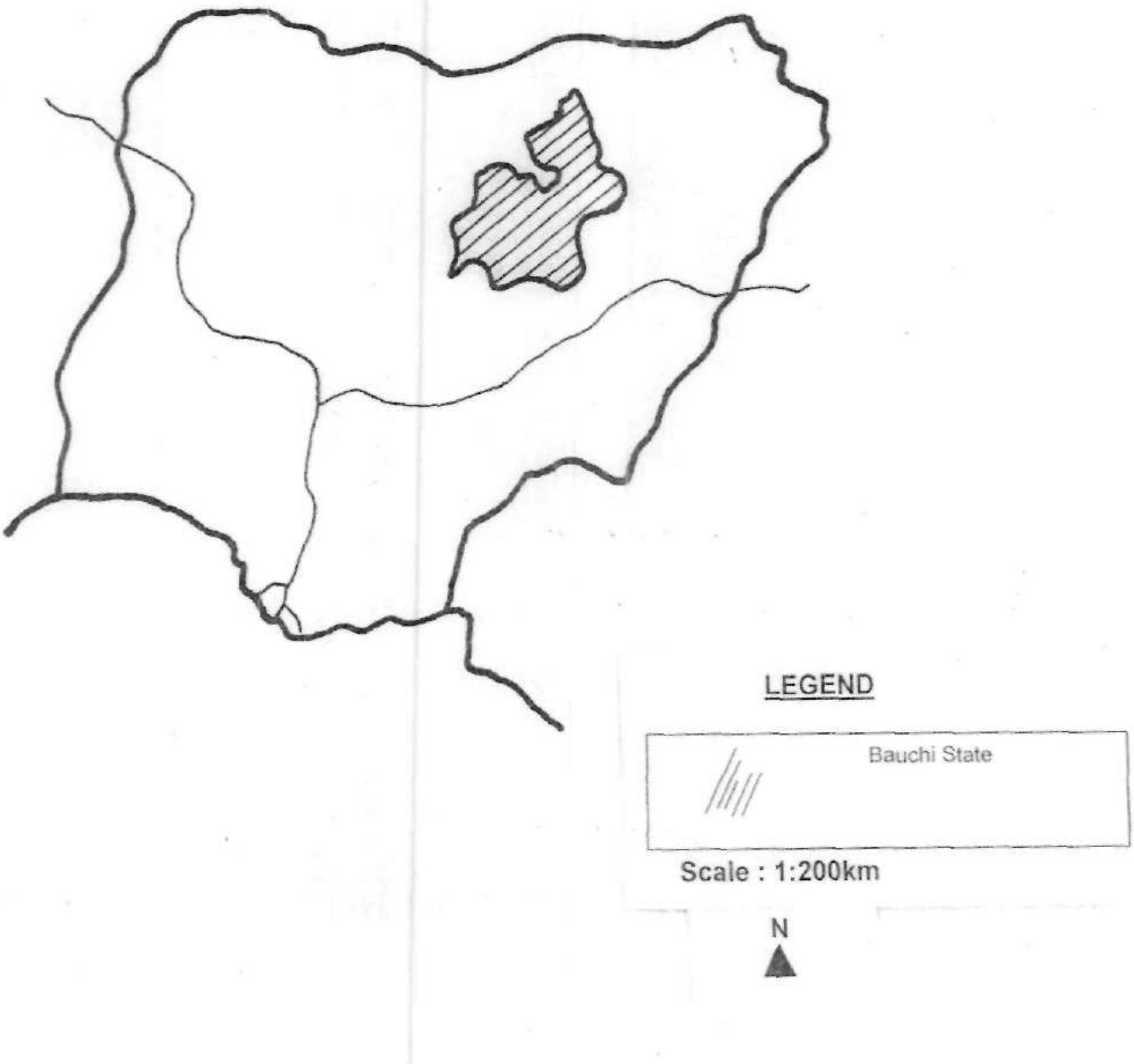

FIG. 1.1 BAUCHI STATE IN THE NATIONAL CONTEXT

CHAPTER TWO

SPATIAL INPUT IN THE DESIGN OF INTEGRATED RURAL DEVELOPMENT (IRD) PROJECTS

2.10 INTRODUCTION

Physical planning in rural areas is concerned with locational decisions for projects, facilities and services as well as for the organisation of rural land use, settlement systems (patterns and hierarchy) and physical linkages. Evaluation studies of IRD projects however place emphasis on social issues of sustainability, equity considerations and aspects of project design and public participation. As shown ir Chapter One, the spatial input in their design is rarely investigated, bu nonetheless necessary to improve knowledge of the implications of the spatial inpu during implementation.

To set the broad context of the research, aspects of the spatial input of concern conventional IRD project design are established in this chapter. Related to it is th review of rural spatial problems and the response of physical planners to the The chapter is organised in four sections as follows: The first section address the nature of spatial problems in rural areas, and the second discusses effects spatial problems on rural productivity. The significance of spatial planning in II project design is examined in the third and aspects of the spatial input in I design in the fourth.

2.20 NATURE OF ACCESSIBILITY PROBLEMS IN RURAL AREAS

Accessibility problems in rural areas are associated with inefficiencies in locational decisions for facilities, services, land use and physical linkages. The problems appear as distance constraints in journeys to farm plots, and to service centres or markets for purchases. In most of rural Africa, inadequate transport facilities and inefficient modes of conveying goods and people are additional limiting factors to improved accessibility. The most affected are women, being the main providers of water and fuel wood, and who quite often perform longer field hours than men.

Accessibility problems in journeys to farm plots are associated with long distance separating home and field. They occur mainly in areas of large population growth, and in restricted areas with few opportunities for long term adaptation. Examples are areas of rapid population influx due to resettlement schemes, villagisation or refugee settlement programmes, or areas with sudden restrictions on land availability such as land alienation for plantations or state farms. Problems also exist, though less seriously, in areas of sustained but gradual growth rates where there has been less time to adjust.

Indirectly, through Government policies that emphasise minimum hectrages as condition for loan disbursements or subsidies, many farmers resort to larger plots in distant locations, thereby adding to the overall accessibility problem. Where the incentive to move to more distant plots is absent, there is the problem that environmental deterioration may occur around population clusters, including the destruction of fuel wood resources. This in part is due to land use intensification a a result of increasing population and declining soil fertility from intensive cultivation.

Accessibility problems also exist where there is high level of land fragmentation. In that case, average home site-plot distances may be small but aggregate travel per season may be high. Nevertheless, fragmentation does not necessarily mean that farmers are forced to use distant plots. Through adjustment processes, farmers can work their nearer fields most intensively. As such, activities requiring the most labour hours, and thus most trips per season are located at the nearer fields.

Based on studies from Uganda by Tindituuzu and Kateete (1971), the problems of accessibility associated with land fragmentation is shown as being more likely in nucleated settlements than where homesteads are scattered. This is presumably due to more persistent processes of inheritance, indebtedness, litigation and land redistribution, coupled with fewer possibilities of relocating in low density zones. Commonly, farmers in such situations are known to walk longer than 4km to better quality farm and grazing land (Chisholm, 1979).

Accessibility problems to service centres can also be significant in rural areas. Using evidences from sub-Saharan Africa, McCall (1985) has shown this category of trip as being rarely over 150, with the exception of children's school trips which may exceed 800 per household per annum. Trips to a grain mill are normally 70 a year. Water is usually collected twice per day and fuel wood once or twice a week.

In such trips, the accessibility problem can be significant where central services are beyond walking distances of village locations. Since peasants have direct control over modes of transport between home site to fields, and much less over that of home site to service centres, delays and inefficiencies are easily created in journeys for the purchase of farm inputs.

Since maximum headloads per peasant farmer are typically 25-40kg depending on the type of load (McCall 1985), longer walking distances to Farm Service Centres can be particularly limiting on the load that can be carried and the amount and quality of labour time devoted to farming. This problem is greater in the rainy season when the frequency of trips to service centres for purchase of farm inputs is more significant. In the dry season, trips are limited involving those for purchases of durable goods and sale of surplus produce.

2.30 ACCESSIBILITY PROBLEMS AND THEIR EFFECT(s) ON RURAL PRODUCTIVE SYSTEMS

The pattern of productivity in a rural farming system is a function of resource constraints in overcoming distances in farm journeys. The constraints are time, energy and financial resource commitments to the farmer. They include time lost in movement from home site to fields and cost(s) in moving farm inputs, implements and harvests to and from the fields.

The constraints appear as accessibility problems associated with inefficiencies in locational decisions at two levels of planning. First, they occur at the farm level involving the selection of farm plots as well as crop options for plots at locations relative to home site. That is, the best allocation of labour effort in different fields as well as for fuelwood, water, etc. Secondly, they emerge at the level involving the selection of sites for Farm/Agricultural Service Centres, (FSCs) relative to farm villages (McCall,1985).

From studies in Tropical Africa, Morgan (1969) showed that average distance covered to fields has effect on labour input and productivity and thus on yield and total production. He showed that travelling to and from fields can take up to 50 percent of the average working day (see table 2.31).

TABLE 2.01: **Reduction In Work-Day Per Distances Covered To Farm Plots**

Distance (km)	4km	5 km	6 km	10 km
Reduction in working day (%)	20%	25%	30%	50%

Specifically, studies by Jackson (1972) showed that farmers walk up to seven hours to and from fields per day in Northern Nigeria. Chisholm (1979) also showed intensive cultivation as dropping off beyond 2-4km of farm villages, while Morgan (1969) showed the limiting distances for farming in Tropical Africa to be 6-11km from home site.

Generally, longer journeys to fields imply more time and more effort before work begins. Also, shorter field hours mean faster and less careful plant husbandry. This deteriorates during the day with more field work falling at the hottest periods often without a food break. There is also the problem that yield improving husbandry measures will be drastically reduced or even curtailed to ensure that sufficient area is covered in the short time available (Carlstein, 1982).

Under these conditions, yields are bound to reduce, both by poor husbandry and also by less careful harvests. For instance weeding around tree crops may be replaced by burning weeds. The adverse effects are on soil fertility and tree cover. This has for instance affected distant cashew nut holdings after the villagisation programme in Tanzania in the 1960s (Ellis 1981).

Also, where fields are at distant locations, the protection of pre-harvest crops against wandering livestock, monkeys, pigs and birds is difficult. Preventing theft of standing crops is similarly harder. In many parts of rural Africa, adults move to farmsteads in distant temporary shelters for periods of 2-3 months. The implications are on health and productivity as well as risks of social dislocation for the family.

Longer walking distances to plots can also lead to an urge to cultivate more accessible plots intensively. This could mean the reduction or elimination of fallow with consequences of soil degradation and the destruction of fuelwood resources. Quite often, marginal lands on steep slopes or poor soils that are more accessible are exploited, with the more distant, formerly cultivated areas reverting to scrubland. As a result of declining fertility, the farming system can become increasingly dependent on high-yielding, low nutrition foods like cassava, sweet potatoes and bananas, thereby adding to the poverty-nutrition cycle (Ruthernberg, 1976).

Where the distance problem arises suddenly, as with land re-organisation, crop options formerly grown like perennial and tree crops, may be abandoned when farmers move cultivation to new plots or when they resettle. This was the case for cashew nuts, oil palm, castor seed and firewood trees, etc. after the Tanzanian Villagisation Programme of 1973-1975 (McCall, 1983).

In sub-Saharan Africa, farm inputs and harvests are moved largely by head portage and animals. The maximum head load is estimated at between 25-40 kg, depending on the distance and type of load (McCall, 1975). By implication, only a limited quantity of farm inputs and harvested crops can be carried over long distances. Therefore, more trips involving substantial resource commitment in time, energy and financial resources are required in farm journeys to farm input supply centres and markets. Where distances are prohibitive, the trips are abandoned, and the continued usage of farm inputs discarded, with severe consequences on farm output. Even where farm inputs are moved from home, as is shown from studies in sub-Saharan Africa by McCall (1975), the use of manure for instance on distant cotton fields is impossible at a recommended 17 tons per hectare.

Limitations of access problems have also been shown in studies on the use of FSCs by farmers. Kaltho (1990) for instance, in a study of the BASIRDP, showed access problem as an important limiting factor for the use of Farm Service Centres by farmers. In the study, 30% of respondents gave distance as the main reason for their inability to use FSCs regularly. Also, about 20% of farmers indicated never attending Farm Service Centres on account of excessive distances to such centres. Attendance at Extension Demonstration sessions is also affected, since Demonstration Farms are located at the Farm Service Centres (Kaltho, 1990).

The effect of access problems on segments of the population is also well documented. *Studies have shown women as most affected since they do more* than a proportional share of field work and headloading to and from the fields. The evidence is from Kenya where female peasants were found to be responsible for 80 percent of field loading (Carr, 1983). Under these conditions they are shown to have less time available for domestic activities, like child care, food storage and its preservation and preparation, collecting water and fuel wood, etc. Low protein and uncooked foods are also a common element in peasant diets associated with the distance factor limiting time devoted to food preparation.

2.40 SIGNIFICANCE OF SPATIAL PLANNING IN RURAL DEVELOPMENT

Spatial planning is useful in guiding the efficient use of space. It is concerned with the spatial distribution of activities, functions and physical elements and the linkages that integrate them (Larry, 1979). At the urban level, it is useful in guiding locational decisions and in managing physical growth and development. At the regional level, it involves organisation of rural land use, settlement systems (patterns and hierarchy) and physical linkages as well as guiding rural locational decisions for projects, facilities and services.

Other concerns of physical planning are the reconciliation of the competing demands on land development, the demand for movement of goods and raw materials, and the scale and timing of migration as it affects the supply of housing, hospitals, schools and other facilities. By providing a framework for the development of a system of settlements, physical planning also ensures that social services are efficiently supplied and managed (Funnel, 1976). In this context, elements of the regional productive system can be functionally integrated for achieving regional economic growth and development. That is, elements in the regional spatial system can be organised through a network of physical, economic, social and service linkages to perform specialised and diversified production, distribution, consumption and exchange functions (Omuta, 1987).

By manipulating physical linkages between regional spatial elements, physical planning can enhance not only travel, but also widen marketing opportunities and commuting operations, as well as increase productive capacities. Also, it is useful in regions with access problems associated with dispersed settlement systems by defining the hierarchy and pattern of distribution of transport infrastructure and the framework of settlement reorganisation required to facilitate integration and exchange.

In aiding spatial equity within and between regions, the application of spatial planning principles can guide and induce the process of economic and spatial transformation of lagging regions. This is vital in areas where the scattered nature of small sized settlements has provided limited incentive for the location of facilities, infrastructure and services. In Africa, it has provided little incentives and advantages for the location of propulsive economic activities in the rural areas.

For IRD programmes, physical planning provides the instruments for guiding the rational use of resources in project areas and for defining horizontal and vertical linkages that should exist within settlement systems as well as between project elements. It also ensures the reconciliation of the likely competing and conflicting demands on land development, and facilitates the creation of effective spatial linkages between projects and activities. Also, in project design and implementation, physical planning techniques provide valuable instruments for facilitating the operation of, and interplay between the elements of rural development, viz. landuse, institutional systems, rural community organisations, rural industrial farms and the spatial system.

2.41 SPATIAL PLANNING INPUT IN IRD DESIGN

Spatial planning input in IRD project design has focuses on the planning of farm plot layout, rural landuse, settlement systems, physical linkages and the siting of rural facilities and services.

At the farm level, the focus is primarily on the organisation of farming activities for plots at different distance locations, as well as the planning of landuse and linkage systems within individual land holdings. Aspects emphasised vary between projects. In the World Bank supported Agricultural Development Projects (ADPs), Farm Planning and Farm Management are important components of programme design. They involve the conduct of land evaluation studies and surveys for farmers; design of farm layout for crop options; soil management, and identification of locations of farm facilities, water points, and the linkages between them, etc.

Other projects emphasise land use planning, for instance, involving the design of farm plot layout for large project areas that have major environmental constraints and those with inefficiently organised farm enterprise locations. In the National Land Development Programme (NALDP) initiated in Nigeria in 1985, individual land holdings within designated project areas are consolidated into a central pool, surveyed, designed and reallocated to participants. The plans show clearly defined linkage systems, areas for conservation, water points and facility locations, etc. The objective is to eliminate inefficiencies in journey to farm work in distant and unorganised farm locations and also maintain sustainable land development. This is also the case with resettlement and rural land consolidation programmes in Tanzania, Zimbabwe, Ethiopia, Somalia and Mozambique (McCall, 1985). Landuse planning associated with the layout of plots are also an aspect of emphasis in the design of canal systems in irrigation projects, such as for instance, in the River Basin and Rural Development Projects (RBRDA) started in Nigeria in 1973.

At the regional level, spatial planning appears in the organisation of settlement systems, physical linkages and the siting of rural facilities and services. The emphasis is largely in the design of delivery mechanisms for rural services. It is visible for example in the World Bank supported Agricultural Development Projects (ADPs) in Nigeria, where the adoption of a spatial approach to planning rural service delivery systems was clearly recognised (IBRD, 1974). It involves the location of Farm Service Centres within a reasonable walking distance of farm villages, to limit the effects of the distance constraint in the purchase of farm inputs. The centres also provide the framework for the delivery of extension advice, marketing of produce, and other aspects of programme administration.

There is a similar emphasis in the National Accelerated Food Production Programme (NAFPP) in Nigeria. It was a co-operative programme between the Federal and State Governments and the farmers in each state. The project was introduced in 1973 to increase the productivity of both staple and import substituting food crops. The focus of the programme is on Agricultural Extension and the provision of improved farm inputs, and tractor-hire service to farmers from Agro-Service Centres, set up in the rural areas. The choice of locations of the centres constitute the level where the spatial planning input is most visible. It involves the choice of central locations from where inputs can easily be distributed. The centres have farm inputs and farm produce stores, consumer goods shops and offices. Though they were far between, the centres served as viable initial points of contact between farmers, research and extension staff. They were also used for credit administration, promotion of recommended packages and marketing as well as farm adaptive research, seed multiplication, and field training of extension staff (Adegbola and Kehinde, 1986).

In the River Basin and Rural Development Programmes, the spatial input has focus on facilities needing to be located within the project areas and the assumption they are predicated on. That is, that the local population would move from isolated and dispersed farmsteads to nucleated villages provided with services. These facilities include Agro- Service Centres, demonstration and research farms and farm storage and processing facilities. The resettlement schemes in the programme as well as the layout of the service villages are planned in respect of the relationship with indigenous planning principles applicable to each basin. The objective is to address environmental constraints, enhance access to central services and improve efficiency in the network of irrigation channels.

The execution of social and infrastructure projects, especially the provision of social services and amenities are other aspects of emphasis of physical planning in the design of IRD projects. They involve the choice of location and hierarchy of health projects, such as for instance the Primary Health Service scheme in Ghana (Opong, 1994); planning of rural roads in the villagisation programme of Tanzania (Ellis, 1981) and the planning of school systems in the Zobe-Machinga Region in Malawi (Pelly, 1983).

2.50 SUBJECT OF THE RESEARCH ISSUE ARISING

Spatial planning has received more emphasis in IRD programme design relating to rural service delivery than aspects of rural landuse, transport and land consolidation programmes. The reason is that it has been easier to consider that spatial problems of access to improved farm inputs are a major constraint to farmer productivity in peasant farming areas. The spatial planing input is used therefore in defining a system of centralised and accessible locations for the delivery of new production methods and farm inputs. The objective is to minimise the cost in journeys to service delivery centres as a motivational compliment for inducing farmers to adopt new farm inputs and practices as basis for improving productivity.

The review of access problems in rural areas and their effects on rural productivity given in section 2.20 are useful in spatial policy formulation of IRD projects. However, there is still much to be learnt about the implementation of the spatial input in IRD programmes. In particular, what implications are associated with the pattern of implementation of the spatial input in IRD design is relatively unknown. Also, much less is known about the pattern of influence of the spatial input on programme outcomes.

Aspects of spatial issues reported in case studies of IRD projects have provided some understanding of the spatial outcomes of IRD programmes (e.g. Masau, 1983; Balarabe, 1988; Ahmed, 1990; Kaltho, 1990; Mabogunje and Gana, 1981, etc.). Nonetheless, the focus on the aggregate level covering social and economic concerns have meant that only a limited knowledge has been gained, of the influence of the spatial input during implementation. Also, for use of inappropriate evaluation techniques and for assessing IRD implementation based on considerations other than those implied in programme design, results from many studies have not been adequate for strategic decision making.

There is therefore a gap in knowledge that needs to be filled through research that takes cognisance of limitations in the scope of, practice and methods employed in assessing IRD projects. This has been clarified and detailed out in Chapter Four, Section 4.20. Research with this focus will provide information on the problems associated with the quality of the spatial input in IRD design, for use in improving policy and implementation strategy.

2.60 SUMMARY

Aspects of the spatial problems in rural areas and their effects on rural productive systems have been established in this chapter. Solutions within the framework of spatial planning have also been reviewed.

A critique of the scope of reported studies on the spatial input in IRD programmes provided the basis for identifying the research focus. The focus is assessing the pattern of implications arising from the spatial input in the design of service delivery systems of IRD projects with the Bauchi State IRD programme chosen as a case study. In the chapter that follows, the research issues are clarified based on a review of the spatial input in the design of the service delivery network in BASIRDP and aspects of its implementation.

CHAPTER THREE

SPATIAL INPUT IN THE SERVICE DELIVERY SYSTEM OF BASIRDP

3.10 INTRODUCTION

The review in Chapter Two was used for setting out the subject of the study. The subject was identified as the elements of the spatial input necessary for the design and implementation of IRD programmes.

To get a clear framework for the research, the design and the spatial inputs in BASIRDP need to be described. That is, it is necessary to first identify the main elements that constitute the BASIRDP design; and second, review the scope and targets of the spatial input in the design and implementation of the service delivery network of the programme. These constitute the main issues of discussion in this chapter.

3.20 THE DESIGN OF BASIRDP

The Bauchi State Integrated Rural Development Programme is the maturity stage of the World Bank initiated pilot Gombe Agricultural Development Project (GADP). It has been the major initiative for developing the rural areas of Bauchi State based on the World Bank's (IBRDs) technical and financial assistance.

It was started in 1975, along with two others (Funtua ADP in 1974 and Gusau ADP in 1975) as the enclave Gombe Agricultural Development Project (GADP). It covered an area of 6,450 Sqkm (Fig. 3.1) and served about 76,000 farming families in 1980/81. The project was expanded to cover the whole state in 1981, as the Bauchi State Agricultural Development Programme (BSADP). The BSADP shared the same operational concept as the GADP, but differed in having the additional objective of strengthening farm support institutions and of improving technical manpower for implementing project activities. In 1985, the scope of the programme was expanded to include other sectors of the rural economy and social welfare as the Bauchi State Integrated Rural Development Programme (BASIRDP).

Like other ADPs and ADP-based programmes in Nigeria, the main objectives of BASIRDP is to improve Agriculture and increase productivity and income of rural farm families, as means for raising rural living standards. The basis for achieving this is built around three core elements as follows:

(a) Input delivery and distribution system

(b) Integrated Agricultural extension and training system

(c) Management system involving monitoring and evaluation.

These elements are implemented through a network of Farm Service Centres as the physical support system for input supply and delivery of Agricultural Extension Service. The strategy was to slowly and carefully introduce improved farm inputs and farming techniques into the farming areas of the State to ensure that majority of farm families are accessible to project provided resources.

