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The management of tea research

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............(It is) *surprising that little attention has been directed to understanding and improving the management of agricultural research in developing countries............*
.............we know more about how to do research than about how to run agricultural research systems ....(**Douglas E. Horton**).

.... *intellectual leadership is essential to being a good scientist. Organisational leadership involves both vision and execution. The head of a research team must be a good leader and must combine these attributes with good organisational and management skills*...........(**John L.Nickel**).

DEDICATED TO

MY WIFE,

DAUGHTER, AND

SON.

ABSTRACT

The management of tea research

Sponsors and clients of agricultural R & D are showing increasing concern about research costs and benefits. R & D organisations need to assess the impact of research to justify spending, obtain continuous technical and financial support from donors, and research sponsors. Further, impact assessment for R & D organisations are essential to assess their management systems in order to optimise the benefits from scarce research resources. At present criteria to assess the performance, objective verifiable indicators and means of verification are not available. No systematic method is in practice to assess the research management performance.

Therefore, a study was under taken to develop tea R & D management criteria and incorporated these in a methodology to assess performance of research management in the tea sector. A case study approach was adopted. Six case studies were conducted on Tea Research Institutes of Asia and Africa. Case studies were grouped into two phases. Phase One was exploratory in nature and developed the conceptual framework for the research. This enabled the identification of research management criteria, objective verifiable indicators and means of verification. These can be used to improve in R & D management decision making. In addition, a scoring model was developed to assess the performance of research management in tea.

Phase Two applied the developed conceptual model to four tea R & D organisations and analysed their performance. This clearly showed that the identified criteria and developed conceptual model can be used to analyses the performance of tea R & D management. Results indicated that there is lack of a structured approach to organising and conducting R & D activities. Research is carried out without any systematic approach for research prioritisation.

Appraisal and resource allocation are inadequately addressed. Management information systems for rational, quick and effective decision making for the most part are weak and unorganised. Data on resource utilisation and benefits derived by individual research projects are rarely recorded and maintained properly. There is a lack of general awareness especially regarding importance of studying the rate of uptake of technology.

A good correlation, however, was observed between organisations adopting best practices and suggested guidelines and the performance of tea R & D organisations in terms of perceived benefit to the client industry. The most effective R & D was associated with committee culture, problem identification, monitoring, evaluation, publication, technology dissemination and feedback.

The developed model was applied in specific context of Bangladesh Tea Research Institute. Specific suggestions are made on how to improve the linkages with the industry, better ways of problem identification, evaluation and technology dissemination, and there by increased contribution to the productivity of the tea sector.

A research management cycle (RPCM) was developed which proposes to carry out research in an organised way emphasising the participation of the beneficiary. Best practices for all the identified criteria and guidelines for major research management criteria were developed to support in R & D decision making. The study recommends further work to monitor and evaluate the application of the guidelines in practice.

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ACRONYMS

ADR	Assistant Director Research
AHP	African Highland Produce
AIDS	Acquired Immune Disease Syndrome
ASC	Area Scientific Committee
BARC	Bangladesh Agricultural Research Council
BATIS	Bangladesh Tea Institution Support Project
BBK	Brooke Bond Kenya
BCS	Bangladeshio Cha Sangshad
BMDC	Bangladesh Management Development Centre
BT	Board of Trustee
BTB	Bangladesh Tea Board
BTRI	Bangladesh Tea Research Institute
BTRP	Bangladesh Tea Rehabilitation Project
BTRS	Bangladesh Tea Research Station
CAL	Central Africana Limited
CB	Commodity Board
CBA	Cost benefit Analysis
CGIAR	Consultative Group on International Agricultural Research
CM	Council of Management
CRIS	Current Research Inventory System
CSIR	Council of Scientific and Industrial Research
DDR	Deputy Director Research
DMC	Duncan Macneill and Company Limited
DPA	District Planters Association
HRMD	Human Resource Management and Development
EC	Executive Committee
EEC	European Economic Council
FAO	Food and Agriculture Organisation
FSC	Finance Sub-committee

ICAR	Indian Council of Agricultural Research
ISNAR	International Service for National Agricultural Research
ITA	Indian Tea Association
ITC	International Tea Committee
JASS	Joint Area Scientific Symposium
KS	Kenyan Shilling
KTDA	Kenyan Tea Development Authority
KTGA	Kenyan Tea Growers Association
KVK	Krishi Vigan Kendra
MARRIS	Minnesota Agricultural Resource Allocation System
MB	Management Board
MIRR	Marginal internal rate of return
MIS	Management Information System
NASULGC -USDA	National Association of State Universities and Land Grant Colleges-US Department of Agriculture
NARS	National Agricultural Research System
NRI	National Resource Institute
NSF	National Science Foundation
NTRF	National Tea Research Foundation
ODA	Overseas Development Administration
OECD	Organisation for Economic Co-operation and Development
PDU	Project Development Unit
PTA	Pakistan Tea Association
PTRS	Pakistan Tea Research Station
RAC	Research Advisory Committee
RPC	Research Production Committee
RPSC	Research Production Sub-committee
TAM	Tea Association of Malawi
TRA	Tea Research Association

TRFCA	Tea Research Foundation of Central Africa
TRFK	Tea Research Foundation of Kenya
TRI	Tea Research Institute
TRIS	Tea Research Insstitute of Sri Lanka
TTAB	Tea Traders Association of Bangladesh
TTC	Tea Technical Committee
UPASI	United Planters Association of South India
VSC	Valley Scientific Committee
WAFRSN	West African Farming System Research Network

CHAPTER 1
INTRODUCTION

1.1 STUDY BACKGROUND

Agriculture is the mainstay of the economy in most developing countries. It provides employment and generates foreign exchange. As a result, developing countries need to focus on the agricultural sector as a means of achieving sustainable development. This requires continuous updating of existing technologies and evolving new country-specific suitable technologies and their effective dissemination among potential clients. It is beyond doubt that, like other sectors, any advancement in agriculture is not possible without adequate research.

Research is an original creative, intellectual and systematic activity which endeavours to discover new facts. It helps to increase knowledge and develop technology which contributes to the welfare of Mankind. Research may broadly be grouped in to two types. One is basic research, which is motivated exclusively by intellectual curiosity and helps to understand basic facts and broaden knowledge without immediate applicability. On the other hand, applied research is directed towards the solution of specific problems which have commercial objectives. The findings of basic research are used by applied researcher to develop new technologies.

Agricultural research embraces both basic and applied research. It is a costly activity, requiring specially trained human resources and other costly inputs. Developing countries usually put particular emphasis on agricultural research in order to achieve development objectives.

Natural resources are being rapidly depleted. There is a continuous and severe pressure on research to generate new technologies to satisfy the demands of a rising population in the face of limited resources. In response, agricultural R & D organisations have grown in size and complexity. Consequently, there is greater need for efficient R & D management.

At the same time, however, there is a gradual decline, shrinkage and tightening in research budgets, especially as many economies face recession. There is scarcity of resources in the public sector. Private sector clients are concerned about the justification of research spending and research payoffs. More and more questions are arising about the research management and resource accountability. International sponsors of research have become critical about research funding. They want greater transparency. While Governments are particularly interested on overall research benefits to the society, researchers are much interested in their specific area of interests and career building. Under such diverse conditions, there is a need to ensure that valuable resource are allocated and managed in such a way that benefits are maximised for each unit of resource utilised.

In order to justify benefits from research spending, to obtain and ensure continuous financial and technical support both from the donors and the Government, the performance of agricultural R & D organisations needs to be assessed and monitored. Furthermore, to identify what are the key deficiencies in management, performance needs to be assessed in order to rectify and improve them. But currently no such criteria, indicators and means of verification for performance assessment in agricultural R & D organisations are available. The situation in the plantation sector is similar.

However, realising these facts the International Service for National Agricultural Research (ISNAR) has made efforts to help in improving R & D management in developing countries. It formed eight task forces and developed some broad guidelines but no country specific studies were carried out. ISNAR did however suggest modifications according to country specific situations. These guidelines mostly represent the donor's point of view and interest.

Tea is one of the most popular and cheapest natural beverages in the world. Every day, a billion cups of tea are consumed around the globe. Tea drinking has been in vogue before the Christian era, and is deep-rooted in Chinese mythology. Since the fourth century tea drinking has been considered as a medicinal decoction exerting stimulating action on the human central nervous system.

Tea cultivation is considered as one of the most labour intensive agro-based industries. At present about 30 countries are known to grow tea over an area of almost 14 million ha. Total global production is 2.6 million metric tons of which more than 44% are exported from the country of its production. Consequently, in all most all tea producing countries, tea has become a major source of foreign exchange earnings and the single largest employer in the private sector. For example, in Bangladesh, tea is the second largest foreign exchange earner in the agricultural sector and single largest employer in the private sector. In Sri Lanka and Kenya, tea ranked top of the list among the foreign exchange earning commodities. While in India, tea industry is the largest and most remunerative private sector employer.

Research for the tea industry is mainly funded by clients through the cess from the industry. In addition, international donors and respective Governments provide substantial amounts of funds for tea R & D activities. Like other agricultural research, however, there is a general scarcity of resources against the objectives to be met. Donors, Governments, clients and beneficiary groups have become increasingly critical about the research spending, accountability and research benefits.

It is difficult to trace the actual record, where and when research on tea originated. However, records on the history of tea Research in Indian sub-continent date back as early as 1888, which were initiated by the Indian Tea Association at Calcutta museum. Gradually most of the major tea producing countries developed their own organisations to support research on tea. Currently in most of the major tea producing countries, research on tea is carried out by individual national research organisations. For example, in :

India: Tea Research Association; and,
United Planters Association of South India;
Sri Lanka: Tea Research Institute of Sri Lanka;
Malawi: Tea Research Foundation of Central Africa;
Kenya: Tea Research Foundation of Kenya;
Bangladesh: Bangladesh Tea Research Institute; and
China: China Tea Research Institute.

In addition, research on tea in Indonesia is carried out by the Research Institute for Tea and Chincona and in Japan by the National Research Institute of Vegetables, Ornamental Plants and Tea (NIVOT). Other than the respective national tea research institutes, some of the multi-national companies are also carrying out research on tea. Such as, Plant Breeding International at Cambridge, Ngwazi Tea Research Unit in Tanzania, Brooke Bond in Kenya.

Though there is some awareness about the need for studying the management of tea R & D, little or no attention has been attached to it. To date, no specific study has been undertaken to address tea R & D management issues. One of the limitations of carrying out such study is lack of standard criteria and methods that can be used to assess tea R & D management performance.

In this context there is a need to develop standard research management criteria and management systems under which management activities can be organised and carried out in a logical and sequential way. These systems are needed to assess the performance of tea R & D management to enable the justification for research spending and continuity of funding. There is particular need to develop tea R & D management guidelines and framework to help R & D managers to improve decision making in respect of: problem identification, priority setting and resource allocation, monitoring, evaluation and technology dissemination and feedback. For these reasons the following aims and objectives were identified for study.

1.2 AIMS AND OBJECTIVES

The aim of the study is to contribute to an improvement in the production and performance of the Bangladesh tea sector by developing guidelines for the improved management of tea research.

The objectives of the study are:

i) to develop criteria for assessing the performance of research management in tea;

ii) to develop guidelines for the management of tea research, including project identification, priority setting and resource allocation, implementation and subsequent technology dissemination; and

iii) to examine the likely impact of applying the guidelines on the management of research at BTRI, and make recommendations accordingly.

1.3 STRUCTURE OF THE THESIS DOCUMENT

The thesis document is divided into eleven chapters. Chapter 1 describes study background, aims and objectives of the study.

Chapters 2, 3 and 4 defines the study topic and review relevant literature. Chapter 2 focuses on different views of research and development, the interrelations between research and development, technology innovation and diffusion; the rate of adoption of technology and different factors that influence the uptake of new agricultural technologies. Chapter 3 reviews the planning, management and research project cycle, highlights the current situation in relation to agricultural R & D management, identify constraints and rationale for adoption of a structured management approach to improve agricultural R & D management. Chapter 4 concentrates on research project appraisal, especially priority setting and resource allocation in agricultural R & D. It examines different techniques, their relative merits and suggests the rationale for adopting a simple technique for quantification of research payoff.

Chapter 5 describes the methodology and procedures that have been developed and adopted for data and information collection, analysis techniques.

Chapter 6 reports on so-called ***Phase One*** case studies were used to describe current management systems. These assisted in the development of management criteria and a conceptual framework for analysis.

Chapter 7 addresses objective *one* of the study. It reports the developed research management criteria (systems), audit of best practices, conceptual framework, and objective verifiable indicators against research management criteria. Further, it describes the application of the developed scoring model and the means of quantifying the effectiveness of research management systems.

Chapter 8 applies the previously developed conceptual framework to a number of additional so-called ***Phase Two*** case studies namely:

Tea Research Institute of Sri Lanka,

United Planters Association of South India,

Bangladesh Tea Research Institute, and

Tea Research Association, Tocklai

Thus it shows how the conceptual framework can be used to assess the performance of tea R & D .

Chapter 9 satisfies objective *two* of the study. It suggests standard criteria and method for assessing the performance of tea research. Further, it suggests a model cycle for effective and efficient management of research projects. This consists of an innovation and a project cycle that emphasise the participation of clients for problem identification, prioritisation, evaluation, technology dissemination and feedback from the industry.

Chapter 10 addresses objective *three* of the study. It demonstrates the application of the developed model on BTRI, and in so doing identifies the advantages and limitations of implementing the research management model in practice. As a consequence of applying the model, some modifications were suggested in structure and functional approach for the present Advisory Division of BTRI.

Finally Chapter 11 reports the summary conclusions, recommendations for further work, scope, and ways and means of promoting the application of results out of this study.

The thesis is supported by a number of statistical appendices.

CHAPTER 2

RESEARCH AND DEVELOPMENT PROCESS: A REVIEW

This chapter deals with the different categories of research, their interrelations, the operational processes involved, the decision making levels, and implications of research output to different client groups, various factors that influence of the uptake of innovations.

The main focus of this project is to develop a system which will help to improve decision making in agricultural R & D organisational management. The core functions in any R & D organisation are conducting research, developing appropriate technologies and disseminating results and recommendations to the clients. In addition, most of the agricultural R & D organisations also provide training for extension agents and for client organisations in order to improve their understanding of new technology for easy adoption and dissemination. It is therefore important to know the different categories of research that are undertaken by research organisations. A clear understanding of their similarities, dissimilarities, their nature and importance and their inter relationships will all help the research manager to understand the nature of researchable problems. In addition this knowledge will help managers and others to decide the level of thrust needed between basic and applied research, and hence to develop a balanced research programme.

Proper planning is a key element in research management. It requires a clear understanding of the operational processes of research, and the different hierarchical levels involved in decision making. In order to foster the dissemination of technology effectively, a knowledge of the development process, and of the factors that influence the adoption of technology, and the context at which it will be used are necessary.

2.1 RESEARCH

The word research has been defined by authors in different ways. According to Klopsteg (1945) research is an original and creative intellectual activity, carried out in a laboratory, the library or the field, which endeavours to discover new facts and to appraise and interpret them properly in the light of previous knowledge. With constantly increasing understanding, it revises previously accepted conclusions, theories and laws, and makes new applications based on these findings. Whether it seeks to extend knowledge for its own sake or to achieve results with specific economic or social values, its primary purpose is to contribute to human welfare.

Later Hertz (1957) described research as the application of human intelligence in a systematic manner to a problem, the solution of which is not immediately available. This view was supported by Andrew and Hildebrand (1982) who described research as an orderly procedure by which Mankind increases its knowledge. This approach can be contrasted to an accidental discovery since it normally follows a series of steps previously specified for the purpose of developing new information. Similarly Roger (1985) described research as a systematic, careful inquiry or examination to discover new information or relationships and to verify as well as broaden existing knowledge for some specified purpose.

Though different people describe research in different ways the ultimate purpose of research is to increase knowledge, to solve problems, and to develop technology for social development to enhance the survival of Mankind on this earth.

2.1.1 BENEFICIARIES (CUSTOMERS)

Although farmers use the technology, the ultimate beneficiary from agricultural research should be society. Farmers utilise the findings of research and transform the findings into usable products. Cultivators can be grouped in to two broad categories: annual crop / field crop farmers, and perennial crop / plantation crop farmers (Herren and Donahue, 1991).

Plantation crops

As this research is particularly aimed at plantation crops, a brief literature survey is appropriate at this stage in order to define the meaning and characteristics of plantation crops, to help in designing appropriate research programmes.

Binns (1955), as cited by Goldthorpe (1983), reported that the Food and Agriculture Organisation (FAO) monograph on plantation agriculture described 'plantation' as a vague and unsatisfactory word. Grigg (1974) supported this idea.. In addition he suggested the use of the term plantation crop, to distinguish between plantations and smallholdings. However, Goldthorpe (1983) reported that some authorities used the term plantation agriculture to cover the culture of perennial crops in the tropics irrespective of the size of farm. For example, Ruthenberg (1980) defined a plantation as any land which is planted with perennials.

In Bangladesh the term plantation /estate /garden is used simultaneously to specify the cultivation of perennial crops such as tea, rubber and coffee in a large production unit. On the other hand Goldthorpe reported that in Sri-Lanka and India the word estate is used to describe only tea plantations, but not for other large scale plantations. Further he suggested the term estate is used by non-Americans to denote large scale farms growing any perennial crops.
From the literature review one general conclusion can be drawn: ***the term plantation refers to the cultivation of perennial crops in a large area.***

Characteristics of plantations

Many agricultural geographers have studied plantation agriculture including Church (1969), Courtenay (1965; 1970), Grigg (1970; 1974) Jackson (1969), Morgan and Munton (1971). They have summarised the characteristics of plantation crops as follows:

- is highly organised large scale mono-culture production of mostly perennial crops;
- *the management of the production process is centrally controlled in a bureaucratic manner, where internal communication is vertical;
- crops are cultivated mainly for commercial purposes for which standard agricultural practices are adopted;
- the crop is processed before leaving the plantation;
- the working force, including management are provided with housing, food, education and medical facilities on the plantation;
- because it is a commercial, highly organised and centrally controlled production system, the diffusion of technology is relatively rapid;
- *a large working force is deployed, with a sharp division of labour based on different cultural operations. For example, in the tea industry some labour is skilled in pruning, planting, plucking, and others in different factory operations;
- * large scale investments are required.

(* not applicable for smallholders)

Depending on the size, tea plantations can be divided into estates and smallholdings.

Smallholders

There is no common definition of smallholders. Categorisation based on the quantity of land possession varies from country to country, which depends on the Government policy. For example, in Sri Lanka tea smallholders could be any farmer having less than 10 ha (Kulatunga, 1995). On the other hand in

Kenya smallholders are those individual farmers with an average holding of about 0.6 ha (Ng'etich, 1995). However, the Oxford Advance Learners Dictionary described smallholders as owners or tenants of a piece of land usually ranging from 1 hectare to 50 hectares (Hornby, 1989).

Estates

By comparison an estate is described as a large area with one owner, developed for a specific purpose. As a group both estate and smallholdings have some distinct features of their own. However, there is a wide range of variation to be found with smallholders: for example, most are resource poor, while others are not. But estates are generally resource rich and homogenous in character in most respects. As potential research beneficiaries, it is important to define the group characteristics of smallholders and estates. At the time of research planning, technology development and validation due consideration must be given to the development of technology appropriate to specific target groups. For example, a high yielding variety which is not drought resistant, and requiring irrigation cannot be cultivated successfully by resource poor smallholders situated in drought prone areas.

Policy makers

To know how policy makers benefit from R & D, it is essential to understand how R & D policies are formulated and executed at a national level. In particular:

- how does a national agricultural system operate (particularly programme formulation, implementation and communication of results) ?;
- how are decisions taken ?;
- what levels of management are involved ?.

Dagg and Haworth (1988) illustrated the planning and programme formulation process for national agricultural system (NARS) as follows (Figure 2.1)

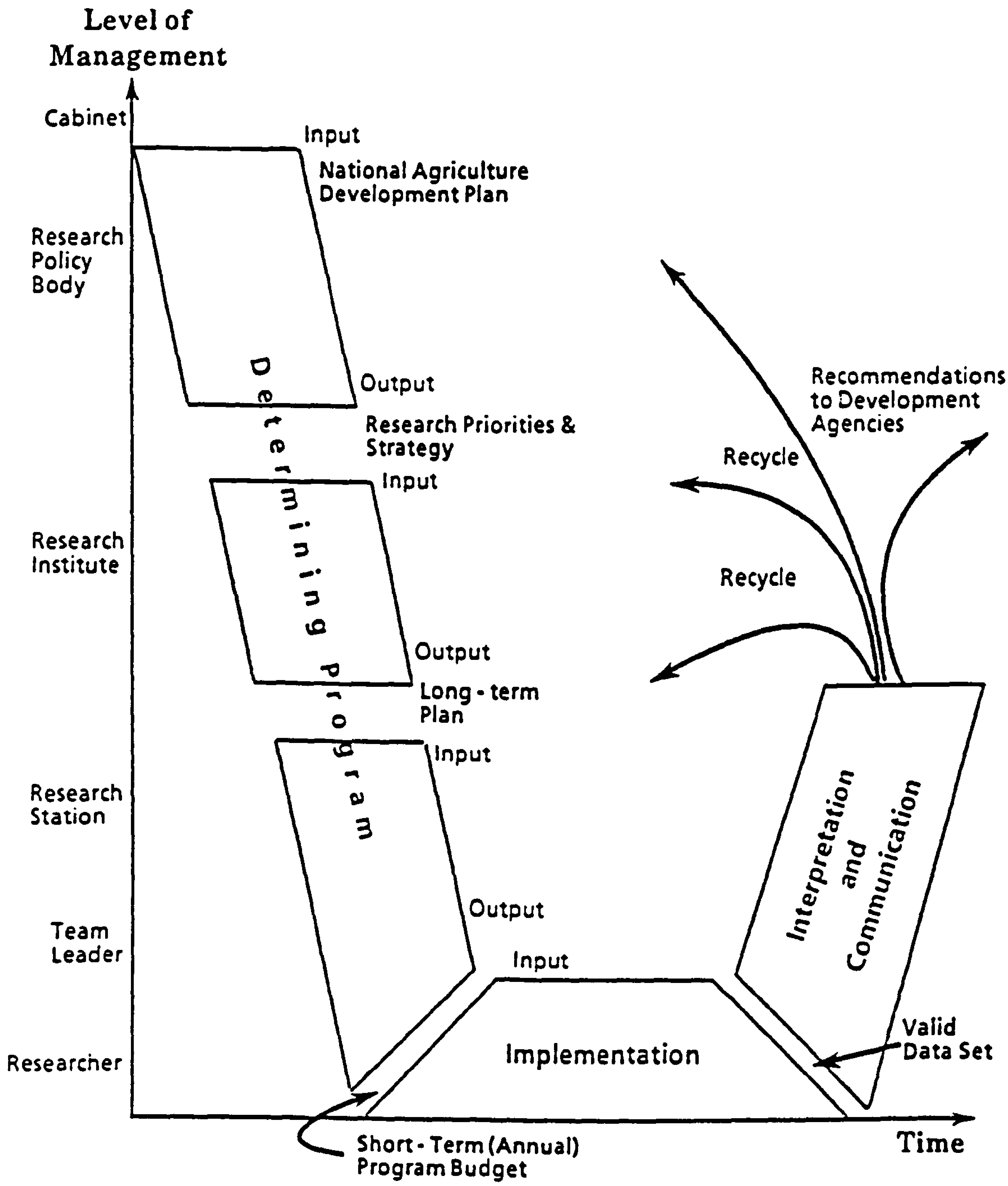


Figure 2.1 The national agricultural research process (Source: Dagg and Haworth, 1988).

The process is divided into three parts:

a) programme determination,

b) implementation, and

c) interpretation and communication of conclusions.

Programme determination entails three levels of decision making at three stages, such as policy level, institution level and research station level

Decision at the policy level: in formulating the national agricultural research programme, the process begins at the highest political level in the parliament / cabinet and ministries. At the cabinet level national development goals are determined and policy guidelines are established. At the Ministerial level, sectoral objectives are defined in accordance with the national guide-lines. Decisions on broad priorities and allocation of resources with respect to commodities, production factors, and regions are taken.

Decision at the institution level: policy guide-lines are translated into institutional goals and research programmes are established accordingly. Decisions on long-term or medium / short term research plans within a commodity or factor are established.

Decision at the research station level: department and individual researchers are involved at this level. Institutional goals are translated into specific projects and annual programmes are developed and carried out by the researcher.

Though decisions are taken independently at different levels of management, there is a logical sequence, continuity and consistency in this process. Javier (1987), and Dagg and Haworth (1988) reported that in the research process at the national level, one level of management feeds information to the other management level sequentially in both directions until a final decision is reached. Figure 2.1 also illustrates how each of the higher levels is an input to the decision making process. At the final stage research is completed, results are interpreted and conclusions are drawn. Later when a review is carried out, conclusions and recommendations become inputs to the whole review process to back up the sequence to the policy level.

National level

Policy makers derive benefit from R & D when the flow of information occurs in two ways. From the bottom level (i.e. from the research station and institute) information regarding research constraints, farmers circumstances and attitudes towards technology and knowledge about the problem to be solved are transmitted upwards to a higher level. The policy makers then take into account this knowledge and decide what needs to be done to plan future activities. They can then determine what should be the real priorities in-light of the feed back received.

Organisation level

At the organisation level, senior research managers and project or programme managers are involved in decision making. Primarily their decisions are concerned with selecting and designing new programmes (for example the Uganda Working Group, 1991).

An organisation uses the evaluation reviews to determine which programmes need to be strengthened, modified or deleted. Evaluation reviews carried out on a regular basis are of particular value to this group. Project or programme managers within the research system can use monitoring and evaluation information from on-going research projects to assess the progress, and can then identify problems which may hinder the performance. If these are known corrective measures can be taken. The organisation also benefits by reviewing what has been done and what needs to be done to achieve the organisational goal. In particular monitoring and evaluation provides information about the whole research management process to the concerned authority, namely policy makers both at national and organisation levels.

Donor agencies

The Uganda Working Group (1991) reported that donor agencies play a vital role in supporting agricultural research in developing countries. They can be benefited by utilising the information from R & D monitoring, evaluation and programme review to compare and justify their investments. Research programme reviews can also help to identify areas that are weak and / or need strengthening, where donor assistance can play a strong role. Besides directly supporting agricultural research, donor and technical agencies can also help agricultural research networks. For example, the West African Farming Systems Research Networks (WAFRSN) exchange the latest information and knowledge between members (Burley, 1987; Plucknett, Smith and Ozgediz, 1990 and Eyzaguirre, 1993). Such networks also benefit from R & D monitoring and evaluation from specific countries.

Agribusiness sector

One of the rapidly expanding areas at present involves multinational companies which are investing large amounts of money to develop new agro-chemicals, farm machinery and biotechnology. They have their own R & D, however they also need country specific research information to augment their business policy, which they obtain from different national agricultural research organisations.

2.1.2 TYPES OF RESEARCH

Like the definitions of research there is variation regarding the classification of different types of research. Bonnen (1986) classified research in two main categories: basic and applied. He further divided applied research into adaptive research and maintenance research. In the same study he suggested that basic research develops disciplinary knowledge whilst applied research develops subject matter knowledge which is later used in problem solving. Smith (1990) in his study on the origin of UK based irrigation research reported that Irvine and Martin (1984) identified three types of research; basic and applied or tactical and or experimental development. They further divided basic research into pure or curiosity-oriented research and strategic research. The categorisation of different research activities along with main performers are outlined in Table 2.1.

Basic research

Research which is motivated primarily or exclusively by intellectual curiosity and an interest in the studies of the laws of nature for their own sake, without regard for the immediate applicability of any findings that may be reached (National Science Foundation, 1959). Later, basic research was defined by Kornhauser (1963) as research that is carried out only to extend the range of scientific knowledge or as free enquiry into nature. He further described this type of research as uncommitted research, which is prompted by disinterested curiosity and is aimed primarily towards the extension of knowledge.

Similarly, Wortman and Cummings (1978) described basic research as the process in which knowledge is developed with no pre-determined use in mind. They pointed out that it is an important category of research on which all supporting, strategic, tactical and operational advances depend. Basic research has also been defined as experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view (OECD, 1981).

In basic research properties, structures, and relationships are analysed with a view to formulating and testing hypotheses, theories or laws. It is usually undertaken by scientists who may set their own goals, and to a large extent, organise their own work. However, in some instances basic research may be oriented or directed towards some broad fields of general interest. Such research is sometimes called "Oriented basic research" (OECD, 1981).

Applied research

The National Science Foundation (1959) defined applied research as research which is directed towards the discovery of new scientific knowledge, and which has specific commercial objectives with respect to either product or processes. Applied research is usually committed to the search for a solution to a specific problem (Shepard, 1956; NSF, 1959). Applied research is an original investigation undertaken in order to acquire new knowledge. It is however, directed primarily towards a specific practical aim or objective (OECD, 1981).

Applied research is undertaken either to determine possible uses for the findings of basic research, or to determine the new ways of achieving some specific and pre-determined objectives. It involves a consideration of the available knowledge and its extension in order to solve particular problems. In the business enterprise sector, the distinction between applied research will often be marked by the creation of a new project to explore any promising results of a basic research programme.

The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. Applied research develops ideas into operational form. The knowledge or information derived is often patented but may also be kept secret (OECD, 1981).

Table 2.1 Nature of R & D activities and their main performer(s)

Nature of R & D		Main performer (s)
Basic research: Original investigation with the primary aim of developing more complete knowledge or understanding of subject (s) under study	Pure or curiosity-oriented research: basic research carried out without working for long-term economic or social benefits other than the advancement of knowledge, and no positive efforts being made to apply the results to practical problems, or to transfer the results to sectors responsible for its application	Normally (together with teaching) the main function of the academic university based research systems
	Strategic research: basic research carried out with the expectation that it will produce a broad base of knowledge likely to form the background to the solution of recognised current or future practical problems	Carried out in universities and Government laboratories as well as in the most larger science based companies (in which it typically accounts for no more than 5-10% of the R & D budget).
Applied or tactical research: original investigation undertaken in order to acquire new knowledge, and directed primarily towards specific practical aims or objectives such as: determining possible uses for findings of basic research or solving already recognised problems.		Mainly carried out by industry and laboratories of mission-oriented Government agencies, although also undertaken (under contract or as part of targeted Government research programmes) within the academic research system.
Experimental development: systematic work drawing on existing knowledge gained from research and / or practical experience that is directed towards producing new or improved materials, products, devices, systems or methods, including design and development of prototypes and processes.		Overwhelmingly carried out in industry (where it typically accounts for 80-90 % of company R & D budgets) and in mission-oriented Government agencies (often where the estate is also the customer for the final envisaged product, such as advanced military hardware).

Source: Irvine and Martin (1984).

Arnon (1989) reported that these variations are mainly due to confounding the nature of the research with the motivation of the research worker.

2.2 DEVELOPMENT

This is the effort by which new ideas, concepts, principles or technology, which have evolved from applied research or from other sources, are transformed into new or improved products, materials, devices, systems, methods or processes. OECD (1981) reported that experimental development is systematic work drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products, and devices; to installing new processes, systems, services; and to improving substantially those already produced or installed.

Later Arnon (1989) defined development as a technical activity concerned with solving non-routine problems encountered in translating research findings or other general scientific knowledge into products or processes. According to Roman (1968) the development phase includes new product evaluation, design engineering, and the investigation of advanced manufacturing and quality control techniques, processes and equipment. He further concluded that development does not include quality control, routine testing for manufacturing control purposes, field testing normally required for customer acceptance, market research, sales promotion, sale services or other non-technical activities or services.

In plantation agriculture, the development process sometimes starts before the experimental findings have been confirmed. Some of the clients who are in constant touch with a research institute, may obtain the information in advance and try to use it on their estate. However, the general rule is that once a promising result has been obtained from a research programme the next step is to find out how consistent are these results over a large area. At the same time, results are tested at different locations to find the response under different agro-climatic zones. When the results at all locations appear to be consistent and worthwhile, recommendations are made to the industry, and efforts are made to disseminate the technology.

2.2. 1 RELATIONS BETWEEN RESEARCH AND DEVELOPMENT

Irrespective of the nature of an organisation (e.g. industry or an agricultural research institute), research and development (R & D) is a continuous process. Research findings initiate the development process. Research, either basic or applied, generates knowledge. This knowledge is ultimately transformed into technology. During the development phase the knowledge is developed into a technology package and into usable products. Commercial exploitation and ramification also occurs. Knowledge is taken to the door of the end user. It is obvious that there is a clear relation between research and development and knowledge (Bonnen, 1986, Figure 2.2).