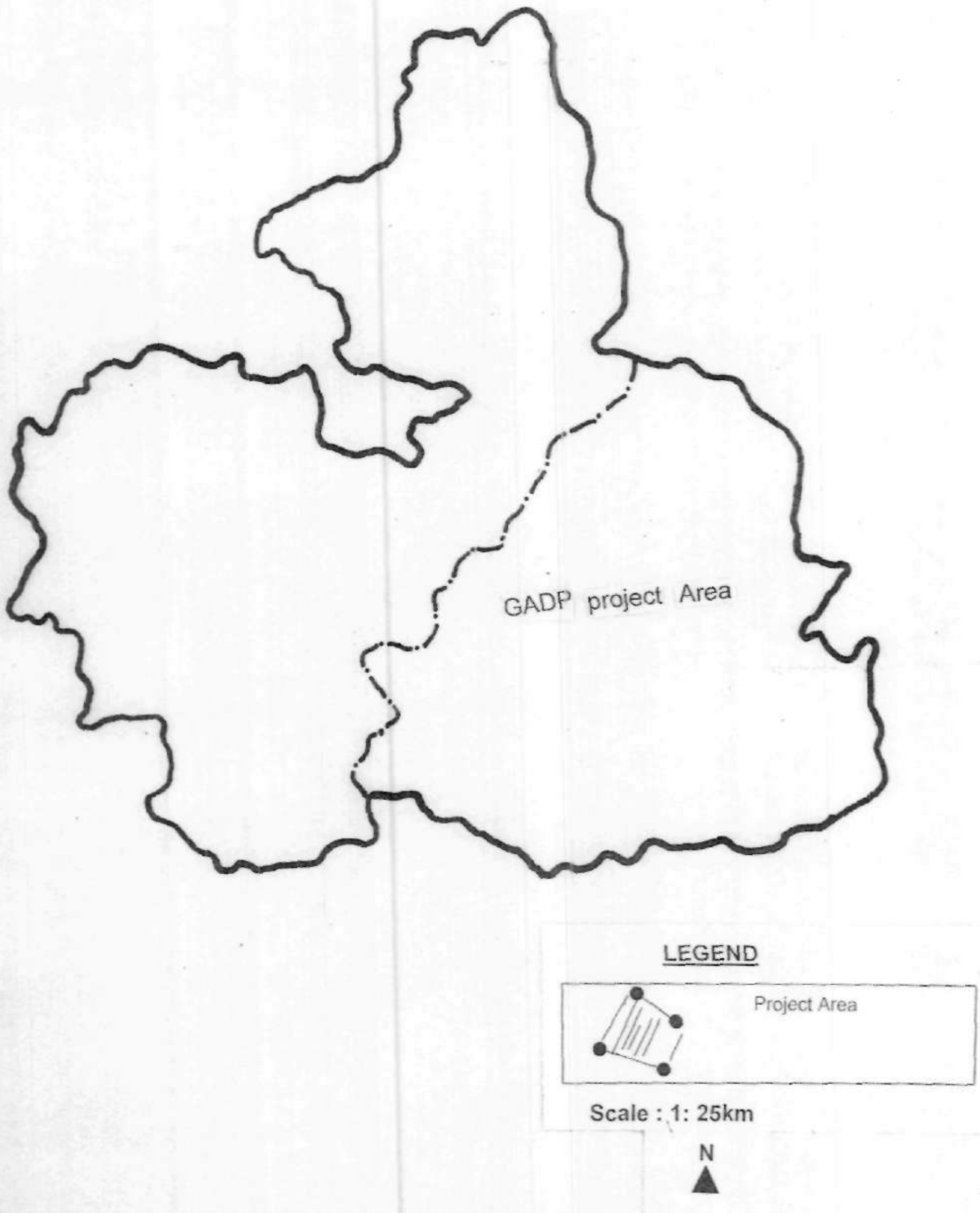

FIG. 3.1 GOMBE AGRICULTURAL DEVELOPMENT PROJECT (GADP): PROJECT AREA

In the design, farmers were to be motivated through the development service principle to adopt improved inputs; that is biological farm inputs, agro-chemical inputs and improved farming techniques. The assumption is that the benefits accruing to them would support their continued usage of the services. To achieve this, incentives were to be provided to farmers in the form of free extension services and delivery of Government subsidised farm inputs, delivered by extension workers at Farm Service Centres (FSCs). The second level of incentive is to eliminate the distance constraint in journeys for purchase of farm inputs by locating the FSCs within walking distances of villages.

The BASIRDP is managed as a corporate agency by the Bauchi State Integrated Rural Development Authority (BASIRDA). Like the pilot GADP, the Authority has three operational departments; Agricultural, Engineering and the Services Department consisting of Training and Administration; Monitoring and Evaluation; and Planning and Finance. The implementation of the programme is carried out using four zonal structures (Fig. 3.2). With each zone having 3 to 4 Development Areas, as the main blocks for organising and delivering programme services.

3.30 FARM SERVICE CENTRES IN BASIRDP

Farm Service Centres in BASIRDP provide the physical structure for programme implementation. They constitute the main structures for the programme administration, and monitoring and evaluation. The other structures are the zonal programme offices and the Central Administration at the headquarters.

LEGEND

\ x. \ \ s,	Zonal Boundary

Scale : 1: 25km

N

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Fig. 3.2 ZONAL AND ADMINISTRIVE STRUCTURE OF BASIRDP

The most important function performed at the FSCs in BASIRDP is the provision of input supply and delivery of extension services. The two constitute the main programme elements, and programme success is considered a function of the efficiency with which they are delivered. At each Farm Service Centre, input stores, offices and staff housing are built.

3.31 **Input Supply Function of Farm Service Centres in BASIRDP:**

Input supply in BASIRDP is carried out by agr cultural extension Staff through the programmes commercial division viz. Bauchi State Agricultural Supply Company (BASAC). Emphasis is placed on agency support in making farm inputs available to farmers at FSCs that are at convenient locations to farmers.

In BASIRDP, farm input supply is seen primarily as a development service. It is organised with the objective of motivating farmers to adopt the new and improved farm inputs. To achieve this, a package of ncentives is provided to farmers to include the following:

(i) Construction of Farm Service Centres within walking distances to villages, for easy access of farmers to production inputs and for extension advice.

(ii) Subsidies on the prices of inputs and

(iii) Inputs credit to farmers with phased repayment after harvests.

Since 1981, farm input supply has been the responsibility of the BASAC. It replaced the commercial division of the GADP and operated as a limited liability company. Like in the GADP, the function being implemented by BASAC include the following:

(i) Procurement of farm inputs to be purchased by farmers within the project Area.

(ii) Management of Farm Service Centres (FSCs) for retailing of inputs to farmers and wholesale service to co-operatives.

After 1988, the subsidy element was removed and BASAC operated on strictly commercial criteria. Like the main programme management structures, BASAC is organised into four zonal administrative areas; the Eastern, Western, Northern and Central zones. Regarding the aspect of input distribution, Farm Service Centre locations at the zonal level and in Development Areas are determined based on the development service concept. The target is to locate them at distances of 6km walking radius of farm families.

32 Agricultural Extension Delivery Function Of Farm Service Centres In BASIRDP

Agricultural extension is the other core service in BASIRDP. It is used to motivate farmers to adopt new inputs and farming practices through the delivery of free extension services as basis for improving productivity and rural well-being. The focus of the extension messages is on:

(i) Types of new inputs and recommended methods of use

(ii) Research findings and field tests relating to crops and farm practices.

Agricultural extension service is performed by the Agricultural division of BASIRDP. As with input supply, agricultural extension is packaged and delivered from Farm Service Centres located within walking distances of the villages. Each centre has a full compliment of project demonstration farms, extension supervisory staff, adaptive research trail farms, and project research farms, as aid to the teaching of extension packages.

During the GADP pilot stage, and the early period of BASIRDP, the "Training and Visit System" (T&V) was used. It consists of structured extension staff visits to farmers and pre-planned messages given through radio, films, drama and discussion sessions. The strategy is based on the "persuasion paradigm" or the "DO TO APPROACH", in which a select group of farmers, considered more likely to adopt recommended innovations are used as targets by the extension agents.

The extension programme consists of a hierarchy of extension staff from the chief extension co-ordinators at the central office to the village extension agents (VEA) at the village level. These are linked by various categories of extension staff assigned to perform different aspects of extension work at various levels. Each village extension Agent (VEA) was required to form 8 farmers groups, with each created out of a specified area called 'Unguwa'. The groups consist of about 80 farmers each. From each group, eight "progressive farmers" are selected and visited individually on their farms by the village extension agent on a fortnightly basis. Close to the end of the cycle, farmers in each group undertake follow-up visits to Farm Service Centres where further discussions and demonstrations are held to boost the extension packages delivered by Village Extension Agents at the regular on-farm fortnightly visits. At the end of each cycle, each VEA submits a report at a Discussion and Training meeting held at the Farm Service Centre in the service area within which their Unguwa falls (GADP 1975).

With the expansion of the GADP into BASIRDP, the system of agricultural extension was changed from the Training and Visit System to that of Training and Demonstration (T&D). The T&D system is a "DO FOR APPROACH" to extension where emphasis is placed on practical demonstrations to ensure that farmers saw the advantages in using new inputs and farming practices in their own area. Under the new system, individual visits to village farms by extension agents was cancelled. Instead, a limited fortnightly visit element for the senior extension supervisors and village extension agents to meet with extension target farmers groups was introduced. In the new system, the Demonstration component consists of Field-Days and On-farm demonstrations carried out by village extension agents on selected farmers plots and on village extension agents' trial plots at the Farm Service Centre location.

3.40 SPATIAL ORGANISATION OF THE SERVICE DELIVERY SYSTEM OF BASIRDP

The spatial planning input in the design of BASIRDP has primary focus on the aspects of decisions governing the locational pattern of Farm Service Centres. As shown in section 3.30, the Farm Service Centre network is the support system for programme implementation, and specifically used for input distribution and dissemination of agricultural extension advice. The efficient and timely distribution of services is considered the most critical factor in ensuring programme success.

In BASIRDP, the design of the spatial input in its service delivery system pre-supposes access problems as the main limiting factor for farmers use of improved inputs delivered at distant urban locations. Within the farming areas of Bauchi State, settlements are relatively dispersed, with access problems. Rural travel is therefore expensive, and constitutes a burden on farmers especially where long distance journeys are required. Influenced by the programme objective of improving productivity through use of enhanced inputs and extension packages, the emphasis in the design of the spatial input was to ensure that Farm Service Centres are located within walking distances of farm villages.

In BASIRDP, like in most first generation ADPs, the target was to locate the Farm Service Centres within an average radius of 6km of villages. This was considered the reasonable walking distance for farmers in areas of peasant agriculture (World Bank, 1975). Therefore farm families are to travel a distance of not more than 12km in journeys to and from FSCs.

Through this, travel costs are reduced, and incentives created for the use of services delivered at the centres. Thus, a basis is created for improving productivity and rural welfare, with the resultant higher income guaranteeing sustainable Agricultural Development and acquisition of durable items; Kaltho (1990) reports substantial improvement of productivity during the GADP and early

BASIRDP stages of programme implementation, associated with improved access to services.

3.50 PATTERN OF IMPLEMENTATION OF THE SPATIAL INPUT IN THE LOCATION OF FARM SERVICE CENTRES IN BASIRDP

The spatial framework for the implementation of BASIRDP, has been discussed in Sections 3.30 & 3.40 above. It is based on a network of Farm Service Centres which provide the physical structure for inputs and extension delivery. Their location is defined by a 6km criterion, as the appropriate distance between villages and service centres.

During the latter stages of programme implementation however, the location of many Farm Service Centres were decided on none of the adopted planning criteria, nor were most Farm Service Centres established at the planned locations. In identifying service centre locations, villages along rural-urban roads and major settlements were given priority (Kaltho, 1990) In effect, the location of Farm Service Centres has turned out to be guided by criteria other than those specified in the programme design.

By 1988, some 125 Farm Service Centres have been established. This gives an average of 15 farm villages and 8,5000 farm families per Farm Service Centre per 110 square kilometres. That is, the density of Farm Service Centres in the state by 1988 was only 0.1 Farm Service Centre per 100 Sqkm. There are however variations between the four administrative zones of the programme. In the Eastern

Zone, where the GADP has been in existence since 1976, a total of 45 Farm Service Centres only were functional by 1988 to serve 125 farm villages. Most of the centres were located along rural-urban roads and in large settlements with populations of over 5,000 people. The density of Farm Service Centres was 0.1 per 100 Sqkm.

The Western Zone covers an area of 450 sqkm and has a total of 18 Farm Service Centres serving 165 villages. Over 20% of Farm Service Centres in the zone were located at accessible locations and 32% in settlements of over 5,000 people. The density of Farm Service Centres is as low as 0.08 per Sq km.

In the Central Zone, 24 Farm Service Centres were established to serve 128 farm villages, over an area of 425 sqkm. The average density of Farm Service Centres was only 0.07 per sqkm. The proportion of farm centres along rural urban roads was 28% and 38% found in large settlements of over 5,000 people.

The Northern Zone has the largest land area covering 525 sqkm. The zone has 28 Farm Service Centres serving 136 villages. The average density of Farm Service Centres was only 0.06 per sqkm. The spatial pattern of distribution shows that 25% are located along rural-urban roads and 26% in settlements of over 5,000 people.

3.60 SUMMARY

The spatial input in the design and implementation of the service delivery system in BASIRDP is the main aspect examined in this chapter. The purpose is to clarify the subject and framework of the investigation. The review showed the BASIRDP design as consisting of two main elements viz. input supply and agricultural extension. They are organised based on the development service concept and delivered from a network of Farm Service Centres. The design of the network is the level where the spatial input was most visible. The objective involves the location of Farm Service Centres within about 6km-12km walking distance of villages, as the means of redressing the constraint of long travel distances in the farming areas of the state. On the implementation of this principle lies the prospects of programme success; that is, enhancing production and welfare of rural farmers. However, it was shown that lack of conformity with the spatial criteria of programme design in selecting Farm Service Centre locations constitute the main aspects of distortion during implementation. This is expected to have negative implication for programme targets and by implication the potentials for success. The pattern of distortion and its effects are aspects evaluated in the study.

The next chapter builds on these discussions to set out the elements and methodology of the research and the framework of analysis adopted.

CHAPTER FOUR

THE RESEARCH PROBLEM AND METHODOLOGY

4.10 INTRODUCTION

Spatial planning input in IRD project design focuses on the planning of farm plot layout, rural landuse, settlement systems, physical linkages and the siting of rural facilities and services. However, knowledge of the implications associated with the spatial input during programme implementat on are limited. This is associated with limitations in the scope and methods of reported studies as indicated in the background chapters.

To isolate the problem investigated in the research, aspects of the design and spatial input in BASIRDP were examined in Chapter Three. It involved a review of the main elements of the BASIRDP design, including discussions on the scope and targets of the spatial input in the service delivery network of the programme and the changes or limits in attaining the spatial policy criteria.

In this chapter, the specific aspects of investigation in the research are given. The scope and methodology of the research is also outlined based on the limitations of conventional evaluation methods in common usage.

4.20 THE PROBLEM INVESTIGATED

The spatial framework for implementing the BASIRDP takes its form from a network of Farm Service Centres. The centres constitute the physical support system for organising farm inputs supply and agricultural extension, as the main programme components. Their location is guided by the principle that farmers are not to travel a distance of more than 12km in journeys to and from Farm Service Centres for access to programme services. The pattern of implementation does not however suggest conformity to programme design considerations. Principally, the management has tended to select villages arbitrarily, but largely those along rural-urban roads as shown in Fig. 4.1 in identifying Farm Service Centre locations. Therefore, the location of many service centres were not decided based on the adopted planning criteria.

What pattern of implications are attributable to these changes constitutes the issue investigated within an evaluatory framework. The answer is necessary in improving policy formulation regarding IRD programme design and implementation in regards to the spatial components.

4.21 Scope Of The Study

The focus of the study therefore, is the implications of the limited and inappropriate spatial input in the design and implementation of BASIRDP. That is, the study constitutes an investigation of the relationships between the spatial planning input in the locational pattern of Farm Service Centres and the pattern of its implications in BASIRDP .

The emphasis in the research is associated with three major issues. Firstly is evaluating the proportion of villages within 6km distance of Farm Service

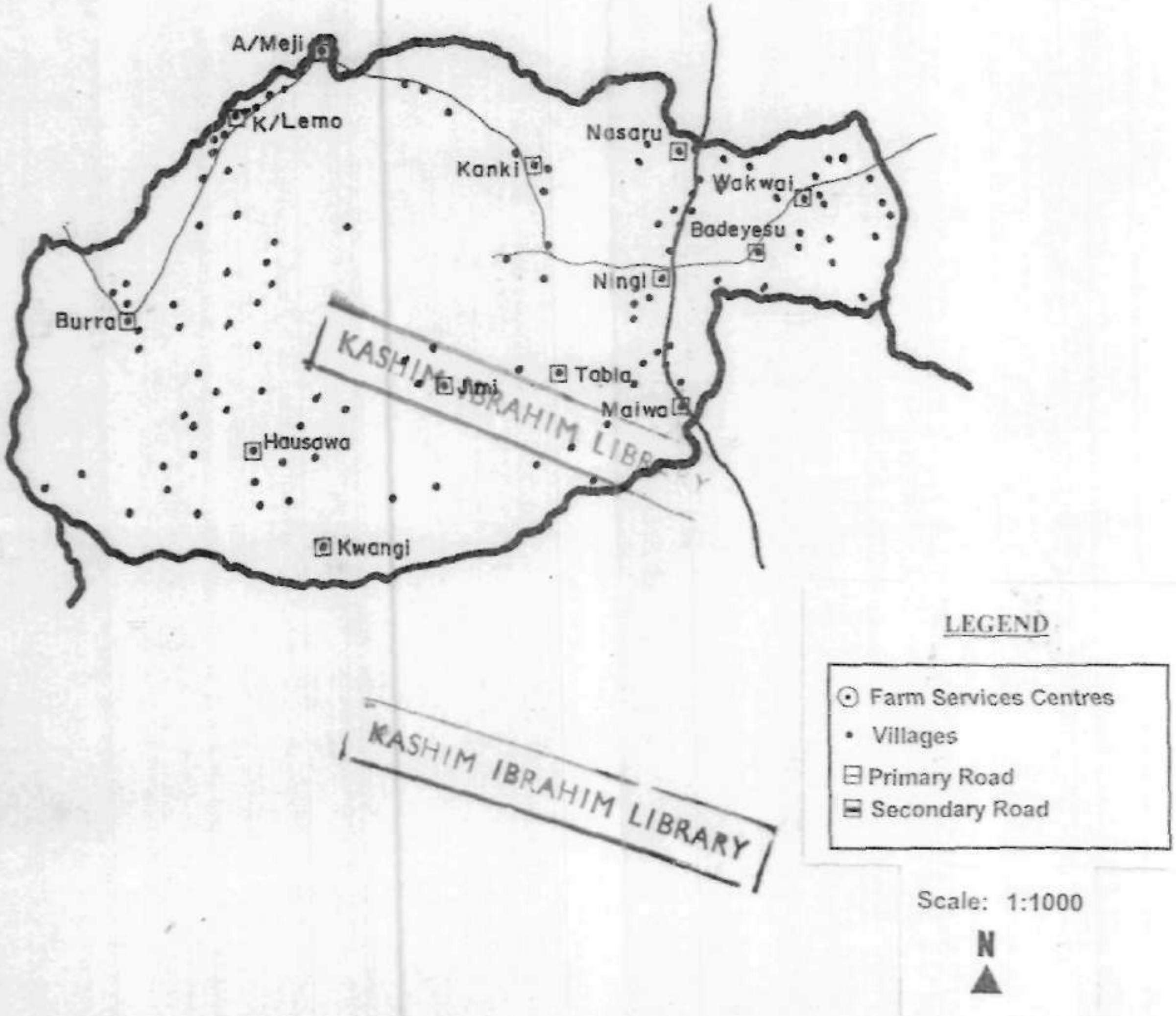


FIG. 4.1 FARM SERVICE CENTER LOCATIONS IN NINGI DEVELOPMENT AREA.

Centres. The object is to assess whether programme implementation relating to the location of FSCs is in conformity with design targets. That is, to answer the question: what proportion of farm families are within the recommended 6km distance in BASIRDP? Related to this is, how efficient is the existing pattern of distribution of Farm Service Centres in BASIRDP?

The second aspect of emphasis in the study, is the limits in attaining the spatial policy criteria in BASIRDP. The object is to determine whether the existing number of FSCs are capable of achieving the programme design targets. That is, to answer the question: How achievable is the 6km target in BASIRDP? Related to this is what is the optimal location and number of FSCs capable of achieving the 6km target in BASIRDP? Also, what pattern of difference exist in maximum and average distances imposed by the existing locational pattern compared with that under an optimal locational arrangement?

The third aspect of emphasis in the study is the determination of an appropriate technique for evaluating the spatial input in IRD programmes. The object is to identify evaluation tools with specific focus on the spatial planning component for use in improving precision in the spatial analysis of IRD programmes.

4.22 Aim And Objectives:

The aim of the study is: to evaluate the pattern of implications in BASIRDP relating to the spatial planning input in the design and implementation of its service delivery system.

The aim of the research is achieved through the following objectives:

(i) To investigate the pattern of implementation of the spatial input in the design of the service delivery system of BASIRDP.

(ii) To determine the level of efficiencies relating to the spatial planning input in the design of the service delivery system in BASIRDP.

(iii) To determine the implications for BASIRDP influenced by the level of efficiencies of the spatial input in the design of its service delivery system.

4.23 The Research Hypothesis

The hypotheses in the study are as follows:

(i) The locational pattern of distribution of Farm service centres in BASIRDP is spatially inefficient.

(ii) The spatial inefficiency of the design of BASIRDP is associated with longer travel distances to Farm Service Centres.

4.30 METHODOLOGY OF THE RESEARCH

4.31 Frameworks For Evaluating The Spatial Input

Two conceptual approaches are used in investigating the influence of spatial inputs in IRD project design. First, space is conceived as a friction to the flow of goods and services and distance is viewed as a critical factor in determining the extent, quality and spatial variation of economic growth and development (e.g. Isard, 1956; Maos. 1984; McCall, 1975, etc.). It emphasises the isolation of distance as a factor in locational decisions and establishing its implications over space.

The second approach treats distance implicitly in evaluating the nature and extent of economic growth and development. Distance is viewed as a context for development rather than a determinant of it. In the approach, time is the essence rather than space in evaluating how the regional economy works and its performance. Much of the analysis based on this approach is categorised as 'regional macro-economics' (Richardson, 1969).

Evaluation studies that treat the spatial input in IRD design explicitly are carried out based on impact assessment models as 'expost' and 'process' evaluation studies. At one extreme, data on actual levels of farm inputs uptake and crop harvests, etc. are each compared, and the variations explained by the extent and quality of the spatial input in project design. The surveys are carried out using the questionnaire application methods with focus on the individual farm family or groups of families distinguished by village area and socio-economic situations (Kaltho, 1990; Ahmed, 1990; Mabogunje & Gana, 1981, etc.). The techniques employ trend and comparative analysis, in estimating the relationship between productivity and production characteristics over space to provide understanding of problems and underlying reasons, as well as those that restrain or enhance productive capacities.

At the other extreme, the evaluation incorporates location models based on the linear optimisation and the graph theory methods. These models are quantitative in nature and have emphasis on optimisation techniques. They have been used to asses political party platforms (Ginsberg, Pestieau and Thisse, 1987); archaeological settlement patterns (Bell and Church, 1986) and pattern of health cares (Reggia, Nall and Wang, 1983), etc.

For the linear optimisation approach, the P-median algorithm has been applied by Harvey et al (1974) to determine where central places of various orders are to be located in the densely populated regions of Sierra Leone. The object was to minimise average travel time between central nodes. Also, Goodchild and Massam (1969) report the use of the optimisation model in the siting of administrative centres to serve the population of southern Ontario. The study involved determining median points and follows the general approach of the generalised Weber location problem. It has also been applied by Hogan (1990) in locating rain gauges within a watershed area in Arizona to minimise errors in observing storms; Horner (1980) in the siting of hospitals in Ireland; Robertson (1978) in determining the optimal locations of recreational centres in Glasgow and Malczewski and Orgryczak (1990) in sitting pediatric hospitals in Warsaw. In the application of the models, the common factor is the attempt to optimise the spatial relationships between consumers and central facilities and with modelling the service supply process in the context of facility location. The pattern simulated provides the basis for a comparative analysis with the existing pattern to determine potential impact areas.

The farming systems (FS) framework for establishing the characteristics of rural production systems is also used in spatial analysis. Its conceptual features are based on the systems approach with a four staged analysis involving the identification of key problem areas through sequential sieving; multistage information acquisition based on rapid appraisals; and detailed field verification surveys, employing indigenous knowledge (Collision, 1982; Raintree, 1984;

Byerlee et al, 1980; ICRAF, 1983). As a technique for rapid appraisal, the spatial characteristics of farming systems including the spatial conditions of production, marketing and consumption is established based on rough but quick field measurements and map overlays.

The techniques above are carried out based on manual methods enriched with data from questionnaire application techniques. They are therefore cumbersome, subjective and unreliable for evaluation studies where precision is required as in the appraisal of the spatial input in IRD projects.

Although not common, computer-based models can be useful in eliminating limitations associated with conventional techniques for evaluating the spatial input in IRD schemes. The models can improve precision in data acquisition, processing and retrieval, and could be useful as tools for rapid rural appraisal as required in the design and monitoring of rural development projects.

4.32 The Adopted Evaluation Model:

The computer-based evaluation models constitute the framework chosen for the study. The model adopted is based on a computer programme designed using the principles of the linear optimisation technique and the graph theory methods. It is to achieve two objectives. First, is the assessment of the pattern of distances imposed by the existing locational distribution of Farm Service Centres to determine the efficiency of existing Farm Service Centre distribution. Second, is the simulation of an optimal pattern of Farm Service Centre distribution and estimation of distances imposed therein to establish any inefficiencies in the existing pattern of distribution of Farm Service Centres.

In the study, the optimal locational pattern is determined using the principles of the P-median approach. It is a form of linear optimisation technique for choosing the location of a fixed number of central facilities as basis for minimising the average distances covered by users. In the context of the study, it is used in selecting the locational pattern of distribution of Farm Service Centres capable of minimising travel distances between farm villages and service centres. As described by Hakimi (1964), the linear optimisation technique is defined by:

$$\text{Minimise } Z = \sum^{m} \sum^{n} p_i d_{ij} \; x_{ij} \;\ldots\ldots\ldots\ldots\ldots(1)$$

$$\text{s.t.} \quad \sum_{j=1}^{n} x_{ij} = 1j \qquad 1 - m \;\ldots\ldots(2)$$

$$\sum_{j=1}^{n} x_{ij} = n_{jj} = 1 - n \;\ldots\ldots\ldots(3)$$

$$x_{jj} \, Z \, x_{ij} \quad jj = 1 - m \;\ldots\ldots\ldots\ldots\ldots(4)$$

$$x_{ij} = (0,1)$$

where:

xij	=	(1 if demand node i is assigned to facility j; and 0, if otherwise)
xij	=	(1 if a facility is sited at node j; and 0, if otherwise)
P	=	demand at node; (or total population at node 1)
dij	=	travel distance from node i to node j
n	=	number of facilities to be sited
Z	=	objective function.

In the model, the minimisation of travel time between facility sites and demand points is expressed in equation (1). Equation (2) ensures that each demand point is assigned to a facility location, and equation (3) ensures that the number of facilities to be located is equal to n. Equation (4) ensures that no demand node is assigned to another node that does not possess a facility. In the equations, the xij pairs have a zero-one format which ensures that the P-median problem falls within the zero-one linear programming structure.

In the analysis, it is also possible to estimate the average and maximum distances covered by farmers to FSCs in either of existing or optimal locational arrangement of the centres. Thus, average distance(s) covered within a given service area of a facility is defined as:

$$\frac{\sum vd}{tv} \qquad \text{———————} \quad (5)$$

where $\frac{\sum vd}{tv}$ = sum of all distances between villages and service centres within the service area of a given facility.

Tv = total number of villages within the service area.

The average distance(s) covered within the entire project area is estimated by:

$$\frac{\sum vdi}{\sum tv} \text{.........} \; n \qquad (6)$$

Also, where the service radius of each facility is known, the level of efficiency imposed by a particular locational arrangement is defined by:

$$\frac{nvs}{tnv} \; x \; 100 \text{ ——————} \qquad (7)$$

where nvs = number of villages within service radius and

tnv = total number of villages.

The analytical considerations were coded in a computer programme called PSPEC to carry out the following:

(i) Determine the optimal locational arrangement of FSCs that would improve efficiency and reduce maximum and average distances covered in farm journeys to service centres;

(ii) Estimate the locational efficiency of FSCs distributions; and

(iii) Estimate the average and maximum distances of farm villages to FSCs.

In simulating the optimal distribution pattern of FSCs, each village is treated as a potential service centre. Therefore, several alternative patterns are possible as the optimal pattern is being simulated. Thus, where the number of service stations is given, the alternative patterns possible, defined as loops is expressed as:

$$\sum nl = S\,(nv - s) \qquad (8)$$

where nl = number of loops

S = number of service stations and

nv = number of villages.

In the model, three basic assumptions are used. The first is that the number of facilities is known and that all villages are potential locations of service centres. That is, where for instance the number of facilities is given as 13, the function of the P-median algorithm would be to resolve the question of the optimal locational arrangement possible. Secondly, it is assumed that people would use facilities closest to them. Third, that the location of population is fixed and space is conceived as a friction to the flow of commodities between fixed points. Friction is defined by distance and is measured in terms of transport costs. In the model therefore, it is considered that transport costs would limit the ability of services supplied at distant locations to compete favourably with those that are nearby.

4.33 Application of the Model and Procedure of Analysis

Two data sets were utilised in performing aspects of the analysis involved in the research. These are the geographical co-ordinates of farm villages in the study area and co-ordinates of existing Farm Service Centres. They were computed from topographical maps showing village locations and also maps of BASIRDP showing infrastructure and Farm Service Centre distribution.

Using the data sets and the computer programme PSPEC, a two part analysis was carried out. First, the percentage level of efficiency characterised by the existing locational pattern of Farm Service Centres was computed. This is defined as the number of villages within 6km service radius of Farm Service Centres as a proportion of the total number of villages in the study area. Also, average distances to Farm Service Centres influenced by the existing locational pattern as well as the number of settlements falling within different distance segments were computed.

In the second part of the analysis, PSPEC was used in simulating an optimal locational pattern of Farm Service Centres capable of improving efficiency and minimising average distances in farm journeys. The procedure in the first part was repeated in estimating average and maximum distances covered as well as the proportion of villages in different distance segments.

4.34 **Data Sources And Collection Methods**

The primary source of data were maps showing BASIRDP Farm Service Centre locations and villages. These were obtained from the programme Head office. Other secondary data were obtained from a review of official reports obtained from BASAC and other BASIRDP offices at the Zonal, Development Area and Farm Service Centre offices. Materials collected included project inception reports, village listing reports, periodic programme evaluation and monitoring reports, etc. Library search involving reference to journal articles, conference papers and text books, etc. was also used extensively in the research.

The choice of the survey area was guided by the objective of covering an area that has many farm villages and a substantial number of Farm Service Centre facilities. This is in order that the measures of the relationships between the locational pattern of Farm Service Centres and villages would adequately register the implications of locational decisions in the implementation of BASIRDP on the pattern of distances covered in farm journeys.

Ningi Development Area fulfils this selection criteria and was therefore chosen as the survey area. It is one of six Development Areas in the central zone of BASIRDP. The survey area covers a total land area of 5,450 Ha and has 117 farm villages and 13 Farm Service Centres as shown in Fig. 4.2. As in other Development Areas of BASIRDP, Farm Service Centres are to conform with the spatial criteria of programme design. Unlike most Development Areas however, it registers higher numbers of Farm Service Centres and farm villages. Other conditions of personal convenience, and familiarity with the area were also met by the choice of the survey area. The choice of BASIRDP is explained by the researcher's knowledge of the programme, having worked there as a landuse planner.

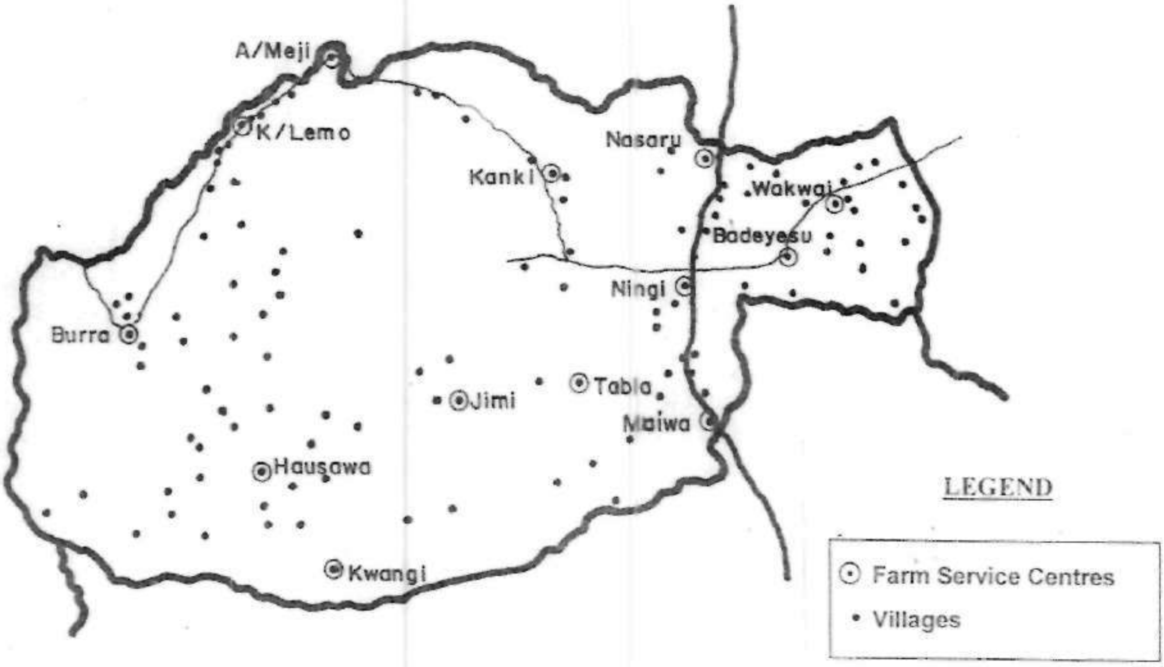


FIG. 4.2 VILLAGE AND FARM SERVICE CENTER DISTRIBUTION IN NINGI DEVELOPMENT AREA.

4.40 SUMMARY

The specific aspects of investigation in the research have been reviewed in this chapter. It involves evaluating the pattern of implications associated with the implementation of the spatial input in the design of BASIRDP. The objective is to answer the question: How efficient is the spatial pattern of implementation of the service centre network in BASIRDP, and with what pattern of implications?

The methods of evaluating the spatial input in IRD design were also presented in the chapter. The discussion provided a useful basis for the choice of a model that can satisfy the research objectives. The model adopted is based on a computer programme designed to improve precision in data processing and retrieval. Aspects of the Application of the model were then discussed including the choice of the study area. The results are presented in the chapter that follows based on the focus of the study.

CHAPTER FIVE

PATTERN OF DISTANCES IMPOSED BY THE SPATIAL INPUT IN THE SERVICE DELIVERY SYSTEM OF BASIRDP

5.10 INTRODUCTION

The objective of the spatial planning input in the design of the service delivery system in BASIRDP has been established in Chapter Three. It is to minimize the distance constraint in farm journeys, against the backdrop of the constraints that long travel distance could have on farmer productivity. The emphasis was in locating Farm Service Centres within reasonable walking distances of majority of farm families. It was to ensure effective and efficient delivery of programme services by minimizing the cost to farmers in the movement for purchase of farm inputs. This was considered a crucial determinant of the pattern of programme outcomes.

This chapter discusses the spatial structure of the BASIRDP for service delivery to establish its inefficiency. The materials are organized in four sections. The first section examines the efficiency of service centre locations in BASIRDP, while average distances to Farm Service Centres are evaluated in the second. The third section examines the maximum distance to Farm Service Centres and the fourth, the pattern of village distribution within distances segments of Farm Service Centres. The inferences drawn are discussed in section 5.60 as conclusions.

5.20 EFFICIENCY OF SERVICE CENTRE LOCATIONS IN BASIRDP

The efficiency of service centre locations in the study is considered a measure of the proportion of farm villages within the radius of 6km of Farm Service Centres. The 6km radius having been taken as given for the purpose of the study. This is necessary for establishing the potential of the design inputs to facilitate the attainment of programme targets. The evaluation of the desirability of 6km as reasonable walking distance was not therefore considered an element of the study. Also, other distance aspects of connectivity, intervening opportunities and multi-purpose journeys are held constant.

In the study area, the predominant mode of transport is foot and donkey. Few farmers use bicycle. Analysis of the existing situation shows that the 13 service centres in the study area are distributed unevenly and mainly concentrated to the east as shown in Figure 5.1. Farm villages within the recommended 6km radius were only 57. It represents a spatial efficiency of service centre locations of 48% (see table 5.01). That is, less than half of the 117 farm villages in the study area are within the distance radius recommended in the project design. By implication, Farm Service Centres are not as accessible to 52% of farm villages in the existing situation.

The simulation of the optimal locational arrangement of the existing 13 service centres as shown in (Fig. 5.2) was achieved with improved spatial efficiency of service centre locations. In the optimal system, an additional 21 farm villages

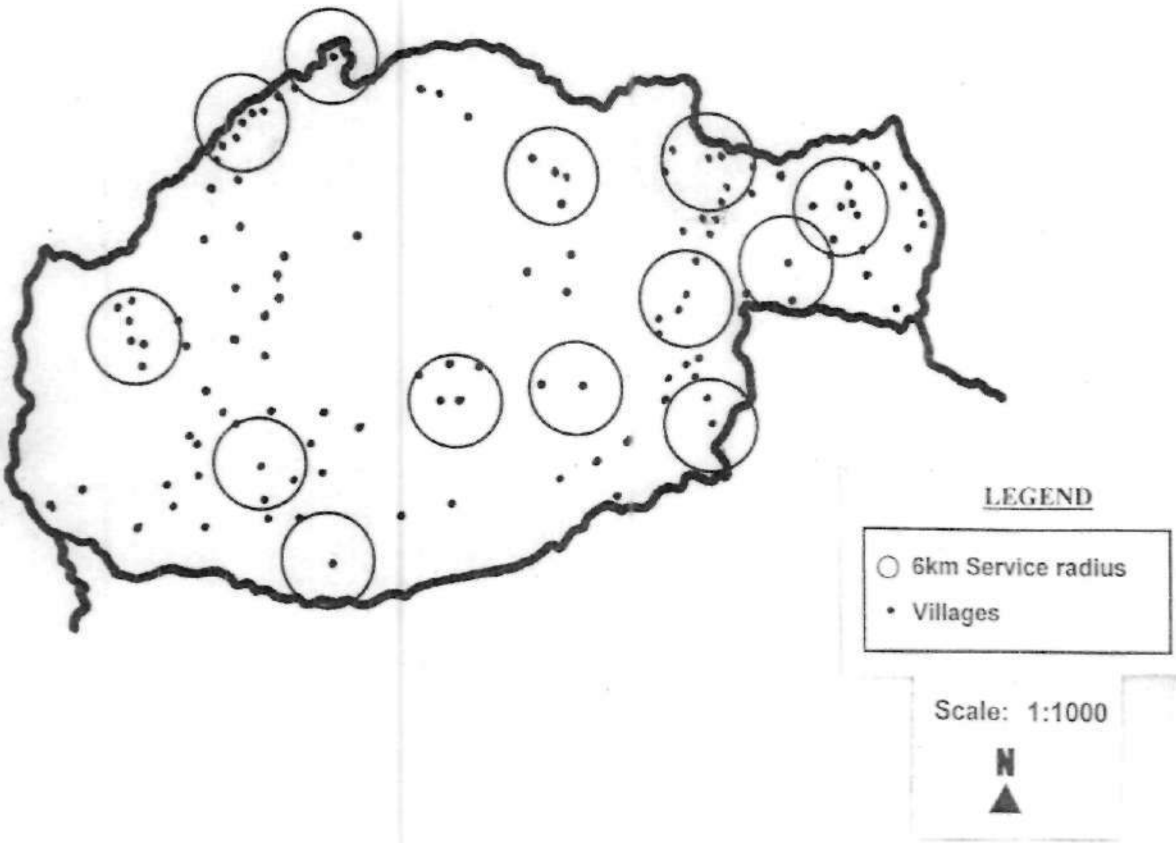


FIG. 5.1 VILLAGES WITHIN 6KM RADIUS OF 13 EXISTING FSCs

representing about 39% more villages than in the existing situation fell within 6km of Farm Service Centres. It represents an improvement in efficiency to 66.6%. By implication, it is the maximum level of efficiency achievable where the existing 13 FSCs are optimally located. The evenly spaced service centres in the optimal system (See Fig. 5.2) contrasts with the relatively uneven distribution in the existing system (Fig. 5.1).

Next, the possibility of improving spatial efficiency using additional Farm Service Centres was considered. How many optimally located service centres would ensure that farm villages in the study area are within 6km walking radius? To answer this question, the optimal locational arrangement with additional numbers of service centres were simulated and their efficiency levels estimated. From the analysis, it was established that 29 Farm Service Centres are needed to achieve 100% efficiency level for facilities in the study area. Details of the results are given in Table 5.01 for facilities ranging from 14 to 29.

In the table, it is shown that improvements in the spatial level of efficiency of service centres was achievable with increase in the number of optimally located facilities. However, after initial huge improvements in efficiency levels, additional service centres produce rather marginal improvements. As shown in the table, efficiency levels improved from 66.6% with 13 optimally located service centres to 86.3% with 20 service centres, representing an average of 2.8% improvement with each additional facility. Between 21 and 26 Farm Service Centres, efficiency improves from 88.0% to 96.5%, but improvement in efficiency levels per additional facility

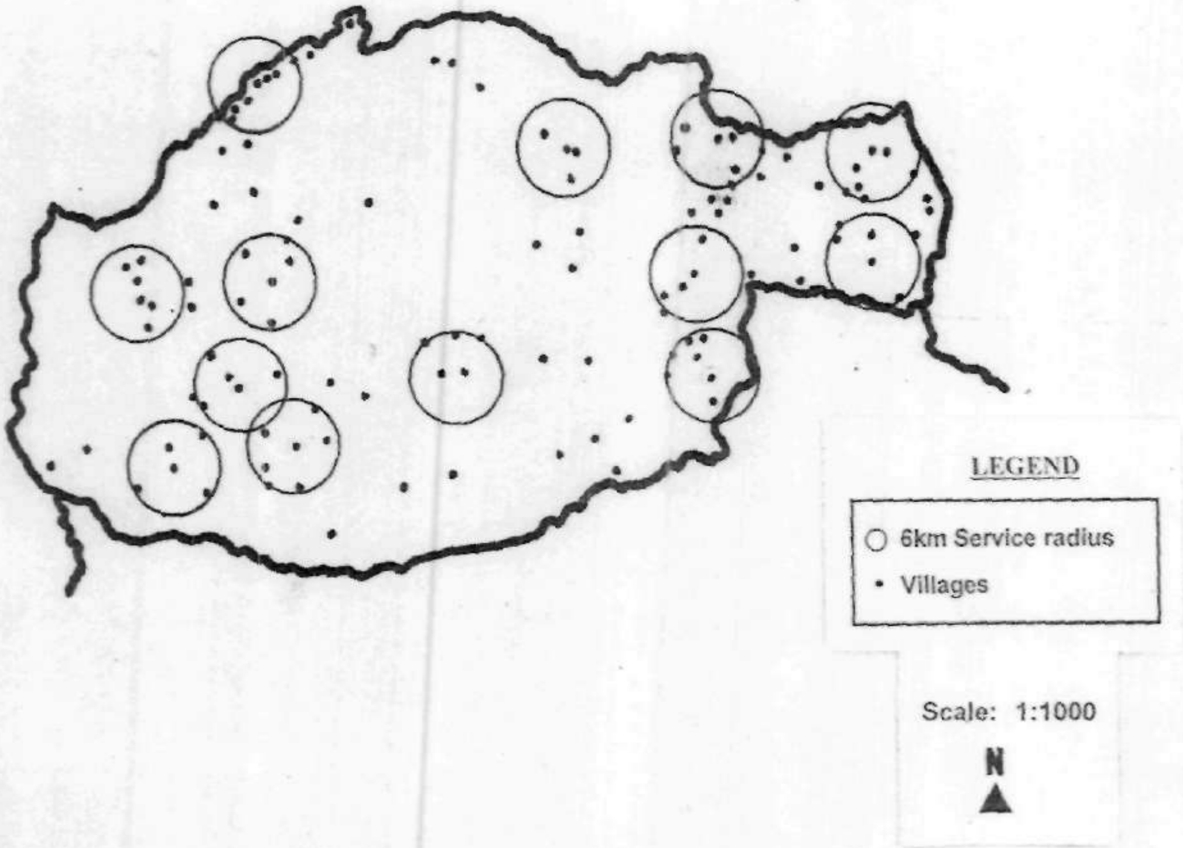


FIG. 5.2 VILLAGES WITHIN 6KM RADIUS OF 13 OPTIMALLY LOCATED FSCs

declines to 1.7%. Beyond 26, the improvement achieved with additional facilities is rather minimal. Fig. 5.3 gives a graphical representation of the efficiency level attainable with additional optimally located Farm Service Centres. It shows that the benefit from adding more facilities, even optimally located ones, has become minimal for considerably higher than 20 facilities.

Table 5.01: **Efficiency of Service Centre Locations**

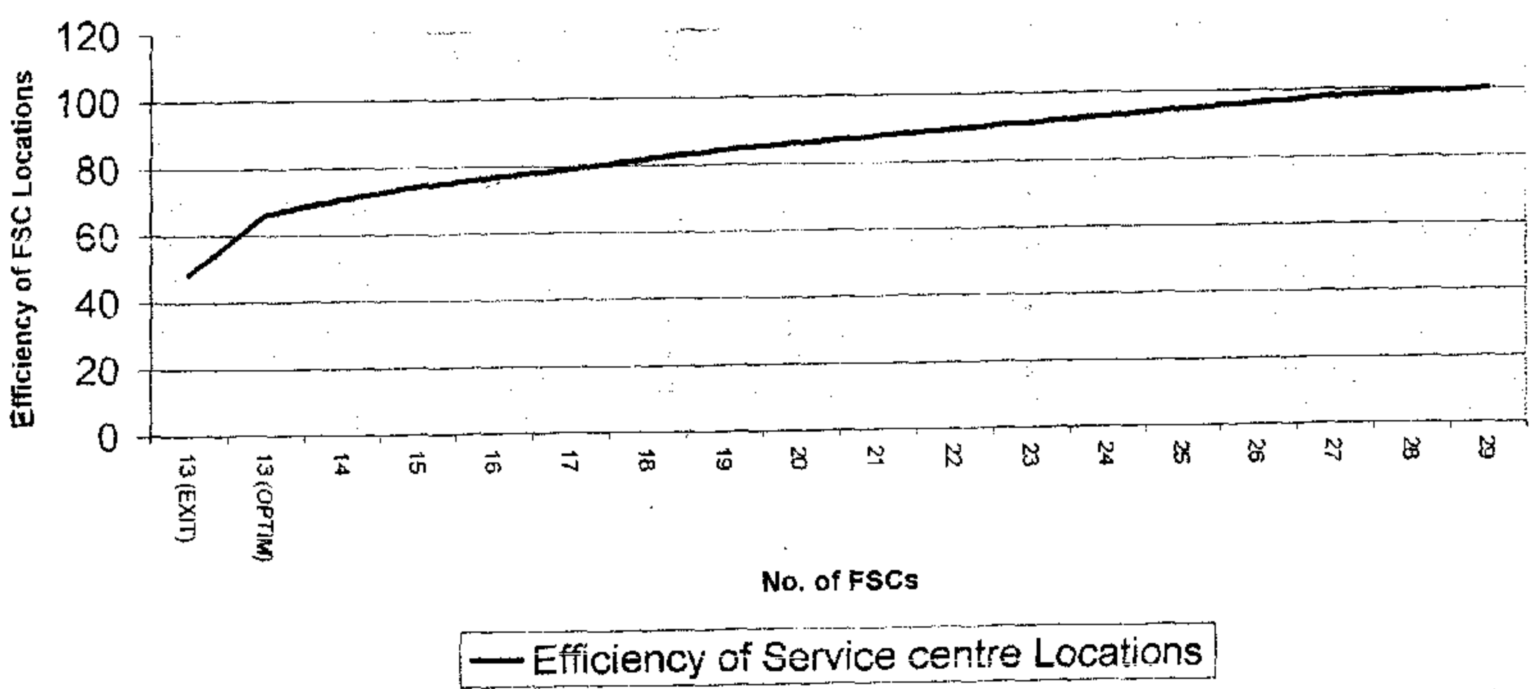
No. of Service Centres	Efficiency %	No. of Service Centres.	Efficiency %	No. of Service Centres	Efficiency %
13 (Exit)	48.7	18	82.0	24	93.1
13 (Optimal)	66.6	19	84.6	25	94.8
14	70.9	20	86.3	26	96.5
15	74.3	21	88.0	27	98.2
16	76.9	22	89.7	28	99.1
17	79.4	23	91.4	29	100.0

The optimal locational arrangements of Farm Service Centres are shown in figs 5.9 - 5.25 for facilities ranging from 14 to 29. As shown in Fig 5.25, all villages within the study area can be within 6km walking radius of facilities with 29 FSCs. That is, the efficiency level of FSCs can be improved to 100% with 29 optimally located facilities.

5.30 AVERAGE DISTANCE TO FARM SERVICE CENTRES

In the existing pattern, the average distance of villages to Farm Service Centres is 9.93km. Compared with the 6km recommended in the project design, this represents an additional travel distance of 3.93km to Farm Service Centres.

Fig. 5.3: Efficiency Levels of FSC Locations



Therefore, Farm Service Centres in the existing system are not as accessible as they ought to be.

In the optimal pattern, substantial reduction in the average distance covered to Farm Service Centres was achieved using the same number of Farm Service Centres as in the existing situation. The average distance recorded in the optimal situation was 7.90km. Compared with the 9.93km in the existing situation, it represents a reduction of 2.03km in walking distance of farmers to and from FSCs. That is, as shown in table 5.02, the existing pattern of distribution of FSCs imposes an additional travel of 25.6% on farmers above the distances which they would have had to travel if the FSCs had been optimally located.

Table 5.02: **Average Distance of Villages to Farm Service Centres in the Existing and Optimal situations**

Average Distance (Km)			% Inefficiency
Existing	Optimal	Difference	
9.93	7.90	2.03	25.6%

This suggests that it is possible to reduce the travel distance in the actual system using the same number of optimally located FSCs. That is, a higher level of accessibility could be obtained for the same number of FSCs as in the existing system. As shown in Fig. 5.7, the shorter distances and evenly spaced facilities in the optimal system contrasts with the relatively longer and uneven allocations in the existing system (Fig. 5.6). Compared with the project design provisions however, the 7.90Km achieved under the optimal system is still 1.90km higher than the 6km recommended in the

BASIRDP project design. By implication therefore, the 6km walking distance to FSCs in the project design is unattainable even where the existing 13 FSCs are optimally located.