Models for the research and development process

To express the relation between R & D processes Wise, Beak and Upton (1988) put forward two different models, the linear and interactive views.

The linear view (Figure 2.3) is simple. An idea is generated first, its investigation consequently leads to applied research, and finally it passes into the development phase during which the practicability of exploitation on a commercial scale is explored. This whole process is supply driven. There is no feed back to the basic research from the applied phase. Even in the applied phase, if any new idea or investigation is needed , there is no provision to carry this out.

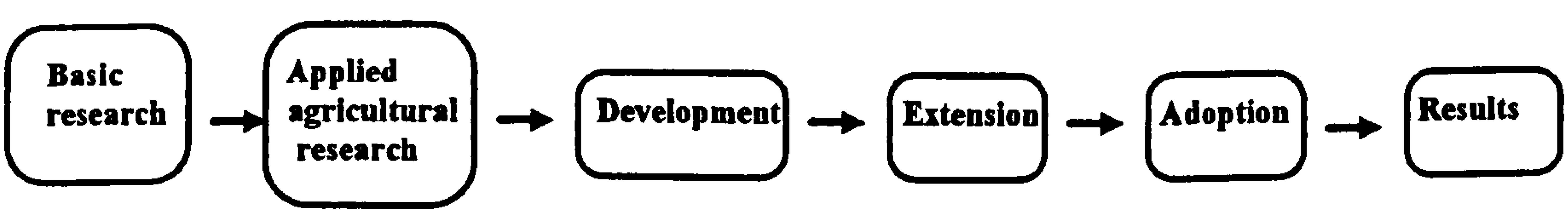


Figure 2.3 Research and development process: Linear view (Source: Wise *et al.*, 1988).

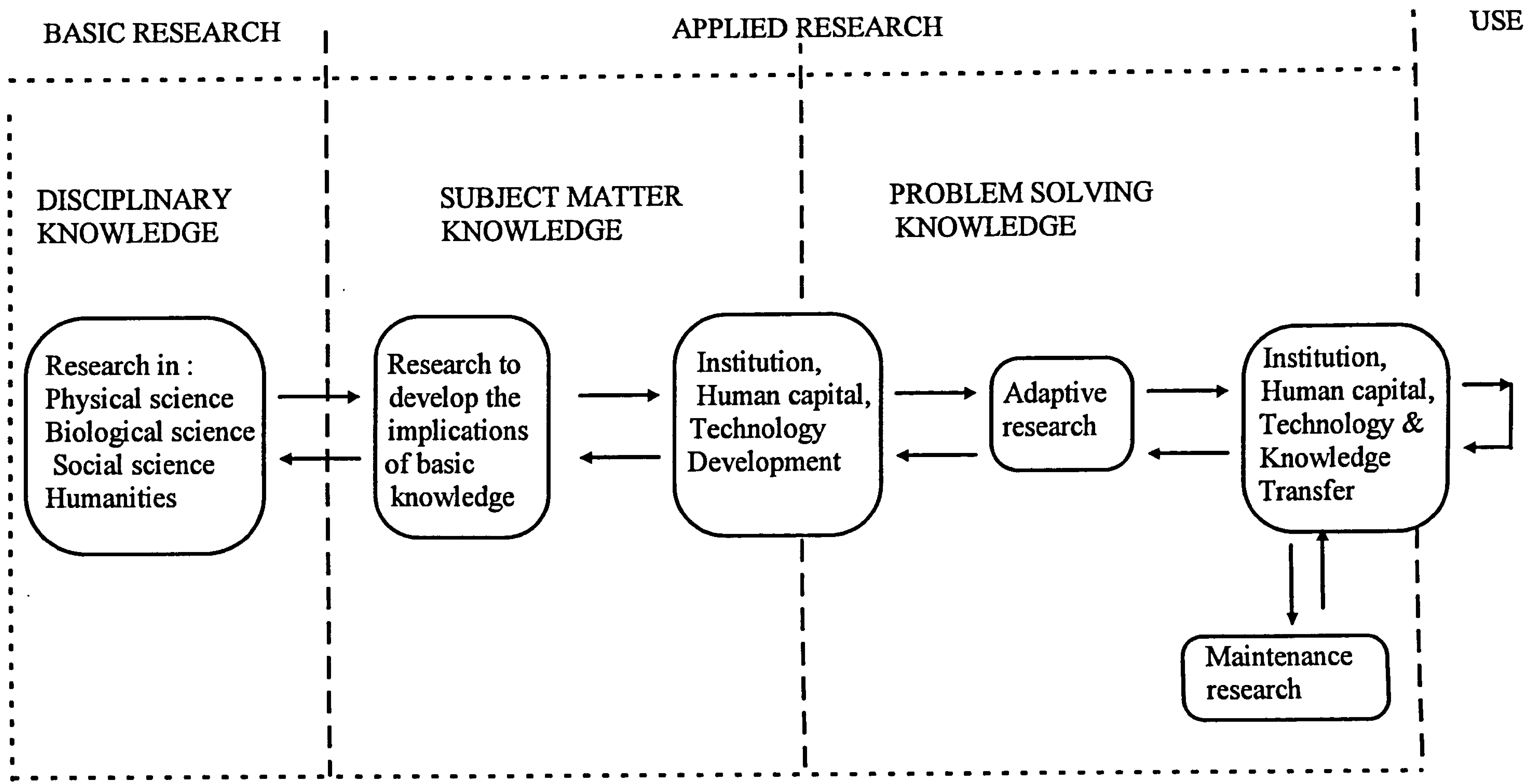


Figure 2.2 The relation between research, development and utilisation of knowledge (Source: Bonnen 1986).

By comparison the interactive view is expressed in terms of both the supply of and the demand for knowledge, resulting a good feedback between the different R & D phases (Figure 2.4). An interactive view may be criticised on the grounds that new ideas do not always arise from basic research. Moreover the demand and supply functions may not operate at all the stages of a research process. Though both definitions can be criticised as inadequate representations of the R & D process, they do illustrate some of the key components that need to be considered.

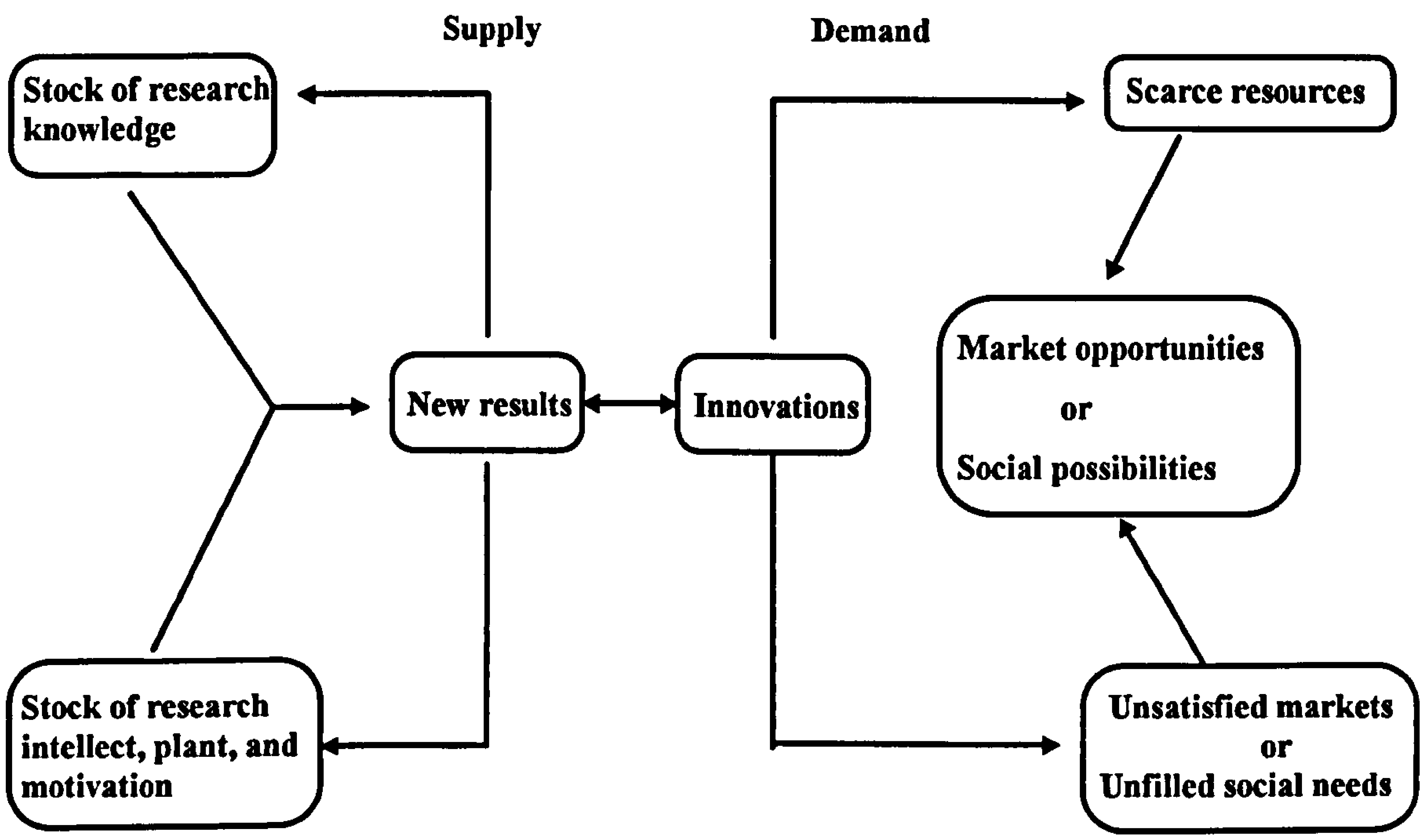


Figure 2.4 Research and development process: Interactive view (Source: Wise *et al.*, 1988)

However, the same study concluded that the general consensus is that neither of the models is an adequate representation of the research system. It is not always necessary for ideas to arise from basic research only. For example, during the development phase of a technology new scientific aspects might be revealed which demand investigation if the process is to be successful.

Since both the Linear and Interactive views do not explain the complete relation of R & D models a new modified view has been put forward by the author (Figure 2.5). According to this view, an idea is generated first, investigations are carried out which lead to the applied research from which technology is developed. If any pertinent points arise during the course of applied research, which need further research, basic research may be undertaken to seek the answer. Similarly, during the technology development and implementation phase if any new ideas or problems arise, they can be referred back to basic research, where solutions can be identified. Thus the new model enables strong feedback between different R & D phases, the main weakness in the Linear model. On the other hand it overcomes the limitation of demand and supply function operation constraints of the Interactive model.

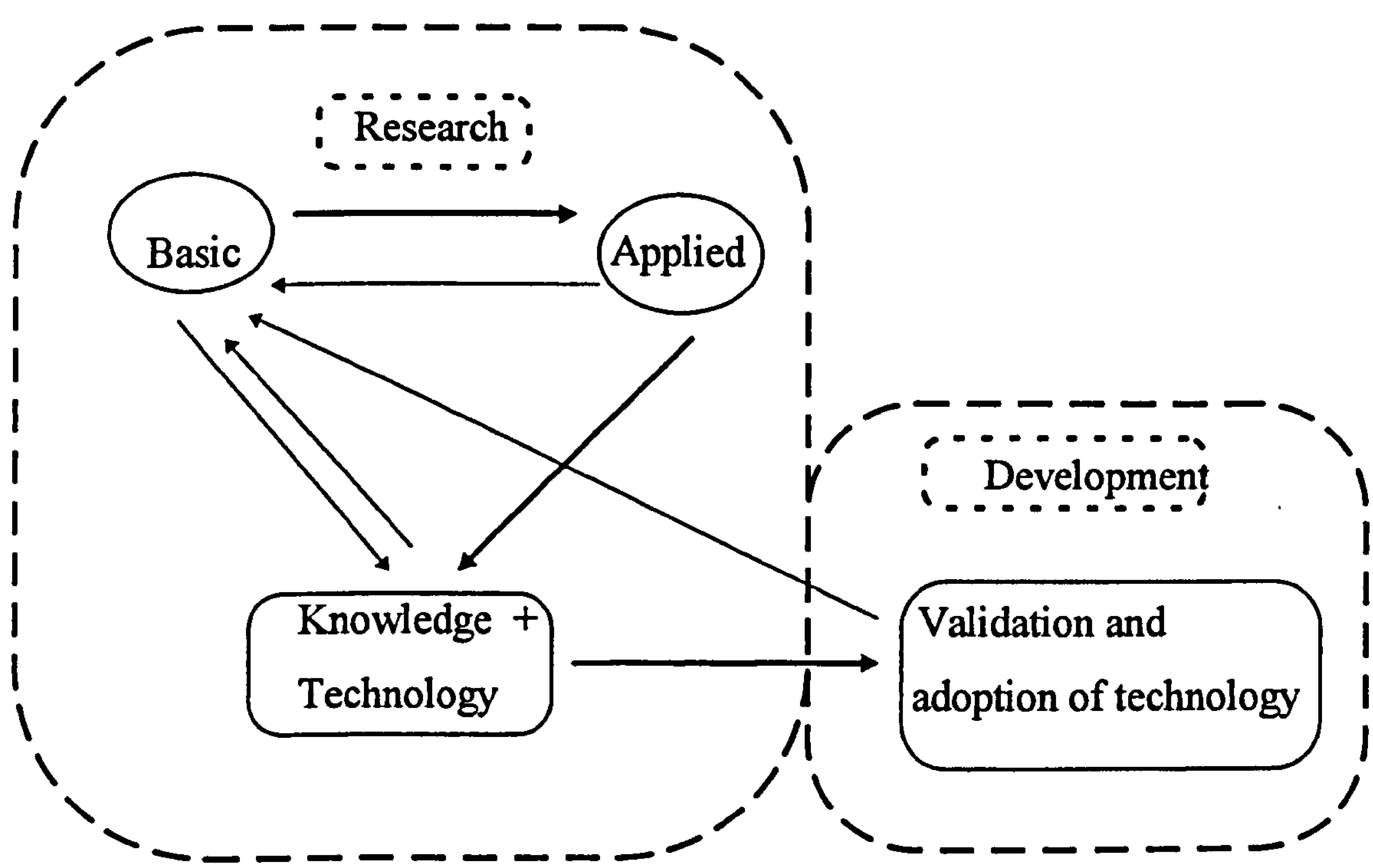


Figure 2.5 Research and development process: modified view

2.3 AGRICULTURAL RESEARCH

Agriculture is by far the most important sector in developing countries. For example, Drilon and Librero (1981), Nickel (1989), reported that it provides food, fodder, fibre, fuel, shelter and medicine. It also facilitates employment and generates foreign exchange. This foreign exchange in turn is used to procure other capital goods for the development purpose. Consequently, agricultural development has often become the key focus in the process of economic development. Similar views were also expressed by Schuh (1991). He further described agricultural progress as the engine which drives economic development in developing countries.

Historically growth in agriculture has passed through stages. In the past agricultural production was increased largely by expanding the area under cultivation. Evenson *et.al.*, (1979) and Judd *et.al.*, (1987) reported that this option has been largely exhausted. At present where such expansion takes place, it is often into marginal lands, frequently in fragile ecosystems. Similar views were expressed by Byerlee (1988) and TAC (1990). They further reported that in many of the favourable environments, cereal grain yields appear to have reached their ceiling. Moreover intensification of production on existing land through the increased use of purchased inputs is an option frequently unavailable to farmers with limited resources (Nickel, 1989; 1987). In addition there is a gradual decrease in productive agricultural land because of urbanisation and ecological degradation (Anderson, 1991; El-Swaify, 1991; TAC, 1990). These factors are all hindering increases in agricultural productivity.

On the other hand the human population is increasing rapidly especially in developing countries. This ever increasing pressure of population has become a challenge to the scientific community and begs the obvious question of whether agricultural production can continue to cope with the expanding demand for food, fodder, fuel and fibre.

It is undeniable that increases in agricultural production is required to meet these demands. Future increase in production will have to come entirely from increases in productivity (Nickel, 1989). This cannot be achieved by traditional practices. Traditional systems although stable are not sufficiently productive.

To have a productive agricultural system technologies must be continuously updated through research. In developing countries higher productivity is essential for survival, while in developed countries it is required for sustainability. To achieve the goal of rapid sustainable increase in agricultural production, to alleviate hunger, poverty and malnutrition in developing countries, advancement in agricultural technology is essential. This advancement very much depends on relevant local agricultural research (Arnon 1989, Nickel, 1987;1988).

Agricultural research is an example of where basic, applied and adaptive research are carried out simultaneously. For example, the Agricultural Research Council (ARC) in 1967 reported that agricultural research in the UK is mission oriented and includes both basic and applied research, which together contribute to the solution of practical problems .

Later, Mallick (1988) described agricultural research as work seeking answers to the questions related to production, processing and marketing of particular products; increasing productivity, employment, income, cheaper food for consumers and providing in general a better quality of life for the farming population. Similarly Arnon (1989) defined agricultural research as research which involves using a wide range of scientific disciplines in the development of new approaches to agricultural production.

According to Aldrich (1966) the mission of agricultural research is:

- to apply all possible sources of scientific discovery to the solution of the technical practical problem of agriculture;
- to engage in basic research where the lack of fundamental knowledge may impede progress.
- to solve the specific problem in agriculture.

Arnon (1987) summarised the objectives of agricultural research as follows:

- to increase productivity by increasing production per unit area of land or animal by overcoming limiting factors.
- to increase efficiency through mechanisation.
- to increase the stability of production through the adoption of high yielding varieties resistant to pest, disease, nematodes, and immune to unfavourable environmental conditions.
- to improving quality in respect of nutrition and appearance in order to realise high market value through improved production techniques.
- to avoid environmental pollution.

Arnon (1989,1975,1968) summarised the basic characteristics of agricultural research as follows:

- it is multi-disciplinary in nature i.e. the solution of a problem involves using a range of scientific disciplines.
- it is regional in character: not only does the application of basic research findings require investigation under a wide variety of ecological conditions, but it is also often required to solve problems of regional significance.
- it is international in character, for example, there is an interaction between people and the exchange of research results, ideas, information, expertise, and, for example genetic material from different countries in order to identify solutions to problems.

The interdependence of various fields of agricultural research is a source of organisational difficulty that can only practically be overcome by team work.

2.3.1 TECHNOLOGY INNOVATION AND DIFFUSION

The ultimate aim of research is to generate knowledge, to solve problems and to develop technologies according to the need of the society or clients. Research particularly in tea, is a long, continuous and costly activity. As such, the potential of any technology generated through research must be fully utilised. Otherwise it can be a costly waste of resources.

To derive the full benefit from a technology package, the results of research have to be transferred among the potential client groups. For effective diffusion and transfer, it is important to know the different attributes and factors that influence uptake. A good understanding of all the influencing factors also helps to tailor the technology according to the needs of clients and to guide future research in ways which will best serve the clients.

Understanding and quantifying the rate of uptake of the results of research can also be used to assess the financial return from a particular research programme. In order to understand and to discuss the transfer of technology, it is important to specify what is meant by the following terms: innovation, technology, diffusion of technology and transfer of technology .

Innovation: according to Ban and Hawkins (1985) innovation is an idea, method, or object which is regarded as new by an individual, but which is not always the result of recent research .

Technology: on the other hand Mogavero and Shane (1982) defined technology as specialised knowledge applied to achieving a practical purpose. In Section 2.1 technology was described as the ultimate result of applied research.

Diffusion of technology: Arnon (1989) stated that this is the act of making new technology known to the potential adopters.

Technology transfer: Kleiman and Jamieson (1978) stated that "technology transfer is a chameleon like process for differing applications, environments, participants and problem areas. It rewards many human endeavours, easily crossing internal and cultural boundaries". Similarly Press (1979) gave another simplified definition of technology transfer. He defined the process as the moving of research and development results out into the communities, in the country of origin and abroad.

Later Harvey Brooks (cited in Mogavero and Shane, 1982) described "technology transfer as the process by which science and technology are diffused through human activity. Whenever systematic knowledge developed by one group or institution is embodied in a way of doing things by other institutions or groups, we have technology transfer".

From the literature it appears that different people have described technology transfer in different ways. For this project the following simplified definition will be used.

Technology transfer may be regarded as the process by which knowledge of practical utility (in the form of technology) is diffused and / or transferred to the society or end user for whom it has been developed.

Also important is the rate at which an innovation is adopted by members of a social system. It is generally measured as the number of individuals who adopt a new idea in a specific period, expressed as a percentage (Rogers, 1983).

This approach can be criticised on the grounds that there are certain technologies for which it is not appropriate to quantify in terms of the number of adopters. For example, compare 60 smallholder tea farmers with a total of 50 hectares of land with one large estate with 500 hectares. In this situation if a new technology "A" is accepted by all the smallholders but not by the estate, the rate of adoption if measured by the number of adopters will be 98.36%, whereas only 4.76% of the area of tea has been covered.

This example clearly indicates that in agricultural technology the rate of uptake cannot be measured only by looking at the number of adopters. For a perennial crop like tea, where the potential cultivable area is known, the rate of adoption of a particular technology may be best measured by the percentage of the area under the new technology compared with the total target area over a specific time period.

The following parameters may also be used to measure the rate of uptake of a particular technology:

- increases in yield per unit area
- increases in the total export / import (or consumption) of a particular agricultural product / input because of technical recommendations. For example, because of the adoption of new fertiliser recommendations, there is an increase in fertiliser use, which results in an increase in imports.
- increases in profits through reduced costs of production.

When the rate of adoption of a new technology is measured as the percentage of people who have adopted an innovation over a period of time, the results can be expressed as a graph (Rogers, 1983). Where the number of (or percentage) adopters is plotted against the time, since the innovation was released. The shape of the curve is usually in the form of an S (Figure 2.6a and 2.6b). The steepness of the S curve will vary depending on the stage of diffusion and adoption, and when the data are collected.

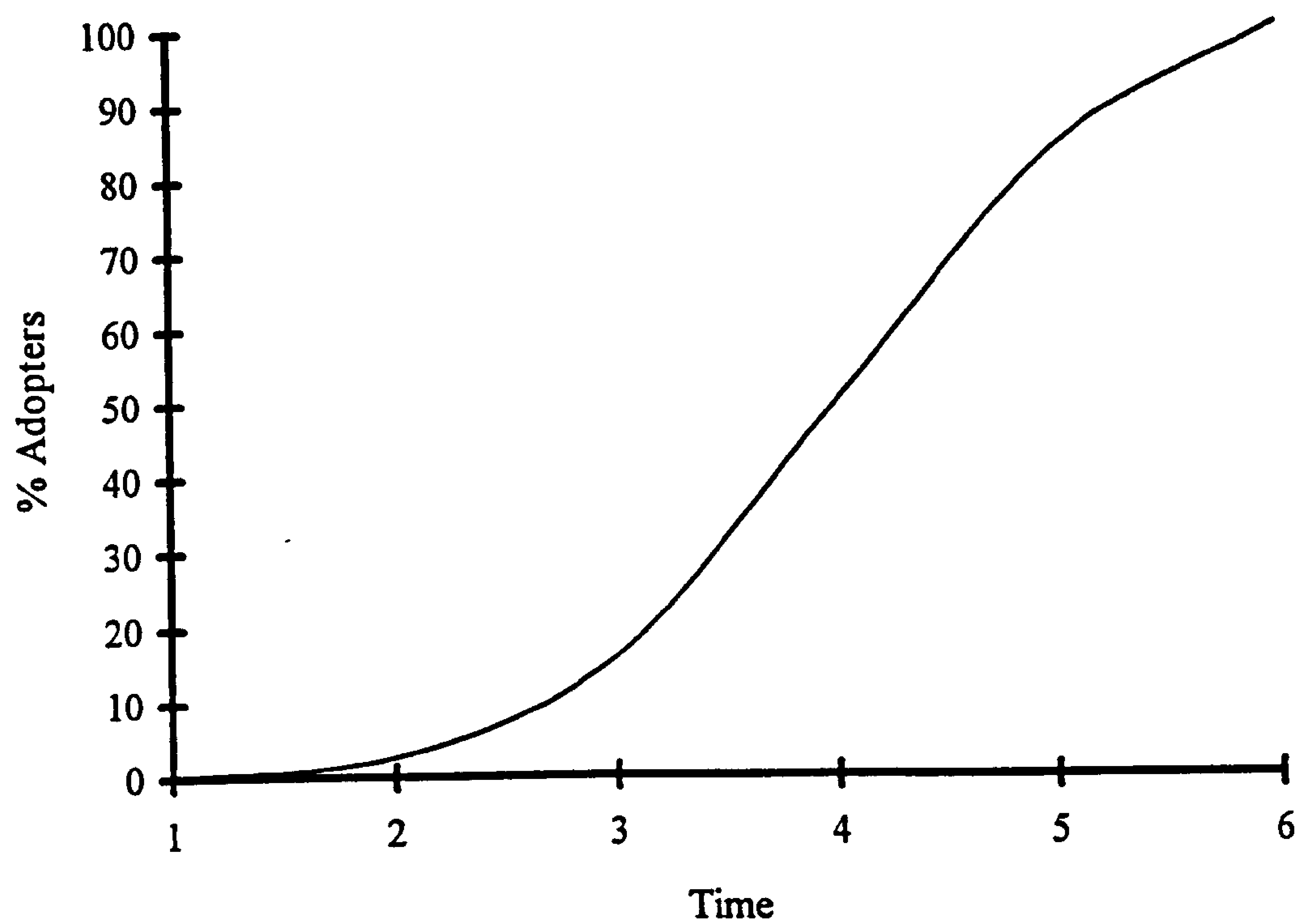


Figure 2.6a "S" shaped cumulative adoption curve of an innovation over time since release of a technology

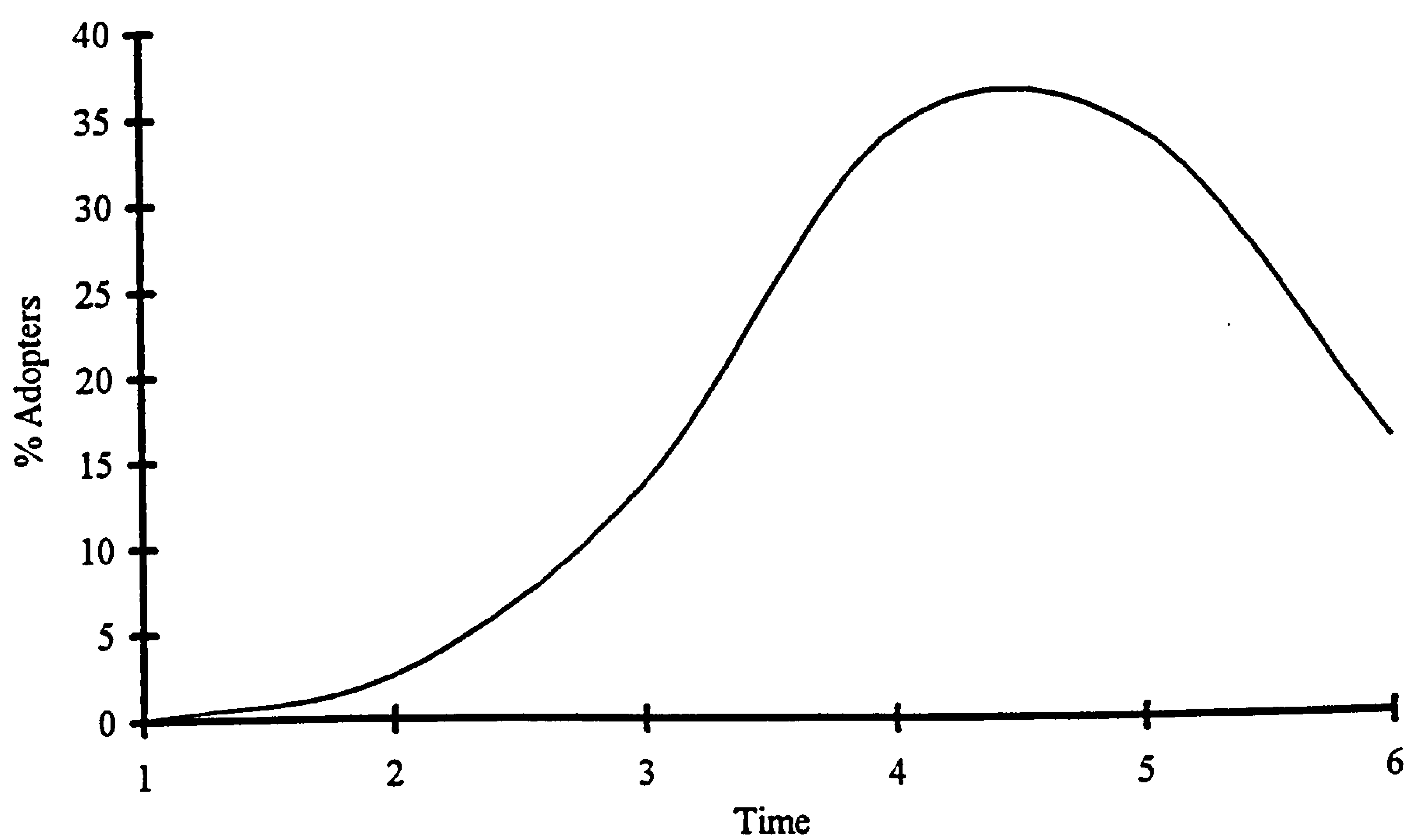


Figure 2.6b Bell shaped adoption curve of an innovation in terms of individual adopting since release of a technology

Diffusion and adoption of any technology is a long and continuous process. Its rate of adoption will vary among the members of a social system. Some people readily accept a new idea before others. Many investigations have been carried out to understand and explain this differential behaviour. Instead of studying each and every innovation individually, most of these investigations have combined a sample of several innovations into an 'adoption index' (Rogers, 1983).

Adopters can be divided into the following five categories:

		$\sum$%
a) Innovators	2.5 %	2.5
b) Early adopters	13.5 %	16.00
c) Early majority	34.00 %	50.00
d) Late majority	34.00 %	84.00
e) Laggards	16.00 %	100.00

According to this concept, an innovation is first adopted by a very small group of people, who are known as 'innovators'. They are sufficiently educated to realise the potential value for profit of the innovation, have money to invest in the inputs required, and can afford to take any risks involved in adopting the new technology. If the innovation process is successful, the innovators are followed by 'early adopters'. As time passes, the new technology spreads at an accelerating pace. The early adopters are followed by the 'early majority' and then by the 'late majority'. Those who are last to adopt a new technology are termed 'laggards'. Laggards are usually the poorest, eldest, most conservative and the people most averse to taking risks.

Engel (1976), as cited by Arnon (1989) explained adoption behaviour in a different way from Rogers (1962), particularly about innovators and laggards. From his analysis he concluded that it is the access to resources by farmers which determines the rate of adoption of a new technology. Instead of the innovativness of 'early adopters', it is their access to the necessary resources which helps them to be 'early adopters'. Similarly 'laggards' are people with little or no access to resources.

Studies on farm size and adoption behaviour of new wheat and maize cultivars have been conducted in a number of countries. For example, Perrin and Winkelman (1976) found that the adoption rate between large and small farms areas in Africa, Latin America, India and Turkey could only be partially explained by the differences in access to information, availability of inputs, marketing facilities, farm sizes and aversion to risk. The study also showed that the most persuasive factor was the difference in expected yields. Adoption accelerated only when significant increases in yield could be made in the agro-climatic environment of those farmers presently not adopting.

In order to ascertain as well as to explain the rate of adoption of technology, a number of studies of the relation between characteristics of an innovation and its rate of adoption have been made. Some of these were conducted with farmers by Rogers (1983), Elliot (1968), and Kivlin (1960) which found that the following five attributes of the technology, which are empirically interrelated but conceptually distinct, played an important role in rates of adoption:

- Relative advantage,
- Compatibility,
- Complexity,
- Trialaibility, and
- Observability.

In addition Holloway (1977) suggested that another attribute, status conferring, was important particularly for predicting the uptake of a new innovation in education.

Relative advantage

This is the degree to which an innovation is perceived as being better than the idea it supersedes. There are a number of sub-dimensions of relative advantage: the degree of economic profitability, low initial cost, a decrease in discomfort, savings in time, and the immediacy of the reward. From a number of studies, Rogers concluded that, the relative advantage of an innovation, as perceived by members of a social system, is positively related to its rate of adoption.

Compatibility

This is the degree to which an innovation is perceived to be consistent with the existing values, past experiences, and needs of potential adopters. An innovation can be compatible or incompatible with:

- socio-cultural values and beliefs
- with previously introduced ideas, and or
- with client needs for innovations

Complexity

This is the degree to which an innovation is perceived as relatively difficult to understand and use. Any new idea may be classified on the complexity and simplicity continuum. Kivlin (1960) found that the complexity of farm innovations for example were more highly related to their rates of adoption than to the many other characteristics of the innovation except relative advantage. Similar results have been reported by Singh (1966) in Canada and by Petrini (1966) in Sweden. It is more likely that an innovation which is relatively simple will be more readily accepted and implemented in a society.

Trialability

This is the degree to which an innovation may be experimented with on a limited basis . Farmers will be more inclined to adopt innovation which they have tried first successfully on a small scale on their own farm, than those which they have to adopt immediately on a large scale.

Observability

This is the degree to which the results of an innovation are visible to others. If farmers find that one of their colleagues has adopted an improved technology and they observe that it performs well, they will certainly be influenced to adopt the new technology.

In addition to the above, Rogers (1983) has also listed the following variables which affect the rate of adoption of an innovation:

- the type of innovation decision;
- the nature of communication channels;
- the nature of the social system, and
- the nature of the change agents promoting the innovation.

2.4 CHAPTER SUMMARY

Most of the developing and under developed countries are dependent on advancement in agricultural technology for their economic growth and development. To achieve such goals, development of appropriate, sustainable technology through research and its dissemination is essential. In order to make the research more productive, and responsive to the client's needs, research must be planned and managed properly. Without a clear vision regarding the research process, the needs and circumstances of the beneficiary target groups, productive research management may not be possible. A clear understanding of the different elements in the research process can only help to the research system to be managed more efficiently.

This Chapter has reviewed available pertinent literature on agricultural R & D, thus provided a basis for clear understanding of the research process. Next Chapter addresses the literature on planning and management of R & D organisations.

CHAPTER 3
RESEARCH MANAGEMENT: A REVIEW

Research management is a complex task. It embraces variety of activities for example, problem identification, formulation of research programme (project formulation, appraisal and resource allocation), implementation, evaluation and dissemination of proven technologies to the clients. At every stage of these activities different factors need to be considered, and critical decision making is required.

For better planning, quick and effective decision making, a good understanding of different interrelated research activities and the precise meaning of research management terminology and adopted techniques are important. Experience shows that some of the essential research management terminology are not clear to most of the research managers.

This chapter briefly focuses on some of the essential research management terminology. The chapter identifies the need and rationale for adopting a more structured and systematic research management approach involving the application of the concept of research project cycle and management (RCM).

3.1 RESEARCH MANAGEMENT TERMINOLOGY

The literature suggests that each of the terms 'planning', 'programme' and 'project' mean different things to different people. Clear understanding and some common definitions of these terms is necessary at the beginning.

Plan

It is a document that lays out a specific set of objectives and the means of accomplishing them.

Planning

Libik (1969) and Mallick (1988) described planning as a process through which an organisations or institutions identify, select and implement actions to achieve its goal and objectives. More recently Hanngan (1995) described planning as a course of action for an organisation to meet its goals.

Programme

Mclean (1988a) described research programmes as co-ordinated research activities whose combined scientific outputs address national research objectives. Programmes are long term, continuous activities and are composed in some cases of sub-programmes and of projects. Collion and Kissi (1991) described a programme as set of research activities undertaken to meet the needs of research clients in a particular area, whether this be a commodity or group of commodities, a system of production, a factor of production or a theme. More recently, Horton, Peterson and Ballantyne (1993) described a programme as an organised set of research projects, activities or experiments that are oriented towards the attainment of specific objectives. They further argued that a programme is not time bound as projects are, and programmes are higher in the research hierarchy than the projects.

A programme may be at the national or institute level. A national level programme encompasses the activities in several institutions concerned with one area of research. On the other hand, at an institute level, a programme combines only the activities of a single institution (McLean, 1987; Arnon, 1989; and Nickel, 1989).

Project

A project is a set of activities designed to achieve specific objectives in a specific time period. Projects address specific research problems, and have explicitly defined time frames, resources and targets and comprise a number of specific operations or experiments (McLean 1988c).

Throughout this study 'programme' and 'project' definition given by Dagg and Haworth (1988) and Horton *et al.*, (1993) will be followed respectively. Dagg and Haworth (1988) defined programme as the collection or aggregation of the individual experiments, studies and activities that a researcher will carry out in order to obtain information and materials that are required by clients. A research project is composed of a group of interrelated activities or experiments that share a rationale, objectives, plan of action, schedule for completion, budget, inputs, out put and intended beneficiaries (Horton *et al.*, 1993).

3.2 RESEARCH PLANNING AND MANAGEMENT

The importance of agricultural research & development and its role has been described in the Sections 2.2 and 2.3. Agricultural R & D is a complex process involving costly inputs i.e. trained scientists, technical assistants, equipment and materials. The outputs include knowledge and technology packages (Klador, 1968; Dagg and Haworth, 1988).

Therefore, R & D activities need to be planned and managed properly if they are to be beneficial and cost effective. Successful R & D management requires careful planning. Planning is a basic management function which determines the success of all subsequent operations. The function of planning is to improve the quality of decision making by a careful consideration of all relevant factors before a decision is made (Glautier and Underdown, 1994). They further reported that planning helps in deciding : what should be done ?; when it should be done ?; how it should be done ?; and who should do it ?.

Planning involves specifying desired end results or objectives and the means by which these will be achieved. It includes the subjects of goal setting, strategy formulation, and the development of policies, programmes, budgets, procedures and rules (Carroll, Paine and Miner, 1977).

Arnon (1968, 1975, 1989), Elz (1984), Contant and Bottomley (1988), Mallic (1988), Islam (1988) and Ali (1988) suggested that research planning essentially involves:

- setting of priorities at national and institutional level;
- determination of constraints and opportunities to be overcome by research both at institution and programme level;
- establishing a programme, encompassing a series of annual work plans development over a longer term planning period.

Arnon (1989) further described that programme establishment should be based on overall national policy which defines the research topics and their relative importance. According to Arnon (1975, 1989) the objectives of planning in research are:

- to determine the specific investigations required in relation to the national development plan;
- to assign responsibility for specific areas of research and to communicate what is being done.

Later, highlighting the importance of management in agricultural R & D, Daniels and Dottridge (1993) reported that management is an increasingly critical determinant of the effectiveness of agricultural research.

There has not been much work on management aspects of agricultural research. For example, Horton (1990) reported that surprisingly little attention has been directed to understanding and improving the management of agricultural research in developing countries. In addition, he reported that in many senses the research process is treated as a mysterious "black box" in which technologists employ the modern tools of science to transform human and financial resources into new technologies. As such, information on agricultural research management is scanty. He further added that economists and policy makers may set priorities and evaluate the results of research, but what goes on inside the 'box' remains the province of technologists: management aspects are neglected.

Nevertheless, there has been some analysis of research management issues. Efficient research management, which is a prime need in managing valuable resources has not been given due importance, particularly in developing countries (Pinstrup-Andersen and Franklin, 1977; and Elz, 1984). While studying the impact of agricultural research: Kenya Government (1986), ISNAR (1986) and U.S Congress (1986) identified that weak management of agricultural R & D organisations was one of the principal factors responsible for overall low productivity in agriculture.

Later, Farrington and Howell (1987) supported this idea and reported that poor performance of National Agricultural Research System in developing countries was mainly attributed to management constraints. Horton (1990) grouped available literature on the impact of R & D into following two categories, namely: reviews and evaluations of development programmes in developing countries, and management studies of private enterprises and public-service institutions.

He showed that low output in agricultural research was due to poor research management rather than insufficient funding. In addition, he suggested that an increase in spending in any country does not guarantee high return, unless the research is managed effectively. Further he reported that more is known about how to do agricultural research than how to manage the research system. There is more capability in handling technical aspects than the institutional or management aspects. From similar study Nickel (1987), Von der Osten, Pardey and Trigo (1986) identified weak management as a prime reason in most of the developing countries for severe decline in agricultural output during 1970-1980.

International Service for National Agricultural Research (ISNAR) conducted a review on 40 National Agricultural Research System (NARS) during 1980s (Collion and Kissi, 1991). The study pointed out the following deficiencies in research programme planning:

- programme activities are not relevant to the needs of research users, nor are they geared to producing technologies easily adopted by them;
- regular evaluation / review of activities is lacking;
- research programmes are often made up of a hodgepodge of projects, activities and experiments;
- research activities are often proposed without reference to the resources they demand;
- research objectives are often not well linked to economic and agricultural objectives at the policy level: development objectives and means of obtaining those objectives are often confused;
- not enough is known about the technology available from external sources, resulting in missed opportunities for borrowing technology;
- researchers' and producers' interests are divergent;
- researchers tend to overlook socio-economic and institutional constraints on the absorption of their research results.

In addition to these points, Nestel (1989) reported that at the time of programming, limited attention is given to monitoring and evaluation of agricultural research and that verifiable indicators for achievements are rarely available.

A further characteristics of agricultural R & D is that it is a large user of resources in systems that are becoming increasingly large, complex and interactive both within countries and at global level (Ruttan, 1987; Von der Osten, 1987). Pardey, Roseboom and Anderson (1991) showed that NARS in developing countries have grown bigger in the past decades. They cited that the number of researchers more than doubled between 1961-65 and 1981-85. He also showed that expenditures have almost tripled for the said period. Gijsbers, Mook and Nestel (1993) expressed similar views, pointing out that NARS are becoming more complex organisations, mainly as a result of having to respond to new tasks and challenges.

When organisation becomes large and complex, decision making become more critical requiring extra attention for its management. In addition, it creates extra pressure on resources. One of the major concerns of agricultural R & D management is priority setting and resource allocation. Currently in most developing countries agricultural research is carried out without proper priority setting. For example, Norton and Pardey (1987) and Contant and Bottomley (1988) reported that the process whereby resources are allocated to agricultural research is often ill defined. Priority judgements and resource allocation are based on the previous year's record and budget. A similar trend was reported by World Bank (1983). It conducted review of 128 projects in 10 countries covering agricultural research and extension. The study identified marked inadequacies in several countries in their resource allocation to, and among, research and extension. It further identified weaknesses in planning and monitoring process in respective countries as a major cause.

The agricultural R & D environment is also characterised by scarcity of resources. This is particularly true and acute for developing countries where, there is a gradual shrinkage and tightening in NARS research budgets both nationally and internationally (Norton and Pardey, 1987; Nickel, 1987 and

Pardey and Roseboom, 1988). Supporting the view more recently, Horton and Elliott (1993) described that in the 1990s, demands on agricultural research systems are pitted against a background of declining resource and increased competition for funds both nationally and internationally.

The World Bank, reduced its lending for research by almost 20 percent between 1977-79 and 1988-90 (Lipton and Paarlberg, 1990). The Consultative Group on International Agricultural Research (CGIAR) reported that funding for the centres core programme has been declining in real terms over the last few years (Ozgediz, 1993; Lipton, 1994). The funding level for each successive year has been about the same or lower in nominal terms than that of preceding year. At the same time there was an increase in the number of CGIAR centres from 13 to 18. As a result, there is greater competition among the centres for available funds. As a direct consequence of decline in CGIAR funding, there has been a major decline in domestic funding for NARSs, especially in Sub-Saharan Africa and Latin America. In this situation, there is a growing need to define and protect the priorities so that available funds can be directed towards the highest priority needs.

The decline and tightening in research budget on one hand, and new global problems like AIDS, pollution and environmental degradation on the other are biting into traditional sources of funding. At the time global recession and fiscal austerity in aid giving countries, reduced total funds are available. These trends make it critical for agricultural research organisations to employ their resources more effectively and efficiently.

Research managers and policy makers in agricultural R & D are facing difficulties in making decisions on resource allocation without adequate information on costs and returns. In the recent past some attempts have been made to quantify the costs and returns on agricultural R & D projects. Ruttan

(1982) and Javier (1987) reported that appraisal models have been developed but these are often technically too sophisticated, require huge amounts of data collection, information retrieval and computer facilities for data analysis and storage. As a whole they are very costly, and in some cases mathematically too complicated. Because of these technical limitations, these models are not widely used, especially in developing countries.

At present there do not appear to be any simple procedures which can help to compare research benefits and costs, and justify resource allocation between different research projects. Also relevant information essential for taking such decision seems to be scanty. From the available literature it appears that ISNAR have been carrying out extensive studies to resolve R & D management issues. It has developed and formulated broad based general guiding principles for agricultural R & D management through its group of task force. However, it could not study management aspects in detail. Most of its study geared towards the need for public funded agricultural R & D, focusing on the needs of donors.

On the other hand, most of the suggested guidelines and principles need to be modified to suit a specific country's national or sectoral context (national goal, clients need, funding system, availability of resources, skilled human resource in particular). For example, few, if any, studies have addressed the research planning and management issues of industry funded plantation crop R & D management such as tea research. Thus this particular issue deserves critical study.

As such this project has been undertaken to develop a system for helping to achieve the efficient management of plantation R & D, and tea in particular.

3.3 PROJECT CYCLE AND MANAGEMENT

The concept of the project cycle has been developed to support the management of agricultural and rural development programmes and projects. The project cycle comprises a number of successive steps, each of which provides information for the next step. The cycle is a coherent set of activities with a rationale, goal, objectives, plan of action, expected outputs and beneficiaries, budget and implementation schedule. The principle of project management provides a framework for information gathering and analysis to assist in orderly planning, implementation, monitoring and evaluation of projects. Available literature on project cycle and management are discussed below.

3.3.1 PROJECT IDENTIFICATION

Like any other development investment project, identification is the first phase of a research project. FAO (1986) described identification as the initial process of deciding what kind of project is most needed given development requirements at a particular time and place. Research projects are identified to solve specific problems which may be basic or adaptive in nature, whilst simultaneously fitting the objectives of the research organisation. Identification of any research problem should be according to :

- the urgency and relevance of the problem to the goal and objectives of the institute in accordance with the guidance mentioned at the national level priority.
- importance of the problem to the clients for whom the institute has a mandate.

Research problems may be identified by research workers, clients or by extension workers. Other sources of research ideas can be scientific literature, progress and survey reports on various problems and case studies. These research ideas are subsequently developed into research projects. In so doing an institute can adopt either top-down or bottom-up approach. Islam (1988) reported that both the approaches are followed in agricultural research organisations to a variable extent. In the bottom-up approach, problems are identified at the grass root level and proposals are initiated by the scientists working in close contact with the client groups. This type of problem identification approach suggests that there is a good interaction with client groups.

In the case of top-down approach, however, research ideas are identified or proposals are initiated from the national policy formulator, senior research administrator or project leader. Proposals are subsequently developed by the scientists closely working with them. In this approach there is little interaction of the researcher with the farmer / client during research problem identification. Mostly national research policy bodies dictates the nature of problems to be researched.

Once problems are identified, their relevance must be reviewed be confirmed by the competent management authority. Institutions may have a committee structure for this purpose. Example of such include: Technical Committee (TC); Research Committee (RC); Research Sub-Committee (RSC); Research and Production Committee (RPC), Research Advisory Committee (RAC), Technical Advisory Committee (TAC), Agricultural Committee (AC), Engineering Committee (EC), which are working in different institutes.

3.3.2 PROJECT PREPARATION (DEVELOPMENT OF RESEARCH PROPOSAL)

At this stage identified research ideas are developed into research proposals. Design parameters must be defined as part of the formulation task (Goodman and Love, 1980; FAO, 1986). Preparation of research proposals is one of the most important steps in research project management, because subsequent implementation, monitoring and evaluation are based on the initial research proposal (Horton *et al.,* 1993). Research proposals are written documents in which requests for both authorisation and funds are made to carry out a specific project (Seiler, 1965; Arnon, 1989). At this stage a range of issues need to be considered, including technical, economic resources, social and environmental elements.

Irrespective of the organisation and nature of research, a proposal will have certain things in common and follow a fairly standard format. Lawson (1962), Arnon (1989), Horton *et al.,* (1993) outlined that a formal proposal must have:

- a title and abstract,
- objective of research in which problem is clearly stated,
- importance of the work with all the pertinent data needed to substantiate the significance of the research including expected outputs,
- outline of previous work in the field indicating what is new in the proposed approach,
- a clear and specific plan of work, breakdown of operations (work schedule and activities) which is appropriate in achieving the objectives proposed,
- indication of human resources with particular skill needed and time duration;
- a realistic cost estimate,
- monitoring and evaluation techniques to be used,
- probability of successful achievements, and
- relative priority of the research.

R & D Organisations usually develop and bring forth their research proposals annually in the form of a research programme. A pre-structured standardised pro-forma (based on a check-list) helps to manage the process of project implementation.

3.3.3 PROJECT APPRAISAL

Appraisal is the assessment of the overall ability of the project to succeed. Several critical decisions need to be made during this stage. Such as, whether the project is capable of achieving of its objectives within the limits imposed by the decision maker, and whether the project will be undertaken or not (Goodman and Love 1980). Close analysis of the prepared project is done at this stage to ensure that it meets relevant planning and investment criteria and that adequate arrangements for its implementation have been made (FAO, 1986).

Research project appraisal essentially involves review of research proposals, approval of research projects and commitment of resources. The first detailed assessment of research proposals are done through peer or expert review. Gapasin (1993) suggested that peer review works best where constructive criticism can be made in open discussion. In order to maintain objectivity, an external review of research proposals may be undertaken to eliminate bias among peer researchers or to ensure that certain specialisation are covered.

The approval of research projects and commitment of resources are often approved on the basis of technical information provided by the review groups (Gapasin, 1993). Once projects are approved, funds and necessary resources are allocated. At this stage research organisations may carry out the priorities among approved research projects. This can help to ensure that most essential projects, which address the most pressing needs, receive adequate funding. It may be better to design and fund a few projects than to disperse limited resources across many under-funded projects.

During appraisal stage a preliminary estimate of resources required, decisions about the location, size and phasing of research project are taken. Research project appraisal is one of the key process to ensure that projects will be successful in achieving their objectives.

3.3.4 PROJECT IMPLEMENTATION (MONITORING)

The United Nations (1984) defined monitoring as the continuous review by the management at every level of the hierarchy of implementation of an activity to ensure the input deliveries, work schedules, budget expenditures, targeted outputs, and other required actions proceed according to plan. Monitoring is the ongoing process of recording, analysing, reporting and sorting data during the implementation of an activity (McLean, 1987).

Through monitoring a research manger may become aware of any deviation in expected results of the on-going project, whether corrective action is required. Deviation between plans and expected results often mean that the plan needs to be revised. Thus by providing timely feedback, monitoring allows managers and sponsors to improve the implementation of on-going research projects or to make adjustments in research plan or design and saves resource wastage (Horton *et al.*, 1993; Caslley and Lury, 1982; McLean, 1988b; and Gapasin, 1993).

Thus monitoring of on-going research projects helps management to compare the progress of work against planned implementation targets, detect deviations, identify bottle-necks and take corrective actions while research is in progress. Monitoring is an essential tool for improving decision making. As such it should be an integral part of day to day good research management practice.

3.3.5 PROJECT EVALUATION

The United Nations (1984) Task Force on rural development, as cited by Dagg (1986), has defined evaluation as a process for determining systematically and objectively the relevance, efficiency, effectiveness and impact of activities in the light of their objectives. It further reported that it is an organisational process for improving activities still in progress and for aiding management in future planning, programming and decision making. One of the important aspects of evaluation is to determine whether the problem investigated is still relevant in relation to the situation in the field (Acharya, 1987).

Evaluation can be viewed as an integral component of on-going technology management information system (Nestel, 1989). It helps to draw lessons from past experience and to incorporate them into the planning and implementation of more effective future activities. Thus, it can improve on-going research, through improved technical decision-making and management. McLean (1988c) enumerated that the purpose of evaluation is to assess:

- the potential impact of research in priority-setting and planning exercises;
- the performance and quality of research in progress;
- the successful completion and relevance of research projects; and,
- the ultimate impact of research results on the achievement of development objectives.

Evaluation may be categorised into *ex-ante* and *ex-post* according to whether it is carried out before or after the project respectively (McLean, 1987; Nestel 1989 and Falconi; 1993). McLean (1988c) added another category of evaluation, namely on-going evaluation.

Ex-ante evaluation

McLean (1987; 1988c) and Nestel (1989) described ex-ante evaluation as a planning process, which does comprehensive analysis of the potential impact of an activity before it is carried out. The prime method used in this process is peer or expert review and the techniques followed include: check-lists; scoring models; and benefit / cost analysis. This type of evaluation can be carried out at all levels of planning, at institute, programme, and research project level.

McLean (1988c) reported that the term is often used interchangeably with the terms priority setting, planning, and programme formulation.

McLean (1988c) suggested that at these various levels of evaluation, different evaluation criteria are taken into account. For instance, at policy level economic data are more important where planning takes into consideration the allocation of resources to different commodities. At the programme level, however, scientific and technical criteria become more dominant. Similarly techniques of cost / benefit analysis, and econometric techniques using a production function approach are used at national or institute level decision making. On the other hand, at the project and programme levels, check-list and scoring models are widely used with less emphasis on economic analysis.

Ex-ante evaluations are not always as comprehensive as they should be. They tend to be restricted in their focus to particular disciplines without adequate integration / information. For example, an economist tends to conduct an ex-ante evaluation to look at potential returns to investments; a rural sociologist, through diagnostic surveys, enlarges the criteria to include social benefits from research; while a biological scientist might look only at the scientific merit or the potential to make a technical breakthrough (McLean, 1988c). *Ex-ante* evaluation serves to set target objectives and is used in priority setting and resource allocation. It defines the baseline against which progress towards planned objectives would be measured in subsequent evaluations.

Ex-post evaluation

McLean (1987; 1988c), Nestel (1989), described ex-post evaluation as an assessment of performance after completion of the project. This type of evaluation attempts to measure the efficiency and effectiveness of a completed activity and includes an analysis of original assumptions. It is carried out to determine whether the project objectives were attained (achievements) and to identify the causes of any discrepancies (constraints). Lessons learned can be incorporated into subsequent planning and implementation.

Ex-post category of evaluation is an analysis of the project from the beginning to the end. In addition, it assesses the cost effectiveness, cost value-added and relevance of the research. It also justifies the acceptance of research results by potential users and the contribution of result to world knowledge systems. Importantly ex-post evaluation indicates which projects might be continued, expanded, reduced in scope are terminated (McLean, 1988c).

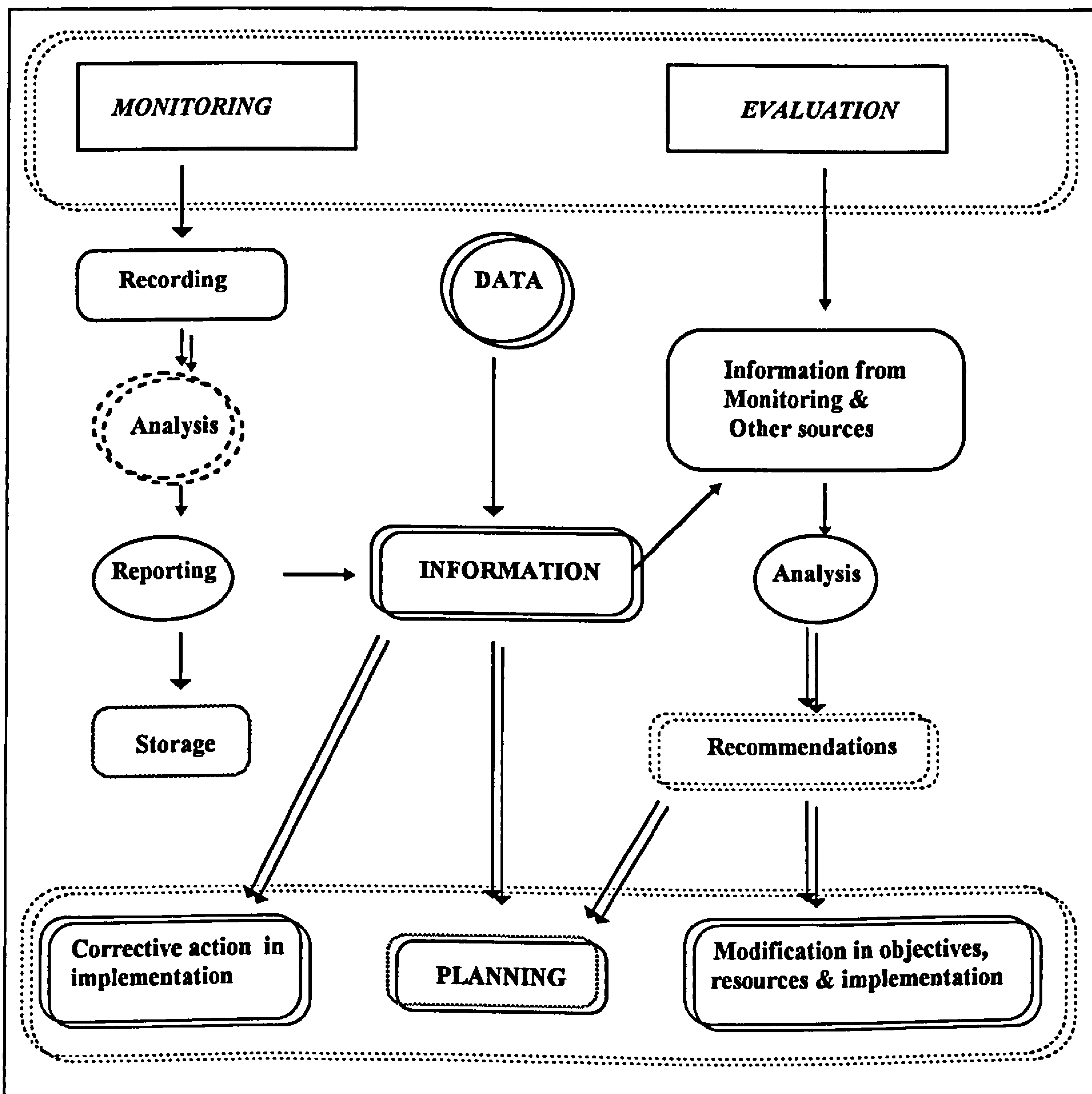
Evaluation of on-going research

Evaluation of on-going research is the periodic review of research which is in progress. According to McLean (1988c) it helps to analyse the use of resources, the quality of research, the continuing relevance of research programmes and projects and the identification of implementation problems. This type of research evaluation generally looks at research performance on an annual basis, and compares the achieved progress with expected activities. Ongoing evaluation mainly addresses problems which are associated with the day-to-day management of research. Monitoring is closely linked to this type of evaluation as it tracks the provision and delivery of inputs and services. Ongoing evaluation also requires the generation of information on the availability and deployment of staff, infrastructure, equipment supplies, services and funds for projects within the programmes. This type of evaluation is primarily concerned with quality of research and, to some degree, its continuing relevance. Information generated through this type of evaluation may also indicate the need for changes in project objectives and targets. On-going evaluation is mostly conducted through expert or peer review under the technical leadership of heads of institutes or programme.

Relationship between monitoring and evaluation

Although monitoring and evaluation are two different processes, their functions are interrelated. Both operational processes are important management tools. As such, a better understanding of their relationship is necessary to be able to perform monitoring and evaluation of the work in an effective manner. Figure 3.1 describes the relationships according to McLean (1987; 1988c)

Figure 3.1 Relationships between monitoring and evaluation (modified)



Monitoring records data on project or programme performance. Analysis of these data generates both qualitative and quantitative information and reports are prepared. Subsequently, these are transmitted to appropriate levels of management for use to take corrective action at the operational level, as well as storing the information for subsequent evaluation.

Evaluation gathers information from other, external sources. Based on the analytical findings, evaluation makes the recommendations which may address the issues of planning. For instance, a modification in programme objectives, content, resources, or processes. In comparison to monitoring, evaluation involves people or outside agencies.

Monitoring usually ends when the project is completed. On the other hand, evaluation goes beyond that. When a project is over its impact remains in the field. Evaluation mostly depends and also use the data generated by monitoring.

3.4 CHAPTER SUMMARY

This Chapter has examined the research management terminology. Further, it has reviewed existing planning and management techniques. It identified deficiencies in current management practices, rationale for adopting a project cycle approach for efficient and productive research management. In addition, the need for adoption of a systematic approach for priority setting and resource allocation in agricultural research was identified. The next Chapter addresses research project appraisal techniques that are currently used in deciding research priorities and resource allocation.

CHAPTER 4
RESEARCH PROJECT APPRAISAL TECHNIQUES: A REVIEW

Agricultural research is carried out by both government as well as privately managed organisations. In most developing countries, agricultural research is mainly carried out by the Government (Horton, Peterson and Ballantyne, 1993), but some commodity crop research is funded by the industry. Whether agricultural research is funded by the Government or industry, attention has been focused on the productivity and efficiency with which research funds are allocated. Decision makers in agricultural R & D organisations require information on research payoffs in order to assess alternative uses for public or private funds. For example, McCalla (1994) cites that besides National Agricultural Research Systems (NARSs), investment in international agricultural research also requires a basis for priority setting and choice making. Irrespective of the nature of funding, research clients have become more concerned about the research cost, benefits and the way research is managed.

This chapter reviews the advantages and disadvantages of the major techniques, that have been developed to quantify the benefits of agricultural research. At present in developing countries some of the techniques cannot be applied for various reasons as described earlier. The chapter illustrates and suggests the adoption of a simple and modified approach to quantify research efficiency which is easy to use and could be effectively utilised to help in decision making in resource allocation in research.

4.1 PRIORITY SETTING METHODS AND PROCESS

Priority setting is a management process which enables decisions on the relative importance of research areas or projects, usually in terms of their expected contribution to organisational goals. This is a key element which helps in optimisation of resources.

Contant and Bottomley (1988) while working for I S N A R on priority setting in agricultural research reported the following three priority setting processes, or some combination thereof:

- in the first process prioritisation and resource allocation are determined on an historical perspective. There is a little consultation either within or between different levels of policy makers. This gives rise to a stereotype research programme which fails to address national problems and also fails to fulfil the need of clients;

- in the second type of process there are some, limited, albeit informal participation and consultation mainly among and between senior policy makers and scientists. They determine the priorities at the inter ministerial level. This is basically a top down approach. Here programmes are firmly tied to national development plans. A great disadvantage of this approach is that it is influenced by the top executive at the top decision level;

- the third approach is open and participatory. It involves a multi-agency task-force convened by the Minister of Agriculture or high authority and supported by specialist committee and / or sub-committees. Here representation from national planning bodies, producer levels and scientists all jointly decide the programme.

Contant and Bottomley (1988) further concluded that of the three types, only the third type provides a suitable basis for the introduction of formal priority setting methods. The approach used is iterative, involving repeated consultation within and between different hierarchical levels of decision making in agricultural research as well as producer groups or clients. Due to participation from all levels, it can also take into account the research constraints and producer's comments.

Norton and Pardey (1987), and Contant and Bottomley (1988) recognised the following methods for research priority setting:

- establishment and weighting of multiple criteria for ranking commodities and research areas with a final aggregate ranking based on implicit or explicit weights;
- use of Benefit cost analysis, including expected economic surplus techniques, to select commodities and research areas;
- application of mathematical programmes to choose an optimal research portfolio incorporating multiple goal and constraints; and
- development and use of simulation models.

4.1.1 WEIGHTING AND SCORING METHODS

Congruence

According to this technique total research funds are allocated to the commodities in the same proportion as their existing contribution to the agricultural domestic products. For example, if a crop (*x*) represents ***10%*** of total value added in agriculture, the crop (*x*) should get ***10%*** of the resources allocated to research.

The concepts congruence can be expressed by the formula :

$$C = 1 - \sum_{i=1}^{n} (A_i - S_i)^2$$

Where **Ai** is the share of particular commodity in the research budget, and **Si** is the share of that commodity in agricultural value added. Perfect congruence is achieved when **C=1** for **n** commodities. This technique can be applied only to the programme based on commodities. One of the limitations of this technique is that it can not be applied to decide among different research projects at institute level. The other drawback of this procedure is that it favours commodities which are already well established and do not reflect potential marginal returns to research. Under changed circumstance if a minor or low congruence commodity deserves special importance in the national plan, research can not be promoted because of established commodity influences.