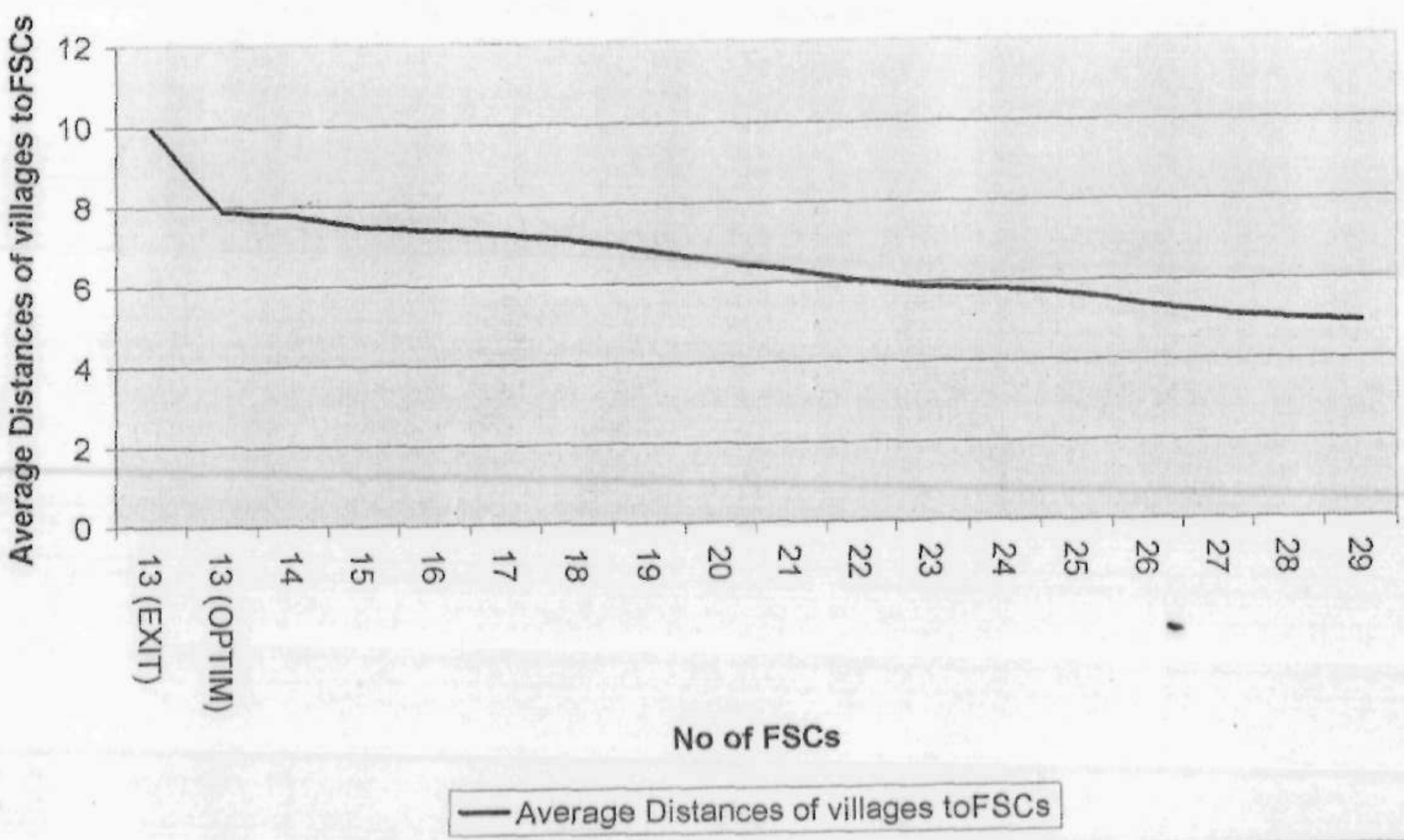
In that circumstance, the possibility of achieving improved accessibility using additional optimally located FSCs has to be considered. How many optimally located service centres would ensure a 6km average walking distance? Table 5.03, shows that even if all 13 Farm Service Centres were optimally located, 10 additional FSCs would be required to ensure that farm villages are within an overall average distance of 6km of service centres in the study area as recommended in the project design. Where additional facilities are not optimally located however, many more would be required.

Table 5.03 **Average Distance of Villages to Farm Service Centres**

No. of Service Centre	Average Distance (Km)	No. of Service Centres	Average Distance (Km)
13 (Existing)	9.93	21	6.32
13 (Optimal)	7.90	22	6.02
14	7.77	23	5.86
15	7.48	24	5.80
16	7.39	25	5.65
17	7.26	26	5.37
18	7.09	27	5.15
19	6.82	28	5.01
20	6.55	29	4.92

In table 5.03 and Figure 5.4, it is shown that huge improvements in accessibility were recorded initially, but additional FSCs produced rather marginal improvements.

Fig. 5.4: Average Distances of villages toFSCs



Accessibility improves from 9.93km in the existing situation to 7.77Km with 14 optimally located FSCs representing a reduction of 2.16km walking distance.

5.40 MAXIMUM DISTANCES TO FARM SERVICE CENTRES

Maximum distances to Farm Service Centres were computed and shown in table 5.04. In the existing situation, the maximum walking distance was estimated at 31km. A comparison with the optimal locational pattern simulated using the same number of facilities shows the reduction of the maximum distance to 23Km. This shows that the villages most isolated from Service Centres are closer in the optimal pattern than in the existing system. That is, peripheral villages travel much longer distances in the existing system than they would in an optimal situation.

Table 5.04: **Maximum Distance Coverage to Farm Service Centres**

No. of FSCs	Maximum Distances (Km)	No. of FSCs	Maximum Distance (Km)	No. of FSCs	Maximum Distance (Km)
13 (Exit)	31	18	23	24	18
13 (Optim)	23	19	23	25	18
14	23	20	23	26	16
15	23	21	23	27	14
16	23	22	18	28	12
17	23	23	18	29	6

Further reduction of the maximum distance is achieved with additional optimally located Farm Service Centres. Thus, additional 9 FSCs can lead to a reduction of the maximum distance to 18km as shown in Table 5.04 and Fig. 5.5. At the point that the 6km average walking distance is achieved using 23 service centres, the maximum distance has remained at 18km, suggesting substantial dispersal of villages in the study area.

5.50 DISTANCE PROFILE OF VILLAGES TO FARM SERVICE CENTRES

The pattern of distribution of villages within different distance segments of Farm Service Centres was also used as an indicator of the quality of the spatial input in the implementation of the BASIRDP service distribution network. The distance segments considered are shown in Tables 5.05 - 5.22. The pattern of distribution of villages within each distance segment in the existing situation were established and then compared with those under an optimal system using the same number of service centres.

In the existing situation as shown in Table 5.05, the number of villages within the recommended 6km distance of Farm Service Centres were 57. It represents an average of 9 villages for each kilometre segment. On the other hand, the number outside the 6km radius was 60. Also, the actual number of villages in distance segments higher than 6km were initially high (7-9), but gradually declined to 2 in the range 14.1-15.0km. The highest number of villages (13) fall within the 15km and

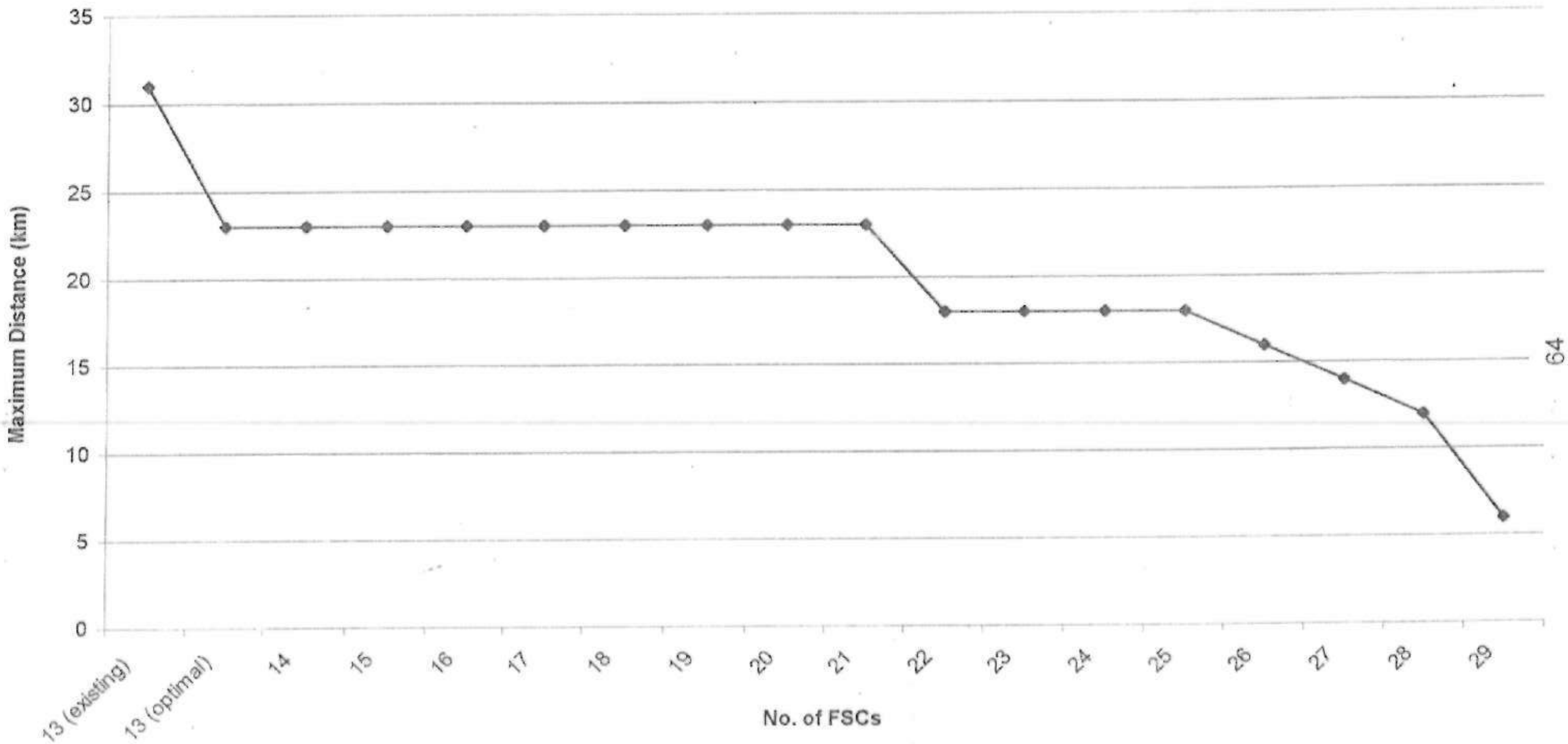


Figure 5.5: Maximum Distances of Villages to FSCs

above distance segment (see fig 5.6). As shown in table 5.05, there were an average of 6 villages within each distance segment greater than 6km.

Table 5.05: **Profile of villages in distance segments based on the existing distribution of 13 service centres**

Distance Segment (Km)	No. of Villages	%	distance Segment (Km)	No. of Village	%	Distance Segment (Km)	No. of Villages	%
<1	13	15.21	6.1-7.0	9	10.53	12.1-13.0	4	4.68
1.0-2.0	8	9.36	7.1-8.0	5	5.85	13.1-14.0	4	4.68
2.1-3.0	5	5.85	8.1-9.0	7	8.19	14.1-15.0	3	3.51
3.1-4.0	12	14.04	9.1-10.0	6	7.02	> 15.1	12	14.04
4.1-5.0	8	9.36	10.1-11.0	4	4.68			
5.1-6.0	11	12.87	11.1-12.0	6	7.02			

In the optimal situation, it is shown that accessibility of villages to Farm Service Centres can be improved using the same number of Service Centres. As shown in Table 5.06 and Fig. 5.7, 78 villages are within 6km of FSCs, representing an average of 11 villages for each kilometre segment. Only 39 villages are located outside 6km of FSCs compared to the 60 in the existing situation. It represents an improvement of accessibility of 36.8%.

In the optimal system, the number of villages that fall within the 7.1-8.0km distance segment was 8. This is almost slightly more than in the existing situation (5). Substantial reduction in the number of villages in the distance segments greater than 8.0km was however observed. Within the 15km and above segment for instance, the number of villages was 5; down from 12 in the existing situation. That

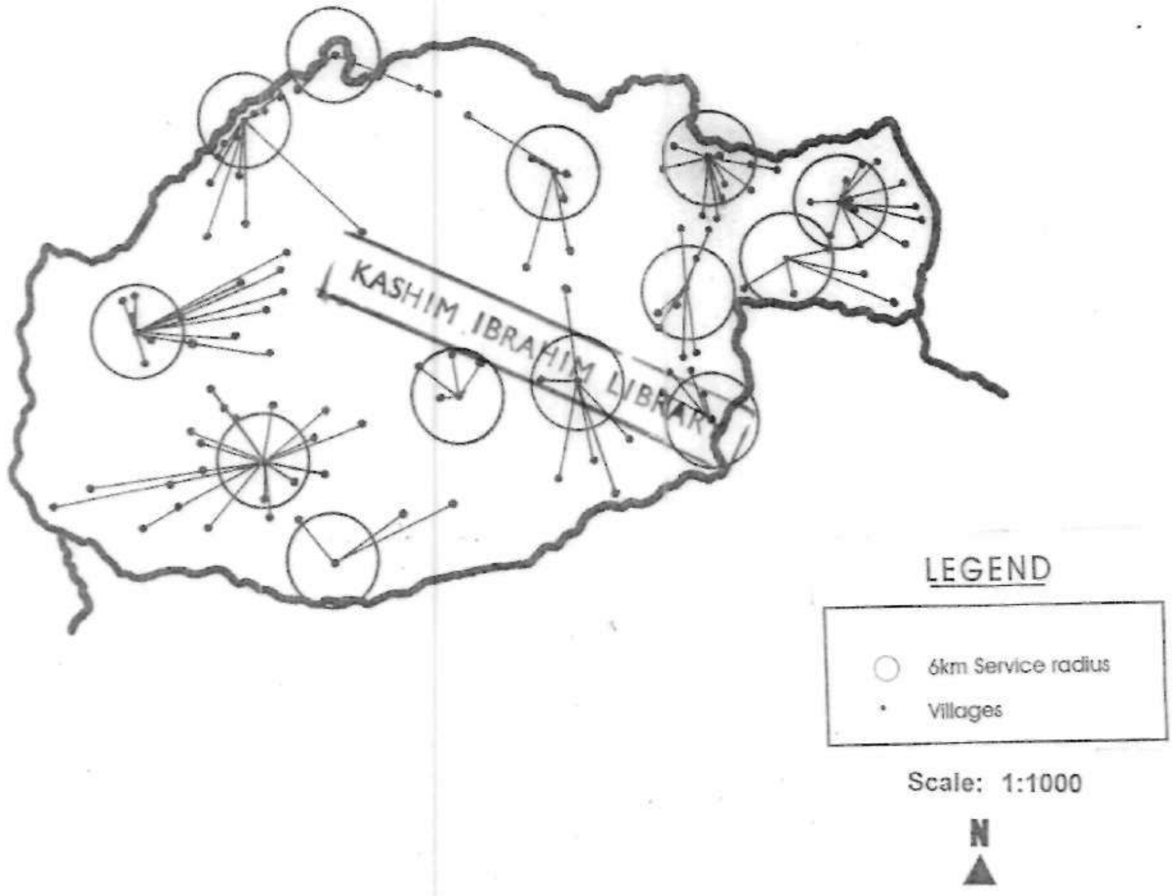


FIG 5.6 PROXIMITY OF VILLAGES TO 13 EXISTING FSCs

is, it is generally shown that the profile of villages within different distance segments in the optimal system is an improvement over what is in the existing system. As the distance profiles in Table 5.06 and Fig. 5.8 show, it is simply unnecessary for a large percentage of the population to travel longer distances to Farm Service Centres.

Table 5.06 Profile of villages in distance segments based on the optimal distribution of 13 service centres

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Village	%	Distance Segment (Km)	No. of Villages	%
<1	13	15.21	6.1-7.0	3	3.51	12.1-13.0	4	4.68
1.0-2.0	4	4.68	7.1-8.0	8	9.36	13.1-14.0	2	2.34
2.1-3.0	13	15.21	8.1-9.0	3	3.51	14.1-15.0	2	2.34
3.1-4.0	14	16.38	9.1-10.0	4	4.68	> 15.1	5	5.85
4.1-5.0	15	17.55	10.1-11.0	4	4.68			
5.1-6.0	19	22.23	11.1-12.0	4	4.68			

The distance profile of villages as the number of FSCs were increased beyond 13 was next considered. Table 5.07 and Fig. 5.9 show that as the number of FSCs was increased to 14, the proportion of villages located less than 6km to FSCs increased to 83 compared to the 78 in the optimal system. It represents an improvement of 6% over the existing situation. There was also a gradual decline in the number of villages in distance segments greater than 6km.

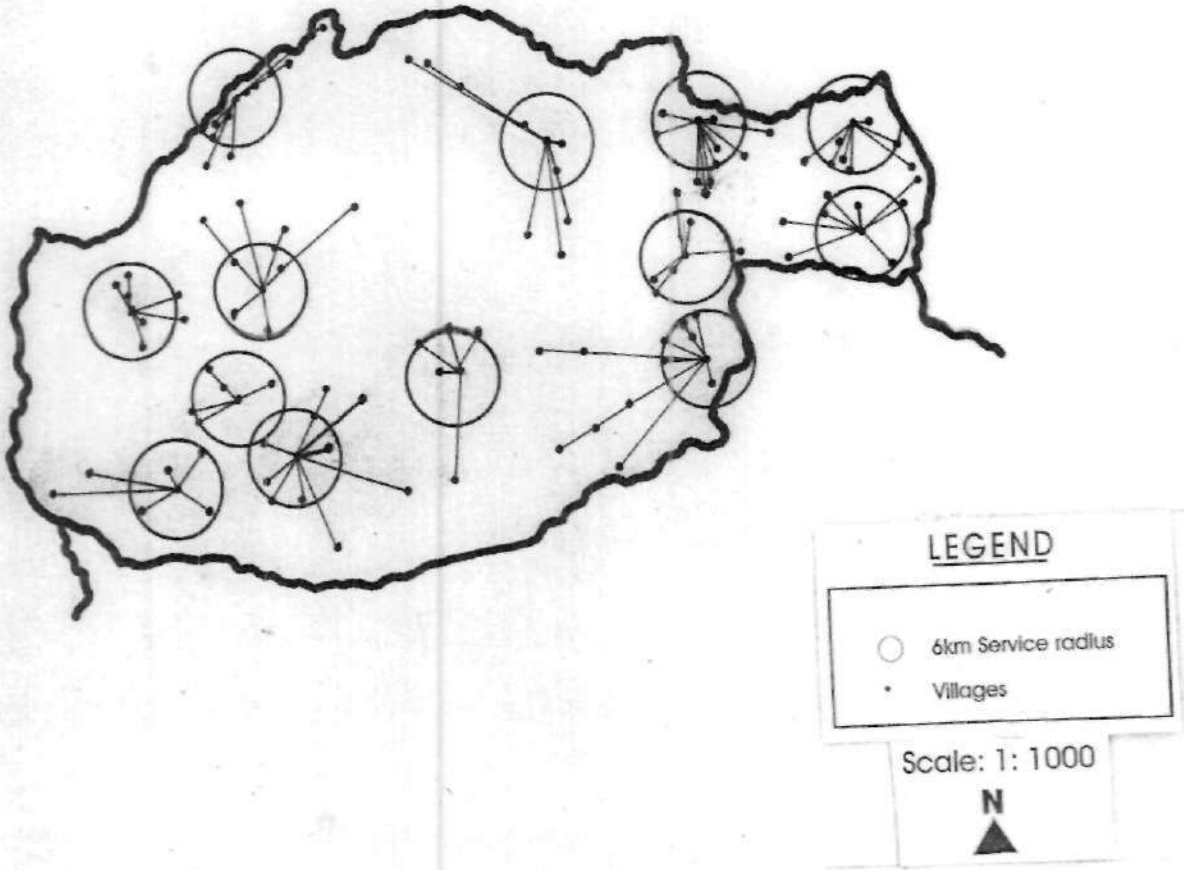


FIG. 5.7 PROXIMITY OF VILLAGES TO 13 OPTIMALLY LOCATED FSCs

Fig. 5.8: Profile of village distances to FSCs influenced by the existing and optimal distribution of 13 FSCs

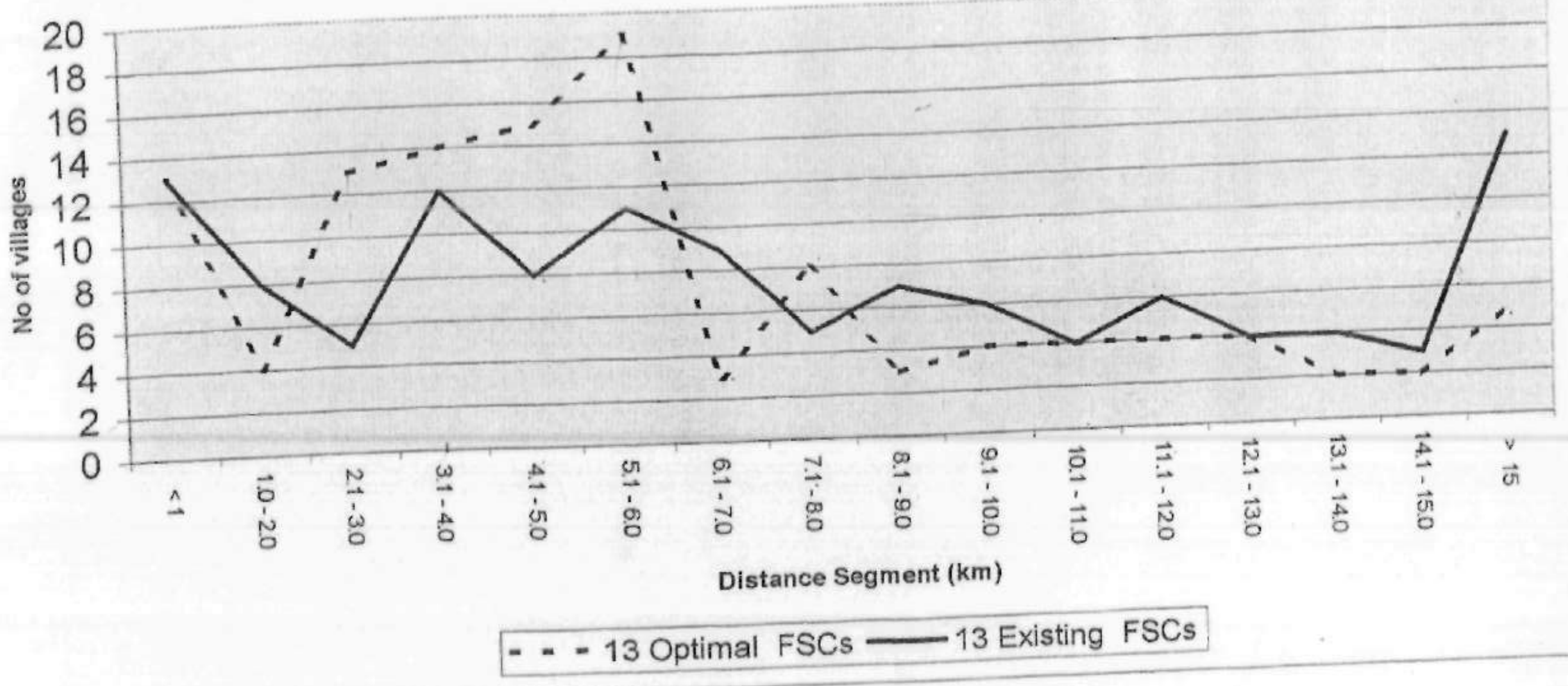


Table 5.07: **Profile of villages in distance segments based [illegible] of 14 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Village	%	Distance Segment (Km)	No. of Villages	%
<1	14	16.38	6.1-7.0	2	2.34	12.1-13.0	2	2.34
1.0-2.0	2	2.34	7.1-8.0	7	8.19	13.1-14.0	2	2.34
2.1-3.0	14	16.38	8.1-9.0	3	3.51	14.1-15.0	2	2.34
3.1-4.0	13	15.21	9.1-10.0	3	3.51	> 15.1	5	5.85
4.1-5.0	17	19.89	10.1-11.0	4	4.68			
5.1-6.0	23	26.91	11.1-12.0	4	4.68			

The results obtained for 15 optimally located facilities are shown in Table 5.08 and Fig. 5.10. In the pattern simulated, 87 villages are shown to be less than 6km to Farm Service Centres as compared to 83 with 14 FSCs. Also, the proportion of villages located at longer distances to FSCs declined substantially, confirming that improvements in accessibility are achieved with increased number of optimally located facilities.