Check-list

This is an approach where the planner uses a list of criteria and associated questions. Information obtained and knowledge gained from above is considered and / or incorporated while deciding on priorities.

Contant and Bottomley (1988) advocated that for research systems which have no formal priority setting procedures in place at all and currently rely entirely on historical allocations and personal judgement, the use of a check-list is the most useful initial approach. In addition they consider that, later on when expertise is available, scoring can be assigned to the check-list criteria to determine weights and values. Usually most of the questions on the check-list revolve around three important areas; the impact of research, its cost, and its feasibility. The technique is simple to apply. It does not require any formal training. But it requires a great deal of knowledge and experience in agricultural research to compile a meaningful check-list of questions.

Contant and Bottomley (1988) suggested that for all practical purposes the check-list method will be favoured by all priority setters in agricultural research because of its simplicity. They further reported that this preference for simplicity is acceptable as long as the check-lists and the manner of their application builds information and knowledge on different factors underlying benefits and costs. Not only that, a carefully structured check-list also helps in analytical and factual understanding.

One of the disadvantages of the check-list method is that quantification of what is important and what is not is not possible. Nevertheless the experience and perspicacity of the check-list user will safeguard against major error. Contant and Bottomley (1988) strongly recommend that whatever sophisticated method is adopted for priority setting, a check-list can and should still be used to ensure against the omission of important considerations. In fact, whatever formal methods are used, a planner should never wholly abandon the concept of a check-list. Though check-list is not a very sophisticated method of priority setting techniques, it can greatly improve the quality of priority setting.

Scoring

Scoring Model (SM) technique, sometimes called weighted criteria model, is a sophisticated version of the check-list technique. The difference is that answers of check-lists are assigned of numerical values and weights. Criteria weights are multiplied by the values which a particular research programme merits under each criterion to produce a final score.

Norton and Davis (1981) reported that a task force in 1966 evaluated the research programme published by the National Association of State Universities and Land Grant Colleges-U.S. Department of Agriculture (NASULGC-USDA). They developed and used a simple scoring model, which is known as US Land Grant Model. They evaluated the strength and weakness in the research programme and identified future research problems. Based on the model they recommended a level of public research investments for the next five years.

Later Williamson (1971), as reported by Norton and Davis (1981), considered that the SM was not employed on a systematic basis to arrive at the final estimate of research needs presented in the NASULGC-USDA study. Nevertheless, the result of the study developed a systematic classification of research problem areas, which is now used in USDA's current research inventory system (CRIS). Another study was carried out at Iowa State University (Paulsen and Kaldor, 1968) using SM combined with the Delphi technique. The study was undertaken to ensure the greatest return for research money spent at the experiment station.

Another SM model was used by at the North Carolina Agricultural Experiment Station to determine the emphasis on each of several research areas defined by USDA CRIS classification (Shumway and McCraken, 1975). In addition to SM they also used Delphi technique. They reported little consistency within and among groups of scores. Later, Schuh and Tollini (1979) pointed out that less attention was given to set goals in the North Carolina procedure than was done in the Iowa case. In their study they first set the goals of growth, equity and security. Then research was classified into three major areas; commodity, resource and agricultural research management. These areas were again divided into sub-areas. Finally a scoring procedure was used based on ten criteria including the probability of success.

Moore and Baker (1969) as reported by Shumway and McCracken (1975) considered that SM is comparatively simple. They further reported that by SM it is possible to compare in accuracy and sensitivity estimation error. Norton and Davis (1981) concluded that scoring models are conceptually simple, but labour-intensive, requiring frequent meetings among people for whom the opportunity cost is high. However, they further reported that SM has the advantage of incorporating benefits and goals that are difficult to quantify by most other techniques.

SMs are most popular amongst all the priority setting processes. Shumway (1973) favours the adoption of SM for priority setting and resource allocation because of its basic simplicity. Contant and Bottomley (1988) expressed the view that scoring has significant advantage over the use of a check-list, because scoring forces the planner to consider all the factors which may influence prioritisation. It also compels the planner to try to assess the relative importance of criteria. The SM approach is very simple, and does not require special training. Data requirements are very modest. But it does require broad experience and deep knowledge of research issues.

4.1.2 BENEFIT COST ANALYSIS

The Benefit Cost (BC) technique has been used in different forms to determine research priorities. This technique typically calculates benefit cost ratios, internal rates of return (IRR) and net present values (NPV). These values are compared in order to justify and select amongst alternative research projects.

From the review of literature it appears that the studies on benefit cost analysis have most commonly been grouped into *ex-post* and *ex-ante*. In case of the former type the evaluation is done on the basis of information and data obtained on completed research, while in case of latter analysis is done based on information and data obtained before the experiment starts or project is undertaken. *Ex-post* evaluations of research are based on the concept of economic surpluses, i.e. the economic consequences of increased production is used as the measure of the return on research output.

Ex-post evaluation

Norton and Davis (1981), and Donavan (1989) identified three approaches to *ex-post* method of evaluations: economic surplus approach, production function approach and impact approach.

a) The economic surplus approach

This approach is also known as consumer and producer surplus (CS) approach or the index number approach. Consumer surplus is the benefit that a consumer gets over and above the price paid for the commodity. Producer surplus is the benefit that the producer gets over and above the cost of supplying the product. It is based on the assumption that, due to new technology and its adoption, there will be a shift to the right in the supply curve of the commodity. More product will be available and consequently there will be a lowering in price or a reduction of the cost of production. This relation can be demonstrated in the following model (Figure 4.1).

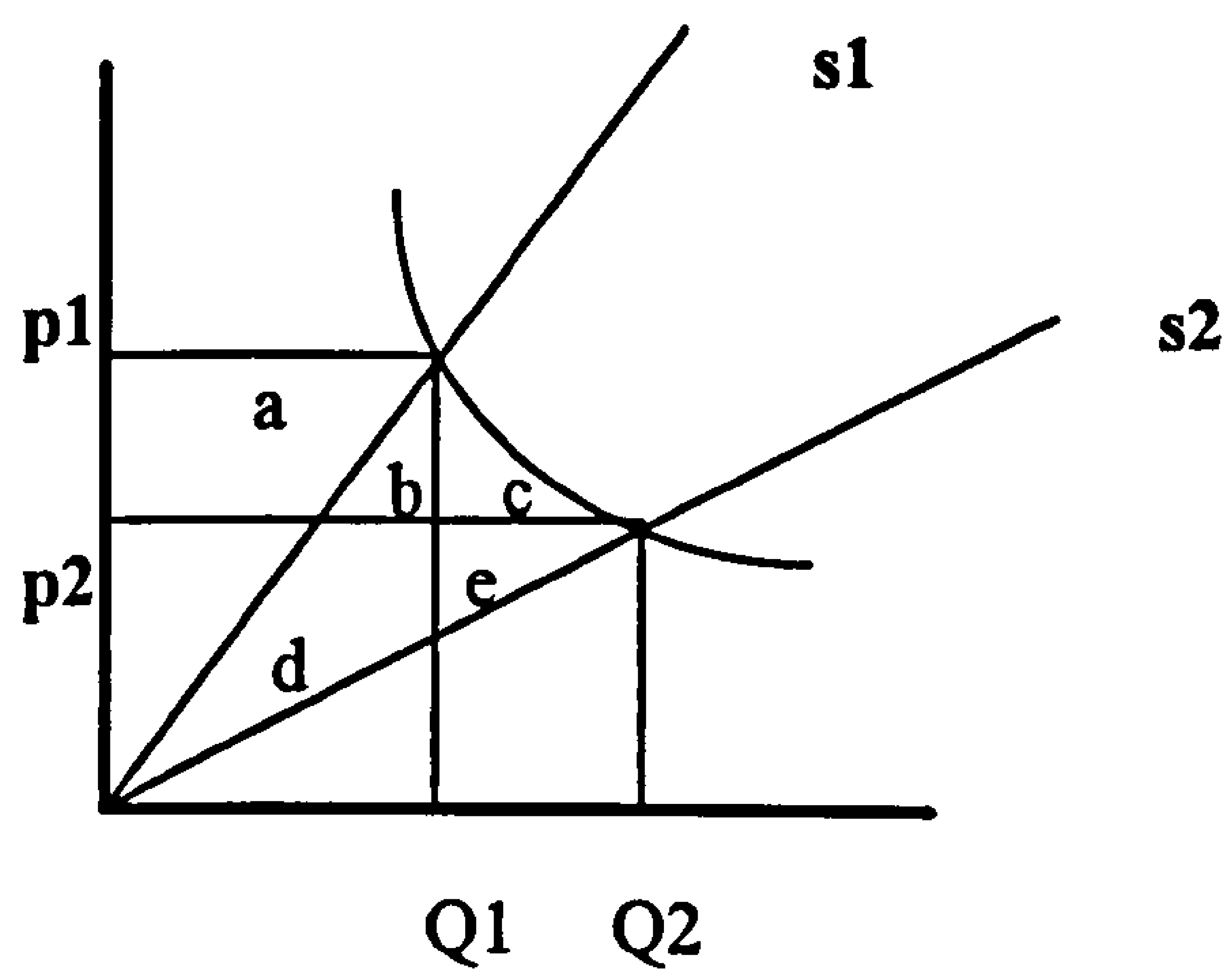


Figure 4.1 Effect of technological change on economic surplus

Because of the application of a new technology for example there is an increase in the supply of a commodity from (s1) to (s2.). As a result of this increase in production, other things remaining the same, the price of the commodity falls from (p1) to (p2). Now this change in consumers surplus can be measured by adding the area *a+b+c*. The resultant supply also creates a change in the producers surplus. This can be measured by the area *d+e-a.* Thus the total change in the economic surplus can be measured by the area *b+c+d+e.*

R & D technology influences consumer and producer surplus. Everything else remaining the same, technology change will tend to increase output and reduce prices. This affects incomes of consumer and producer depending on the slope of demand and supply curves. In case of inelastic demand, the consumer will enjoy more benefit than the producers. Adoption of technology helps to reduce per unit cost of production. Producers who do not adopt the new technology find that their cost of production will remain high and they will not survive. Biological technologies have an advantage over other forms of technology because, they often require relatively less capital to implement. In addition, biological technologies could be used in large or small quantities by large and small farmers alike. They do not require large economy of scale compared to other technologies such as mechanisation.

Schultz (1953) as described by Norton and Davis (1981) attempted the first major quantitative evaluation of agricultural research investments. He calculated the value of inputs saved through more efficient production techniques and compared these benefits with the cost of R & D. Since Schultz's work there have been many studies on consumer producer surplus (CS) approach to research evaluation studies, for example, Currie, Murphy and Schmitz (1971), Hertford and Schmitz (1977), and Willig (1976). Most of these studies were at commodity level.

Griliches (1958) applied the economic surplus method for hybrid corn. He calculated the loss in net social surplus if hybrid corn were to disappear and estimated returns considering both perfectly elastic and non elastic demand. Later Peterson (1967) working in poultry research developed a formula for estimating social surplus which eliminated the Girliches's supply and demand elasticity restrictions.

For agricultural research evaluation, distribution of benefits between producers and consumers were estimated by Ayer and Schuh (1972). They developed and applied the model for Brazilian cotton. They also carried out a sensitivity analysis of their results by varying the elasticity of supply.

Likewise Akino and Hayami (1975) used a similar approach to estimate social benefits in Japan from rice breeding research including distributional effects of rice import policies. Akino and Hayami as cited in Donavan (1989) pointed out that although producers benefit directly from the research on crops that are mostly exported, consumers also benefit appreciably from the indirect effects of such exports, especially through exchange earnings. Scobie (1979), Linder and Jarrett (1978), and Wise (1984), confirmed that the distribution of benefits between consumer and producers is an extremely sensitive issue.

Later Scobie and Posada (1978) employed the consumer producer surplus approach to study technical change in Colombian rice production. They considered the incidence of research costs and benefits among upland producers, irrigated producers and consumers in various income groups. They concluded that consumers benefited mostly while small producers suffered overall losses.

Beside the above mentioned studies, other studies using the consumer surplus and producer surplus approach are found in Hertford, Ardila, Rocha, and Trujillo (1977) for rice, soya beans, wheat and cotton in Colombia; Flores-Moya, Evenson and Hayami (1978) for rice in Philippines; Barletta (1970) for corn and wheat in Mexico; Hines (1972); Nagy and Furtan (1978) for rape seed in Canada. Pinstrup-Andersen (1977) applied the consumer surplus and producer surplus approach. They study the effects of new agricultural technology on consumers at various income level.

Schuh and Tollini (1979) reported that the economic surplus method of evaluating research is particularly useful in economic policy formulation in spite of its major limitations of not being able to quantify the gain due solely to research, and to separate research and technical transfer (extension) effects.

b) The production function approach (PF)

This approach treats the R & D as a production activity. It is based on the premise that the production function for a commodity can be used to estimate the pay off, or contribution of any production factor (R & D). Griliches (1964) used this approach and estimated the contribution of agricultural research and extension and their rate of social return. Dalrymple (1977) as quoted by Donavan (1989) reported that the functional form for an estimate of total return has been conceptualised as follows:

Formula $B = PQK(1 + K / Ed)[1 - (1 - Ed)Ez / (Ed - Ez)]$

Where B= Total return

P= Product price

Q= Product quality

K= Shift in supply due to research

Ed= Elasticity of product demand

Ez= Elasticity of product supply

The most difficult factor is measuring of K, because of its congruity with other factors that influence K. Griliches (1964, 1958); Dalrymple (1977) argued that the estimation of elasticity factors are also often difficult to make.

In PF studies aggregate output was used by Griliches (1964), Davis (1979) for the United States and Kahlon, Ball, Saxena and Jha (1977) for India. Other workers like Bredahl and Peterson (1976) and Norton (1981) estimated the marginal internal rate of return (MIRR) to each of 4 commodity groups (cash grains, dairy, poultry and livestock). They suggested that the overall rate of return could be increased by reallocating research money from relatively low to relatively high research responsive commodities. An important advantage of the production function approach is that it estimates the marginal product of research as Peterson (1967) has demonstrated for poultry research in United States, and therefore the value added at the margin of research resources used.

Norton and Davis (1981) reported that the production function approach is useful for separating the production effects of research from conventional inputs. It also allows estimation of marginal as opposed to average rates of return. Difficulty in obtaining data on production inputs such as labour, machinery, and chemical application by commodity remains a major limitation.

c) The impact approach

Tweeten and Hines (1965) calculated how much lower the national income would be if the percentage of the total population engaged on the farm was the same now as in 1910 and the resulting additional farmers had the income of today's farmers instead of today's non farmers. This, they suggested provides an estimate of the benefits of research. Donavan (1989) suggested that impact approach can only give a rough approximation of the value of research on single commodities. This method is easily understood in the national context.

A second type of impact approach was developed and proposed by Pinstrup-Andersen, de Londono and Hoover (1976). They adopted the approach to estimate the nutritional implications of alternative commodity priorities in agricultural research policy. The model estimated the distribution of commodity supply increased among consumers, the related adjustments in total food consumption, and implications for calorie and protein nutrition. This may be relevant where research is focused on improving standards of nutrition.

Ex-ante benefit cost analysis approach

Fishel (1971) developed a computerised model for the collection and computer processing of information required to appraise research activities and to select an efficient allocation of research resources. The model is known as Minnesota Agricultural Resource Allocation Information System (MARRIS). The model involved three major steps: specification, estimation and analysis. The model was designed to estimate benefit-cost ratios and internal rates of return (IRR) calculated by computer to obtain needed information for research projects or programme. Project selection was left to the decision maker.

Questionnaires were sent to different scientists working in the related proposed research projects in order to estimate average annual research expenditures, time requirements and scientific and technical feasibility. Subjective probability distributions of costs and values were generated for alternative levels of annual expenditures by a Monte Carlo sampling procedure. Norton and Davis (1981), and Ruttan (1982) reported that MARRIS is one of the most logically thought out procedurally sophisticated research planning and evaluation models. Use of this model is constrained by the complexity of data generation as well as high cost. Later Easter and Norton (1977) developed a simplified MARRIS type model. They applied the model to analyse U.S. Langrant University's national budget for Soy-bean and Corn production. Ruttan (1982) reported that **BC** ratio were calculated from the lower range estimates provided by the scientists on the yield and cost effects of each research line and on the expected adoption rates for the new technology.

An important aspect of the analysis was the BC ratio's sensitivity to variations in probabilities of success, expected yield increases, product prices, and lags between research expenditures and availability of results. Sensitivity analysis provides decision makers with information on the importance on the precision in the evaluation. Araji, Sim and Gardner (1978) also conducted similar simplified Benefit cost analysis to appraise research and extension impact for various commodities in the western United States.

Ramalho de Castro and Schuh (1977) developed a model to study growth and distributional effects of technical change by direct and indirect effects of research. They discussed effect of technological change in agriculture on the non agricultural sector and the effects on economic policies on social benefits and cost of research. They used secondary data to project yield increases, adoption rates and probability of success. The study used secondary data in order to minimise burden on scientists.

4.1.3 MATHEMATICAL PROGRAMMING (MP)

Norton and Pardey (1987) described this approach which relies on mathematical optimisation. In this technique research programmes are chosen by maximising a multiple goal objective function, subsequent to resource constraints on the research system. From the literature it appears that two studies have used **MP** to determine optimal allocation of a given research budget. The resource allocation system for agricultural research (RASAR) has been developed by Russell (1977). He developed the model to assist in selecting a portfolio of government sponsored agricultural research projects in the United Kingdom.

He used budget, human resources, state of knowledge and policies as constraints. Norton and Davis (1981), Norton and Pardey (1987) pointed out that this procedure uses exactly similar information to the weighted criteria model, but selects an optimal research programme rather than simply ranking research areas. In addition they mentioned that the model provides information on: set of projects in the research programme; financing for each project; the marginal utility derived from investing in extra unit of resources from the programme and each project; and the sensitivity of project selection to varying weights on goals. The system was tested on a group of projects at a Scottish research establishment.

Another **MP** was developed by Cartwright (1971). The model focused on research resource allocation within an agricultural economics department. He analysed the problem of choosing major research areas and specific research jobs. Norton and Davis (1981) reported that to optimise the major research areas, Cartwright developed a non linear integer programming model. The model used a staff preference production and information on: researcher time; funds that new research areas would bring into the department; and new staff positions that would be created.

Norton and Davis (1981) concluded that a major difficulty in using **MP** to guide research resource allocation is that a preference function must be specified. Only **MP** and **SM** approaches require elicitation of decision maker's preference.

4.1.4 SIMULATION MODEL (SI)

This technique has been used by a number of researchers to identify and select research priorities. Pinstrup-Andersen (1977) built the model to predict the contribution and cost of alternative research activities. First they established overall goals. Then they identified changes in product supply, demand for inputs and demand for output needed to achieve these goals. Later they identified needed technologies, time and financial costs, and the probability of research success and adoption. This model is very through but it requires extensive data and estimation of several mathematical relationships.

Lu, Quance, and Liu (1978) developed another **SI** model. They used research and extension (R & E) expenditures as a principal decision variable. In their model agricultural productivity changes were attributed to lagged values of production-oriented public agricultural R & E investments, changes in farmers' education, and weather. They used the model to project agricultural productivity growth under three alternative R & E investment growth scenarios. In addition they estimated benefit: cost ratios and internal rates of return to R & E investments.

White, Havlicek and Otto (1978) as reported by Norton and Davis (1981) also used SI to analyse investment patterns for agricultural productivity growth. They first estimated effects of R & E on aggregate U.S agricultural productivity with a time series production function. Then they used control theory to determine optimal research expenditures for a given rate of increase in farm prices under selected conditions. Finally they examined effects of reduced research funding on consumer food expenditures and on taxes.
Knutson and Tweeten (1979) used an SI model similar to the Lu, Quance and Liu model. They used the model in USDA-ESCS National Inter Regional Projections (NIRAP) system to project farm output and prices resulting from projected changes in productivity. Scobie (1979) as reported by Norton and Davis (1981) developed an SI to determine optimum level of agricultural research investments. The model included production functions, supply functions and a discounted cash flow analysis. Output was assumed to grow at a given minimum rate without research. As research investment increased, the output growth rate increased, but at a diminishing rate becoming asymptotic to a minimum rate. By varying assumptions about lags, and functional forms, he estimated annual research investments that would generate various economic returns.

Simulation models vary in their construction and flexibility. SI can be used to estimate optimum level of research at national, commodity, or programme level and effects of research on prices, income, employment, or other parameters. But their construction requires much time and information. They also require extensive amount of data and estimation of several mathematical relationships.

From this study of relevant literature for appraisal and selection of appropriate research project it appears that no single approach is superior in all situations to come for a conclusion on resource allocation. In such context it is useful to compare different approaches, drawing conclusions about their strength, weakness and ability to answer different questions.

4.2 COMPARISON OF DIFFERENT PRIORITY SETTING METHODS

A comprehensive relevant comparison of different methods are given in the Table 4.1a and 4.1b.

Table 4.1a Comparison of different priority setting methods

Parameters	SM	BC	MP	SI
Operational considerations				
Relative overall data requirement	M	M	M	Y
Relative ease of comprehension by decision maker	H	M	L	L
Relative cost in researcher's time	M	M	M	H
Relative cost in priority setting analyst's time	M	M	H	H
Ease of incorporating subjective information	H	H	H	H
Goal related issues				
Requires explicit election of goals	Y	U	Y	U
Can determine distributional affects on consu-umer and producers at various income level	N	Y	N	Y
Can handle uncertainty	Y	Y	Y	Y
Can consider trade-off among multiple goals	Y	S	Y	Y
Criteria related issues				
Can consider private sector research incentives	Y	D	D	Y
Can consider economic policy and trade effects	Y	Y	Y	Y

SM= Scoring model, **BC**= Benefit cost, **MP**= Mathematical programming, and SI= Simulation model, H= High, M= Medium, L= Low, Y= Yes, N= No, D= Difficult, S= Sometimes, U= Usually

Based on Norton and Davis (1981).

Table 4.1b Comparison of different priority setting methods

Parameters	SM	BC	MP	SI
Can be used to set priorities for research at the aggregate level	N	Y	N	Y
Can be used to set priorities for research at the commodity level	Y	Y	Y	Y
Can be used to set priorities for research at the non-production or non-commodity oriented research	Y	D	Y	Y
Can be used to set priorities for basic research	Y	D	N	S
Can evaluate secondary impacts of research on employment, environment and nutrition	Y	S	S	Y
Usually estimates a rate of return on research	N	Y	N	S
Can quantify geographic slipover effects	N	Y	N	Y
Can consider the lags involved in research and adoption	Y	Y	Y	Y
Facilitates priority setting when the number of commodities are large	Y	D	D	D

SM= Scoring model, **BC**= Benefit cost, **MP**= Mathematical programming, and SI= Simulation model, H= High, M= Medium, L= Low, Y= Yes, N= No, D= Difficult, S= Sometimes, U= Usually

Based on Norton and Davis (1981).

The procedure of establishing criteria and using weights to arrive at a final set of research priorities has the advantage of forcing decision makers to consciously trade off multiple goals. It can incorporate both quantitative and qualitative information and can be applied to a long list of commodities or research areas in a relatively short period of time. The procedure is relatively easy for administrators to understand, but does require their time in obtaining the explicit weights for criteria.

Furthermore, these weights are inevitably subjective, and their elicitation must be carefully structured. The method also requires scientist's time in collecting information on quantitative criteria. As a result the approach is better suited for periodic or major priority setting efforts than situations where frequent marginal changes are anticipated. The expected economic surplus approach has the major advantage of incorporating several criteria related to economic efficiency and distribution into one or two measures. It also can be used to examine the general equilibrium effects of research, and the benefits of research under alternative, possibly distortionary, domestic pricing and international trade policies.

These factors are pervasive in developing countries and affect the efficiency and distributional consequences of research. The procedure requires a high level of understanding of economic analysis, and more analyst's time than the SM (weighted criteria model), but less administrator's time. It can be difficult to apply to a large number of commodities or research areas because certain types of data necessary for the analysis often do not exist for all commodities.

With adequate data, expected economic surplus analysis can be incorporated into the weighted criteria model or could be used on the set of commodities / topics which the weighted criteria model indicates to have the highest priority. The latter approach would allow for the calculation of income foregone as a result of placing weights on non-economic efficiency criteria. Expected economic analysis has the major advantage of calculating a rate of return which can be compared to alternative public investments.

The mathematical programming is similar to the weighted criteria model approach because weights are placed on a set of goals or criteria. The procedure has the advantage of explicitly considering the budget, human resource and other constraints on the research system. Unless the constraints are well specified, including changes over time, however, there is a risk of nonsense solutions (Norton and Davis, 1981). The model is more intensive of an economic analyst's time and ability than the simpler weighted criteria approach, and decision makers may be less willing to accept what appears to be a "black box" solution. Trade off among goals are easily quantified with this approach.

The advantage of simulation models is their flexibility. They can be constructed as relatively simple or complex tools, can incorporate optimising or ranking procedures, and can readily include probabilistic information. Their major disadvantage is that to be useful they must be relatively complex and typically require extensive amounts of both data and time of skilled analysts.

4.3 CHAPTER SUMMARY

This Chapter has reviewed literature on different research project appraisal techniques and discussed the advantages and limitations of different techniques. The checklist approach is the most simple and easy method to implement. The congruence approach is difficult to apply in deciding allocation of resources among different research projects at the institute level. The scoring model is conceptually simple and most widely used. Benefit cost analysis is an interesting and sophisticated technique, but requires huge amounts of data and skilled manpower. Mathematical programming is too complicated, and simulation modelling is very time consuming.

4.4 SUMMARY CONCLUSION FROM LITERATURE REVIEW (CHAPTERS: 2, 3 AND 4)

Chapter 2 reviewed the literature on R & D with particular reference to the research process, namely: type of R & D activities, different hierarchical levels involved in decision making, potential beneficiary target groups, the various factors that influence the rate of uptake of new technologies and client circumstances under which technology will be used. This provided a basis for a clear understanding of the research process, and the objectives and nature of activities of R & D organisations. This will help R & D managers in planning and developing an appropriate research programme for target group clients.

Chapter 3 reviewed R& D planning and management issues, and identified various deficiencies in current management practices. Available literature suggest that resources are limited, funding agencies are becoming increasingly concerned about the benefit of research. They want transparency and more accountability in resource utilisation. More and more questions are asked about the justification of research spending. R & D policy makers and managers are looking for relatively easy methods to compare the benefits of research in order to decide on resource allocation.

Agricultural R & D organisations are becoming large and more complex creating pressure on limited resources. In developing and under developed countries R & D planning and management issues have not been addressed adequately. The literature survey appears to suggest that most developing and underdeveloped countries do not follow any systematic procedure for priority setting and resource allocation in agricultural research. In developed countries, selected models are used in deciding priorities and resource allocation. Therefore, Chapter 3 identified the rationale for the adoption of a structured management approach and need for adoption of priority setting techniques.

Chapter 4 addressed current research project appraisal techniques and their advantages and limitations. Some of the developed techniques are highly sophisticated, require huge amounts of data and background information and computing facilities for data storage and analysis, especially skilled human resources. Some of them are mathematically too complicated. Because of these limitations, these models are not used in developing countries. Moreover, from the study of relevant literature on the appraisal and selection of appropriate research projects , it appears that no single approach is superior for all situations.

Checklists are the simplest technique. Associated questions in the checklist can cover the areas of impact of research, research cost, and technological feasibility. They are not time consuming, and are easily understandable by all concerned. Data generation is modest. A carefully prepared checklist safeguards omission of any pertinent points related to priority setting and also helps in analytical and factual understanding. This technique does not require much formal training. Nevertheless, it requires a great deal of knowledge and experience in agricultural research to be able to compile a meaningful checklist of questions.

Scoring models are the most popular among all the priority setting methods because of their simplicity. This system has significant advantages over the checklist approach. The model forces the planner to consider all the factors which may influence prioritisation. In addition, it forces the planner to consider the relative importance of criteria. This approach does not require any special training. Data requirement is very modest. However, it requires broad experience and deep knowledge of research issues.

Benefit cost analysis is widely used by the Government and funding agencies. Its language is familiar and persuasive both to the national planner and donor executives. The benefit cost approach is based on discounted cash flow. It takes into account the effect of time when comparing the benefits of one research project with another, particularly in view of the uncertainty of time needed to complete the research and rate of uptake by farmers.

The approach provides a framework for thinking clearly about the impact of a new technology on the society at large. The benefit cost analysis framework can be kept simple and assumptions can be used in place of hard facts. Technology innovation and its impacts are sometimes unpredictable. But benefit cost analysis through sensitivity test can predict what will happen to the benefit cost relation under different conditions. Through this test it is also possible to find out which factors have important effects and which do not. Depending on the national goal, foreign exchange earnings can be valued above the official exchange rate if foreign currencies are rationed by various exchange and import controls.

Wages can be priced below their real level in order to reflect the advantages of a technology which uses under employed labour rather than capital. Benefit cost analysis of a research programme takes in to account the following eight characters in a sequential way: annual research cost, its duration, its probability of success, on-farm implementation costs, resulting rate of adoption of benefits, adoption ceiling and life of the innovation.

Therefore, following this review to achieve the objectives of this project, a combination of checklist, scoring model, and modified benefit cost analysis techniques have been applied according to the need and suitability of study elements. Chapter 5 describes the methods used.

CHAPTER 5
METHODOLOGY

Previous Chapters have described the relevant literature on agricultural R & D and focused some of the key research management issues which require critical investigations in order to improve the performance in management of research.

This chapter describes the methods that were adopted to obtain information and collect data for the study, procedures for the development of a conceptual analytical framework and techniques used for data analysis. The logical flow of the methodology is diagramatically demonstrated in Figure 5.1.

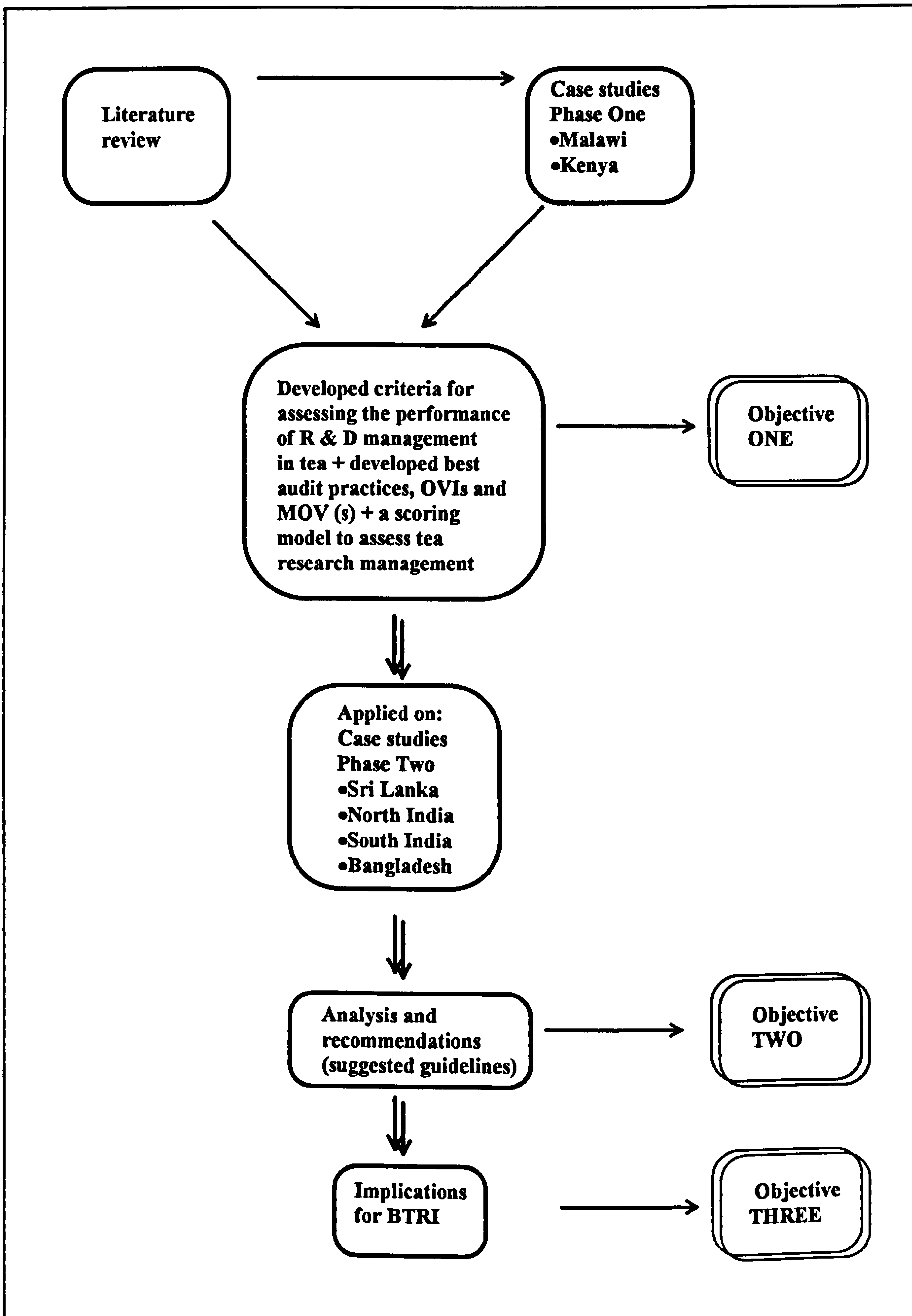
5.1 DATA AND INFORMATION SOURCES

As stated in the study background (Section 1.1) the project was undertaken to develop models (systems) which will assist research managers in identifying research problems, their prioritisation, implementation, efficient utilisation of resources and overall effective management. For the said purpose, data and information were obtained from the following sources:

5.1.1 LITERATURE REVIEW

Available literature pertinent to agricultural R & D and its management were critically reviewed to reveal existing research management practices and systems, and to identify deficiencies in conventional research management performance.