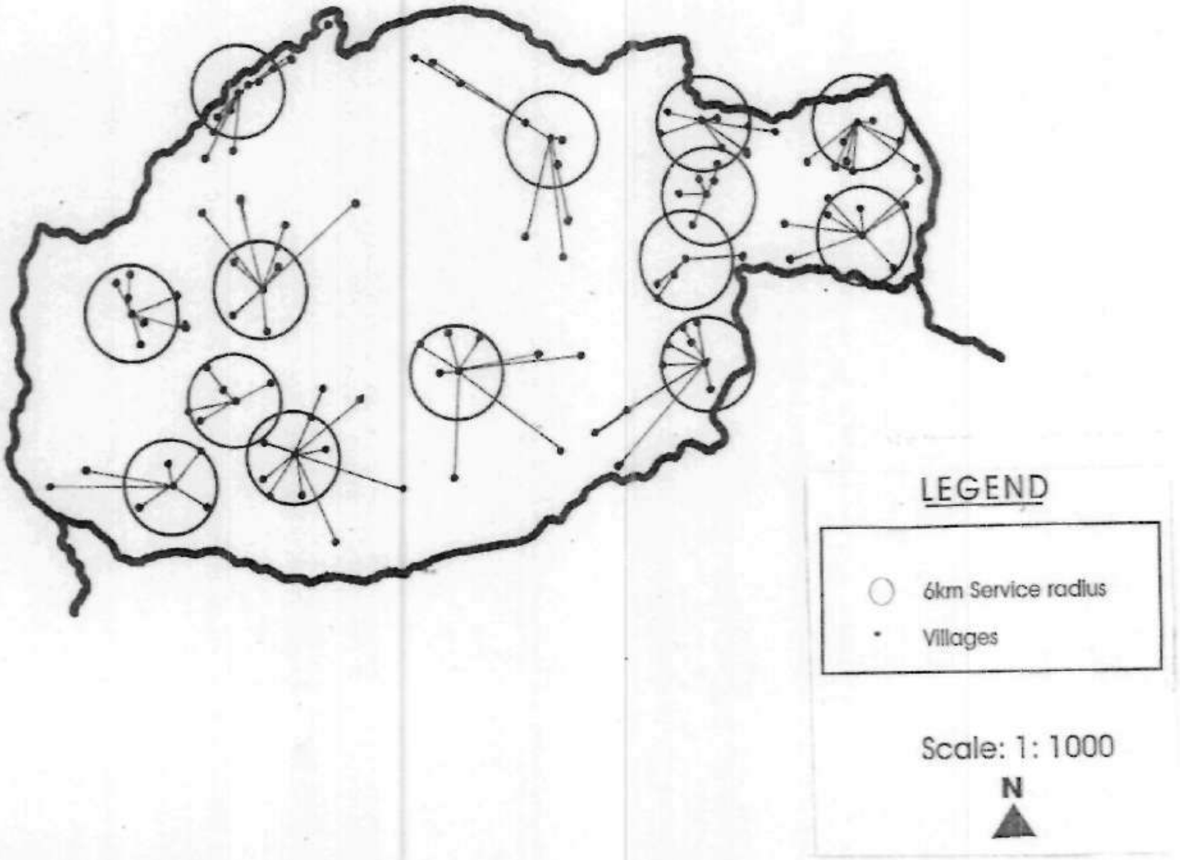


FIG. 5.9 PROXIMITY OF VILLAGES TO 14 OPTIMALLY LOCATED FSCs

Table 5.08: **Profile of villages in distance segments [illegible] of 15 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	15	17.55	6.1-7.0	2	2.34	12.1-13.0	2	2.34
1.0-2.0	4	4.68	7.1-8.0	4	4.68	13.1-14.0	2	2.34
2.1-3.0	15	17.55	8.1-9.0	2	2.34	14.1-15.0	2	2.34
3.1-4.0	15	17.55	9.1-10.0	3	3.51	> 15.1	5	5.85
4.1-5.0	14	16.38	10.1-11.0	4	4.68			
5.1-6.0	24	28.08	11.1-12.0	4	4.68			

With 16 optimally located service centres, the number of villages within less than 6km of service centres increased to 90 as shown in table 5.09 and Fig. 5.11. Only 27 villages are located at distances greater than 6km of FSCs. In table 5.09, it is shown that the improvement in accessibility is gradual in segments lower than 15km. Also, no decline is recorded in the number of villages located at distances that are greater than 15km of FSCs.

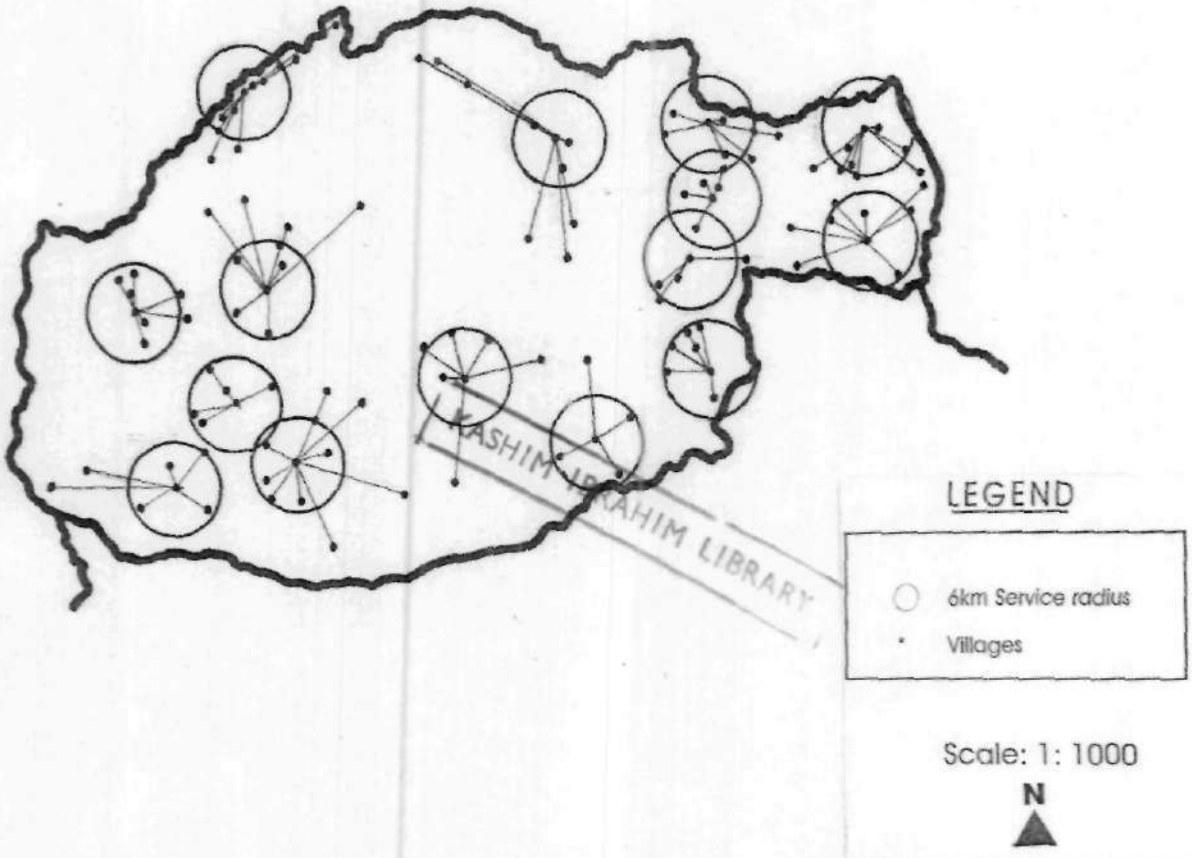


FIG. 5.10 PROXIMITY OF VILLAGES TO 15 OPTIMALLY LOCATED FSCs

Table 5.09: **Profile of villages in distance segments based on the [illegible] of 16 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	16	18.72	6.1-7.0	2	2.34	12.1-13.0	2	2.34
1.0-2.0	4	4.68	7.1-8.0	3	3.51	13.1-14.0	2	2.34
2.1-3.0	17	19.89	8.1-9.0	2	2.34	14.1-15.0	2	2.34
3.1-4.0	15	17.55	9.1-10.0	3	3.51	> 15.1	5	5.85
4.1-5.0	14	16.38	10.1-11.0	2	2.34			
5.1-6.0	24	28.08	11.1-12.0	4	4.68			

The increase in the number of villages falling within less than 6km of FSCs using 17 facilities was achieved with a decline in the number of villages outside the 6km radius (See Table 5.10 and Fig. 5.12). The profile of villages in the distance segments of 8km and above has however remained stable, signifying a marginal improvement in accessibility to service centres.

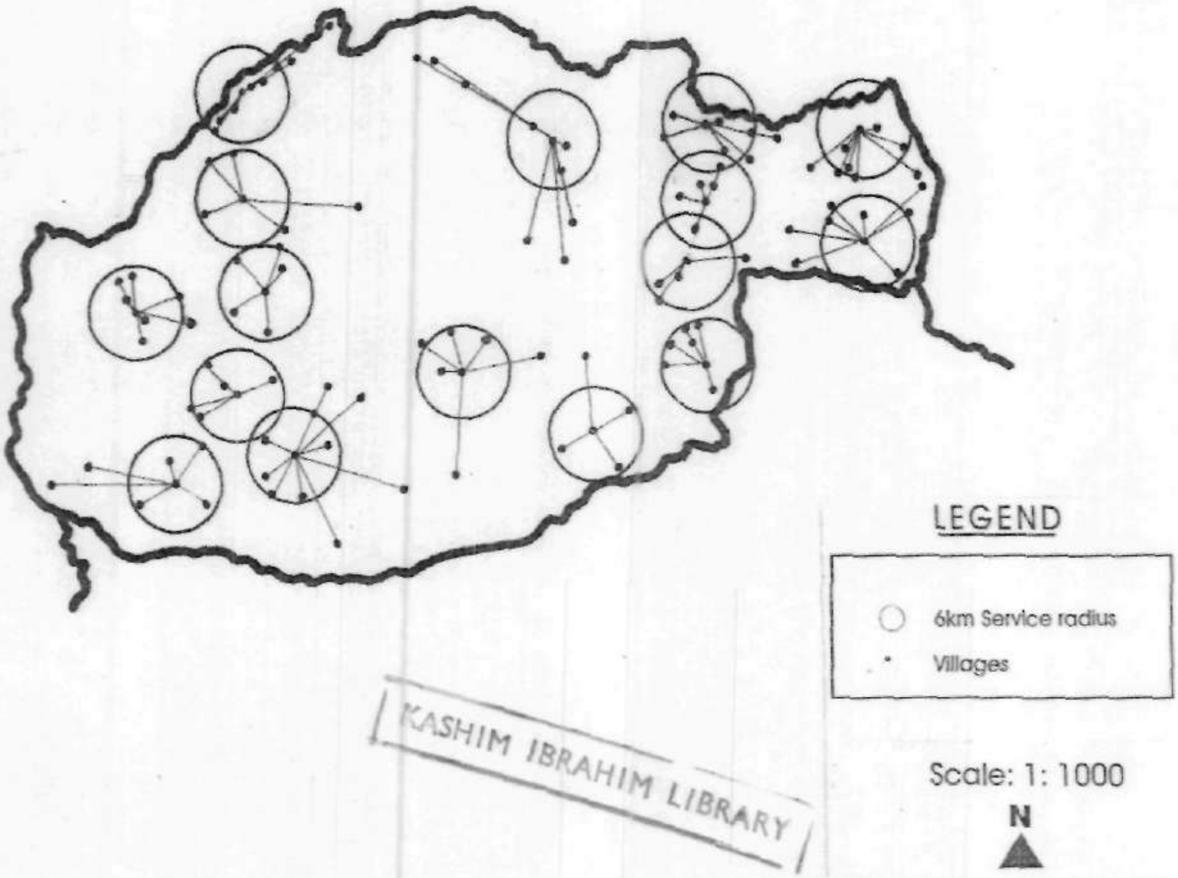


FIG. 5.11 PROXIMITY OF VILLAGES TO 16 OPTIMALLY LOCATED FSCs

Table 5.10: Profile of villages in distance segments based on the optimal distribution of 17 service centres

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	17	19.89	6.1-7.0	2	2.34	12.1-13.0	2	2.34
1.0-2.0	4	4.68	7.1-8.0	2	2.34	13.1-14.0	2	2.34
2.1-3.0	17	19.89	8.1-9.0	-	-	14.1-15.0	2	2.34
3.1-4.0	16	18.72	9.1-10.0	3	3.51	> 15.1	5	5.85
4.1-5.0	15	17.55	10.1-11.0	2	2.34			
5.1-6.0	24	28.08	11.1-12.0	4	4.68			

With 18 FSCs, the improvement in accessibility was marginal. As shown in table 5.11 and Fig. 5.13, the number of villages in distances less than 6km increased to 96. Only villages in the Segments 6.1 - 7.0km; 9.1-10 and 10.1-11km declined. Also, appreciable adjustments in the profile of villages was recorded in distance segments lower than 6km.

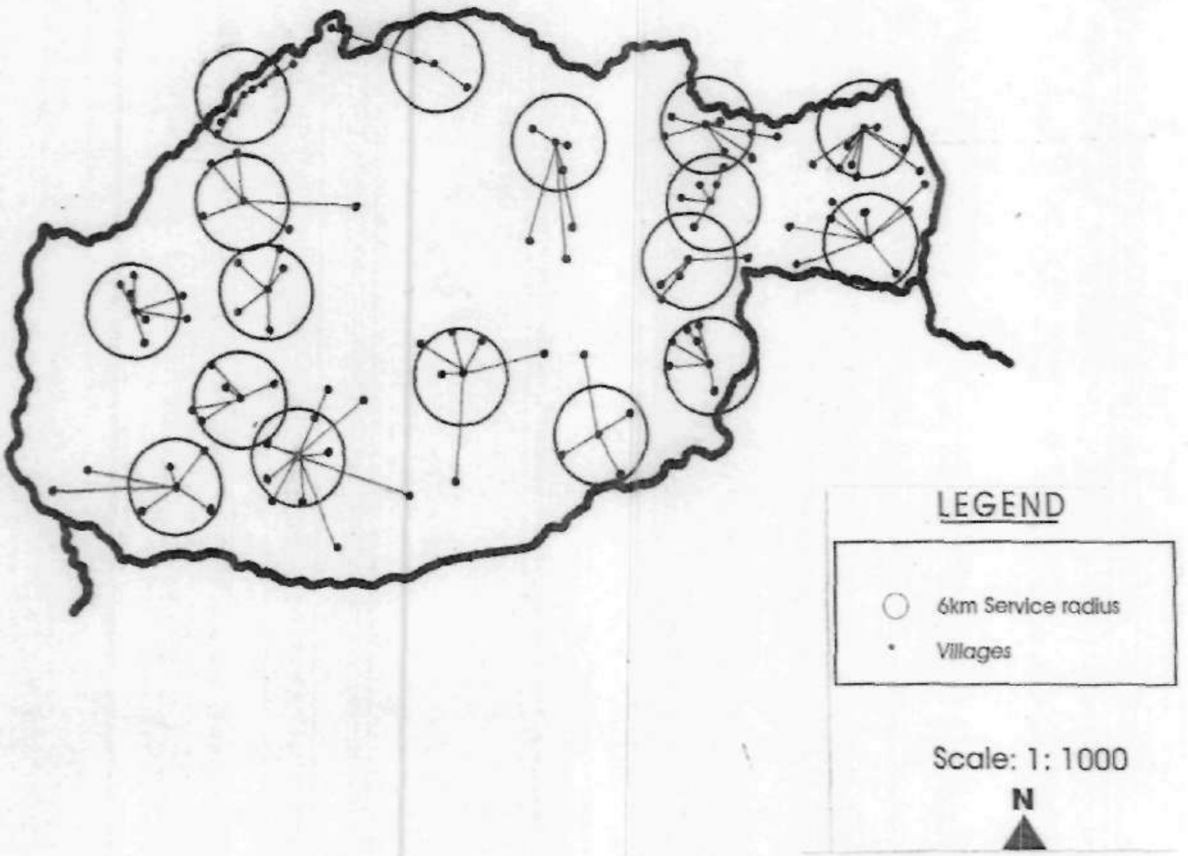


FIG. 5.12 PROXIMITY OF VILLAGES TO 17 OPTIMALLY LOCATED FSCs

Table 5.11: **Profile of villages in distance segments based on the optimal distribution of 18 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	18	21.06	6.1-7.0	1	1.17	12.1-13.0	2	2.34
1.0-2.0	4	4.68	7.1-8.0	2	2.34	13.1-14.0	2	2.34
2.1-3.0	19	22.23	8.1-9.0	-	-	14.1-15.0	2	2.34
3.1-4.0	17	19.89	9.1-10.0	2	2.34	> 15.1	5	5.85
4.1-5.0	14	16.38	10.1-11.0	1	1.17			
5.1-6.0	24	28.08	11.1-12.0	4	4.68			

Substantial reduction in the number of villages further away from Farm Service Centres was achieved using 19 FSCs. As shown in table 5.12 and Fig. 5.14, it was possible to reduce the number of villages lying between 12 - 15km range from 11 with 18 facilities to 9using 19 FSCs. Also, villages that are less than 6km to FSCs can be increased to 99. Only five villages were located at a distance of more than 15km of the nearest Farm Service Centre.

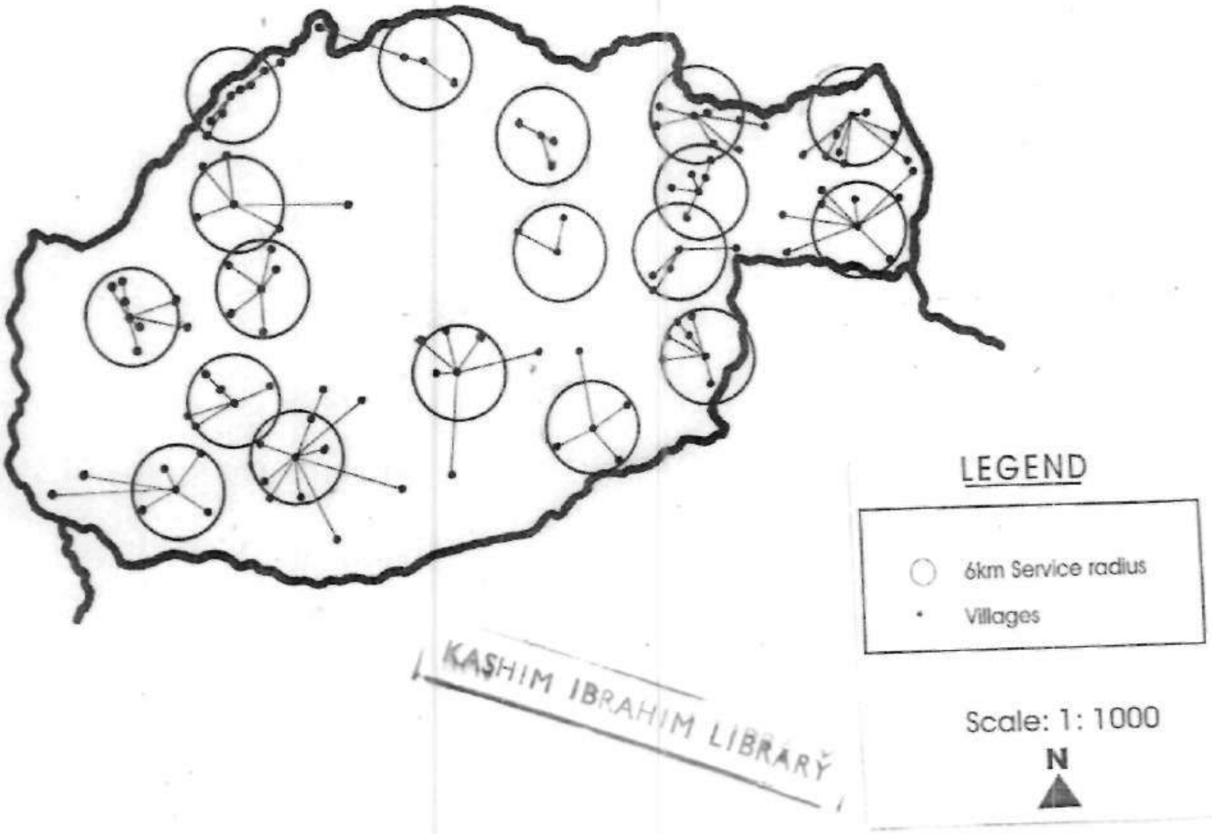


FIG. 5.13 PROXIMITY OF VILLAGES TO 18 OPTIMALLY LOCATED FSCs

Table 5.12: **Profile of villages in distance segments based on the optimal distribution of 19 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	19	22.23	6.1-7.0	1	1.17	12.1-13.0	2	2.34
1.0-2.0	6	7.02	7.1-8.0	2	2.34	13.1-14.0	1	1.17
2.1-3.0	17	19.89	8.1-9.0	-	-	14.1-15.0	1	1.17
3.1-4.0	20	23.4	9.1-10.0	2	2.34	> 15.1	5	5.85
4.1-5.0	14	16.38	10.1-11.0	-	-			
5.1-6.0	23	26.91	11.1-12.0	4	4.68			

Although the number of villages located less than 6km to FSCs increased by 2, the reduction recorded in the number located at more than 15km was minimal with the increase in the number of FSCs to 20. As shown in table 5.13 and Fig. 5.15, only 4 villages were more than 15km to the nearest facility; down from 5 when 19 FSCs were used. Minor improvements in accessibility were noticed as shown in Table 5.20 between the 11.1 - 12.0 km distance segment.

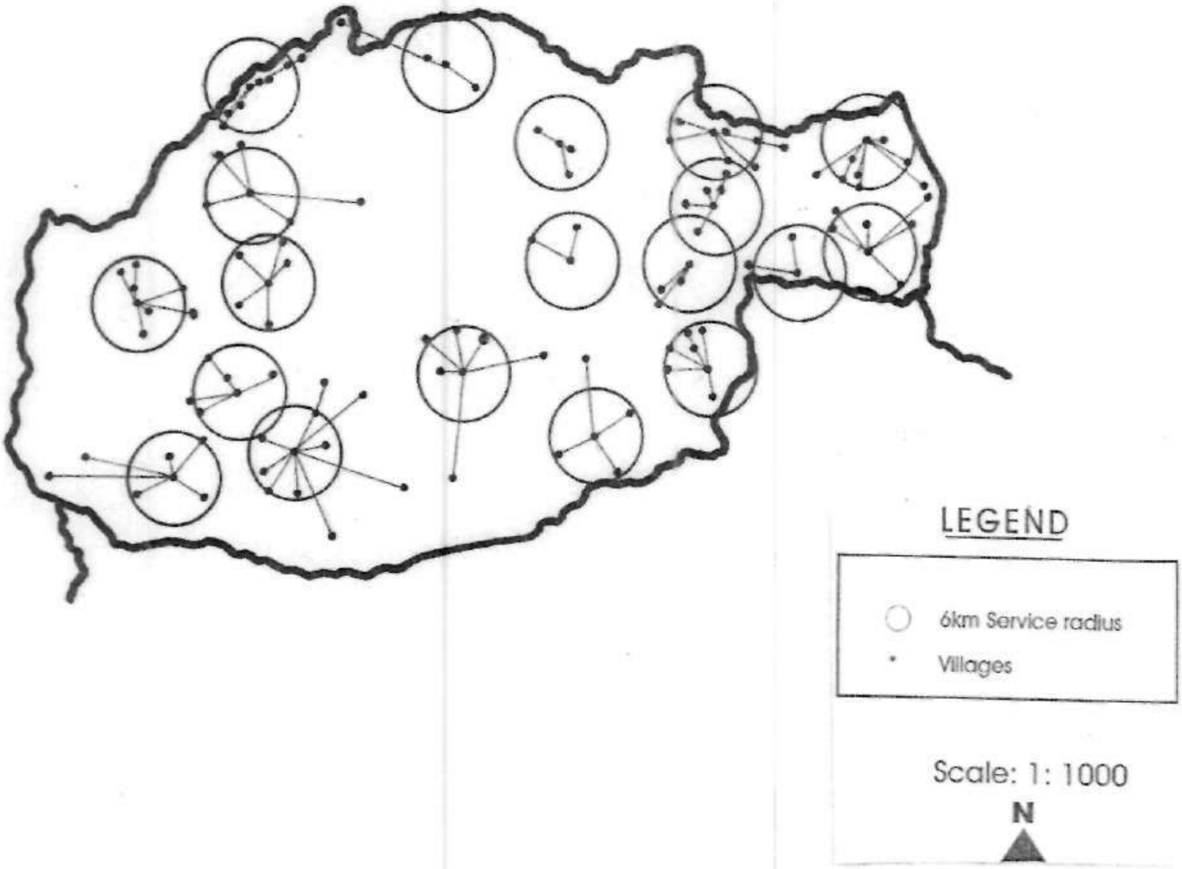


FIG. 5.14 PROXIMITY OF VILLAGES TO 19 OPTIMALLY LOCATED FSCs

Table 5.13: **Profile of villages in distance segments based on the optimal distribution of 20 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	20	23.4	6.1-7.0	1	1.17	12.1-13.0	2	2.34
1.0-2.0	6	7.02	7.1-8.0	2	2.34	13.1-14.0	1	1.17
2.1-3.0	17	19.89	8.1-9.0	-	-	14.1-15.0	1	1.17
3.1-4.0	18	21.06	9.1-10.0	2	2.34	> 15.1	4	4.68
4.1-5.0	16	18.72	10.1-11.0	-	-			
5.1-6.0	24	28.08	11.1-12.0	3	3.51			

With 21 FSCs, villages located furthest from the nearest FSCs were far less than the number when 20 facilities were used. As shown in table 5.14 and Fig. 5.16, the segments most affected are the 9.1-10.0km and the 11.1-12.0km segments respectively. Overall, the number of villages within 6km of the closest FSC improved to 103, two more than the 101 obtained using 20 FSCs.

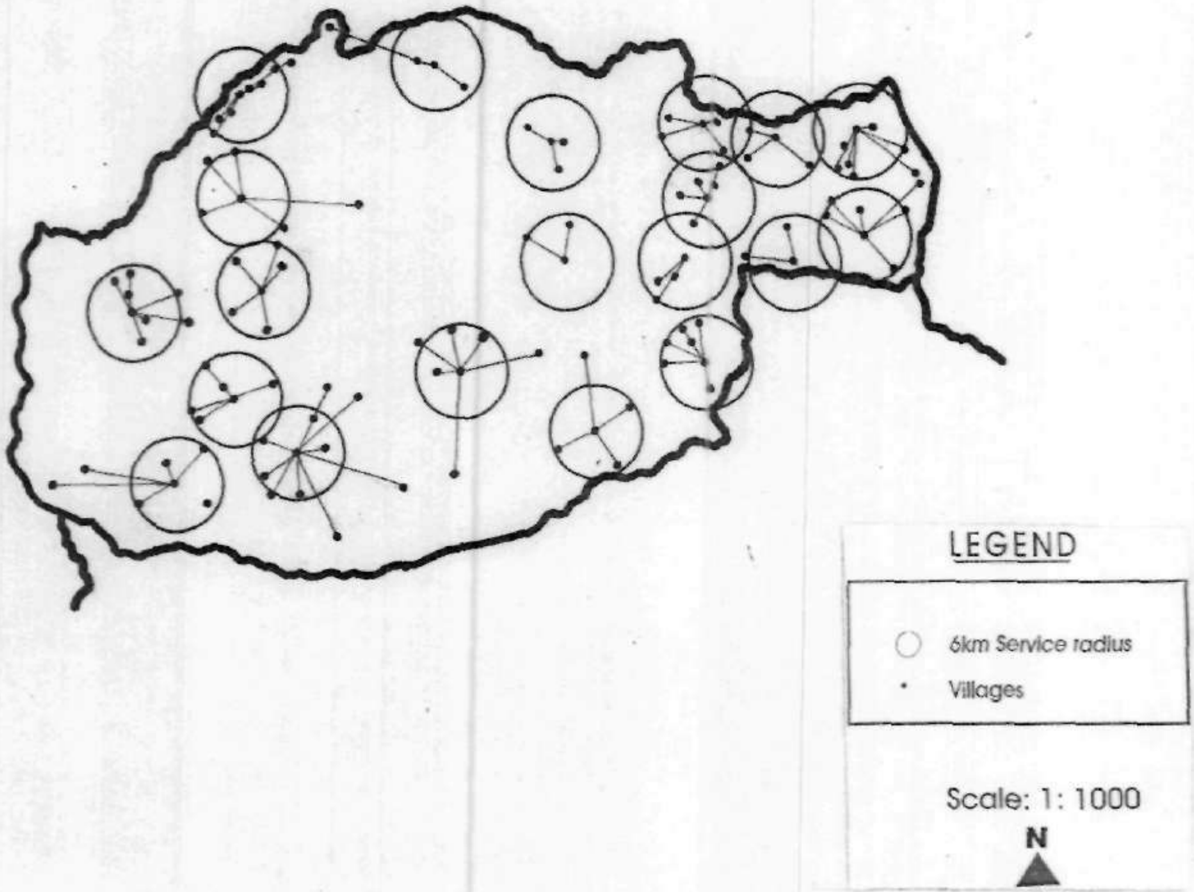


FIG. 5.15 PROXIMITY OF VILLAGES TO 20 OPTIMALLY LOCATED FSCs

Table 5.14: **Profile Of Villages In Distance Segments Based On The Optimal Distribution Of 21 Service Centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Village	%	Distance Segment (Km)	No. of Villages	%
<1	21	24.57	6.1-7.0	1	1.17	12.1-13.0	2	2.34
1.0-2.0	6	7.02	7.1-8.0	2	2.34	13.1-14.0	1	1.17
2.1-3.0	16	18.72	8.1-9.0	-	-	14.1-15.0	1	1.17
3.1-4.0	21	24.57	9.1-10.0	1	1.17	> 15.1	4	4.68
4.1-5.0	16	18.72	10.1-11.0	-	-			
5.1-6.0	23	26.91	11.1-12.0	2	2.34			

Using 22 FSCs, it was possible to reduce the number of villages that are more than 15km of the nearest facility to 2 from 4 using 21 FSCs. Also, marginal improvements were recorded in the number of villages located at a distance of less than 6km of the nearest FSC as shown in Table 5.15 and Fig. 5.17.

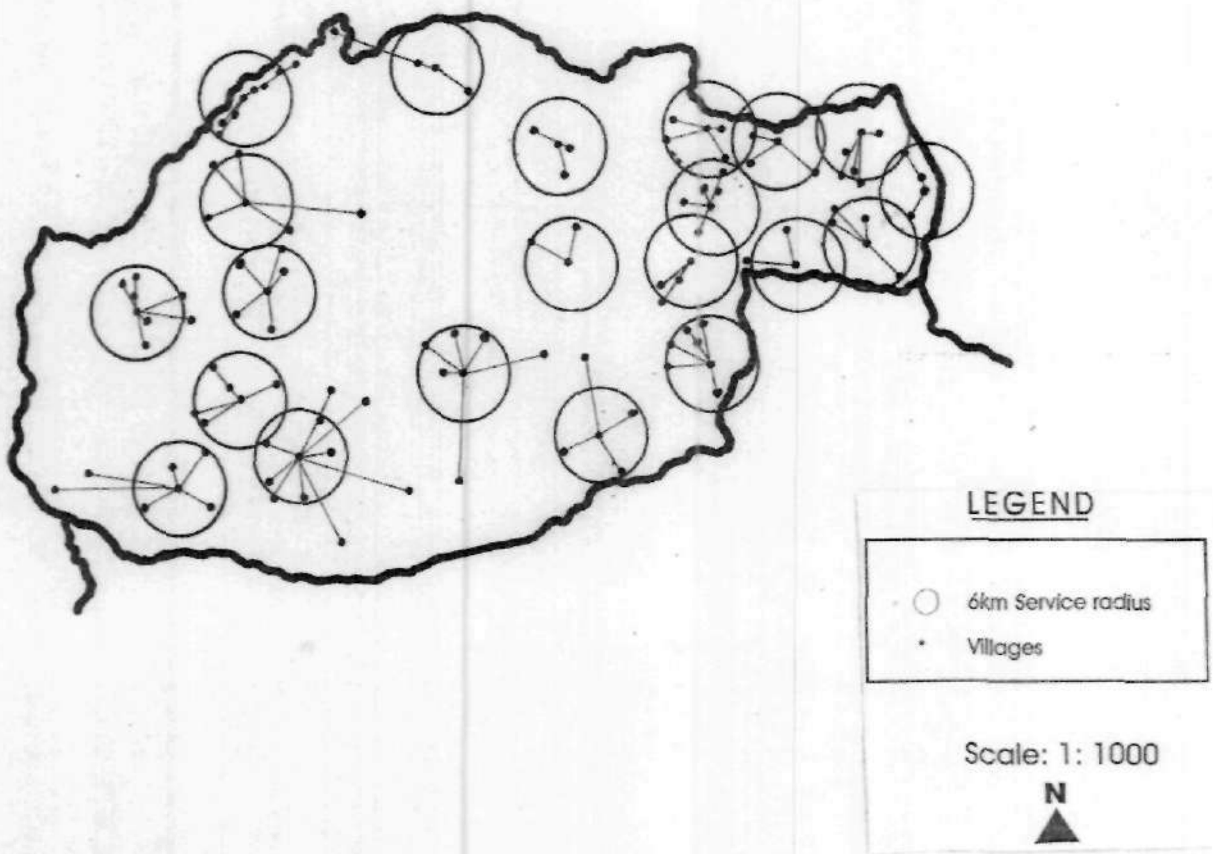


FIG. 5.16 PROXIMITY OF VILLAGES TO 21 OPTIMALLY LOCATED FSCs

Table 5.15: **Profile of villages in distance segments based on the optimal distribution of 22 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	22	25.74	6.1-7.0	1	1.17	12.1-13.0	2	2.34
1.0-2.0	5	5.85	7.1-8.0	2	2.34	13.1-14.0	1	1.17
2.1-3.0	18	21.06	8.1-9.0	-	-	14.1-15.0	1	1.17
3.1-4.0	20	23.4	9.1-10.0	1	1.17	> 15.1	2	2.34
4.1-5.0	17	19.89	10.1-11.0	-	-			
5.1-6.0	23	26.91	11.1-12.0	2	2.34			

With 23 optimally distributed service centres, the improvement in accessibility for villages outside the 6km radius was marginal. As shown in table 5.16 and Fig. 5.18, no village was found lying between 14.1 - 15.0km of the nearest FSC. It is an improvement of the pattern obtained with 22 optimally located facilities. A marginal reduction in the number of villages in the segments 7.1 - 8.0 km was also recorded. However villages located at distances less than 6km to the closest FSC increased to 107, suggesting further improvement in accessibility as additional facilities are provided.

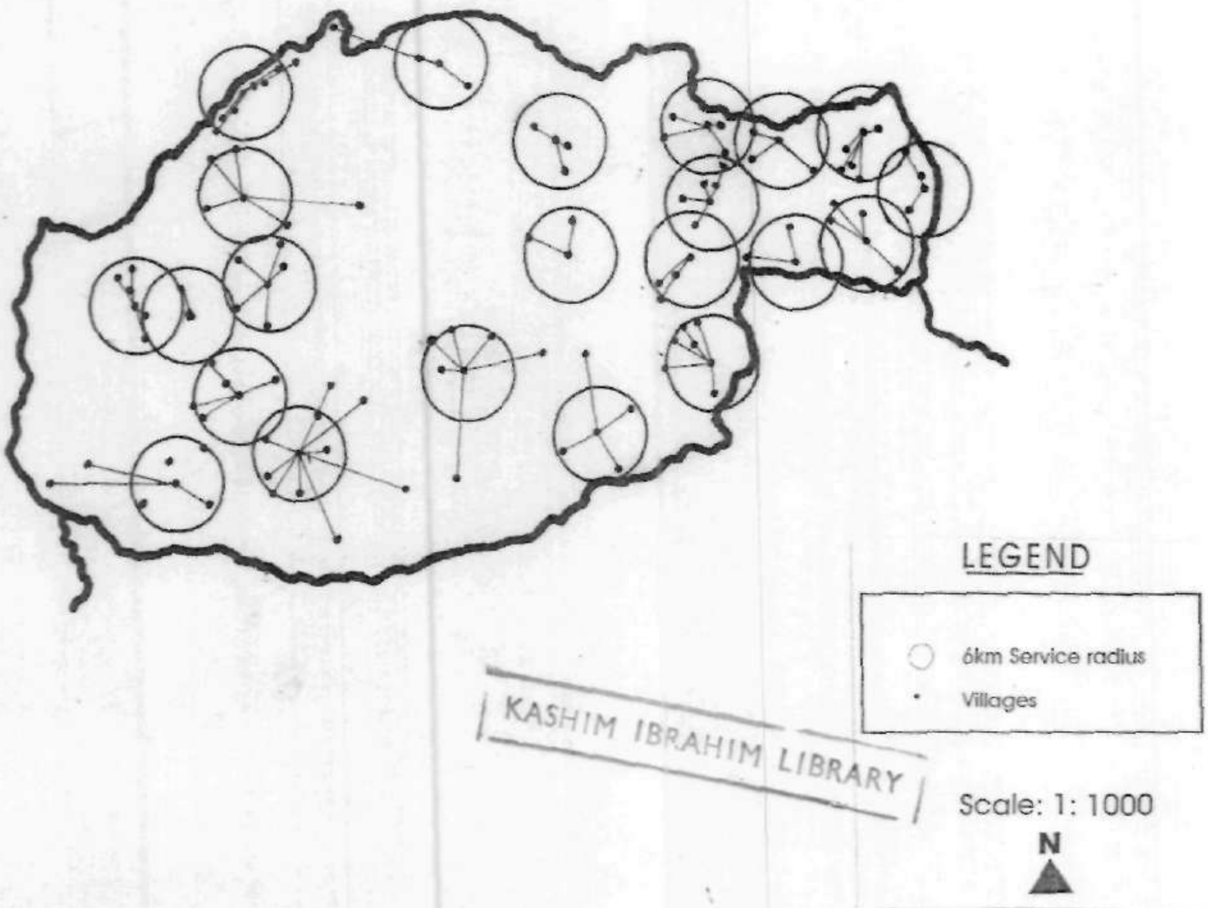


FIG. 5.17 PROXIMITY OF VILLAGES TO 22 OPTIMALLY LOCATED FSCs

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Table 5.16: **Profile of villages in distance segments based on the optimal distribution of 23 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	23	26.91	6.1-7.0	1	1.17	12.1-13.0	2	2.34
1.0-2.0	6	7.02	7.1-8.0	1	1.17	13.1-14.0	1	1.17
2.1-3.0	20	23.4	8.1-9.0	-	-	14.1-15.0	-	-
3.1-4.0	21	24.57	9.1-10.0	1	1.17	> 15.1	2	2.34
4.1-5.0	14	16.38	10.1-11.0	-	-			
5.1-6.0	23	26.91	11.1-12.0	2	2.34			

Also, there was a drastic improvement in the profile of distances influenced by the 23 optimally located FSCs compared with that achieved using 13 optimally located facilities (Fig. 5.19). As shown in Section 5.20, 23 FSCs would ensure that villages are generally within an average of 6km of FSCs.

The proportion of villages located less than 6km to the closest facility increased to 109 using 24 FSCs as shown in table 5.17 and Fig. 5.20. In the distance segments greater than 6km, relatively minimal changes in the number of villages in each segment was noticed. The exception is the 6.1-7.0km and the 7.1 - 8.0km distance segments. It signifies diminishing improvements in accessibility with each additional facility provided.

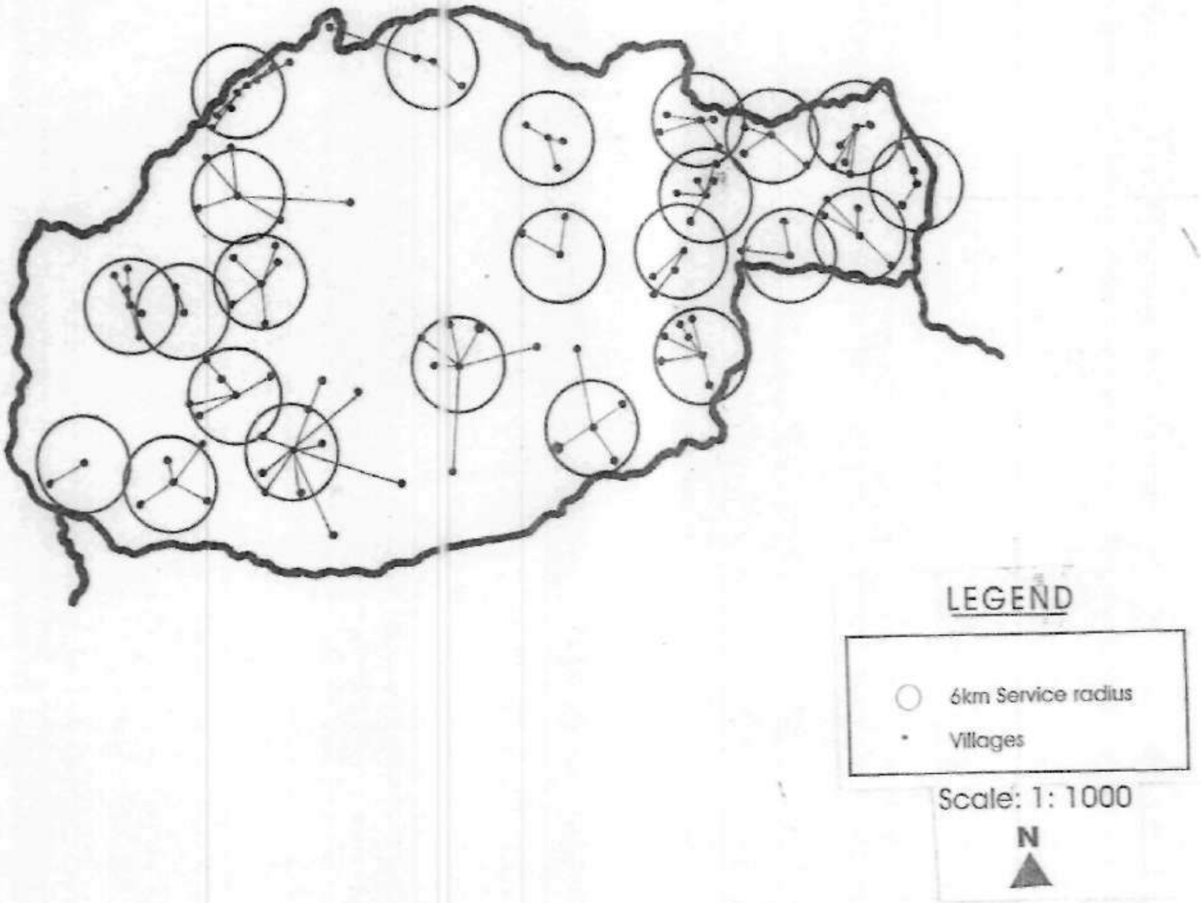


FIG. 5.18 PROXIM TY OF VILLAGES TO 23 OPTIMALLY LOCATED FSCs

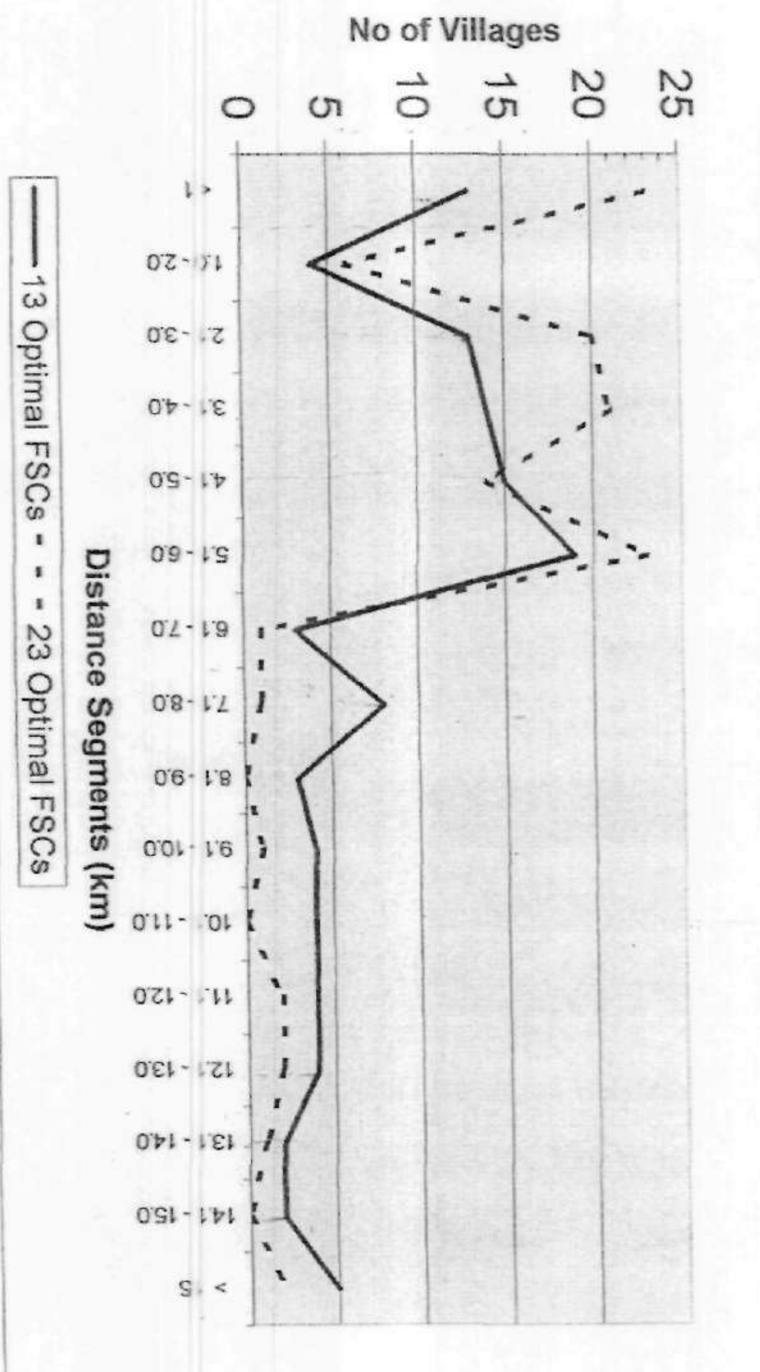


Fig. 5.19: Profile of Village distances to FSCs influenced by the optimal distribution of 13 and 23 FSCs

Table 5.17: <u>Profile Of Villages In Distance Segments Based On The Optimal Distribution Of 24 Service Centres</u>

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	24	28.08	6.1-7.0	-	-	12.1-13.0	2	2.34
1.0-2.0	6	7.02	7.1-8.0	-	-	13.1-14.0	1	1.17
2.1-3.0	20	23.4	8.1-9.0	-	-	14.1-15.0	-	-
3.1-4.0	21	24.57	9.1-10.0	1	1.17	> 15.1	2	2.34
4.1-5.0	15	17.55	10.1-11.0	-	-			
5.1-6.0	23	26.91	11.1-12.0	2	2.34			

With 25 optimally located FSCs, the proportion of farm villages within 6km of any FSC increased to 111. Further indication of the achievement of improved accessibility is also shown in table 5.18 and Fig 5.21 in which only 3 villages are located at a distance of more than 12 km of the closest facility as compared to 5 villages using 24 FSCs.

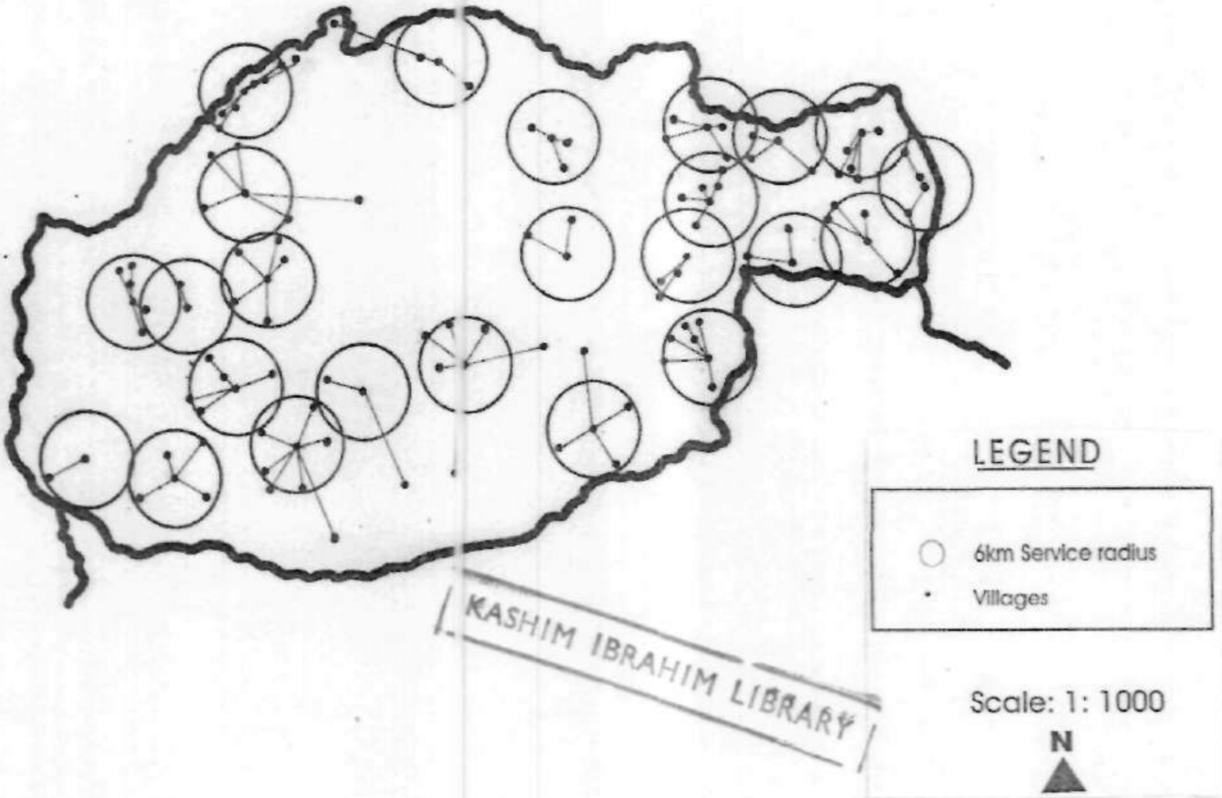


FIG. 5.20 PROXIMITY OF VILLAGES TO 24 OPTIMALLY LOCATED FSCs

Table 5.18: **Profile Of Villages In Distance Segments Based On The Optimal Distribution Of 25 Service Centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	25	29.25	6.1-7.0	-	-	12.1-13.0	-	-
1.0-2.0	6	7.02	7.1-8.0	-	-	13.1-14.0	1	1.17
2.1-3.0	18	21.06	8.1-9.0	-	-	14.1-15.0	-	-
3.1-4.0	22	25.74	9.1-10.0	1	1.17	> 15.1	2	2.34
4.1-5.0	15	17.55	10.1-11.0	-	-			
5.1-6.0	25	29.25	11.1-12.0	2	2.34			

A further increase in the number of optimally located FSCs to 26, led to the reduction of the number of villages 15km and above from the closest facility to 1. This compares to 2 when 25 FSCs were used. The improvement in accessibility is also reflected in the proportion of villages that are located less than 6km of the closest facility as shown in Table 5.19 and Fig. 5.22.