Figure 5.1 Logical flow diagram of methodology



5.1.2 CASE STUDIES ON TEA R & D ORGANISATIONS FOR DIFFERENT COUNTRIES IN ASIA AND AFRICA

Detailed case studies were conducted on the following six Tea Research Organisations of five different countries:

Malawi	Tea Research Foundation of Central Africa (TRFCA),
Kenya	Tea Research Foundation of Kenya (TRFK),
Sri Lanka	Tea Research Institute of Sri Lanka (TRI),
India	United Planters Association of South India (UPASI),
India	Tea Research Association (TRA), Tocklai, Assam, North India,
Bangladesh	Bangladesh Tea Research Institute (BTRI).

Initially case studies were grouped into two phases based on the nature of the data and information requirements and subsequent utilisation of this knowledge and information.

Case studies Phase One : **Identification of research management criteria (systems) for assessing performance of tea research, development of conceptual framework and objective verifiable indicators (OVIs).**

The two case studies involving TRFCA and TRFK were undertaken in order to:

- become familiar with the present management approaches;
- verify gaps in research management that had been identified in the literature review;
- identify gaps in present R & D management approach;
- develop a scoring model to assess the performance of research management systems; and,
- develop methodologies for further case studies and to develop a conceptual framework for the research.

***Case studies Phase Two*: Application, verification and refinement of conceptual framework**

Following the exploratory analysis of Phase One case studies, Phase Two case studies involving TRI-Sri Lanka, UPASI, BTRI, and TES (TRA) were carried out. These studies aimed to:

- identify the criteria which could be used to determine management performance;
- verify the objective verifiable indicators (OVIs) that had been developed to assess research management performance;
- assess the current practices (systems) in terms of the selected OVIs;
- find out how the developed conceptual framework and selected criteria fit into the existing system of R & D management;
- find out the likely constraints to the implementation of the developed conceptual framework;
- modify and refine the conceptual framework in light of any constraints; and,
- look for further information that could be used to measure effectiveness against research management criteria.

5.1.3 INTERVIEWS WITH R & D MANAGERS, RESEARCH PERSONNEL, ADVISORY AND EXTENSION OFFICERS, TRAINING PERSONNEL, BOARD MEMBER(S), OTHER COMMITTEE MEMBERS, AND MEMBERS OF PRODUCERS ASSOCIATIONS.

During the case studies interviews and discussions were conducted with the following groups of people:

a) Personnel engaged in research and development activities

R & D Managers

These are the senior executives involved in the day to day management of the respective R & D organisations, such as people like the Director, Assistant Director(s). Formal and informal interviews, and in-depth discussions were carried out to obtain information on R & D management approach based on the objective of the visits. At this level, discussions were intended to identify the different systems used for research problem identification, planning and formulation of research projects, resource allocation procedures, implementation and evaluation of research projects. Further information have also been obtained on different sources of funding arrangements, systems of industry linkage and feedback mechanisms, technology validation and dissemination procedures. In addition, information was also obtained on the level of interaction and type of guidance from different R & D management structures (management board, trustee board and other management committees). During discussion emphasis was placed on identifying different management constraints and ways of resolving conflicting organisational issues.

Research, advisory and extension officers

This category included heads of research divisions, scientists and extension officers, who are engaged in research and technology diffusion. These are the people working in the laboratory and in fields on the approved research programmes. This group have direct contact with the clients. Information relating to specific research projects were obtained from them, particularly regarding the objectives of different research projects, the structuring and scheduling of work programmes, the type, nature and procedure of data collection, data analysis techniques and reporting procedures, and the CBA related data of different research projects. Further, information regarding the nature of research constraints and ways of managing those constraints were also discussed.

With advisory and extension officers the key issue of discussion was related to technology dissemination, linkage and feedback with clients, constraints in technology dissemination and the role of advisory and extension officers in research problem identification.

Training personnel

In some of the R & D organisations, there is a group of people who are solely engaged in training plantation managers. Detailed discussions were carried out with them to gather information on the objectives of training, the duration of courses, course content, and how training can help in the dissemination of technology.

b) Representatives of R & D Management structures

Board Member (s)

Management board members or trustee members are grouped in this category. Most of them are the senior executives working for different multinational tea trading companies with wide experience in corporate management. Senior officials representing smallholders groups are also included. Together they mainly formulate strategies and broad based policy guidelines for the research organisations. They may also resolve funding issues, approve budgets, and decide recruitment, human resource and staff welfare policies.

Other committee members

There are many different committees working within tea R & D organisations which are intended to help the R & D manager in overall planning, implementation and management of research programmes, including technology dissemination. During field visits information was collected from members of the following committees:

- Executive Committees (EC);
- Technical Committees (TC);
- Finance Sub-committees (FSC);
- Research Advisory Committees (RAC);
- Scientific Advisory Committees (SAC);
- Research and Production Committees (RPC);
- Research and Production Sub-committees (RPSC); and,

- Estate and Extension Management Committees (E & EMC).

These committees consist of industry representatives, which include senior to middle level multinational company executives, such as technical officers or research officers with sound technical knowledge, university professors, senior scientists from other agricultural research institutes and proprietors of tea estates.

c) Information relating to informal evaluation and industry linkage committees (bodies)

The tea area of each country is usually divided into different valleys or zones, based on agro-climatic factors. However, their typology varies from country to country. One of the prime objectives of these committees is to obtain industry feedback on area specific research and extension needs, and to identify and to communicate any constraints in the implementation and adoption of different technologies. Members of these committees are senior estate managers and proprietors. The following are examples of committees and organisations operating in different countries:

Area Scientific Committees (ASC);
Valley Scientific Committees (VSC);
Joint Area Scientific Committees (JASC);
Joint Area Scientific Symposia (JASS),
Estate and Extension Forum (EEF), and,
District Planters Association (DPA).

d) Industry representatives

Representatives from the industry include owners, estate managers, superintendents, and technical officers or research officers from individual companies.

e) Members of producers association

This category includes members of tea producer associations representing the interests of producers, particularly regarding the marketing and promotion of sales, import of agro-chemicals including subsidies, taxation and the leasing of lands, wages and terms of services etc.

5.2 DATA COLLECTION METHODS

Data and information were collected during field visits by using checklists and interviews, documented records, attending seminars, research committee meetings, training workshops, and meetings with heads of research divisions using formal questionnaires.

5.2.1 CHECKLIST AND INTERVIEWS

A comprehensive checklist was developed during the literature review (Appendix I) covering the following broad headings:

- background data (country, industry and organisation under study),
- structure, administration and management of R & D organisations,
- planning, programme formulation and resource allocation,
- monitoring and evaluation,
- communication (linkage) and feedback,
- rate of uptake of technology, and,
- technology transfer constraints.

Based on the checklist, data and information were collected through interviews and discussions during each case study. For convenience a small cassette recorder was used with prior permission of the interviewee. Later, all the recorded discussions were transferred to paper and used for analysis.

During the *Phase One* case studies, most of the questions and discussions covered general information on approaches to R & D management. The analytical findings of these case studies together with information gathered through the literature review were used to develop a conceptual framework containing criteria to assess the performance of the research management function and related objective verifiable performance indicators.

Later, ***Phase Two*** case studies were undertaken, which mainly examined the application of the conceptual framework. During each of the ***Phase Two*** case studies the checklists were modified to suit case requirements. Specific questions were included, and discussions were targeted mainly on different research management systems, depending on the nature of information and data required to verify the conceptual framework. The conceptual framework and objective verifiable indicators were refined after each case study by incorporating lessons and experiences gained in previous case studies.

5.2.2 DOCUMENTED RECORDS

Relevant data and information were also obtained from published materials such as annual, biannual, quarterly and monthly reports, journals, proceedings of different conferences and committee meetings, circulars, pamphlets, memorandums, survey records, garden records, wall charts and brochures published by institutes and different estates. During case study visits, information was also gathered by attending and actively participating in discussions during various seminars, research committee meetings, heads of research divisions meetings, training workshops, and management staff meetings.

5.2.3 FORMAL QUESTIONNAIRE

Three different questionnaires were developed (Appendix II) under the following headings and used to obtain additional information as well as to verify some of the information collected through checklists. They included:

- questionnaire for researchers;

- questionnaire for R & D policy makers; and,
- questionnaire for tea managers.

In the formal questionnaires most of the questions were set to obtain information particularly regarding the objectives of different experiments, type and nature (mono or multi-disciplinary, short, medium or long), level of inter departmental co-ordination within the institute, different research constraints, interaction with clients, type and effectiveness of research client linkages, and the attitude of the industry towards existing R & D management and technology diffusion procedures. Information was also sought regarding research and technology dissemination constraints.

5.3 DATA ANALYSIS TECHNIQUES

5.3.1 COST BENEFIT ANALYSIS (CBA)

Data were collected during each visit in order to carry out a CBA of different research projects. In most cases, benefit and cost related data, information recording and compilation were found to be poor and unorganised. This points to one of the common and fundamental weakness in the Management Information Systems of Tea Research Organisations. Nevertheless, some data were collected, mostly from fertiliser experiments. Due to the lack of a proper CBA related data on capital expenditures and resource utilisation, proper CBA were not possible. Therefore a modified CBA (incremental cost benefit analysis) of research projects was carried out with the data where possible. These were analysed by computer and are presented in Appendix III. Although, some data for CBA analysis were collected for all the case studies, analysis was carried out only with the data which were collected from TRFCA, since here the collected data were most complete and from similar types of experiments (fertiliser).

5.3.2 RATE OF UPTAKE OF TECHNOLOGY

Initially it was planned to collect data from research organisations and from industry on the use of fertiliser, pesticides and improved cultivars based on recommendations and released improved planting materials from experimental findings. During field visits it appeared that the availability of such data at the institute level was scanty. As a result, it was decided to carry out these studies only on the use of improved planting materials i.e. the rate of uptake of clones.

Accordingly a pro-forma was developed (Appendix IV) and data were collected from different tea estates, representing different management groups and smallholders from each country under study. The range of data collected varied depending on the availability of records. It was constrained by time and transport availability during individual case studies. Except for the Tockali (North East India) case study, data were collected for individual tea estates and for individual company or smallholder groups. Data could not be collected from North East India, because of the prevailing political situation during visit.

Where possible computer analyses were carried out with the data with reference to:

- area of seedling versus clone over time; and,
- change in the clonal area as a proportion of the total planted area over time.

The observed trends were graphically presented in a consolidated form in Appendix V.

5.4 IDENTIFICATION OF RESEARCH MANAGEMENT CRITERIA

From the literature review, case studies and personal experience, standard criteria were developed to assess the performance of research management functions. With respect to each criterion:

- the best practices audits (BPAs) were identified;
- the objective verifiable indicators (OVIs) were formulated, and their means of verification were identified; and,

- a scoring system was developed to measure the performance against these criteria.

5.5 DEVELOPMENT OF SCORING MODEL AND ASSESSMENT OF RESEARCH MANAGEMENT PERFORMANCE

A total of fifteen research management criteria had been identified from the Phase One case study. A scoring model was developed and used to assess the performance of research management for phase two case studies. Against each of the identified research management criteria (main), a maximum score of 10 was allotted i.e. total performance was assessed on a cumulative score of 150 (15x10).

In order to analyse the performance of each main criteria, a number of best practices (BPs) or sub-criteria / criteria variables were identified (Chapter 7). Further, the allotted score for each main criteria, which is 10 was, distributed among the identified BPs for each main criteriaon. Distribution of scoring of BPs varied from a minimum of 0.5 to a maximum of 4, depending on the relative importance of the BPs. The importance of individual BPs was decided using evidence from the literature, and professional experience and judgement. The level of implementation of each BP were graded as:

- yes denoted by Y i.e. these BPs are practised fully, hence achieved score is full,
- partial denoted by P i.e. these BPs are practised in part or some of the points included under these BPs are not practised, absent, incomplete, or currently not in place. Therefore achieved score is half of the allotted score, and
- no denoted by N i.e. these are not practised at all or specified BPs are totally absent. Hence achieved score is O (zero).

In order to have a clear understanding about the BPs, scoring model and its application for assessment, an example is shown below (Table 5.1 to 5.3).

Table 5.1 Best practices audit against the performance criteria: Problem identification

Is there any system of link with the industry or clients ? → Yes → How good is the linkage ? (what are the different systems of linkages ?)

↓

Does the organisation have a system to obtain industry information and identification of problems through:

1. Request from the industry through: Correspondence, Contact ?
2. Advisory-extension officers ?
3. Scientists during routine advisory visits ?
4. Workshops and seminars involving clients and discussions during demonstrations and training ?
5. Regional, zonal, local stations or sub-stations ?
6. Different management committees, sub-committees, technical committees which involves clients ?

↓

It could be Weak / Average / Strong

No formal system in place

↓

NIL

(any best practices partial in practice = half of the allotted score)

BEST PRACTICES AUDIT:	1	2	3	4	5	6
ALLOTTED SCORES	1	1	1	2.5	2	2.5

Evaluation: 0 = Nil, 1 to 3 = Weak, Above 3 below 7= Average, and Above 7 = Strong

Table 5.2 Objective verifiable indicator (s) against the performance criteria Problem identification

Objective verifiable indicator (s): specified in terms number, type , duration and relevant period	Means of verification
Information on requests regarding problems encountered by the clients through: • Correspondence • Personal contacts during seminars, Workshops, Demonstrations, Training and • Formal meetings with clients representa-tives (Management or technical committees) and advisory-extension officers	Survey records at the institute and tea estates Proceedings of seminars, workshops Proceedings and minutes of different committee meetings

Table 5.3 Assessment of problem identification by applying the scoring model

Problem identification (Table 5.1)							**Total score**	**Assess-ment**
Best practices audit	**1**	**2**	**3**	**4**	**5**	**6**		
Allotted score	**1**	**1**	**1**	**2.5**	**2**	**2.5**		
Level of implementation	**Y**	**Y**	**P**	**P**	**Y**	**P**		
Achieved score	**1**	**1**	**0.5**	**1.25**	**2**	**1.25**	**7**	**Average**

Using the achieved scores against each main criterion, a profile on research management systems was developed for each case study. For easy understanding and better focus of the systems and their performance, results of each case study were presented graphically. In addition, results obtained through the scoring for all the case studies (research Institute) were then compared. A summary comparison for some of the results were presented in table form while others were presented graphically, depending on the suitability. In addition, a study of the implications of developed model when applied to BTRI was also conducted.

5.6 PROPOSED RESEARCH PROJECT CYCLE MANAGEMENT (RPCM)

For effective and efficient management of research functions, a new approach was identified. The RPCM consist of two different cycles: the innovation cycle and the project cycle (Figure 7.1). During the innovation cycle, a problem or idea is jointly identified by research authority and the industry and later, during research cycle phase, investigation is carried out to solve the problem, results of which would be disseminated to the industry.

5.7 SUGGESTED CRITERIA FOR DIFFERENT RESEARCH MANAGEMENT SYSTEMS (FUNCTIONS)

Phase One of the case studies provided the framework for identification and development of the research management criteria. Subsequently a best audit practice, objective verifiable indicators, and a new scoring system were developed to assess the performance of research management. ***Phase Two*** of the case studies examined the application of these criteria on four tea R & D organisations (Chapter 8). Utilising the conceptual framework as a means of assessing performance, suggestions were made on how to improve the performance of tea research organisations.

5.8 CRITIQUE OF METHODOLOGY

5.8.1 ANALYTICAL APPROACH: DECIDING PARTIAL

The analytical approach used to determine the partial scoring of best practices audits is general in nature. Some of the developed BPs consist of a number of parameters or components. During the assessment BPs were considered partially in place when any one of the components were not practised in a particular organisation. Where organisations may follow most but not all of the components for a single BP, awarding a partial classification might not do justice to those organisations. Take for example, BP 1 under evaluation (Table 7.12), which relates to the evaluation of research projects through regular internal seminars, workshops, peer reviews and demonstrations. A particular organisation may follow seminars, workshops, and demonstrations but not the peer review. In this case, scoring will be classified as partial even though the organisation is practising 75% for the BP.

5.8.2 COST BENEFIT ANALYSIS

In most of the tea R & D organisations benefit cost related data and information are scanty. Where available recording and compilation of data were found to be disorganised. In such situations, data retrieval, analysis and drawing any conclusion is very difficult. Where data do exist, they are mostly benefit related. There are hardly any data on the cost involved in research projects. Records of resources utilised by individual research projects are either incomplete or do not exist. Consequently, cost benefit analysis was not possible. In this study, however, modified cost benefit analysis (Incremental cost benefit) was carried out with collected data. In such analyses, some of the data were obtained either from the industry or drew on assumptions made from available information.

5.8.3 RATE OF UPTAKE OF TECHNOLOGY

Like CBA related data, the study was constrained by the unavailability of data on rate of uptake of technology at the institute level. For some of the technologies, data were recorded but kept in such an unorganised way that it was very difficult and time consuming to obtain data. The study obtained data on the use of improved tea cultivars from different tea sectors. The study was also constrained by time and transport availability during individual case studies. In addition, relevant information and factors influencing the rate of uptake could not be collected. Consequently, data collection was very poor and any conclusion from such data may be misleading. Only in Bangladesh, did the collected data represent over 28% of total tea area. Preliminary indication on the results are given in Appendix V.

5.9 APPLICATION OF METHODS

This Chapter has described the design of the methodology for the study. Chapter 6 describes how these were first used in ***Phase One*** case studies. Chapter 7 reports on the further development of research management criteria, OVIs, BPs, conceptual framework and a scoring model. Chapter 8 describes the application of the developed model and conceptual framework for assessing the performance of tea research management based on the developed methodology.

The development of methods to assess and improve the performance of tea research management is an important output from this study.

CHAPTER 6

REVIEW AND ANALYSIS OF CASE STUDIES: *PHASE ONE*

In order to develop a model for research management criteria and conceptual framework for performance analysis, it was necessary to understand the current R & D management approach of different tea R & D organisations, particularly their organisational structure, funding arrangements, R & D programme planning, monitoring, evaluation and technology dissemination procedures. This information was collected through case studies. This Chapter describes in detail the case studies conducted during the research for the purpose of model development.

As described earlier (Section 5.2) case studies have been divided into two phases: *Phase One* and *Phase Two*, mainly based on the objective of the visits and types of data obtained. *Phase One* was exploratory for the purpose of method development, while *Phase Two* was more concerned with analysis and applications. *Phase One* case studies are analysed and reported in this Chapter and *Phase Two* case studies in Chapter 8.

The first two case studies i.e. *Phase One* (TRFCA and TRFK) were carried out with following common objectives, namely, to determine:

procedures for research problem identification, priority setting, appraisal, and resource allocation,

- procedures for research programme planning, implementation (monitoring) evaluation; and reporting of research results;
- linkage between researcher, and plantation management, extension agents and policy makers;
- cost and benefit of technology; cost benefit for new extension and replanting methods of technology transfer,

- technology dissemination, rate of uptake of technology, and constraints by the industry with respect to adoption;
- monitoring of adoption and technology dissemination.

6.1 Case studies on Tea Research Foundation of central Africa (TRFCA)

6.1.1 Tea and tea research in Malawi

Tea plays an important role in the economy of Malawi. It was the first country in Africa to grow tea on a commercial scale (Ellis and Nyirenda, 1995). Central African Limited and Tea Association of Malawi (1991) reported that after tobacco, tea is the second largest foreign exchange earner in the economy of Malawi. Occasionally sugar overtakes its position when the price of tea is low. Currently Malawi produces 39,479 metric tons of tea over an area of 18,705 ha.

In comparison to other tea growing countries of the world, its position is ninth in respect of production and eleventh in respect of area. However, its position is seventh in respect of export among the tea exporting countries of the world (Table 8.6). The industry is one of the largest employers of labourers in private sector with a total labour of over 42,000 as of 1991. Ownership of the industry includes both smallholders and estates.

Research on tea in Malawi started in the year 1923. Initially research was managed by the industry under the name Nyasaland Tea Association. In 1928 the Agriculture Department of Malawi took over the responsibility for research. In 1957 responsibility of research reverted to the industry. Since then research is managed by the industry itself.

In 1966 the Foundation became an autonomous institution, under the trustee incorporation act of Malawi (Arnold *et al.*, 1989). Apart from Malawi, TRFCA is also responsible to carryout research for its member countries which includes Zimbabwe, Republic of South Africa and Zambia. In the early days, research had been concentrated mainly in Malawi. Whittle (1995) reported that recently TRFCA has recruited research officers in Zimbabwe and South Africa and has created opportunity to link TRFCA with other countries. He further reported that because of this, TRFCA has been recognised as the prime tea research authority within the South African Development Corporation (SADC) region.

6.1.2 Mandate of the Foundation

The Registrar General (1977) described the objective in the constitution of the Foundation as follows: the Institute is responsible for carrying out problem solving research for the improvement of tea, generating technologies and disseminating information pertinent to the tea industry.

6.1.3 The organisation and structure of research

Arnold *et al.*, 1989 reviewed the organisation and management of TRFCA and concluded that despite some problems such as fund constraints, it achieved good success in fulfilling many of its objectives. As a result the Foundation is well respected among its customers. Currently research is organised and carried out by the following 6 divisions:

Agronomy,
Advisory,
Bio-chemistry,
Crop protection,
Plant breeding,
Process research.

Each of these sections is headed by a senior scientific officer. The Institute has four field stations namely, Mimosa, Nusawadzi, Thyolo and Two Rivers. These field stations to carry out field trials for zonal and regional adaptability of various technologies. In addition to research, the Institute also gives advice, disseminates technologies and imparts training to the plantation manager. Besides tea, there is a coffee research and advisory section within the Institute.

6.1.4 MANAGEMENT

TRFCA is an autonomous organisation governed by Board of Trustees (BT), which also acts as a Management Board (MB). The members all have wide experience in corporate management and practical experience in the plantation sector.

The function of the Board is to formulate broad based management policies and guide the Foundation for its smooth functioning and efficient management. From the discussions with the Director, Board Members and clients, it appears that the Foundation has been well served by the Board of Trustees since inception. The Foundation has also been successful in developing a coherent bondage and harmonious relationship with BT. Without interfering in day to day management affairs, BT has been always supportive of the Foundation which has helped to create and maintain a good working relation with a balanced culture of its own.

6.1.5 FUNDING

The Institute is funded by the cess money collected from the member countries. Cess money for Malawi is collected and disbursed through the Tea Association of Malawi (TAM). Other member countries (Zimbabwe, Republic of South Africa and Zambia) directly pay their cess money to TRFCA on quarterly basis. Cess money depends on the quantity of made tea which is at present 1.25 US Cents for 100 kilogram. Other than the cess, the Foundation also receives its income in the following way:

- members' contributions, comprising fixed annual subscriptions from Government Departments and commercial companies;

- the sale of made tea in the factory;
- sale of green leaves harvested from experiment stations;
- sale of cuttings and plant; and ,
- miscellaneous sales of laboratory services and publications.

6.1.6 RESEARCH MANAGEMENT: *PRELIMINARY ANALYSIS*

Previously TRFCA was a small organisation, following an informal, un bureaucratic and horizontal style of management. Most of the decisions were taken at the Directorate level. Gradually the Institute has grown bigger as the industry flourished. Infrastructure and laboratory facilities have been developed. Very recently a Bio-chemistry laboratory has been equipped with modern analytical facilities. Research into tea processing has been introduced to support the improvements in manufacturing.

Funding instability and fund constraints

Production of tea in any country may vary year to year mainly because of climatic variations. In recent past production of tea in Malawi has declined because of unprecedented drought. As a consequence, cess collection has reduced and this has created instability in funding. In addition, the rate of inflation has increased substantially. Collections of money from other sources are sometimes delayed. All these factors have resulted in instability and uncertainty in funding of the organisation.

Fund constraints have seriously affected proper functioning and smooth management of the Foundation. They have not only become a threat for future performance, but also for the existence of the Foundation (Whittle, 1993). Because of this, top management is seriously looking for donors for funds.

Committee system

There was no formal committee to help the Director in research management activities, particularly to obtain industry information on research needs. The post of Assistant Director (ADR) has been vacant for a long time. The Director of the organisation was heavily burdened with day to day management of the Foundation. As a result, the development of research management systems has not kept pace with the growth and development of the Foundation.

Consultation, communication and feedback

There was no formal system to keep linkage and obtain feedback from the industry. Absence of such a system has resulted in isolation of industry from the research. As a result, research problem identification was inadequate and could not focus the actual needs of the industry. This isolation has resulted in researcher led rather than industry led research.

Planning, appraisal and prioritisation of research problems

No systematic approach is followed. In annual open day sessions, industry representatives would participate in discussions and suggest problems and topics for research. As there was no formal procedure for prioritisation, planning and appraisal, relevant disciplines would carry out trials to satisfy the people without ascertaining the need, urgency and severity of the problem. Consequently, there were duplications and excessive number of trials. For example, in the Agronomy Division alone, currently there are more than 40 trials, data of which have yet to be analysed and reported. Some of the experiments were conducted without following a scientific method. For example, Wilkie (1993) argued that some trials appear to have lacked clear objectives and careful design. Absence of research planning resulted in improper use of valuable resources.

Monitoring and Evaluation

There is no mechanism to review and monitor research progress. As a result field trials continued for longer than the actual need. For example, in the Agronomy Division alone some trials have continued for more than 50 years without drawing any conclusion. In absence of monitoring and evaluation, data compilation, analysis, conclusion and recommendations of any technology are delayed. There is no system in place for deciding whether or not to continue or terminate research projects. In some sections there were some experiments which continued even long after plants died because of unfavourable climatic factors. As there was no monitoring and evaluation of progress, these experiments were continued but little value could be attached to results.

Internal Evaluation

There was no system of regular internal seminars, workshops and discussions among the scientists of the Foundation which could be used for internal evaluation of research projects.

Reporting

Whatever knowledge is generated and technology developed through research, it must reach to the industry. Little importance was attached to reporting on a regular basis. Annual reports, one of the primary means of reporting results to the industry, were often delayed. As a result industry does not know the recent results of different experiments. Emphasis should be given to reporting on a regular basis.

Management information system (MIS)

MIS is an important component of an efficient management system. TRFCA is lacking in this respect. For example, it was not possible to trace when the first clone was released to the industry from the Institute. In almost all divisions record keeping is unsystematic. Records on resource utilisation against different research projects are not recorded properly. To predict the rate of uptake of technology no data were available. Further, some of the important information relating to the industry, like area under tea , smallholder hectares, different company wise area under tea, production, were not organised and maintained properly.

Discrete aid projects, and utilisation of aid funds

From time to time aid projects were undertaken with the assistance of expatriate scientists. Once the project life is over, the expatriate goes home and the project often discontinues without any fruitful conclusion. When another new aid project starts, the same process would repeat. Because of this type of discrete and discontinued aid projects, the Institute could not fully develop its research results or capabilities, except with respect to the physical facilities.

Technology dissemination

The size of the tea industry is relatively small and comparatively advisory division is also small. Though there is less problem such as pest and disease incidence in the industry (Wilkie, 1993) some of the systems for technology dissemination are absent. There is no system of imparting training to the tea managers people, who are directly involved in tea culture. This is a great weakness of the Foundation. With respect to the rate of uptake of technology, limited data have been collected and analysed (Tables V.1-V.4 and Figures V.1-V.8). From the analysis a preliminary conclusion can be made that the rates of uptake of improved tea cultivars are not satisfactory. The Foundation needs to put more emphasis on the use of improved cultivars among the clients. Individual analysis of collected data are presented in Appendix V.

6.1.7 CONCLUSION

The infrastructural facilities at the main station are well developed. There are good computer facilities, and laboratories are well equipped with modern equipment. The level of interactions between the Management Board and the research authority is strong. However, research at TRFCA is not achieving its full potential because:

- there is instability in funding;
- there is no formal body for linkage and feedback between R & D and industry;
- research management systems (problem identification, planning, appraisal, monitoring, evaluation) are not followed, which results in improper use of limited resources;
- in the absence of MIS, rational decision making is hampered;
- there is no record of information which could be used to ascertain the rate of uptake of released technologies, which is important for long term planning and future research strategies; and
- there is no system of imparting training to plantation managers, which one of the essential components in effective technology dissemination.

World tea market has become more competitive and there is an increased demand from the industry for more technological support to improve the tea quality and quantity. As a result, recently the volume of research work at TRFCA has increased substantially. On the other hand, financial resource constraints have become acute. Under prevailing circumstances management should adopt a formal and more structured style of research management for rational utilisation of scarce recourses.

One of the priority tasks for the management is to develop some mechanism and system to obtain industry feedback which will help the Institute to identify the actual research need of the industry. Adoption of more formal project planning, evaluation and introduction of priority setting will help to direct valuable resources in the right direction and channel them into priority areas.

Another priority task is for the management, to determine a strategy to attract and secure stable funding for the Foundation in the future. Dependency on donor aid should be minimised. Aid funds should be used preferably to develop infra-structure, training facilities, human resource development and for procuring laboratory equipment.

6.2 Case studies on Tea Research Foundation of Kenya (TRFK)

This is the second case studies that were grouped under the ***Phase One*** case study.

6.2.1 Tea and tea research in Kenya

Tea is one of the major contributors to Kenya's economy, providing employment and foreign exchange. In 1989 tea took number one position in the agricultural commodities list replacing coffee and overall became second only to tourism in foreign exchange earnings (Othieno, 1991). Kenya is the largest producer of tea in Africa. Tea was first introduced into Kenya in 1903. Commercial cultivation started in 1920. Currently Kenya produces 211,168 metric tons of tea over an area of 104,864 ha. In comparison to world's tea production, its position is fourth in respect of area as well as production. But in respect of world exports its position is third among the tea exporting countries of the world (Table 8.6).

The Kenyan tea industry may be grouped into two sectors; the large estate sector and the small-holder sector. Large estate sector composed of multi-national companies and some local companies having medium to large plantations (upto 7000 ha.).The small-holder sector consists of individual small scale farmers with average holding of about 0.1 ha. In 1988, the small holder sector accounts for approximately 66% of the tea area (Othieno, 1991).

Research on tea in Kenya was started in 1949. The Brooke Bond Kenya (BBK) created a private research department within their local company, African Tea Holdings Limited (Othieno, 1981). As the industry flourished, this department started to serve the whole African tea industry. Though it was created by a multinational company for their own R & D purpose, findings and advice was given to all the tea growers of East Africa.

Later, in 1951, the African Tea Holdings research department became the Tea Research Foundation of East Africa. The Foundation was converted into a Limited Company incorporated in Kenya. The Foundation was registered in Uganda and Tanzania in 1957 and 1959 respectively. Its headquarters was in Kericho, with two stations; one in Uganda and one in Tanzania. In the later part of 1970s, because of the prevailing situation at that time, it became impossible to continue its function as a three member Foundation. The governing body lost their control over the management of the Foundation and it ceased to function as a company. The Kenya Government through its Tea Board has now taken over the function of Kericho set-up and has established in its place the Tea Research Foundation of Kenya (Othieno, 1981).

6.2.2 MANDATE OF THE FOUNDATION

The main objective of the TRFK is "to promote research into and investigate all problems relating to tea and such other crops, and systems of husbandry as associated with tea throughout Kenya including : the productivity, quality and suitability of land in relation to tea planting; and on matters ancillary there to".

6.2.3 THE ORGANISATION AND STRUCTURE OF RESEARCH

The Foundation mostly undertakes adaptive research to fulfil its objective. Currently research is organised and carried out by the following 6 divisions:

Advisory,

Agronomy,

Botany,

Chemistry,

Plant protection

The Chemistry division is a combined division of Soil science and Biochemistry. Each of these divisions is headed by a senior scientist. There is no sub-station to carryout zonal or regional adaptability trials for technology. Besides research activities, the Foundation is also responsible to give advice on technical aspects of tea culture, disseminate proven technology and impart training to the plantation managers.

6.2.4 MANAGEMENT

The Foundation is a semi Government organisation, under the Ministry of Science Agriculture and Technology, but the tea industry is under the Ministry of Agriculture. The Foundation is managed by a Board of Directors (BD), which is also known as the Management Board (MB). The MB is the apex body and acts as the policy making unit of the Foundation, which formulates broad based policy guidelines for smooth functioning and management of the Foundation. There is strong interaction, feedback and guidance among the Directorates and the Board members. The Director is the administrative head of the organisation and responsible for day to day management. The Director is also a member of the board. However, some of the major decisions like capital expenditure for development are taken by the board. Members in the Board are represented from :

- the Tea Board of Kenya;
- the Ministry of Agriculture;
- the Ministry of Research, Science and Technology;
- the Kenya Tea Development Authority (KTDA);
- the Kenya Tea Growers Association (KTGA); and,
- the Nyayo Tea Zones Development Corporation (NTZDC).

6.2.5 FUNDING

The Foundation is funded by the industry through cess money. Cess money at @ 25 Kenyan cents per kilogram of made tea produced are deposited to the Tea Board of Kenya. Collected money is spent for two purposes: research, and export promotion of which the research share is 40%. Out of remaining 60%, Tea Board spent 20% for its maintenance and 40% for export promotion (Othieno, 1993). In addition to cess, the Foundation also generates internal revenue though the sale of green leaves produced from the Timbilil tea estate managed by the Foundation. About 20% of total expenditure could be met out of this internal revenue. Cess money and internal revenue are kept and maintained in separate account. Besides cess and internal revenue, occasionally it receives grant from the Kenya Government.

6.2.6 RESEARCH MANAGEMENT-*PRELIMINARY ANALYSIS*

The TRFK is a small organisation compared to the huge industry it serves. Nevertheless, it is a fairly well organised Foundation, which follows an informal and un bureaucratic style of management. No systematic approach is adopted for resource allocation. Yet resource utilisation is good because of the multi-disciplinary nature of research programmes. Management is keen to motivate scientists by introducing a special incentive (cash money) in the form of "Merit award" as a means of recognition and remuneration for excellent research work. In their last Research Advisory Committee (RAC) meeting they raised the amount of money to 100000 Kenyan shillings (KSs) for this purpose. This Merit award has certainly created enthusiasm and competitions for good quality research among the scientists.

Funding consistency

There is a consistency in funding arrangements, which is very important for continuation of research projects. Once research projects are approved, management ensures sufficient operational funds for smooth functioning of research activities and other important function of the Foundation. Furthermore, during major fund constraints, or sudden cut in the budget or because of inflation, if any budgetary shortfalls arise, it is supplemented from green leaf sale revenue. This arrangement keeps the research project going undisturbed during any financial crisis of the Foundation.

Committee system

Besides the Board of Management there are two other Board Committees, to help in research management functions: the Staff and Finance Committee (SFC), and the Research Advisory Committee (RAC). The SFC formulates policy guide lines relating to the staff welfare, decides recruitment policy and looks after the financial affairs of the Foundation. RAC is entrusted with the overall responsibility of formulating research strategies, and guiding the formulation of the research programme and implementation of research.

The RAC is headed by a Chairman, who is a senior representative from the industry with long experience in corporate culture and management skills in plantation crops. The committee consists of experienced people from the industry (clients) who are interested in research, academicians from Universities with sound research background, and people from other research organisations. As a consequence the Foundation gets very good levels of guidance and management inputs from the industry.

The RAC has the responsibility and authority to:

- develop and formulate research strategies for the Foundation;
- decides on overall resource allocation against approved research projects;
- scrutinise and approve the research programme;
- review and evaluate research progress; and,
- decide on whether a research project should be continued or terminated based on its outputs.

Research proposals, once prepared by the scientific personnel, are then preliminarily scrutinised by the Director. If he is not convinced, he may reject or suggest modification / addition of information or make queries. He may then circulate this proposal among the senior scientists for critical review and comments. If there is any suggestion or comment, it is then sent to the proposal initiator to supplement the additional information required. With the required information, it is again sent to the Director, who then gives preliminary approval for consideration by the RAC. Subsequently the RAC critically analyse and appraise the proposals in the context of:

- industry needs and benefit;
- availability of resources (financial, human and physical); and,
- technical feasibility and demand for facilities.

If the RAC is convinced, only then is a proposal approved and transformed into research projects.

Consultation, communication and feedback (between research and industry)

Formal systems of consultation, communication and obtaining feedback from the industry are poor. Research problems are chosen / identified on the basis of limited feed back from the industry.

Planning, appraisal and prioritisation of research problems

Research planning is quite strong. A good pro-forma has been developed for research project appraisal. This requires a lot of relevant information like site of the experiment, layout and design, scientific personnel and technician involved, time span, nature of data collection, data compilation and report writing , time schedule for individual tasks. In addition, the pro-forma requires specification of resources required, and a strong justification for the experiment.

Monitoring and Evaluation

Monitoring and evaluation is fairly strong. It is done on the basis of collected data and information against the information and schedule submitted with the research proposal pro-forma. Heads of research divisions are responsible for monitoring of research progress of individual research projects. Formal monitoring is done quarterly, against the schedule submitted with the research proposal pro-forma. In every quarter, data are compiled, reports are prepared and sent to the Director, who in turn submits these reports to the Board.

The RAC meets twice a year, once during March / April and once in November / December. During the November / December meeting, the committee approves the research programme for the coming year and also reviews the year's research progress. At this meeting all the scientists present their progress reports before the committee. Sometimes experts from outside, such as U.K based multinational company scientists who have interest in Kenyan tea are also invited to participate in this review. RAC also has an internal system of evaluation.

Another form of evaluation is through a symposium. This is held every 2 to 3 years. During this symposium, top policy makers of the industry are invited. Scientists will present papers, based on their findings with specific conclusions which they think are ready for recommendations for technology adoption. There are also open-days and field day sessions where farmers of all kinds are invited to take part in discussions, visit laboratory and field demonstration plots.

Every project is budgeted separately. There is no formal system of financial monitoring, there is a system of monthly staff meeting where all the staff members of TRFK sit with the Director. They discuss various management issues and particularly review the financial situation. During the discussion, project and department specific financial situations are analysed. Responsible officers are required to account for any under expenditure or over expenditure in projects or departments. In this way project resource use is monitored. If a project faces financial constraints, then the Director may increase financial allocation so that the project is completed.

Internal evaluation

There is a good system of review and internal evaluation of research projects in the form of a technical meeting. This is a week long meeting chaired by the Director of the Foundation, where all the scientists of the Foundation present progress of their different research projects. Detailed discussion takes place on: layout of the experiment, statistical design, data collection method, and analysis techniques. It is an open and strong forum where projects are critically examined and, if required, necessary amendments are recommended for the improvement of the projects.

Reporting

Reporting is up to date. Research findings are formally disseminated to the industry through journals and annual reports. For smallholders, however, publications of the Foundation appear to be too technical for easy assimilation.

Management information system (MIS)

MIS is weak and record keeping is not systematic. Proper data on resource utilisation against different research projects are not recorded. Overall information and relevant data on industry is poor. Data on rate of uptake of technologies are not recorded properly and information on CBA is scanty.

Aid projects and utilisation of aid funds

There have been a few projects funded by ODA, in the area of developing technical expertise and modernising laboratory. The biochemistry laboratory was modernised under the ODA project. Currently there are two projects in Biochemistry. There is also possibility of a project proposed by the Silsoe College and ODA in the area of environment and genotype interaction on productivity of tea. Overall utilisation of aid resources is strong.

Technology dissemination

The main responsibility of the Advisory Division is to disseminate proven technology to the industry, advise on specific problems and feed back the industry problems and views to the Foundation. Advisory work has been mainly concentrated towards the smallholder sector (KTDA) because of shortage of manpower in the division. The Advisory Division organises regular visits to the KTDA smallholders (both in plantation and factory) in order to advise on existing problems. Seminars and workshops are delivered to plantation managers. Overall, the advisory function is well organised.

In order to assess the rate of uptake of technology, data from KTDA group and a few multinational groups have been collected. Analysis reveals that among smallholders uptake of improved tea cultivars are encouraging (Tables V.5 and Figures V.9-V.10). One of the main reason could be that the smallholding system was introduced much later than the multi-national companies. When smallholders started planting tea, sufficient improved tea cultivars were available.

Sufficient data could not be collected from the multi-national sector. However, data analysis shows that the rate of uptake of improved tea cultivars is not satisfactory (Tables V.6-V.7 and Figures V.11-V.14). The Foundation needs to gear its advisory / extension activities more towards the multinational companies particularly with respect to the use of improved tea cultivars. Detailed analysis on collected data is given in Appendix V.

6.2.7 CONCLUSION

Research activities are well organised. Research programmes are mostly multi-disciplinary in nature. The Foundation has developed a pro-forma for research proposals which requires a lot of information. As a result, project preparation, monitoring and research evaluation are good. There is a strong Management Board which provides effective guidance to the Research Authority.

Though research was relatively well organised at TRFK, it was not achieving its full potential because of the following characteristics of the research management system:

- the organisation is small compared to the size of the industry and there is a wide range and diversity among individual clients and their respective needs, which require to be targeted more closely;
- there is no infrastructure of sub-stations. This is a major constraint. In absence of sub-stations, regional adaptability trials of released technology and assessment of region specific client's needs are not possible. Furthermore, the constraints of adopting recommendations are not fully appreciated, and quick communication and feedback are hampered. For these reasons problem identification is inadequate;
- the Advisory and Extension Division is one of the smallest units which limits the technology diffusion, feedback and overall interaction with client groups;
- formal and systematic resource allocation is not followed;
- management information service is unorganised and weak. Data on resource utilisation against research projects are not kept properly, and data and information on rate of uptake of technology are difficult to trace.

6.3 COMPARISON OF INDUSTRY INFORMATION AND MANAGEMENT SYSTEMS

At this stage it is essential to show a brief comparison of industry information and management systems of TRFCA and TRFK which are presented below in a summary form (Table 6.1 and 6.2).

Table 6.1 Comparison of organisational management systems of TRFCA and TRFK

Name of the country	Malawi	Kenya
Research organisation	TRFCA	TRFK
Establishing year	1923	1949
Type of management	By Trustee board (industry representatives)	Management board (industry representatives)
Nature of funding	Through cess by the industry	Through cess by the industry
Type of clients	Estates + Smallholders	Estates + Smallholders
Number of research division	6	6
Committee system	Absent	Present
Funding arrangements	Weak and inconsistent	Strong and consistent
Number of committees to help research management	0	2
Client contact	Weak	Average
Research planning, appraisal and prioritisation of problem	Weak	Weak
Monitoring and Evaluation	Weak	Strong
Internal evaluation	Weak	Average to good
Technology dissemination	Weak	Weak
Reporting of research	Poor	Average
MIS	Weak and unorganised	Weak and unorganised
Number of sub-stations	3	0

TRFCA was established much earlier than the TRFK. But both organisations have similarity in respect of certain industry and research management features; for example with respect to, type of management, nature of funding arrangements, type of clients (estates and smallholders) and number of research divisions (Table 6.1). There is one difference however. For instance, the committee system is strong in TRFK, while there is no committee system in TRFCA to help the R & D management decision making. Further more, funding is also inconsistent in TRFCA. Consequently, research appears to be more organised in TRFK than TRFCA. However, one of the weak point for TRFK is that it does not have any sub-stations to carry out wider adaptability trials. Management information systems in both the organisations are weak and unorganised (Table 6.1). In respect of industry performance, yield per hectare (above two thousand kg) and percentage of export compared to individual country production are similar. Both Malawi and Kenya exports almost 90% of their total production (Table 6.2).

Table: 6.2 Comparison of overall industry information

Name of the country	Malawi	Kenya
Area under tea (ha.)	18,715	104,864
Production (made tea in metric ton)	39,479	211,168
Export	35,269	188,390
% share production compared with world production	1.5	8.2
% share export compared with world export	3.1	16.5

6.4 SUMMARY CONCLUSIONS FROM CASE STUDIES: *PHASE ONE*

At this stage it is relevant to produce a very brief summary of findings from the case studies on Malawi and Kenya on the overall management context of agricultural R & D organisations. Two case studies enabled a preliminary identification of research management issues and systems, and provided a basis for assessing performance and impact. The common themes from the two cases studies were that:

- there was no systematic procedure for problem identification. As a result research projects fail to reflect the need of the tea industry;
- planning and implementation of research projects were weak. Eyre (1986) reported that without proper planning organisations will be at the mercy of management whims and external pressures which may make organisations lose sight of objectives. In addition, weak implementation of research projects limits achievement of organisational goals;
- no formal priority setting procedure was followed to take decisions on resource allocation. Consequently most important research problems were

not covered, and resources were diverted to the areas of less importance which leads to improper use of resources;

- appraisal of new research projects was not given due consideration. Without detailed project appraisal, it is most likely that smooth implementation and attaining objectives are difficult;
- data on cost related aspects were either not recorded or where recorded, are incomplete. As result it is difficult to assess the impact of research projects, or to justify research spending which is one of the key element for continuation of funds;
- management information was not kept properly or not recorded properly; where information was recorded, not kept in an organised way for which information retrieval, analysis and drawing of any conclusions were difficult. MIS affects the quality of decision making, in addition, unorganised MIS leads to delay in decision making;
- the rate of uptake of technologies are not formally assessed such that the efficiency of research activities and impacts go unrecorded and do not feedback into the management process; and,
- lack of a structured management approach to carry out activities in a coherent manner.

6.5 CHAPTER SUMMARY

Based on the methodology, *Phase One* case studies were conducted. This Chapter has reported the analysis of *Phase One* case studies on TRFCA and TRFK. *Phase One* case studies has identified the need for, and enabled to design a framework / model for evaluating the performance of tea research management, and for formulating guidelines on best research management practices. Following Chapter addresses this requirement.

CHAPTER 7
PERFORMANCE CRITERIA FOR RESEARCH MANAGEMENT

This chapter suggests a model research management cycle to carryout the research activities in a sequential way for better and more productive management of tea research. Furthermore, it reports and defines the individual criteria and conceptual framework that have been developed from the perspective described in Chapters 3, 4 and 6. In addition, it describes the BEST PRACTICES AUDIT (BPA) i.e. possible best options for the developed criteria. Above all, it describes objective verifiable indicators (OVIs) against performance assessment criteria and their means of verification. Most importantly, it suggests a simple scoring model (procedure) with distribution of scores against BPs for quantification of subjective terms such as: ***nil***; ***weak***; ***average*** and ***strong*** that were used in analysing the case studies presented in Chapter 8.

7.1 DEFINITION OF TERMS

At the beginning it is necessary to explain in brief the purpose of the best practices audit and objective verifiable indicators.

7.1.1 BEST PRACTICES AUDIT

Research management criteria that have been developed are broad based and general in nature. To give them a boundary, and for ease in implementation under specific situation, particularly for R & D management in tea, best practices audit against individual criteria have been developed and described in detail (Tables 7.1, 7.3, 7,5, 7.7, 7.9, 7.11, 7.13, 7.15, 7.17, 7.19, 7.21, 7.23, 7.25, 7.27 and 7.29).

7.1.2 OBJECTIVE VERIFIABLE INDICATORS AND MEANS OF VERIFICATION

Objective verifiable indicators and means of verification are two separate but interrelated elements. Objective verifiable indicators specify the type of evidence that is needed to verify the achievement of objectives and outputs at each level of research management. The means of verification indicates how that evidence could be collected and measured. McLean (1988a) reported that both have consequences for monitoring and evaluation. They define:

- the data collection and reporting requirements during the implementation of the activity (monitoring); and,
- from the outset of an activity, the standard against which actual results will be measured.

Indicators and their means of verification must be carefully selected. These should :

- clearly indicate the criteria for attaining objectives;
- specify the nature, quantity, quality, and time required for the objective to be achieved;
- be of an appropriate scale, and focus on key processes;
- be sufficient in number and detail to adequately measure the achievement of objectives;
- be independent of biases of evaluators;
- be objectively verifiable and unambiguous.

McLean (1988a) suggested that during the selection of indicators, it is helpful to think of the expected output and purpose of the activity in term of targets, answering the questions of what, how many, with which characteristics, and when. Tables 7.2, 7.4, 7.6, 7.8, 7.10, 7.12, 7.14, 7.16, 7.18, 7.20, 7.22, 7.24, 7.26, 7.28 and 7.30 describe the objective verifiable indicators and their means of verification against the criteria for research management in tea.

Before describing the research management performance criteria, it is essential to describe the research project cycle which has been developed to provide a framework on how to carryout research management activities in a coherent manner. The rationale for such a structured project management cycle has been described in detail in Section 3.2

7.2 SUGGESTED RESEARCH PROJECT CYCLE MANAGEMENT (RPCM)

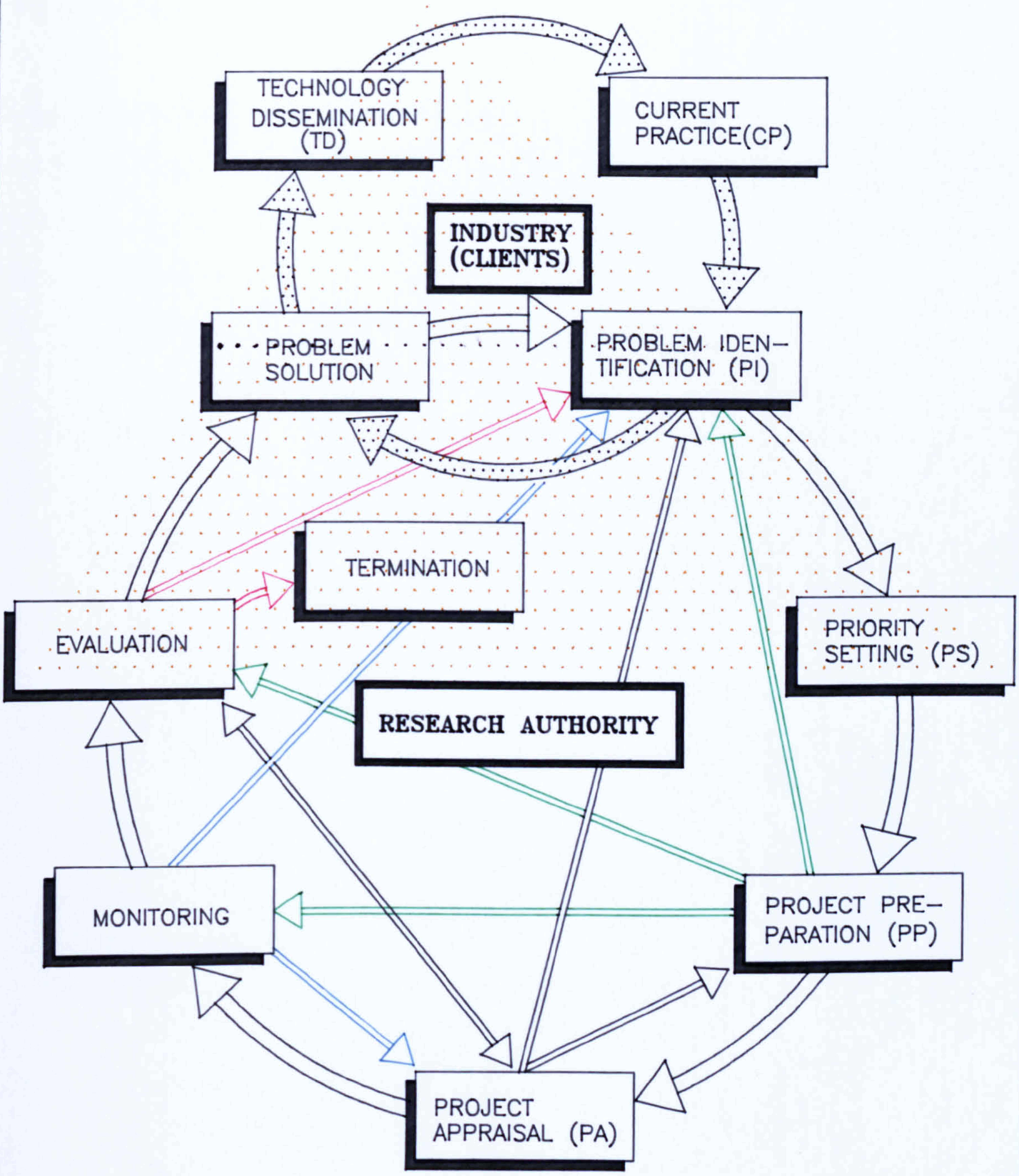
Researchers rarely carry out their work in a neat cycle. Rather they work with a great deal of autonomy usually with little sense of planning or accountability to management or research sponsors (Gapasin, 1993). Experience on case studies also showed that there is a lack of structure and cohesiveness among the different activities of research processes and functions. Under tight funding, strong competition for scarce resources and widespread demand for transparency and accountability, research could be more productive if carried out according to the following suggested model (Figure 7.1) of research project cycle management (RPCM) which consists of two distinct but closely inter related phases. One is an innovation phase and the other is a research phase.

7.2.1 INNOVATION PHASE

During this phase industry problems are jointly identified by the research authority and the industry. Once problems are identified, they are passed on to the research authority, to investigate and find out appropriate solutions. This leads to the research phase.

7.2.2 RESEARCH PHASE

Once the research authority has prioritised problems jointly with the industry, project preparation, project appraisal and monitoring activities would be carried out in a sequential way as shown in the RPCM (Figure 7.1) by the research authority independently. Evaluation would be carried out jointly by the industry



(Shaded area shows interaction between clients and research)

Figure 7.1 RESEARCH PROJECT CYCLE MANAGEMENT (RPCM) and research authority. During evaluation, if a project is completed or solution is obtained, the project could be terminated and results (research findings i.e. problem solution) which pass the evaluation criteria, would be ready for recommendation.

Recommended solutions will become the new technologies and will lead to the technology dissemination, which is a joint activity of industry and research authority. When recommendations are taken up by the industry, they become the current practice, from where new problems are likely to be identified. Thus the activity will continue in a cyclic manner as shown in Figure 7.1.

The proposed RPCM facilitates close interactions and feedback between research authority and the industry in the following manner (Figure 7.2). This is an important feature of productive research management.

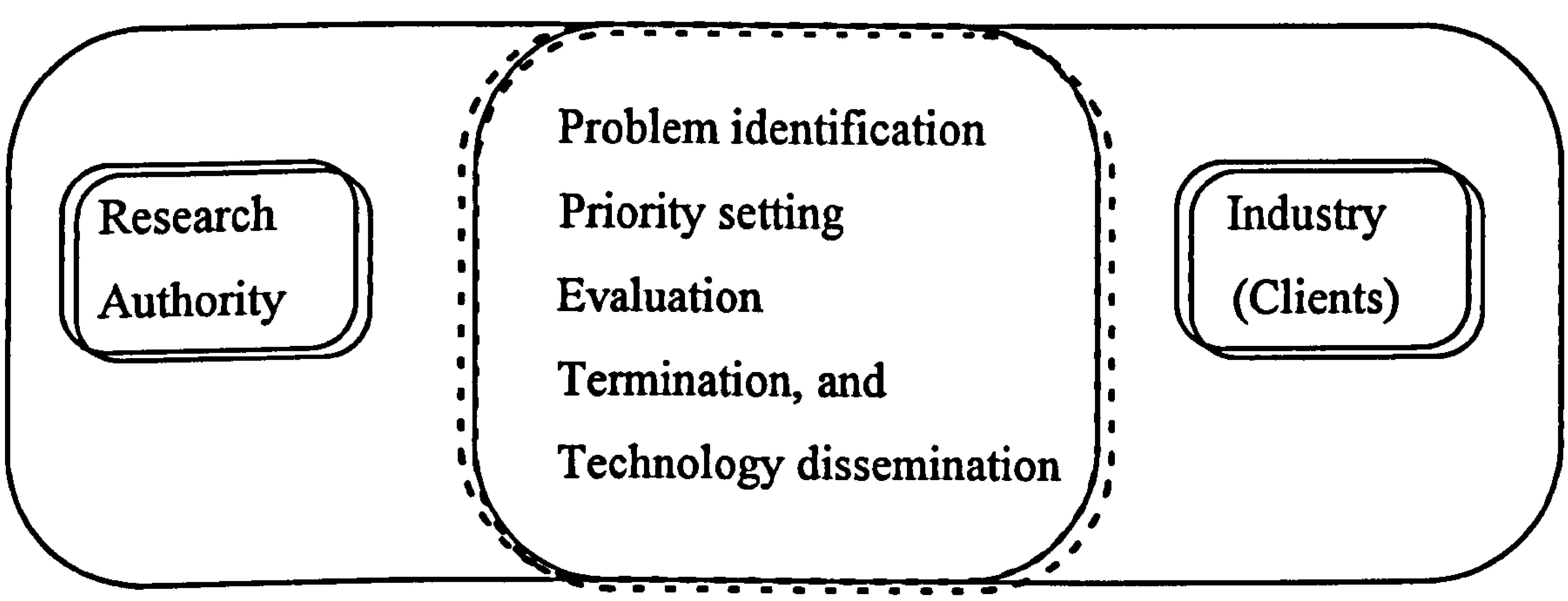


Figure 7.2 Interactions and feedback between research and industry in developed RPCM

7.3 RESEARCH MANAGEMENT PERFORMANCE CRITERIA (RMPC)

The functions of an organisation are guided by the mandate of the individual organisation. Irrespective of type of management system, the mandates of tea research organisations are similar (Chapters 6 & 8). Efficient management is often lacking in agricultural R & D organisations (Chapter 3). In any organisation, functions are often accomplished through management systems. Better planning strengthens these systems and makes the management of work more efficient.

Agricultural R & D organisations share common functions, especially within particular sub-sectors such as plantation crops and tea in particular. In the course of the literature review (Chapters 3, 4) and the ***Phase One*** of the case study enquiries, it became apparent that there are deficiencies in organisational performance. For this reason standard RMPC were developed in order to assess the performance of research management functions. In developing such criteria, various parameters were considered. To keep the criteria simple and considering the practicability of their use, their number has been limited to 10 main points as follows. The criteria are further described in the supporting tables.

7.3.1 PROBLEM IDENTIFICATION (PI)

This is the process which identifies the actual need of clients and the urgency for research. It relies on good linkage and feedback between research and clients. When linkages with the clients are weak, problem identification may be incorrect. Subsequent research will be a waste of resources. Whatever recommendations arise out of improper problem identification, clients will not use them at all.

7.3.2 PRIORITY SETTING (PS)

This is the process which the institute uses to determine the most pressing need of researchable problems from industry's point of view, usually in terms of expected contribution towards the client's needs. Priority setting is crucial to achieve best use of limited resources. In the absence of priority setting, resources may be diverted to other probable areas of less significance, hence there will be wastage.

Table 7.1 Best practice audit against the performance criteria: Problem identification

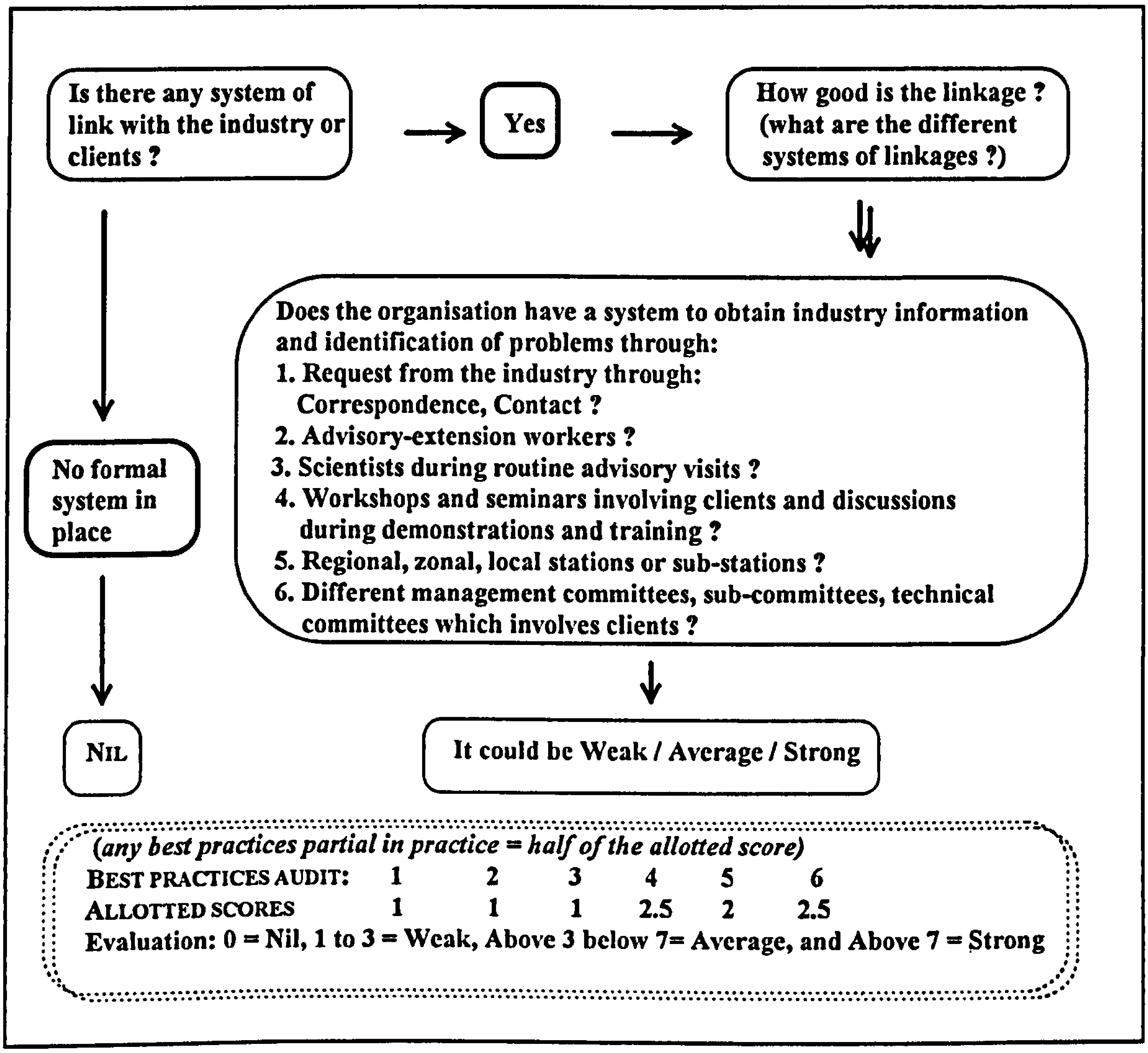


Table 7.2 Objective verifiable indicator (s) against the performance criteria Problem identification

Objective verifiable indicator (s): specified in terms number, type , duration and relevant period	Means of verification
Information on requests regarding problems encountered by the clients through: • Correspondence • Personal contacts during seminars, Workshops, Demonstrations, Training and • Formal meetings with clients representatives (Management or technical committees) and advisory-extension workers	Survey records at the Institute and tea estates Proceedings of seminars, workshops Proceedings and minutes of different committee meetings

Table 7.3 Best practice audit against the performance criteria: Priority setting and resource allocation (PSRA)

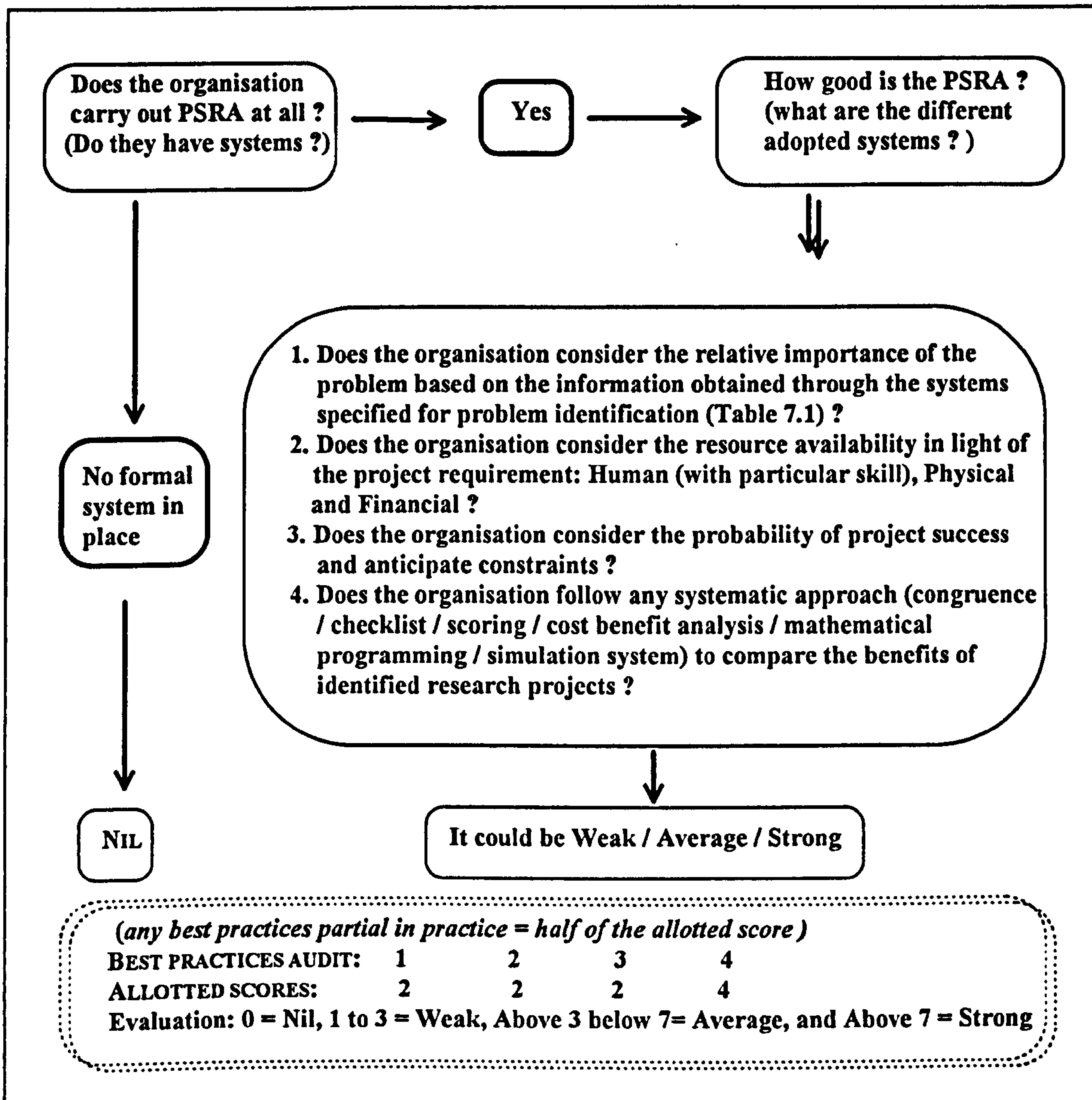


Table 7.4 Objective verifiable indicator (s) for Priority setting and resource allocation

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification
• Importance of the problems according to the criteria specified for problem identification • Cost benefit information on different identified research projects • Information on: resource requirement, indication of likely success and constraints against different research projects	Prepared research project pro-forma at the research Institute (s)

7.3.3 PROJECT PREPARATION (PP)

This is the design of a research project with a rationale, objectives, hypotheses, plan of action, work schedule, specified inputs, outputs, cost, expected benefits, anticipated constraints and likely impact. It is very important because, a number of critical decisions need to be taken during this stage. In addition, subsequent implementation of the project is guided by the document prepared at this stage. Furthermore monitoring and evaluation criteria are determined during project preparation. Preparation varies from preliminary to detailed design according to the stage of project development. Throughout preparation close attention is given to an analysis of expected results and justification.