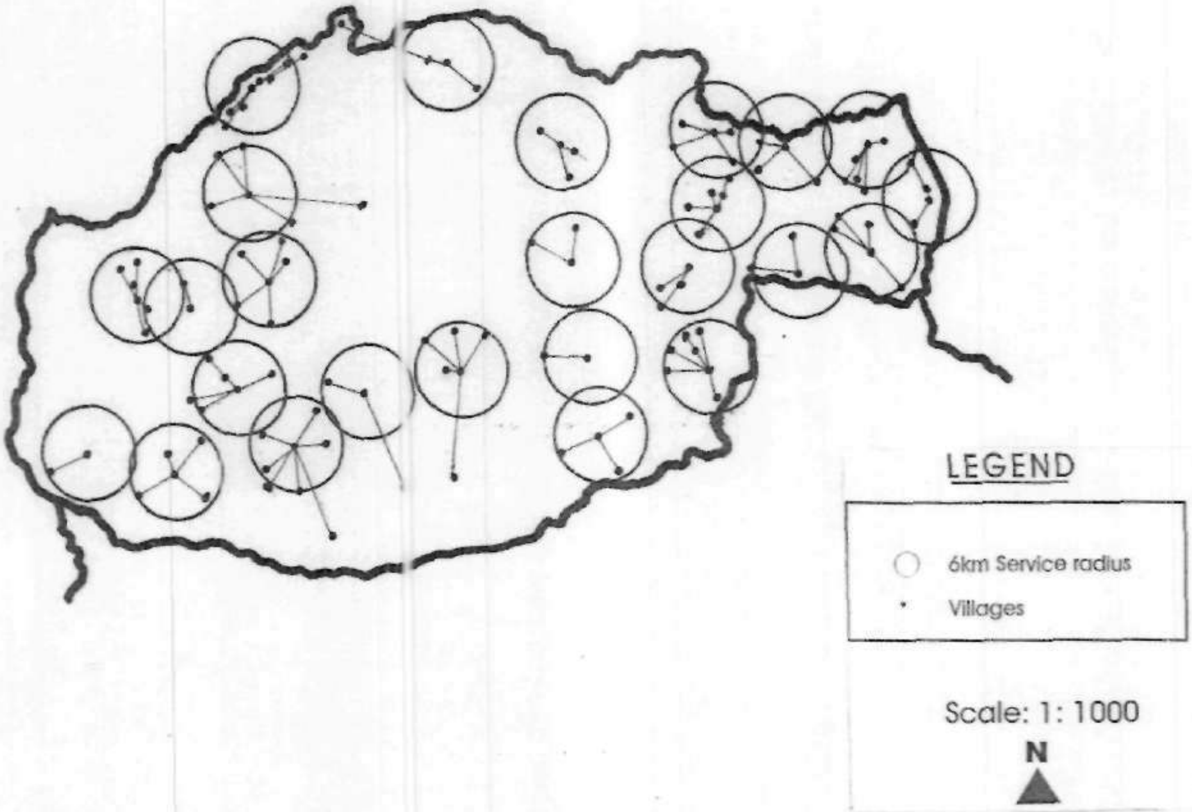


FIG. 5.21 PROXIMITY OF VILLAGES TO 25 OPTIMALLY LOCATED FSCs

Table 5.19: **Profile Of Villages In Distance Segments Based On The Optimal Distribution Of 26 Service Centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	26	30.42	6.1-7.0	-	-	12.1-13.0	-	-
1.0-2.0	6	7.02	7.1-8.0	-	-	13.1-14.0	1	1.17
2.1-3.0	18	21.06	8.1-9.0	-	-	14.1-15.0	-	-
3.1-4.0	22	25.74	9.1-10.0	-	-	> 15.1	1	1.17
4.1-5.0	15	17.55	10.1-11.0	-	-			
5.1-6.0	26	30.42	11.1-12.0	2	2.34			

Only 2 villages were located more than 6.0km of the nearest FSC, when the number of FSCs was increased to 27. Also, no village was found lying more than 14km of any FSC, as shown in table 5.20 and Fig. 5.23, suggesting a further reduction of longer travel distances to FSCs.

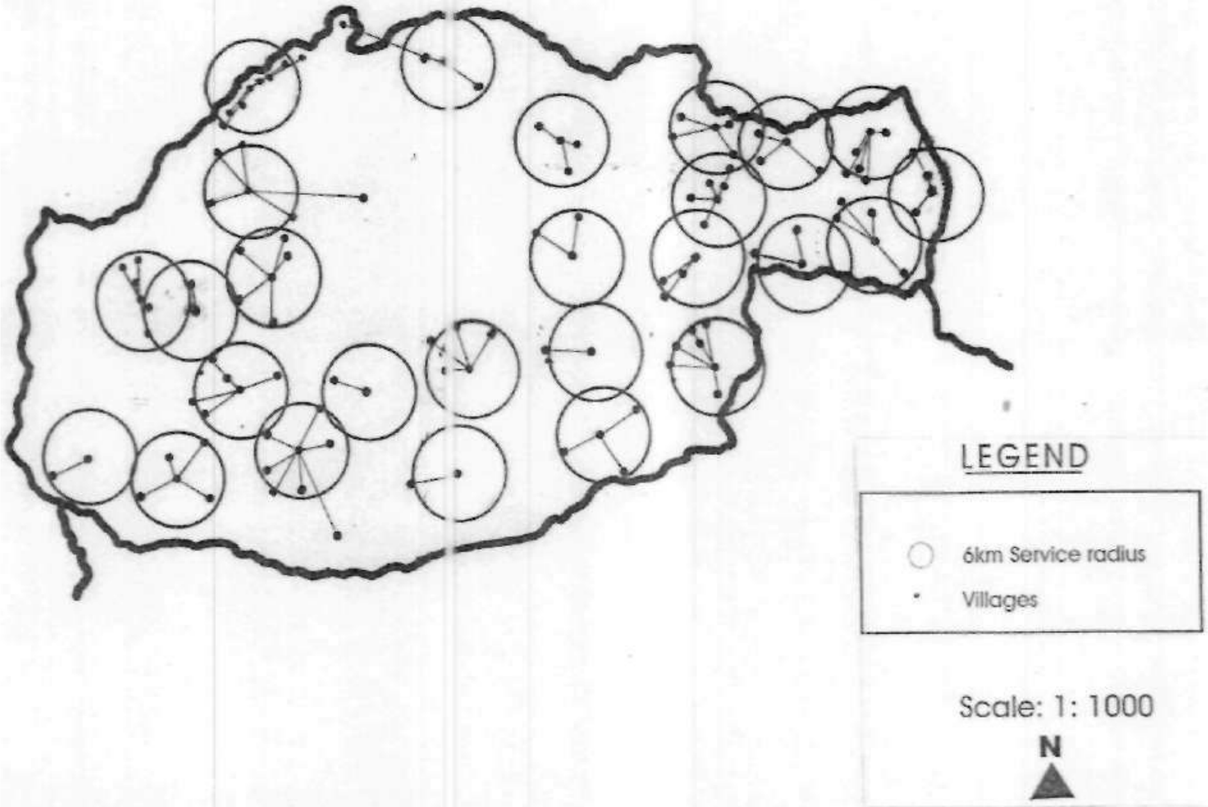


FIG. 5.22 PROXIMITY OF VILLAGES TO 26 OPTIMALLY LOCATED FSCs

Table 5.20: **Profile Of Villages In Distance Segments Based On The Optimal Distribution Of 27 Service Centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	27	31.59	6.1-7.0	-	-	12.1-13.0	-	-
1.0-2.0	6	7.02	7.1-8.0	-	-	13.1-14.0	1	1.17
2.1-3.0	18	21.06	8.1-9.0	-	-	14.1-15.0	-	-
3.1-4.0	20	23.4	9.1-10.0	-	-	> 15.1	-	-
4.1-5.0	17	19.89	10.1-11.0	-	-			
5.1-6.0	27	31.59	11.1-12.0	1	1.17			

The increase in the number of villages within 6km of the closest facility was very marginal with the increase in the number of FSCs to 28 as shown in table 5.21 and Fig. 5.24. Only one village was located outside the 6km radius of a FSC in the study area as compared to 2 under 27 facilities.

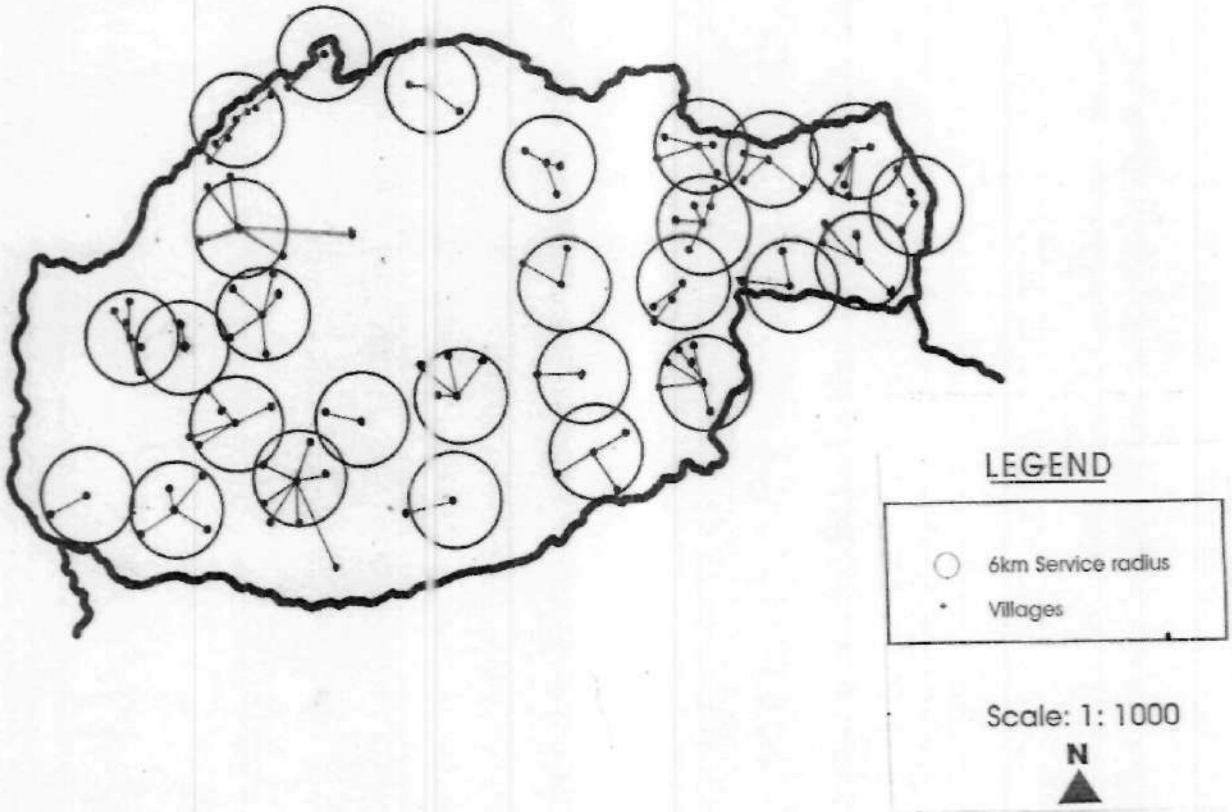


FIG. 5.23 PROXIMITY OF VILLAGES TO 27 OPTIMALLY LOCATED FSCs

Table 5.21: **Profile of villages in distance segments based on the optimal distribution of 28 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Village	%	Distance Segment (Km)	No. of Villages	%
<1	28	32.76	6.1-7.0	-	-	12.1-13.0	1	1.17
1.0-2.0	6	7.02	7.1-8.0	-	-	13.1-14.0	-	-
2.1-3.0	18	21.06	8.1-9.0	-	-	14.1-15.0	-	-
3.1-4.0	20	23.4	9.1-10.0	-	-	> 15.1	-	-
4.1-5.0	17	19.89	10.1-11.0	-	-			
5.1-6.0	27	31.59	11.1-12.0	-	-			

With 29 optimally located facilities, it is possible for all villages to be within 6km of FSCs, as envisaged in the project design. It represents the best possible number and distribution of FSCs capable of attaining the project target, and by implication improving the prospects of attaining better project outcomes. As it is with 28 FSCs, the highest numbers of villages are within less than 1Km of the closest FSC. Fewer villages are within 2km of FSCs as shown in Table 5.22 and Fig. 5.25.

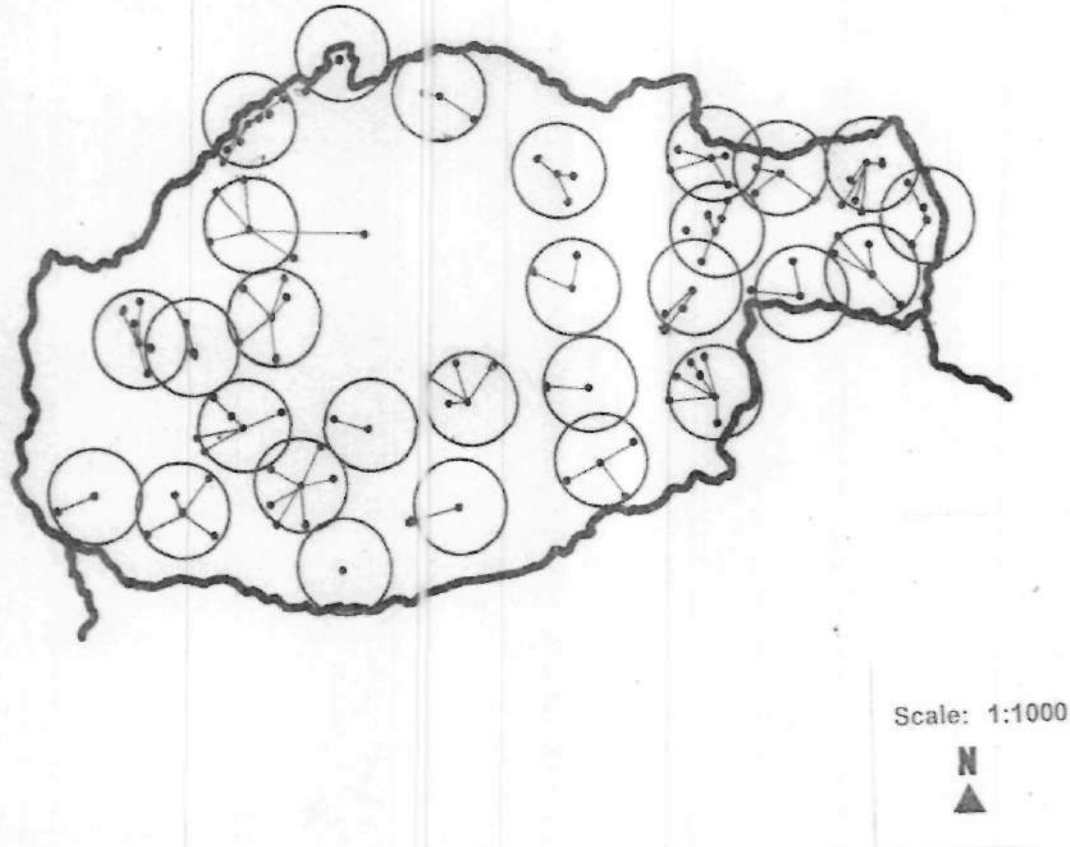


FIG. 5.24 PROXIMITY OF VILLAGES TO 28 OPTIMALLY LOCATED FSCs

Table 5.22: **Profile of villages in distance segments based on the optimal distribution of 29 service centres**

Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%	Distance Segment (Km)	No. of Villages	%
<1	29	33.93	6.1-7.0	-	-	12.1-13.0	-	-
1.0-2.0	6	7.02	7.1-8.0	-	-	13.1-14.0	-	-
2.1-3.0	18	21.06	8.1-9.0	-	-	14.1-15.0	-	-
3.1-4.0	20	23.4	9.1-10.0	-	-	> 15.1	-	-
4.1-5.0	17	19.89	10.1-11.0	-	-			
5.1-6.0	27	31.59	11.1-12.0	-	-			

The pattern of distances influenced by the optimal distribution of 13,23 and 29 FSCs was next compared. This is shown in Fig. 5.26. It is indicative of drastic reduction in village distances higher than 6km as the number of FSCs are increased. This is complemented with increases in the number of villages that are closest to FSC locations.

Influenced by the pattern of results obtained, it is implied that the improved accessibility achieved in the spatial distribution of FSCs, is accounted for by the increase in the number of optimally located facilities. This is confirmed by the gradual reduction in the number of villages within longer walking distances of FCSs, when additional optimally located facilities are provided. However, even with the huge improvements in accessibility recorded, additional optimally located facilities were observed as producing rather marginal improvements.

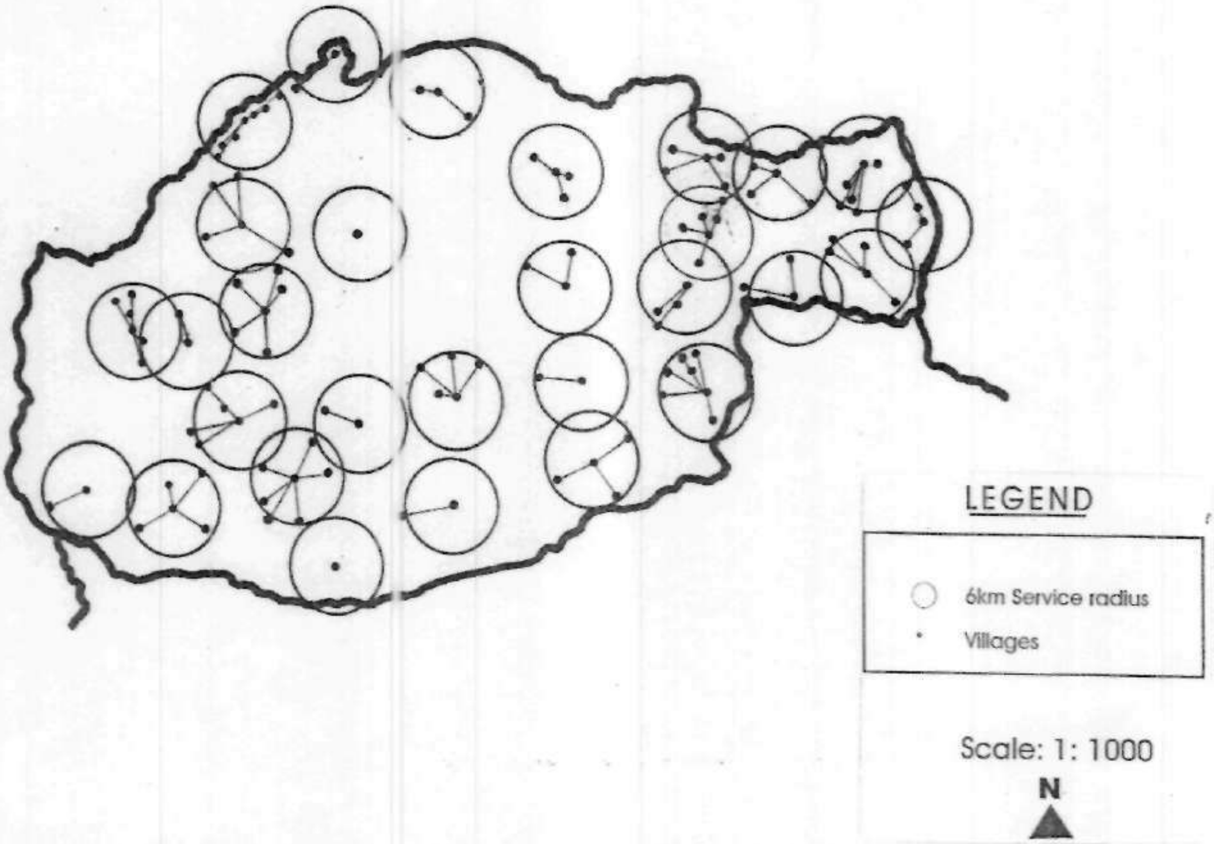
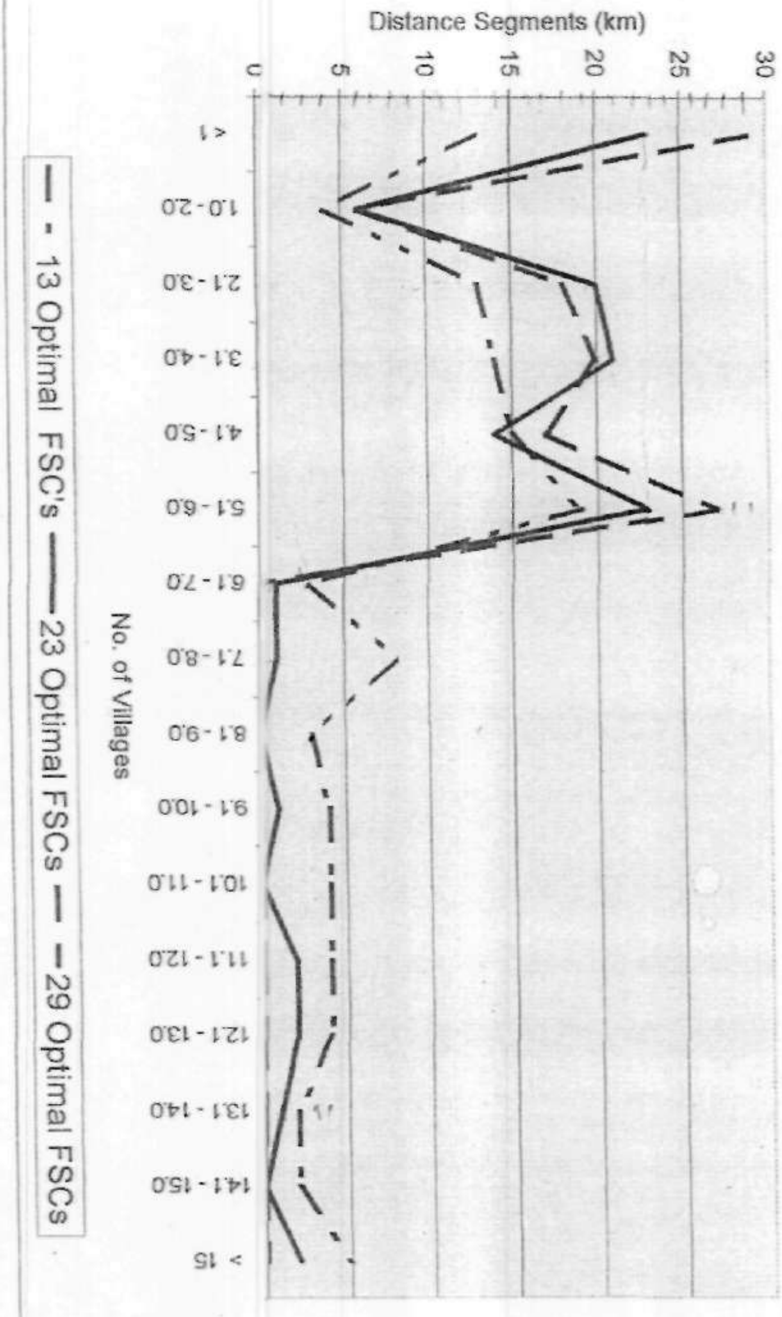


FIG. 5.25 PROXIMITY OF VILLAGES TO 29 OPTIMALLY LOCATED FSCs

Fig. 5.26: Profile of Village Distances to FSCs influenced by the optimal distribution of 13, 23 and 29 FSCs



5.60 SUMMARY

The pattern of distances imposed by the Spatial Planning input in the design of the Service Delivery System in BASIRDP have been examined in this chapter. Specifically, four aspects were investigated. They include the determination of the extent to which spatial efficiency has been achieved by the locational pattern of distribution of Farm Service Centres and; second, evaluating the pattern of distances imposed by the existing locational arrangement of FSCs in BASIRDP. Other aspects are the determination of the average and maximum distances to FSCs. The object is to establish the extent to which the spatial planning input in BASIRDP could have limited the potential for success during implementation.