7.3.4 PROJECT APPRAISAL (PA)

This is the process through which a proposed project is assessed in terms of potential, and whether or not the project will achieve its objectives. This assessment is important, because it gives an opportunity to determine if there are weakness in the project design which need to be addressed if the project is to be recommended for implementation. Appraisal is best undertaken by a third party which has not been involved in earlier preparation stages in order to retain objectivity and compare between competing proposals.

7.3.5 PROGRAMME IMPLEMENTATION (MONITORING)

Once the project is implemented by the relevant authority, monitoring checks are carried out as to whether the research activities are proceeding according to plan. Monitoring ensures smooth implementation of a designed project by checking: inputs use against budgets, activities against plans, progress against milestones. Monitoring is important because by analysing information and data, it helps to detect any deviation from the planned activities and output. It helps to take decisions on whether to continue the research as planned, terminate the project, or to redesign activities to meet objectives.

Table 7.5 Best practice audit against the performance criteria: Project preparation

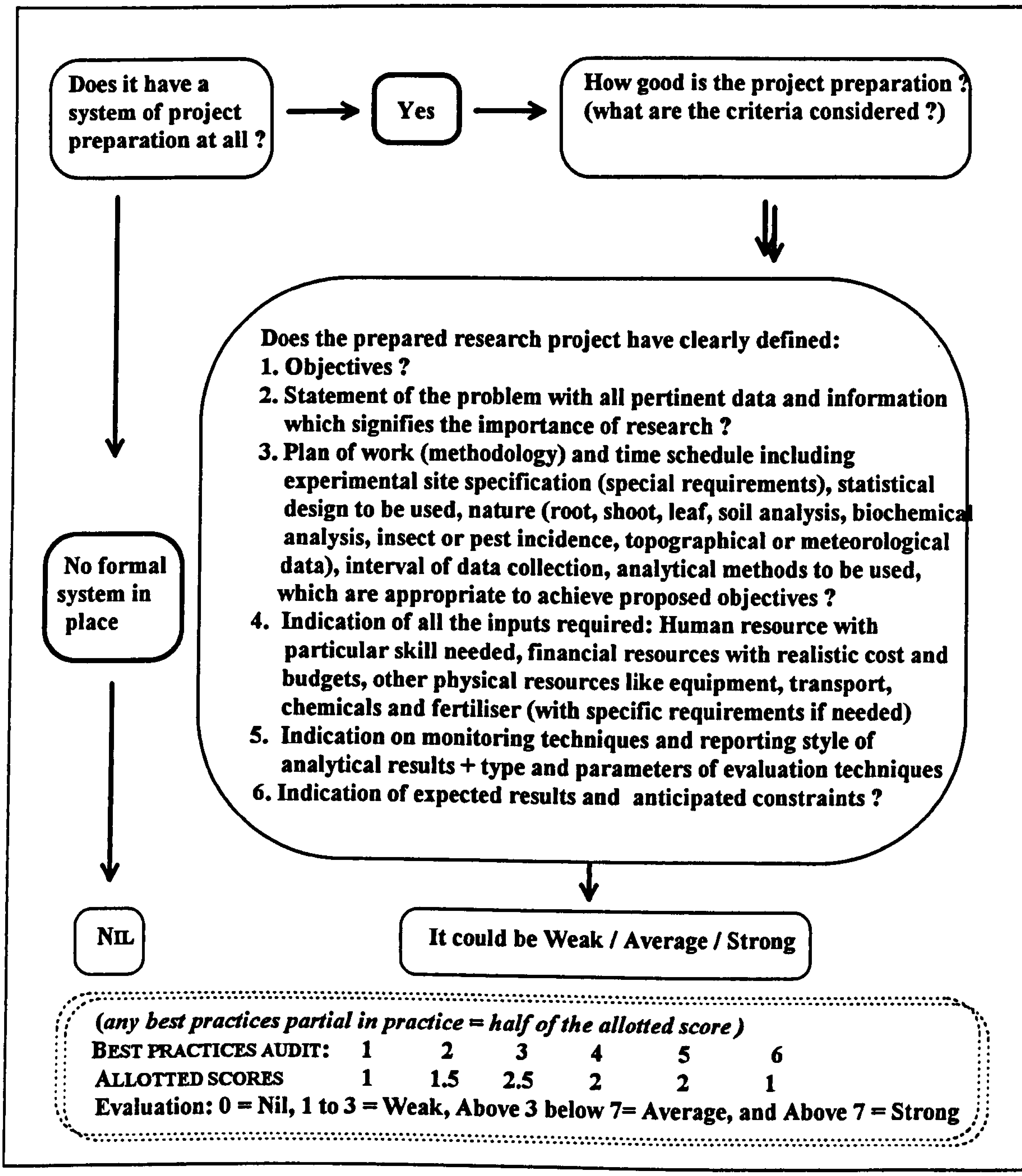


Table 7.6 Objective verifiable indicator (s) against the performance criteria: Project preparation

Objective verifiable indicator (s): specified in terms of number, type , duration and relevant period	Means of verification at the Institute
• Written research project documents highlighting objectives, methodology, resource requirement, monitoring and evaluation techniques to be used. • Specification in work plan what actions will be performed by whom during implementation phase • Breakdown of budgets against individual activities	Project pro-forma at the Institute

Table 7.7 Best practice audit against the performance criteria: Project appraisal

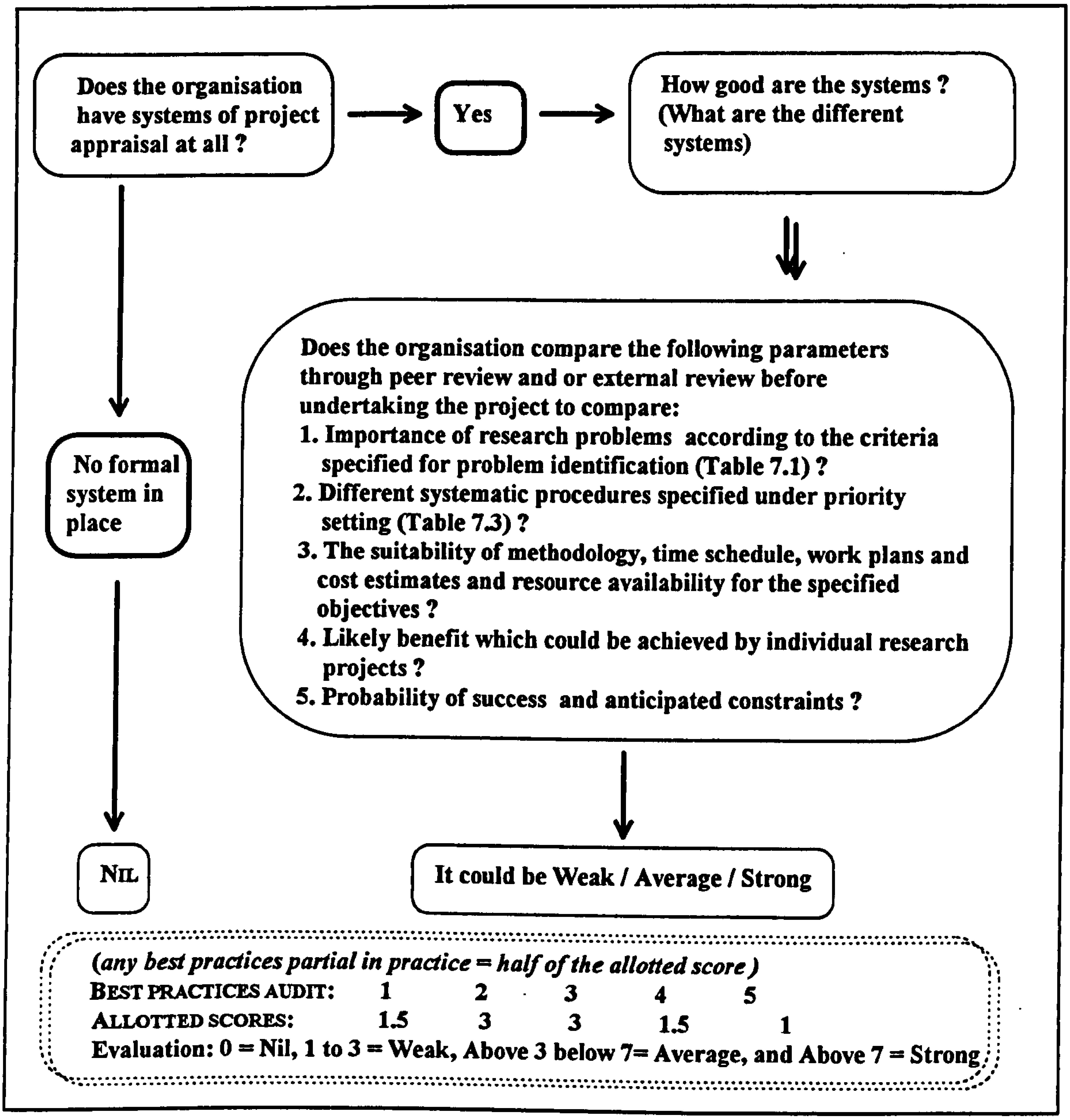


Table 7.8 Objective verifiable indicator (s) for Project appraisal

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
Comparison of different prepared research projects through scoring and or weighted criteria or any form of peer review to compare: • Importance of the problems • Priority of the projects in terms of likely benefits • Availability of resources in time • Methodology appropriate to achieve the objectives	Documented records (project appraisal reports)

Table 7.9 Best practice audit against the performance criteria: Monitoring

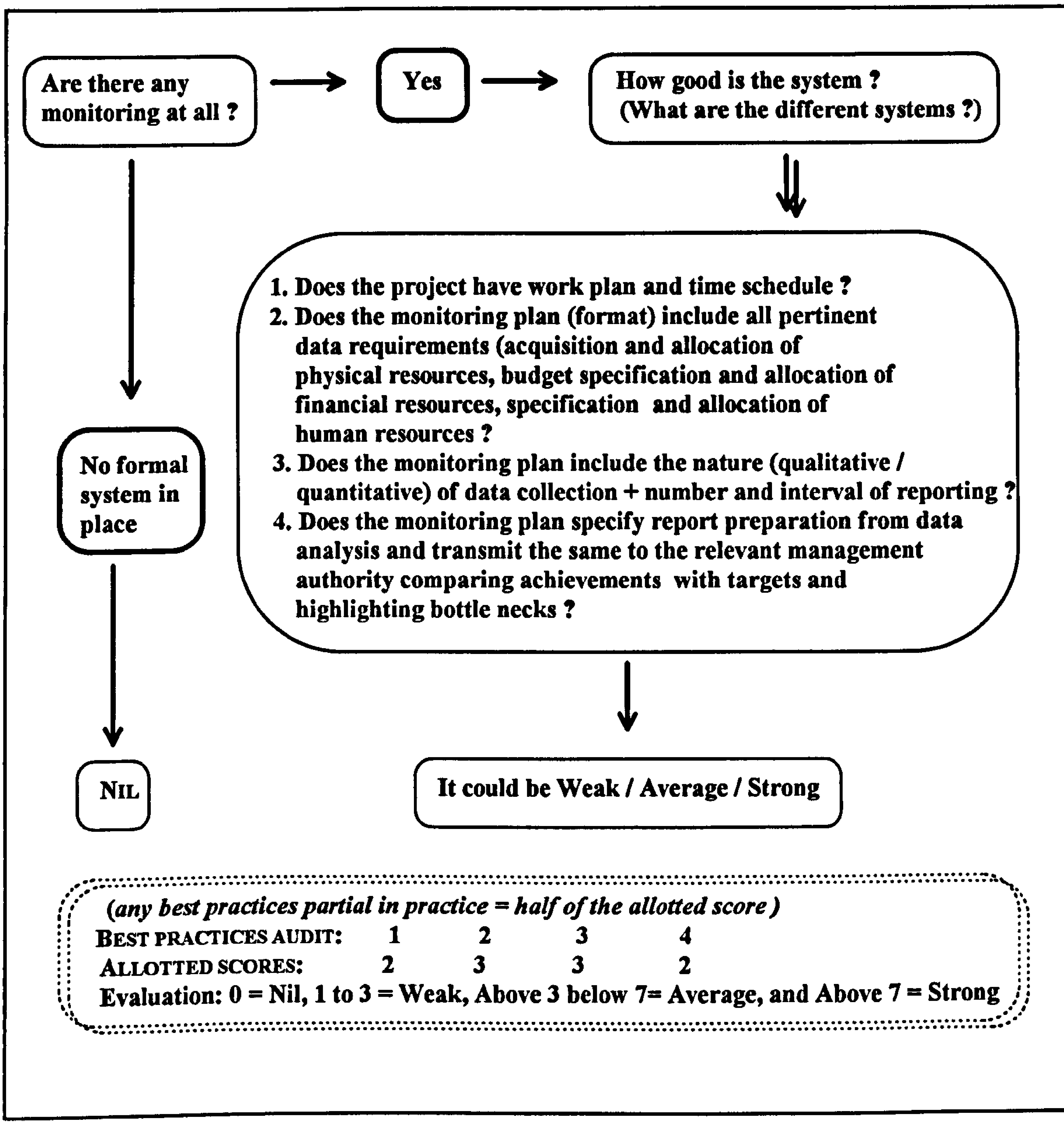


Table 7.10 Objective verifiable indicator (s) for Monitoring

Objective verifiable indicator (s) : specified in terms of number, type, duration and relevant period	Means of verification at the Institute
Filled in data sheet according to monitoring format including: • Data records • Expenditures against budgets	Survey and physical verification on monitoring formats for data Financial records and statements Published reports: Monthly, Quarterly, Annual and Technical reports

7.3.6 EVALUATION

Evaluation involves the assessment of both ongoing and completed research projects to determine whether projects have met their objectives. The process is partly based on the data and information collected through monitoring. Extra enquiry and data collection are usually needed for evaluation. Evaluation asks fundamental questions relating to the relevance, effectiveness and efficiency of the project. Evaluation of ongoing research helps to identify any likely deviation in meeting objectives. It may be possible to modify project activities. Evaluation of completed research project will help the planner to determine whether the objectives have been met, and what more needs to be done, based on which future planning could be improved. Evaluation helps the organisation to justify research spending through the analysis of impact of the project.

Evaluation, like appraisal, is best done by a third party not involved in the ongoing management of a particular project. Monitoring and evaluation are separate but linked processes. Monitoring of a project is an internal organisational activity, while evaluation of a project involves both internal and particularly external parties.

7.3.7 TECHNOLOGY DISSEMINATION AND FEEDBACK (TDF)

Dissemination is the process through which proven technologies are made available for use to the clients. Feedback is the means by which information is obtained on clients needs, circumstances, and performance of research recommendations. Technology dissemination is mainly done through various extension agents. For effective transfer of technology and proper feedback, the link between research, advisory and extension is very important. This feedback plays a major role in planning research programmes, especially identification of client needs and research priorities. Developing any technology will be futile if the dissemination and adoption of technology do not occur.

Table 7.11 Best practice audit against performance criteria: **Evaluation**

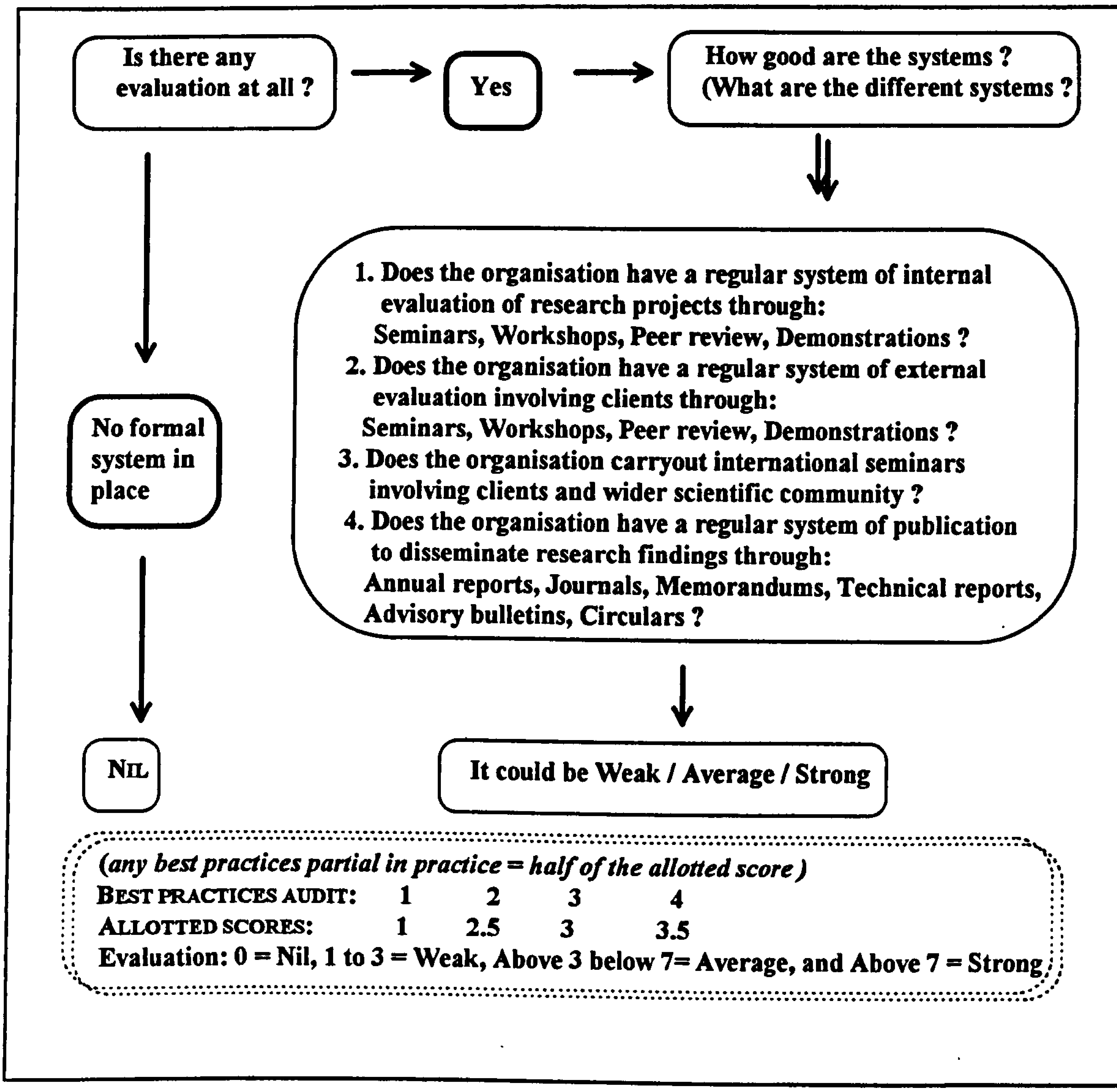


Table 7.12 Objective verifiable indicator (s) for Evaluation

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
Research performance assessment through • Internal peer review, • External peer review, • Seminars, Workshops, Open days involving clients and different management committee members (management board, executive committee, technical committee), • Change in objectives and or methodology of ongoing research projects, • Termination of ongoing research projects.	Different review reports on research performance Proceedings and minutes of meetings

Table 7.13 Best practice audit against the performance criteria: Technology dissemination and feedback

Is there any technology dissemination and feedback at all ? → **Yes** → **How good are the systems ? (What are the different systems)**

Does the organisation have:

1. **Experimental farms and demonstration plots at the main centre ?**
2. **Systems of routine advisory visits by scientists and advisory officers ?**
3. **Is there any system of forecasting routine visits of advisory officers and scientists to the industry ?**
4. **Systems of visiting clients on request by Scientists and advisory officers ?**
5. **Formal fora where advisory-extension officers can meet and discuss client problems ?**
6. **Zonal, regional and local sub-stations to obtain information on area specific problems ?**
7. **Any form of formal body (Committees) to obtain area information regarding client problems and constraints on technology adoption ?**
8. **Does the organisation have any system of formal training to the clients + organising seminars, workshops, field days and demonstrations to disseminate technology ?**
9. **Does the organisation have any system of monitoring on adoption of advisory recommendations and follow-up of visits to the clients ?**

It could be Weak / Average / Strong

No formal system in place → **NIL**

(any best practices partial in practice = half of the allotted score)

BEST PRACTICES AUDIT:	1	2	3	4	5	6	7	8	9
ALLOTTED SCORES:	0.75	0.75	1	1	1	2	1	1	1.5

Evaluation: 0 = Nil, 1 to 3 = Weak, Above 3 below 7= Average, and Above 7 = Strong

Table 7.14 Objective verifiable indicator (s) against the performance criteria: Technology dissemination and feedback

Objective verifiable indicator (s) specified in terms of number, type, duration and relevant period	Means of verification
• Use of technologies by the clients (% area brought under particular technology over a specific time period) • % total population adopting a particular technology over a specific time period • Increase in tea production and quality due to the adoption of improved variety and manufacturing techniques arising out of research	Survey and visits at different tea estates for information on use of technologies Tea estate's programme and records on the use of high yielding varieties and processing techniques Records at tea estates on production and sale price

7.3.8 PUBLICATIONS FACILITIES

Publications are one of the most effective means of communicating research findings. Technology developed through research must be communicated quickly to the potential clients either in industry and or the international scientific community. Research findings from the institute may be disseminated through various publications, in technical and non technical local languages. The latter is especially important to the industry for raising productivity.

7.3.9 LIBRARY FACILITIES

Well organised library facilities with sufficient number of relevant reference books is one of the key resources for a productive research organisation. Researchers desperately need access to the broad world of scientific knowledge, methodologies already developed, and information about what is currently being done by other agricultural scientists throughout the world. Otherwise there is a risk of duplication of work and waste.

In most of the tea research organisations, scientists work in locations which are physically isolated. Mosher (1982) reported that scientists may need to work in physical isolation, but they must not be asked to work in intellectual isolation. He further reported that scientists may benefit from occasional travel to consult with other scientists, and provision should be made for that. Nevertheless, they should be able to tap world knowledge quickly by simply going to the library.

7.3.10 COMPUTER FACILITIES

The benefit of computer use in modern research is beyond doubt. Computer helps in optimising resource utilisation in various ways. For productive research and quick decision making, good computing facilities are essential.

Table 7.15 Best practice audit against the performance criteria: Publication facilities

Does the organisation have system of regular publications at all ? → Yes → How good are the publications ? (What are the regular publications ?)

No formal system in place → NIL

Does the organisation have system of publications of following to disseminate research findings to the clients:
1. Journals ?,
2. Monthly, Quarterly and Annual technical reports ?,
3. Circulars and Pamphlets
4. Bulletins (forecasting future important regular activities need to be carried out by the industry) ?,
5. Popular articles in local languages for easy understanding ?,
6. Findings to the international journals ?.
7. Are the publications (serial number 1-3) regular and in time ?

It could be Weak / Average / Strong

(any best practices partial in practice = half of the allotted score)

BEST PRACTICES AUDIT:	1	2	3	4	5	6	7
ALLOTTED SCORES:	1	0.5	2	2	2	1.5	1

Evaluation: 0 = Nil, 1 to 3 = Weak, Above 3 below 7= Average, and Above 7 = Strong

Table 7.16 Objective verifiable indicator (s) against the performance criteria: Publication facilities

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
Published: • Journals, • Monthly, quarterly, and annual reports • Circulars and pamphlets • Bulletins • Other published materials	Physical verification and check in the library

Table 7.17 Best practice audit against the performance criteria: Library facilities

Does the organisation have library facilities at all ?

Yes

How good is the library (What are the facilities in terms of books and journals) ?

Does the organisation have a library with a systems of regularly obtaining:
1. Text books related with tea culture ?
2. Other text books on allied crops ?
3. Does the library have system of subscribing journals related to tea research of other countries ?
4. Does the library have system of subscribing at least one or two abstract journals like CAB ?
5. Does it have system of borrowing books and journals from:
a) other libraries within the country (from other research organisations and universities) ?
b) outside the country ?

It could be Weak / Average / Strong

No formal library in place

NIL

(any best practices partial in practice = half of the allotted score)

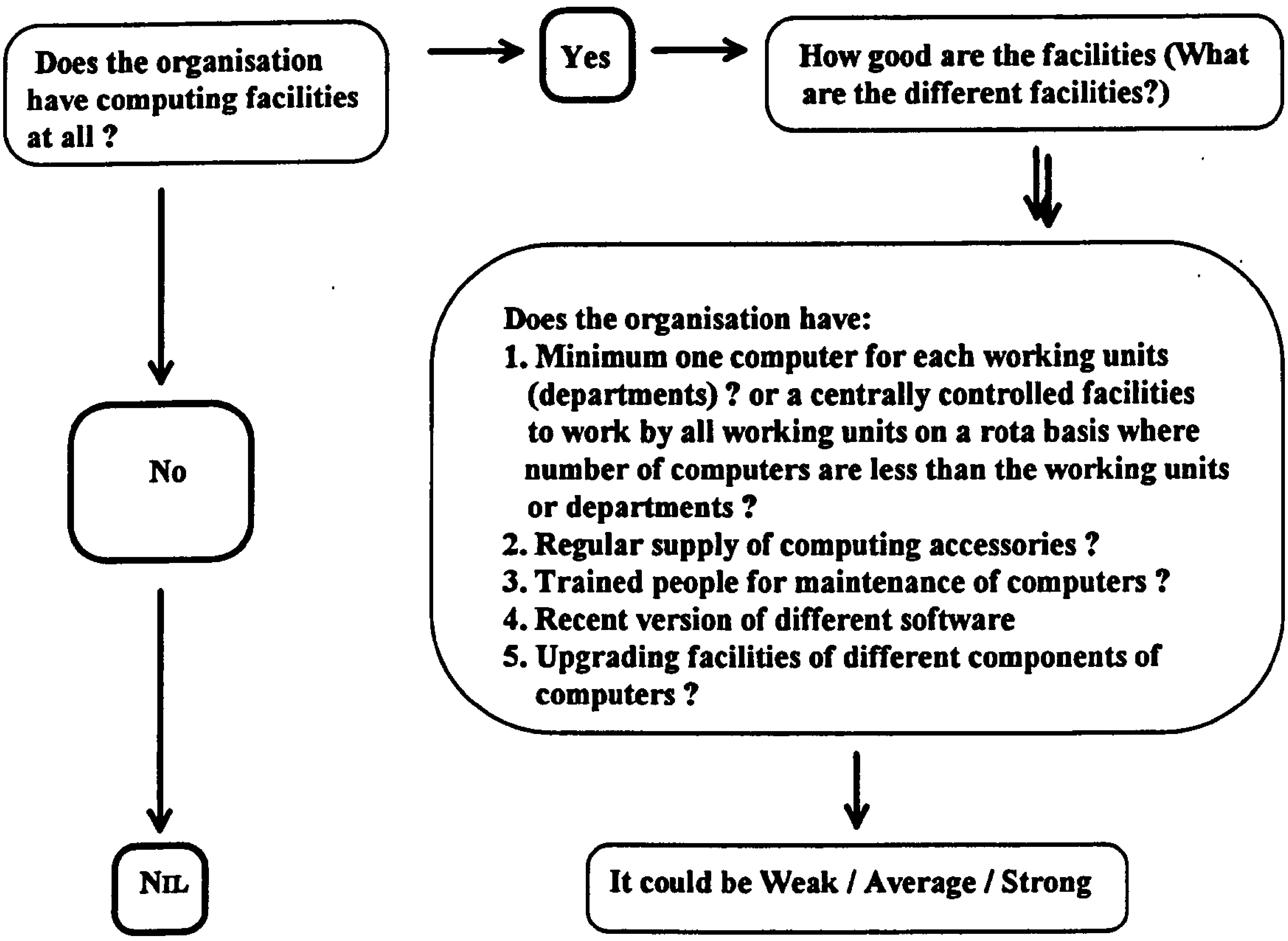
BEST PRACTICES AUDIT:	1	2	3	4	5
ALLOTTED SCORE	1.25	1.25	2.5	3	2

Evaluation: 0 = Nil, 1 to 3 = Weak, Above 3 below 7= Average, and Above 7 = Strong

Table 7.18 Objective verifiable indicator (s) against the performance criteria: Library facilities

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
Number of books and journals	Physical verification and check stock registers Correspondence records with other research Institutes and universities

Table 7.19 Best practice audit against the performance criteria: Computer facilities



(any best practices partial in practice = half of the allotted score)

BEST PRACTICES AUDIT:	1	2	3	4	5
ALLOTTED SCORES:	2	2	2	2	2

Evaluation: 0 = Nil, 1 to 3 = Weak, Above 3 below 7= Average, and Above 7 = Strong

Table 7.20 Objective verifiable indicator (s) against the performance criteria: Computer facilities

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
• Computers • Different software • Trained people	Physical survey and records

7.3.11 MANAGEMENT INFORMATION SYSTEM (MIS)

This involves ongoing data collection, processing and in some cases computerised information retrieval systems which provide timely access to relevant information (research inputs, activities and outcomes) for research managers to enable them to take timely and rational decisions on relevant issues. MIS links and integrates diverse information from various parts of the organisation or systems (Gijsbers, 1993), such as research programmes, personnel and administration, finance and support services and targets this information at managers. The output from an MIS may be used in research planning, priority setting, monitoring progress and evaluating outcomes.