Analysis of the data showed that the existing locational arrangement of Farm Service Centres is inefficient, with less than 48% of villages in the study area falling within the 6km radius of Service Centres contrary to programme design recommendation. Improvements achieved in the optimal system simulated, raises the efficiency level to 66%, suggesting benefits accruable from spatial planning. Influenced by their inefficient locations, Farm Service Centres are also shown to have imposed an additional travel of 25.6% on farmers over and above the distances which they would travel had the centres been optimally located.

Expectedly, the location of a large proportion of villages is skewed towards longer travel distances to Farm Service Centres in the existing system than in the optimal arrangement. Both average and maximum distances of 9.93km and 31km in the existing situation were reduced drastically to 7.9km and 23km in the optimal pattern simulated. That is, it is possible from the findings to answer the questions in the study as follows: First, spatial efficiency is lacking in the pattern of distribution of Farm Service Centres in BASIRDP; and second, more villages travel longer distances to FSCs, than is necessary.

What patterns of implication are imposed by the results obtained in the study need to be established for purposes of improving policy formulation, planning and implementation of IRD projects. These and related issues are examined in the chapter that follows.

CHAPTER SIX

INFERENCES AND CONCLUSIONS

6.10 INTRODUCTION

Spatial planning input is visible n the design of IRD projects. It is used in defining the spatial setting for project elements, resource mobilization and implementation activities. In the World Bank assisted IRD programmes, the spatial planning input has primarily focus on the service delivery system. Specifically the focus is on minimizing the distance constraint to farmers in journeys to FSCs for the purchase of farm inputs and access to extension advice.

In the background chapters, the effects of longer distances to Farm Service Centrres on farmer productivity were discussed. The spatial planning input employed in minimizing the distance constraint were also discussed with particular reference to the design of the service delivery network in the BASIRDP.

To identify the constraints imposed by the spatial planning input in the design of the service delivery system of IRD projects, the necessity to evaluate the efficiency of the Farm Service Centre network in BASIRDP was recognized. Also, the importance was shown of the need to answer the question: How has the spatial planning input in the design of the service delivery system in BASIRDP been implemented? and with what pattern of implications? The details of the research findings and attempts to answer the questions were given in Chapter Five.

In this chapter, the research findings are summarized and reported in section 6.20, covering four aspects investigated; Efficiency of FSC locations; Average distances to FSCs; Maximum distances to FSCs; and the Distance profiles of villages to FSCs. The Inferences drawn from the study and the implications of the findings for the decision making process in the case of BASIRDP and for the planning of IRD projects generally are examined in the later sections. Aspects related to the research findings are also identified as areas for further investigation.

6.20 SUMMARY OF FINDINGS

In the background chapters, aspects of farming activities affected by inefficiencies in locational decisions have been shown. They include effects on labour input, productivity, yields and total production. Specifically, farm work period is shown as shortening by 25% over a walking distance of 4km, with intensive cultivation dropping off beyond 2 - 4km of farm villages. The care, attention and quality control required in farming is also reduced, since most work is performed during the midday heat after the extra wariness from long trips to distant plots. Other effects are on the usage of farm inputs and adoption of improved farm practices, where both are shown as being minimal in villages that are at distant locations from Farm Service Centres.

The response to the distance problems, particularly in the World Bank supported ADPs in Nigeria was found to be in the spatial planning and design of service delivery systems. It involved the location of FSCs within a walking distance of 6km of farm villages, to limit the effects of the distance constraint in journey for the purchase of farm inputs. In the Bauchi State IRD programme, it was identified as crutial in motivating farmers to use new inputs and improved techniques as basis for improving the potentials for programme success.

In Chapter Two, the necessity to evaluate the Spatial Planning input in IRD projects was shown as that of identifying the pattern of constraints influenced by the spatial input in project design as it relates to the potentials for project success. In the case of BASIRDP, it is establishing whether spatial efficiency has been achieved by the locational pattern of FSCs and the pattern of implications arising thereof. Against the background of limitations of conventional evaluation techniques reviewed, the application of a model based on a computer programme was shown as a more appropriate means for achieving the objectives of the study.

Using the review of the BASIRDP design in Chapter Three, the object of the study was narrowed down to establishing the extent to which the poor spatial planning input in BASIRDP constitutes a constraint to the attainment of programme targets during implementation. To achieve this, four main issues were investigated: First, the aspect of efficiency of Farm Service Centre networks. Data results showed that the existing locational arrangement of FSCs was inefficient with only 57 of the existing 117 villages falling within the recommended 6km radius of service centres. The efficiency level was 48%, implying that less than half of villages are within 6km of FSCs, contrary to the programme design recommendation. In the optimal system simulated, the efficiency level was improved to 66.6%. Also, it was shown that the desirable distance of 6km in the project design is attainable with the provision of 16 additional Farm Service Centres.

The second aspect investigated was the average distances of villages to FSCs. The results obtained show that villages were within an average distance of 9.93km of the closest FSC. It is 3.93km more than the 6km recommended in the project design and 2.03km higher than what is attainable under an optimal arrangement. That is, it was shown that an additional 25.6% travel distance had been imposed on farmers over and above what is attainable under an optimal system. The maximum distance to FSCs was next evaluated and shown to be 31km in the existing situation. It compared with 23km attainable under an optimal system. Subsequent decreases in the maximum distances were achieved with additional optimally located facilities.

The fourth aspect investigated was the profile of villages within different distance segments of FSCs. Results obtained showed that most village locations were skewed towards longer travel distances in the existing pattern than in the optimal system simulated. Subsequent improvements in village distance profiles were also shown as achievable where additional optimally located facilities are provided.

Influenced by the pattern of results obtained therefore, it was possible to answer the research question in the study as follows: "That spatial efficiency has not been achieved in the pattern of distribution of Farm Service Centres in BASIRDP".

6.30 CRITIQUE OF SPATIAL PLANNING IN BASIRDP

As shown in Chapter Three, the spatial planning criteria in the design of the service delivery system in BASIRDP is that FSCs should be located within a walking radius of

6km to ensure effective delivery of programme services. During implementation however, the location of many FSCs were decided on criteria other than the project design considerations. That is, not all FSCs were established at the desired locations, nor did most of them turn out to be as operational as desired. As shown in Fig. 4.1, the tendency has been to select villages along rural - urban roads in identifying villages for locating the service delivery centres. Therefore, most centres have turned out to be of little service to farm families in distant and remote villages.

Two major explanatory factors were identified. There is the problem that the technical competence of project staff is inadequate to handle the spatial analysis required as aid in the identification of desirable locations of FSCs. For instance, project staff responsible for the design of the service delivery network were found to be primarily expatriate staff who were either civil engineers, agricultural scientists, economists or soil scientists. By the influence of their training and priorities, Farm Services Centres have been located along rural - urban roads or in the bigger settlements depending upon whether the concern is for improved accessibility for staff convenience or higher volume of sales. It was found out that 9 of the existing 13 Service Centres are located in villages of more than 5,000 population. Also, more than 80% of FSCs as shown in Fig. 4.1 are found in the more accessible locations and particularly along rural - urban roads.

There is also the problem that the technical and administrative frameworks for the spatial planning input in BASIRDP has been narrowly defined as it relates to the design and implementation of the service delivery networks. For example, the general physical planning concerns in BASIRDP are defined in the programme design as simply: to "increase Bauchi State's natural resource data base, and update aerial photographs and satellite imagery requirements (SAR; 1981)." These are specified as the functions of the landuse planning unit, which is to also liaise with management on all aspects of physical planning and also with state ministries and organizations in order to rationalize BASIRDP's infrastructure plans with the State Government's plans. At the zonal level, physical infrastructure developments were to be coordinated through the zonal land use planning officers. That is, aspects of the detailing of the spatial planning input for the service delivery system are neglected and modalities for implementing them not clearly defined.

Based on these inadequacies therefore, locational decisions relating to the siting of FSCs in BASIRDP have been made more on the basis of the rule of thumb and other economic and accessibility concerns than on the distance principles defined by programme design. This accounts for the largely technically irrational and uncoordinated spatial distribution of FSCs as has been shown in Chapter Five. The implications of these constitute aspects discussed in the sections that follow.

6.40 IMPLICATIONS OF FINDINGS

An underlying consideration of the BASIRDP design was the need to motivate farmers to use modern farm inputs and adopt enhanced farm practices as basis for improving productivity. To achieve this, constraints inhibiting the ease of access of farmers to farm inputs and extension adivce were to be eliminated. The most visible constraint was identified as the distance factor in farm journeys. In the design therefore, Farm

Service Centres were to be located in close proximity to villages to lessen the disincentive of longer walking distances as farmers travel to purchase farm inputs. That is, Service Centres were to be located at distances of 6km of farm villages.

In the analysis, distance covered in journeys to FSCs were shown to be higher in the existing pattern than in the optimal pattern simulated. The average distance was 9.93km and the maximum 31km in the existing pattern and 7.90km as the average and 23km as the maximum in the optimal pattern. That is, it is shown that farmers cover longer distances to purchase farm inputs and receive extension advice, for which distances 25.6% higher than necessary and 65.5% higher than the design consideration are imposed on farmers. Also, it was shown that 23 FSCs are needed rather than 13 to ensure that farm villages in BASIRDP are within an average distance of 6km of FSCs.

For the implications on programme outcomes of BASIRDP, walking longer distances beyond what was considered reasonable (6km) is a negation of the BASIRDP project design principle. It implies loss of productive labour time, resources and energy in journeys to FSCs that would otherwise be useful in the care of crops. The effects therefore would be negative for farm output and productivity, which contradict the principal BASIRDP objectives.

For programme implementation, it suggests inefficient deployment of resources in the location of FSCs. This is because the spatial planning input for organizing the FSC network of the project area has been inadequate and limited. It also implies that the successful implementation of the programme based on the design concept has been jeopardised, since the effective administration of the programme is conceived to be dependent upon the efficient distribution of farm inputs and dissemination of improved agricultural extension messages and methods.

6.50 GENERAL POLICY RECOMMENDATIONS:

Using the results of the study as indicators, three frameworks of intervention are argued here as viable options for improving the efficiency of FSCs in BASIRDP as follows:

(i) Creating an optimal distribution of the existing 13 service centres through relocation.

(ii) Increasing the number of optimally located FSCs.

(iii) Regrouping Villages.

By implication of implementing the first option, achieving an optimal distribution of the existing 13 Service Centres would involve relocating 7 facilities as shown in Fig. 5.2. In the study area, existing Farm Service Centres, have little physical infrastructure except the main storage building and an office. Also, most Farm Service Centres, have between two and four extension staff and Sale's Agents. In this context, relocation would mean building new offices and also transferring the affected workers or recruiting and training new ones at the new locations. This would mean economic cost for new buildings to the project management and social cost for the workers and users of the facilities which might be economically and politically contentious. In the form they have taken however, many of the existing Farm Service Centres, service substantially lower people than they ought to. The closure of some centres therefore, might not even be noticed by many users. Also, the enhanced efficiencies from new locations will improve access to service centres and therefore guarantee prospects for achieving programme targets.

In implementing the second option, and without the optimal relocation of FSCs, additional four new facilities would be required to improve accessibility to values obtained under the optimal system. The extra cost of staffing and supervising the additional optimally located facilities makes this option less attractive. Provided however, that the existing FSCs are optimally relocated, the provision of additional facilities can improve accessibility by a margin of 4 - 8% for each facility added. It is clear nonetheless, as shown in chapter five, that the benefit from adding more facilities, even optimally located ones will become minimal for considerably higher than 25 facilities.

The third option would involve the regrouping of villages to enable the economical provision of FSCs. As shown in the study, each additional FSC beyond 27 FSCs will improve accessibility by a negligible value. In Figures 5.24, It is shown that only 2 villages are outside the service radius of any FSC. To ensure that they are within 6km of the nearest facility, 2 additional FSCs are required (see Fig. 5.25). Each addition will improve accessibility by only 0.3% compared to the minimum of 2.0% achieved with each facility added beginning from 13 to 27 FSCs. Depending on relocation costs (which is generally low given the small size of settlements in the study area), the regrouping of the two villages into service areas of FSCs closest to them will ensure that fewer than 29 FSCs would be required to ensure the most efficient spatial distribution of FSCs.

Overall, the result of the study are indicative of the usefulness of the analysis of the spatial planning input in IRD projects as basis for improving the choice of policy options for IRD projects. However, without satisfactory measurement tools, it is difficult to evaluate policy options effectively. Using the technique adopted in the study, location goals may be revised, once the locational outcome of specified decision criteria are known.

In BASIRDP for instance, a coverage distance of 6km for FSC has been specified without knowing the exact number of facilities that would be necessary to achieve that goal. Presumably, a different goal might have been chosen where the implications involved in implementing the chosen design goal is known. Table 5.01and 5.03 show the trade-offs of different average distances and efficiencies with the number of facilities required to achieve the coverage distance of 6km. To ensure that all villages are within 6km of FSCs, 29 FSCs would be needed. Only 15 FSCs would however be required to provide coverage within 8km coverage distance.

Therefore, where resources restrict the provision of facilities to a certain number, the average coverage distance can always be determined using the principles of the model. By extension also, it is possible to determine the percentage of villages that can be covered where the number of facilities and coverage distances are known. Therefore, through this type of analysis, the logic in location Allocation models can be utilised for identifying decision alternatives, by trading off resource inputs against alternative locational outcomes, and even in defining or refining the locational objectives.

In the study, it is shown that data limitations do not preclude the use of simple location-allocation analysis to support spatial decision making. Rather performing simple analysis using readily available data can provide invaluable inputs for making difficult spatial decisions.

6.60 SUMMARY AND CONCLUSIONS

The use of social evaluation techniques in assessing the Spatial Planning Input in IRD project design is faulted on account of its subjectivity and cumbersome procedure. Based on a model of evaluation using a computer programme, the study has easily and more precisely evaluated the spatial inefficiency in BASIRDP arising from the inadequate spatial planning input in the design and implementation of the programme. This is in spite of the declared desire for the inclusion of spatial planning in programme implementation.

The results show that FSC locations in BASIRDP were inefficient and decided on criteria other than the spatial planning input in programme design. This has imposed travel distances greater than the 12km considered reasonable for farm journeys to and from FSCs for farm purchases It implies loss of productive labour time, resources and energy that would otherwise have been useful in farm activities. The optimal number and location of FSCs capable of achieving the desired spatial objective in BASIRDP was also determined using the principles of the model. That is, 23 optimally located FSCs were shown as being required to ensure that all villages in the study area are within 6km of service centres.

Using the results of the analysis as indicators, policy formulation and implementation of IRD projects can be improved both at the design and implementation stages. On the basis of this, some policy recommendations have been made for BASIRDP and for use in the planning and design of IRD projects. In particular, the usefulness of computer based models in spatial analysis to support decision making has been shown from the pattern of results obtained in the study.

To improve on the knowledge gained from the study, some aspects relating to the research findings are suggested as areas for further research. For instance, it would be necessary to identify the extent to which the spatial inefficiency in FSC locations in BASIRDP have undermined the pattern of use of programme services and by implication affected programme performance. That is, to answer the question: what pattern of consequences are there for the attainment of programme objectives attributable to the spatial inefficiency of FSCs in BASIRDP? The answer is crucial for improving further, knowledge about the factors influencing IRD project success.

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APPENDIX I

P.SPEC

```
      PROGRAM NI2
C
C
      common xs(118),ys(118),xv(118),yv(118)
      dimension xt(6000),yt(6000)
C
C
      open(unit=1,file='ni1.da ')
      open(unit=3,file='ni2.da ')
      open(unit=2,file='ni2out dat)
C
      ntotal=118*6
      ismax=7
      nv=118
      ns=13
      pmax=94.0
C      nsfinal=16
      cf=0.5
      do 11 I=1,nv
      read(1,51)ix,iy
      xv(i)=cf*float(ix)
      yv(i)=cf*float(iy)
   11 continue
   51 format(i3,1xi3)
      do 12 i=i,ns
      read(3,51)ix,iy
      xs(i)=cf*float(ix)
      ys(i)=cf*float(iy)
   12 continue
C
      imod=1
      call perc(ns,nv,xs,ys,xv,yv, per)
      p0=per
      write(2,61)p0
   61 format(/,9x,'Maximum Efficiency for initial layout :',f5.2,'%')
      write(2,66)
   66 format(//,20x,'THEN LAYOUT IS')
      do 40 i=1,ns
      xi=xs(i)cf
      yi=ys(1)/cf
      ix=ifix(xi)
      iy=ifix(yi)
```

```
        write(2,51)ix,iy
   40 continue
        call avdst(ns,nv,xs,ys,xv,yv,dav,dmax)
        avd=dav
        write(2,360)avd
  360 format(/,30x,'MAXIMUM DISTANCE TO STATIONS =',f5.2,'km'
        xmax=dmax
        write(2,361)max
  361 format(/,30x,'AVERAGE DISTANCE TO STATIONS =',F5.2,'km'
C
        write(2,67)
   67 format(//,10x,'-------------------------')
        itotal=-nv
  300 continue
        itotal=itotal+nv
        do 31 i=1,nv
        j=itotal+i
        xt(j)=xv(i)
        yt(j)=yv(i)
        31 continue
        if(itotal.lt.ntotal)go to 300
        ns=ns-1
  700 continue
        ns=ns+1
        istep=0
  200 continue
        istep=istep+1
        i1=0
  100 continue
        i1=i1+1
        j=i1-istep
        do 111 i=1,ns
        j=j+step
        xs(i)=xt(j)
        ys(i)=yt(j)
  111 continue
        call perc(ns,nv,xs,ys,xv,yv,per)
        p=per
C
C       write(*,60)p
C       60 format(10x,'PER=',f5.2)
C
        if(p.gt.p0)p0=p
        if(j.lt.ntotal)go to 100
        if(istep.lt.ismax)go to 200
        write(2,68)ns
        write(*,68)ns
   68 format(//,20x,'NO. of stations = ',I3)
```

```
      write(2,62)p0
   62 format(/,9'Maximum Effici‹ ncy after variations is:',f5,'%')
      write(2,66)
      C
      do 41 i=1,ns
      xi=xs(i)/cf
      yi=ys(i)/cf
      ix=ifix(xi)
      iy=ifix(yi)
      write(2,51)ix,iy
   41 continue
C
      call avdst(ns,nv,xs,ys,xv,y',dav,dmax)
      avd=dav
      xmax=dmax
      write(2,360)dav
      write(2,361)xmax
C
      write(2,67)
      if(p0.lt.pmax)go to 700
C
C
      stop
      end
C
C
      subroutine perc(ns,nv,xs,y ;,xv,yv,per)
C
      dimension ys(ns),xv(nv),yv(nv)
      dimension kv(118)
      dt=6.0
      do 11 i=1,nv
      kv(i)=0
      do 12 J=1,ns
      dx=xy(i)-xs(j)
      dy=yv(i)-ys(j)
      d=sqrt(dx+dy*dy)
      if(d.lt.dt)kv(i)=1
   12 continue
   11 continue
      rn=0.0
      do 13 i=1,nv
      if(kv(i).eq.1)rn=rn+1.0
   13 continue
      per=100.0*rn/float(nv)
      return
      end
C
```

```
      subroutine avdst(ns,nv,xs, /s,xv,yv,dv,dmax)

      dimension xs(ns)ys(ns),xv. nv),yv(nv)
      dimension dv(18)
      do 333iv=1,nv
      dmin=1000.0
      do 332 is=1,ns
      dx=abs(xs(is)-xv(iv))
      dy=abs(ys(is)-yv(iv))
      dd=sqrt(dx*dx+dy*dy)
      dmin=min(dmin,dd)
332 continue
      dv(iv)=dmin
333 continue
      dsum=0.0
       dmax=0.0
       do334iv=1,nv
       dsum=dsum+dv(iv)
      dmax=max(dmax,dv(iv))
 334 continue
      dav=dsum/float(nv)
      return
      end
```

APPENDIX II

Maximum Efficiency for Initial Layout: 38.98%

THE LAYOUT IS

44	84
78	51
72	138
97	27
96	156
128	68
154	126
161	73
198	132
190	98
197	64
216	105
230	120

AVERAGE DISTANCE TO STATIONS = 9.93km

MAXIMUM DISTANCE TO STATIONS = 31km

NO. of stations = 13

Maximum Efficiency after variations is: 66.6%

THE LAYOUT IS

63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 7.90km

MAXIMUM DISTANCE TO STATIONS 23km

NO. of stations = 14

Maximum Efficiency after variations is: 70.9%

THE LAYOUT IS

78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 7.77km

MAXIMUM DISTANCE TO STATIONS = 23km

NO. of stations = 15

Maximum Efficiency after variations is: 74.3%

THE LAYOUT IS

71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
320	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 7.48km

MAXIMUM DISTANCE TO STATIONS = 23km

NO. of stations = 16

Maximum Efficiency afte· variations is: 76.9%

THE LAYOUT IS

57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 7.39

MAXIMUM DISTANCE TO STATIONS = 23km

N0. of stations = 17

Maximum Efficiency afte variations is: 79.48%

THE LAYOUT IS

44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 7.26km

MAXIMUM DISTANCE TO STATIONS = 23km

NO. of stations = 18

Maximum Efficiency after variations is: 82.0%

THE LAYOUT IS

243	199
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 7.09km

MAXIMUM DISTANCE TO STATIONS = 23km

NO. of stations = 19

Maximum Efficiency after variations is: 84.6%

THE LAYOUT IS

233	120
243	119
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 6.82km

MAXIMUM DISTANCE TO STATIONS = 23km

NO. of stations = 20

Maximum Efficiency after variations is: 86.3%

THE LAYOUT IS

223	120
233	120
243	119
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 6.55km

MAXIMUM DISTANCE TO STATIONS = 23km

N0. of stations = 21

Maximum Efficiency after variations is: 88.0%

THE LAYOUT IS

207	120
223	120
233	119
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 6.32km

MAXIMUM DISTANCE TO STATIONS = 23km

NO. of stations = 22

Maximum Efficiency afte variations is: 89.7%

THE LAYOUT IS

197	64
207	120
233	119
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 6.02km

MAXIMUM DISTANCE TO STATIONS = 18km

NO. of stations = 23

Maximum Efficiency after variations is: 91.4%

THE LAYOUT IS

187	93
197	64
207	122
223	120
233	120
243	119
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 5.86km

MAXIMUM DISTANCE TO STATIONS = 18km

NO. of stations = 24

Maximum Efficiency after variations is: 93.1%

THE LAYOUT IS

190	132
187	93
197	64
207	122
223	120
233	120
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120
232	125
245	94

AVERAGE DISTANCE TO STATIONS = 5.80km

MAXIMUM DISTANCE TO STATIONS = 18km

NO. of stations = 25

Maximum Efficiency after variations is: 94.8%

THE LAYOUT IS

157	97
190	132
187	93
197	64
207	122
223	120
233	120
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120

AVERAGE DISTANCE TO STATIONS = 5.65km

MAXIMUM DISTANCE TO STATIONS = 18km

NO. of stations = : 6

Maximum Efficiency after variations is: 96.5%

THE LAYOUT IS

141	136
157	97
190	132
187	93
197	64
207	122
223	120
233	120
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120

AVERAGE DISTANCE TO STATIONS = 5.37km

MAXIMUM DISTANCE TO STATIONS = 16km

NO. of stations = 27

Maximum Efficiency after variations is: 98.2%

THE LAYOUT IS

119	148
141	136
157	97
187	93
197	64
207	122
223	120
233	120
44	84
57	82
71	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120

AVERAGE DISTANCE TO STATIONS = 5.15km

MAXIMUM DISTANCE TO STATIONS = 14km

NO. of stations = 28

Maximum Efficiency after variations is: 90.1%

THE LAYOUT IS

90	57
119	148
141	136
157	97
187	93
197	64
207	122
223	120
233	120
44	84
57	82
71.	40
78	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120

AVERAGE DISTANCE TO STATIONS = 5.01km

MAXIMUM DISTANCE TO STATIONS = 12km

NO. of stations = 29

Maximum Efficiency after variations is: 100%

THE LAYOUT IS

82	146
90	57
119	148
141	136
157	97
187	93
197	64
207	122
223	120
233	120
44	84
57	82
71	40
78.	90
63	130
85	148
95	65
124	147
149	130
158	106
196	132
182	90
195	71
199	124
230	120

AVERAGE DISTANCE TO STATIONS = 4.92km

MAXIMUM DISTANCE TO STATIONS = 6km