Quality of information available is crucial to the quality of decision making. Glautier and Underdown (1994) suggested that an efficient and adequate information system is a prerequisite of managerial success. They further reported that the hallmark of efficient management is the ability to specify accurately the information needed, and this ability is in itself a function of clear definition of objectives, sound planning and control capability and satisfactory organisational arrangements.

Information is required at all levels of the research system. Information acts as an integrating force which combines organisational resources into a cohesive whole directed towards the realisation of organisational objectives. For management purposes, information is needed by project managers, programme or department heads, institute or centre directors, and system managers, who may manage several institutes or the entire national research system. The following types of information are the minimum essential components of a research management information system:

- research programmes such as: number and type of projects, objectives, location, starting, and finishing time, indication of expected results and recommendations;

Table 7.21 Best practice audit against the performance criteria: Management information system

Is there any central filing or data maintaining system at all? → **Yes** → **How strong is the system? (What are the different systems ?)**

No formal system in place

A) **Research information (at the Institute) :**
Does the organisation have a system of keeping data on:
1. Financial resources (budgets and expenditures) and utilisation ?, Physical resources ?, and
2. Information on human resource, its management and development (particularly on training and career development aspects)
B) Does the organisation have a system of keeping tea industry data (data and information on clients):
General information and survey data on:
3. Total area, area under cultivation, area under different plan types, area facing specific problems,
Meteorological data on different regions
Data on soil nutrition profile
Data on status of pest and diseases ?
4. Type of management, area under different management category, specific problems faced by management ?
5. Does the organisation have data and information on: rate of uptake of technology, constraints that affect the rate of uptake of technology + data and information on agro-ecological region specific needs ?

NIL

It could be Weak / Average / Strong

(any best practices partial in practice = half of the allotted score)

BEST PRACTICES AUDIT:	**1**	**2**	**3**	**4**	**5**
ALLOTTED SCORES:	**1.5**	**1.25**	**3**	**1.25**	**3**

Evaluation: 0 = Nil, 1 to 3 = Weak, Above 3 below 7= Average, and Above 7 = Strong

Table 7.22 Objective verifiable indicator (s) against the performance criteria: Management information system

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
Readily available relevant information and data from a central file or computer source for quick management decision making	Survey and physical check at the Institute

- research personnel: such as the number of technical personnel with particular skills and the projects they are working on;
- finance including budgets and estimates of individual projects programmes with details of expenditure by disciplines such as soils, breeding, crop protection, technology, and advice;
- equipment available and necessary to carry out research work;
- physical facilities such as laboratory buildings, general office buildings, factory and workshops building, experimental farms and sub-stations, demonstration facilities;
- overall industry (area under tea; number of tea estates, production per hectare);
- clients: number and type of clients, area under individual clients, client specific problems; and
- data such as meteorological, soil nutrition status, pest and diseases incidence, drought and frost prone, area under specific plant types or practices.

A management information system provides an individual manager with the information required for making decisions within their own areas of responsibility. MIS may be compared with the central nervous system of an organism in that it consists of a network of information flows to which each decision may be related. It is evident that information affects decision making in a fundamental way. Hence it is important that information should be effectively organised, and efficiently handled for efficient decision making.

7.3.12 FUNDING ARRANGEMENT AND INCOME GENERATING ACTIVITIES

Funding arrangements and income generating activities involve the system through which an organisation obtains its financial resources and generates revenue. It is the crucial resource on which all the activities depend. Without sufficient operational funding arrangements, whatever other physical and infrastructural facilities and good programmes there are, research activities can

Table 7.23 Best practice audit against the performance criteria: Funding arrangement and income generating activities

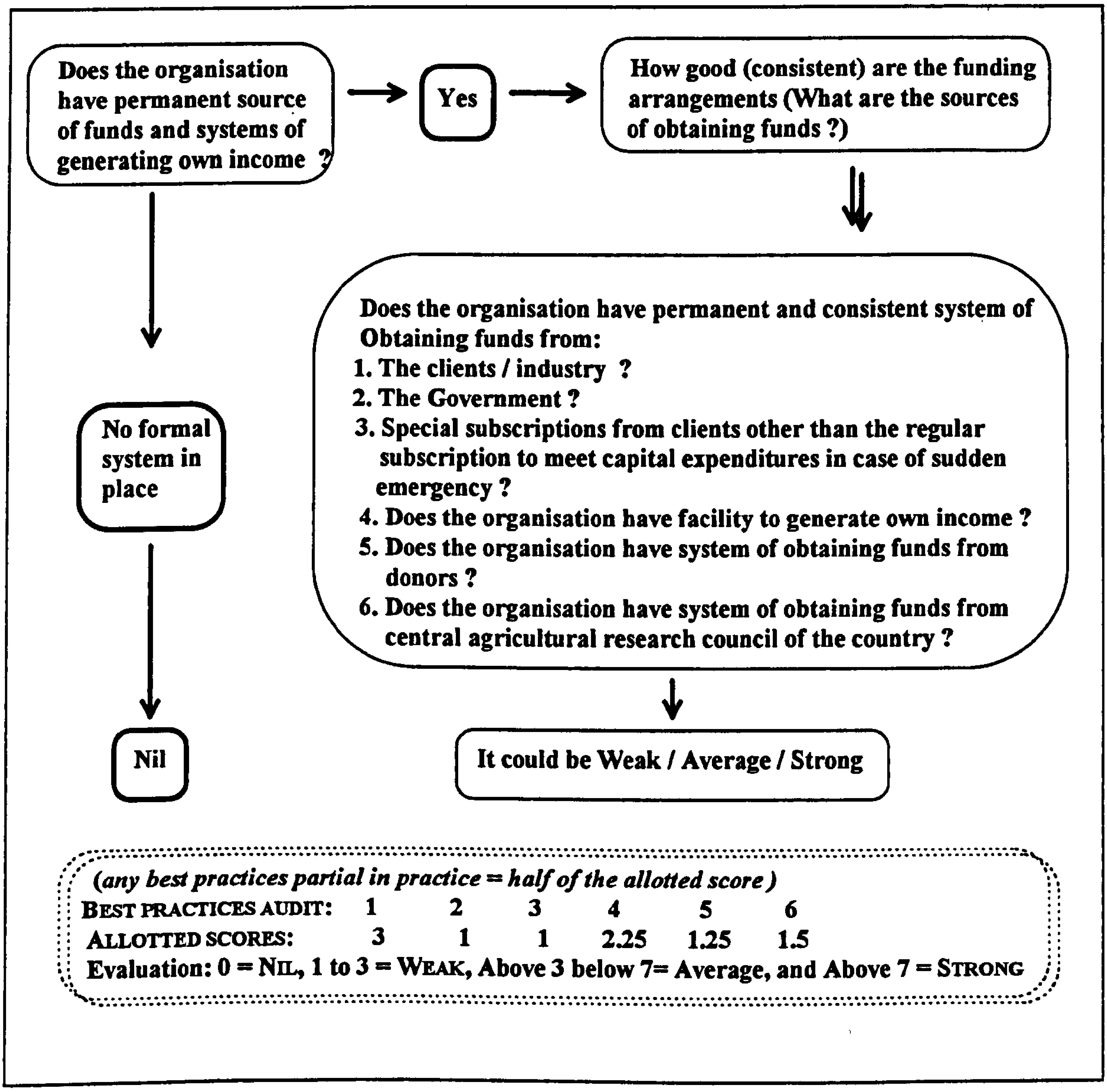


Table 7.24 Objective verifiable indicator (s) against the performance criteria: Funding arrangement and income generating activities.

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
• Annual budget and operating funds • Own income (generated through sales of produce, fees from screening of agrochemical and soil analysis). • Pay structure and other emolument facilities	Survey and verification of account records

not be sustained. Research programmes may be short, medium or long term in nature. All of them require funding continuity. If some research projects are interrupted for only a few days or a few hours, they may be completely spoiled. To be productive, agricultural research programmes need continuous and long term financial support and timely release of funds for expenditure to procure other resources. Generating own income is a key factor in the continuation of organisational activities.

7.3.13 COMMITTEE SYSTEM

This is a formal means of obtaining interactions and guidance from different members who work in management committees. Such committees consist of a wide range of skilled and experienced people, like:

- clients representatives (representatives of different client groups): senior representatives of different national and multinational companies having wide knowledge in corporate management.
- subject specialists from research organisations;
- academicians from universities;
- government officials; and
- directors of research organisations.

There may be different committees with different objectives. The main purpose of such committees is to help decision making in organisational resource management including planning and formulation of research projects, particularly in problem identification, priority setting, appraisal and evaluation of research projects and dissemination of technology. From experience, it is seen that the more is the interaction with such committees, the better is problem identification, the appraisal and evaluation of research projects and the dissemination technology. In R & D organisations where different management committees are active, management is more systematic and research is more productive.

Table 7.25 Best practice audit against the performance criteria: Committee culture (guidance and interactions from different management committees)

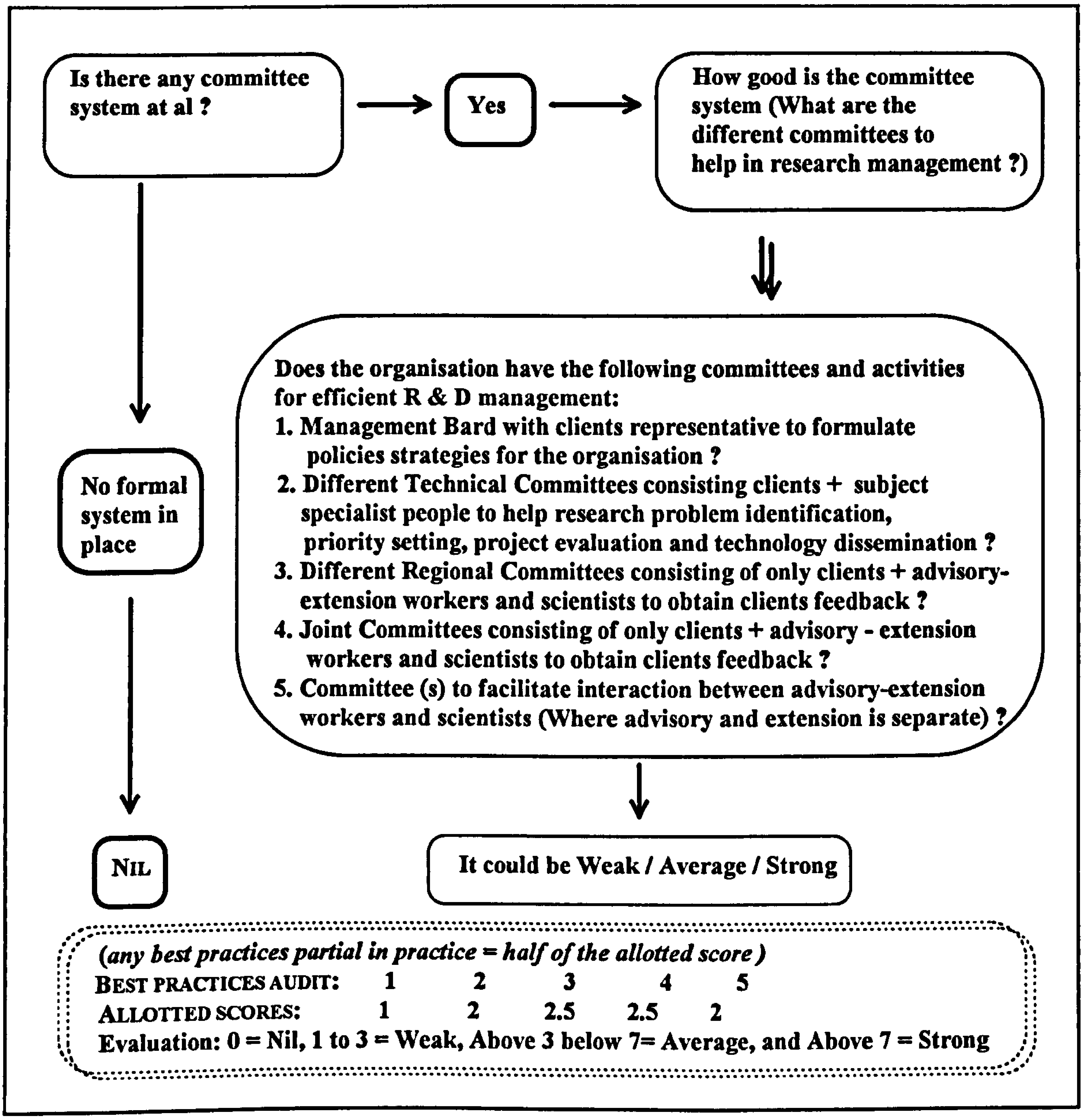


Table 7.26 Objective verifiable indicator (s) against the performance criteria: Committee culture (guidance and interactions from different management committees)

Objective verifiable indicator (s): specified in terms of number , type, duration and relevant period	Means of verification at the Institute
• Number of committees with clear objectives term of reference, frequency of their meetings and type of decisions	Documented records
• Meeting agenda, decisions and actions	Proceedings of meetting, Survey among members and client groups

7.3.14 Human Resource Management and Development (HRMD)

This is an organisational system which enables the organisation to select, obtain, retain and motivate the type of people it needs to achieve its objectives. HRMD facilitates improved organisational performance through the improvement of individuals, now and in future (Armstrong, 1990). Bangladesh Agricultural Research Council (1990) reported that the most critical resource of any research oriented organisation is its personnel. Further it argued that a research organisation can be successful only to the extent that it hires and retains high quality staff and provides them with a rewarding and stimulating work environment. It further reported that staff recruitment, training and development can serve as the major instrument in establishing, directing, and shifting organisational priorities. Hence effective management of human resources is the key to its success. To achieve the improvement of the individual and thus the organisation, the organisation must have performance appraisal systems to find how effectively people are working in their present jobs. Such analysis will help to determine what they need to do and to know in order to perform even better.

7.3.15 Internal Communication and Management Approach

Organisational communication may be described as the deliberate establishment and use of a system to transmit information conveying meanings to a large number of people within and outside the organisation (Carlise, 1982). Communication involves linking all the management functions by transmitting information and instructions within the organisation. However, for the purpose

Table 7.27 Best practice audit against the performance criteria: Human resource management and development

Does the organisation have a strategic planning for human resource management and development at all ? → Yes → How good are the systems ? (What are the elements considered ?)

Does the organisational strategic planning contain:
1. Demand forecasting (estimating future manpower requirement with reference to future activity of the organisation) ?,
   Supply forecasting (current resources and future availability of human resources) ?,
   Forecasting requirements (analysing the demand and supply forecast to identify future deficits or surplus) ?,
   Productivity and cost analysis (actions and resources needed for improvements in productivity and cost analysis) ?,
   Action planning (plans to deal with forecast deficit or surpluses of manpower) ?,
   Budgeting and control (setting budget for the implementation of plans) ?,
2. Clear and specific recruitment and selection policy ?
3. Systems of performance management with following elements: Performance review; Potential review; Performance improvement programmes; Career development programmes; Reward review ?
4. Training systems to develop the potential skills of individual ?

It could be Weak / Average / Strong

No formal system in place

NIL

(any best practices partial in practice = half of the allotted score)

BEST PRACTICES AUDIT:	1	2	3	4
ALLOTTED SCORES:	2	2	3	3

Evaluation: 0 = Nil, 1 to 3 = Weak, Above 3 below 7= Average, and Above 7 = Strong

Source: Armstrong (1990)

Table 7.28 Objective verifiable indicator (s) against the performance criteria: Human resource management and development

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
• Employees under goes training to develop skill and efficiency • Performance review • Performance improvement programmes • Career development programmes • Reward review	Training programmes + Participation records Filled in pro-forma for reviews

of this project, use of the term communication will be restricted to communication within the organisation.
An organisation performs its functions by means of the collective actions of different people serving within it. In any organisation, the specialisation of tasks and the consequent division of labour creates a situation in which an unrestricted flow of ideas and facts is necessary if it is to function efficiently. A high degree of communication binds the various members of the organisation together, uniting them in the pursuit of organisational goals.

In the past, most agricultural R & D organisations operated through traditional discipline-based departments. Now there is a move towards research programmes organised around multi-disciplinary teams addressing specific problems. Obviously such a set-up is more complex to manage, and demands more co-ordination and effective communication between activity performing units, disciplines and departments.

Whether an organisation is small or large, the style of communication plays a critical role in its productivity and performance. For smooth functioning and enhanced decision making, agricultural R & D organisations need to adopt easy but effective communications between functions. Adoption of an informal style of communication in agricultural R & D organisations appears to be more effective, because such an approach can stimulate and encourage new ideas.

Like other research, agricultural research is a creative work, and is carried out by specially trained scientists. From experience, it has been observed that scientists appreciate to enjoy freedom in their work. Thus to be successful, a research institute must not only have creative people, but also an open, creative, participatory and professional work environment. Management should always be positive in fostering such environment. Bureaucratic, rigid rules, formal and tight management style can hinder performance and productivity of the

Table 7.29 Best practice audit against the performance criteria: Internal communication, and management approach

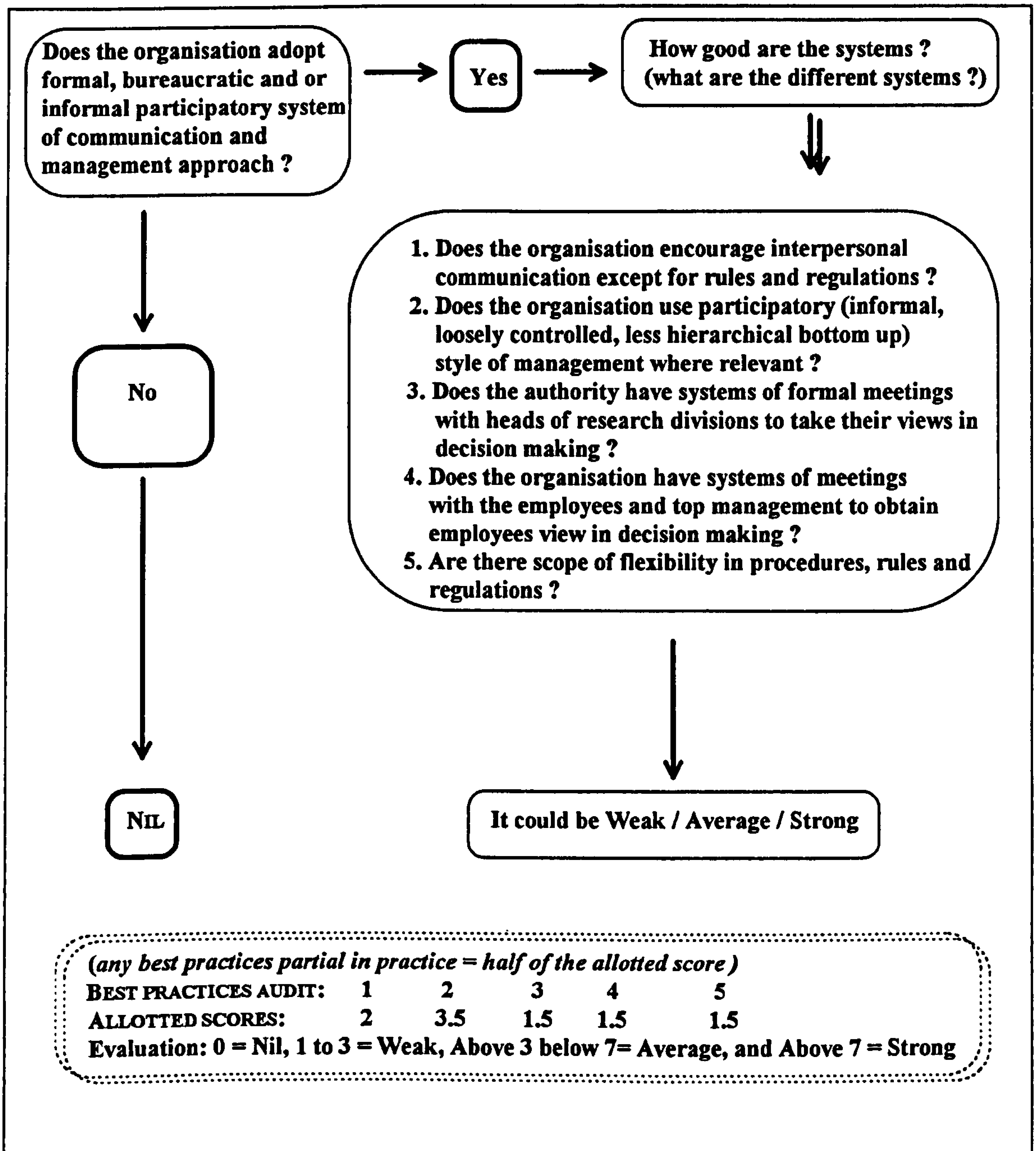


Table 7.30 Objective verifiable indicator (s) against the performance criteria: : Internal communication, and management approach

Objective verifiable indicator (s): specified in terms of number, type, duration and relevant period	Means of verification at the Institute
• Hierarchical structure in the organisation	Documented records
• Operational rules and regulations	Documented records
• Statement of agenda for meetings	Minutes of meetings
• Mission statement of the organisation	Documented records

organisation. The challenge is to achieve a balance of control and direction which simultaneously enables the creativity and free thinking of researchers, and the effectiveness of the R & D organisation.

7.4 CHAPTER SUMMARY

Research management performance criteria, ojective verifiable indicators and their means of verification have been identified and developed. Best research management practices have also been identified, and a scoring model has been designed to enable the assessment of performance against research management criteria. A conceptual framework has been developed. Chapter 8 examines the application of developed conceptual framework on four tea research institutes in order to determine their organisational performance.

CHAPTER 8
REVIEW AND ANALYSIS OF CASE STUDIES: *PHASE TWO*

Criteria for assessing the performance of tea research management have been developed and reported in Chapter 7. This chapter describes the application of those research management criteria on four tea R & D organisations which is *Phase Two* of the case studies. In so doing, it analyses in detail their research management functions, and assesses organisational performance against the best audit practice and objective verifiable indicators. Case studies have been carried out in the order described in Chapter 5.

8.1 TEA RESEARCH INSTITUTE OF SRI LANKA (TRIS)

This is the first case study that were grouped in *Phase Two*.

8.1.1 TEA AND TEA RESEARCH IN SRI LANKA

Tea was introduced in Sri Lanka (Ceylon) during the 1840s. However, commercial cultivation started much later, during the 1860s (Rainer, 1992). Before tea, Sri Lanka had well established coffee plantations. Gradually tea has replaced coffee, hastened by a leaf rust disease which has devastated coffee plantations. Tea ranked top of the list among the foreign exchange earnings commodities for Sri Lanka (Sivapalan, 1991).

In 1994, Sri Lanka produced 233,276 metric tons of made-tea over an area of 221836 ha. In comparison to world tea production, its position is third, while it is the biggest tea exporting country in the world by quantity (Table 8.6). Tea producing area of Sri Lanka has been grouped into three categories according to elevation: high grown (over 1200 m), mid grown (600-1200 m) and low grown (below 600 m) tea. Based on the size of the estate, the industry may be categorised into two sectors; the large estates and smallholders sectors.

Research on tea in Sri Lanka was started during the year 1925, with the establishment of the Tea Research Institute of Sri Lanka. Prior to that research support for the industry was taken from India.

8.1.2 MANDATE AND ORGANISATION

The TRIS was set-up for the purpose of research into and investigation of all problems and matters relating to tea, and the provision of published information relating to the same (TRI, 1982). The Institute is carrying out adaptive research to support its client needs. Currently research is organised and carried out by the following 10 divisions:

Advisory and extension;
Agricultural chemistry;
Agronomy;
Biochemistry;
Entomology;
Nematology;
Plant pathology;
Plant physiology,
Propagation and breeding;
Technology.

Each of these division is headed by a senior scientist. The Institute is also responsible to advise on technical aspects of tea culture, disseminate technology and undertake training to the plantation management. There are 7 supporting units: audio-visual, photography, electronic, land use and mapping, library, publication and statistics to support R & D activities.

The Institute is an autonomous organisation. Since its inception the organisation was under the management of a separate Board. But in 1975, with the creation of the Tea Board, the Government placed its management responsibility to the Tea Board, where it remained until December 1993. In the early part of 1994, The Government placed its management responsibility to a newly formed organisation named Tea Research Board (TRB). The TRB is the apex body with its headquarters at Talawakelle. Its main function is to formulate broad based policy guidelines for smooth and effective management of the Research Institute.

The Tea Research Board has 14 members consisting of the representatives from following sectors:

- the Director, TRI;
- the Secretary, Ministry of Plantations;
- the Chairman of Tea Smallholdings Development Authority;
- nominated members of different Planters Associations (3);
- Trade Union representatives (2); and
- nominated members of the Ministry of Plantations (3) of which one is required to be a distinguished scientist of the country, one is a well known agriculturist, and one is a member to represent the interest of the smallholders.

It appeared that there is a political influence on the management of the Tea Research Board. This is also evident in the structure of the Management Board, where 5 members out of total 14 members are directly appointed by the Government. Presence of union representatives in the TRB also is an indication of political influence. Researchers expressed reservations about the presence of Trade Union representatives in an important policy making body like TRB. Researchers argued that TRB is a strategic policy making body where, in their view, Trade Union representatives may not be able to contribute much.

Using the criteria for assessing the performance of tea research management, the profile for TRIS was compiled (Table 8.1a -8.1c) and the elements of which are discussed below in detail.

8.1.3 PROBLEM IDENTIFICATION (PI)

A comparison of actual problem identification practices with the developed best practices audit (BPs) gives a score of 5.5 (Table 8.1a) which indicates that it is ***"average"***. For PI the Institute mainly relies on request from the industry which is BP 1 from Table 7.1 and 7.2. However, TRIS partially considers following BPs for PI:

- BP 2: information from advisory-extension officers;
- BP 3: feedback from the scientist following advisory visits;
- BP 4: systems of workshops and seminars involving clients;
- BP 5: information from regional, zonal and local sub-station; and,
- BP 6: different management committees, sub-committees and technical committees.

One of the important findings from the analysis is that though TRIS has all BPs in place, its performance is ***"average"*** because of weak and ineffective linkage with the industry; weak linkage and poor co-ordination between research and advisory-extension; insufficient communication and feedback with the industry; and poor interaction with different committees. Although all most all the BPs are in place, the institute has not been able to take full advantages of these BPs for problem identification.

8.1.4 PRIORITY SETTING AND RESOURCE ALLOCATION (PSRA)

PSRA is a joint activity of the Directorate and different Management Committees. The Institute does not practice any formal system of priority setting and resource allocation. Consequently priority setting and resource allocation is ***weak***, because the achieved score is 3 (Table 8.1a). The main reason for such weakness is that the Institute does not practice the following two important BPs from Table 7.3 and 7.4:

- BP 3: probability of project success and anticipating constraints; and,

Table 8.1a.Research management performance profile on TRIS

Problem identification (Table 7.1)							Total score	Assessment
Best practices audit	1	2	3	4	5	6		
Allotted score	1	1	1	2.5	2	2.5		
Level of implementation	Y	P	P	P	P	P		
Achieved score	1	0.5	0.5	1.25	1	1.25	5.5	Average
Priority setting and resource allocation (Table 7.3)								
Best practices audit	1	2	3	4				
Allotted score	2	2	2	4				
Level of implementation	P	Y	N	N				
Achieved score	1	2	0	0			3	Weak
Project preparation (Table 7.5)								
Best practices audit	1	2	3	4	5	6		
Allotted score	1	1.5	2.5	2	2	1		
Level of implementation	Y	P	P	P	N	N		
Achieved score	1	0.75	1.25	1	0	0	4	Average
Project appraisal (Table 7.7)								
Best practices audit	1	2	3	4	5			
Allotted score	1.5	3	3	1.5	1			
Level of implementation	P	N	P	N	N			
Achieved score	0.75	0	1.5	0	0		2.25	Weak
Monitoring (Table 7.9)								
Best practices audit	1	2	3	4				
Allotted score	2	3	3	2				
Level of implementation on	Y	P	P	N				
Achieved score	2	1.5	1.5	0			5	Average

- BP 4: systematic approaches like congruence / checklist / scoring / cost benefit analysis / mathematical programming / simulation system to decide on priorities of research problems.

In addition, the Institute partially follows BP 1, which involves considering the relative importance of the research problem based on information obtained through the systems specified for PI (Table 7.1). Nevertheless, TRIS follows BP 2, which considers resource availability in the light of project requirement (Table 7.3, 7.4 and 8.1a).

8.1.5 PROJECT PREPARATION (PP)

Analysis shows that PP achieved a scoring of 4 and an *average* classification (Table 8.1a). TRIS considers BP 1 in full, that is it clearly defined its research objectives. TRIS follows the following BPs partially (Table 7.5 and 7.6):

- BP 2: statement of the problem with all pertinent data and information which signifies the importance of the research;
- BP 3: plan of work (methodology), and time schedule including experimental site specification (special requirements), statistical design to be used, nature (root, shoot, leaf, soil analysis, insect or pest incidence, topographical or meteorological data), interval of data collection, analytical methods to be used, which are appropriate to achieve the project objectives;
- BP 4: indication of all project inputs (human resources with particular skill, financial resources with realistic cost and budgets, other physical resources like equipment, transport, chemical and fertiliser with specific requirements if needed).

However, the Institute does not practice BP 5, which relates to guidelines on the use of monitoring techniques, reporting style of analytical results, and specification of the type and parameters of evaluation techniques. In addition, BP 6 (indication of expected results and anticipated constraints) is not considered.

8.1.6 PROJECT APPRAISAL (PA)

Scoring against the BPs are 2.25 (Table 8.1a), which indicates that PA is ***weak***, mainly because of lack of clear understanding about the advantages of research project appraisal. However, it appeared that informally the Institute partially follows some BPs (Table 7.7 and 7.8):

- BP 1: importance of research problems according to the criteria specified for problem identification (Table 7.1 and 7.2); and,
- BP 3: suitability of methodology, time schedule, work plans, cost estimates and resource availability for the specified project objectives.

However, the Institute does not consider following BPs at all:

- BP 2: different systematic procedure specified under priority setting (Table 7.3 and 7.4);
- BP 4: likely benefit which could be achieved by individual research projects;
- BP 5: probability of success and anticipated constraints of the projects.

The limited availability of different data and information is a major constraint for the appraisal of research projects in TRIS.

8.1.7 MONITORING

With respect to monitoring, the achieved scores against BPs are 5 out of 10, which suggest that monitoring is ***average*** (Table 8.1a). Institute practices BP 1: which is the implementing projects have detailed work plan and time schedule, in full (Table 7.9 and 7.10):

However, BP 2, which specifies that monitoring plan should include all pertinent data requirements for the acquisition and allocation of physical and human resources are partially in place. In addition, BP 3: monitoring plans included the nature (qualitative / quantitative) of data collection, number and interval of reporting are practised in part. A major weakness in the monitoring system is that the Institute does not practice BP 4, which specifies report preparation from data analysis and transmission of the report to the relevant management authority comparing achievements with targets and highlighting bottlenecks.

There should be a system of preparing a monthly report by research divisions so that activities undertaken in previous month can be focused in the report. One of the advantages of producing such reports is that it helps in the consolidation and analysis of collected data for report preparation. In addition, it helps the relevant authority to know the progress of project implementation and helps management to monitor the level of different project implementation. There is no system of producing monthly report by the research departments in TRIS. Preparation of monthly report by individual research division should be introduced. However there is a system of quarterly performance review. The Deputy Director of Research has developed a pro-forma to carry out project performance review. The pro-forma does not cover some of the important points related to performance review. One of the weakness in the present review pro-forma is that it mainly focuses on personnel appraisal, rather than the project implementation.

8.1.8 RESEARCH PROJECT OR PROGRAMME EVALUATION

Research evaluation is ***average*** because achieved score is 5 out of 10 (Table 8.1b). The Institute practices some of the BPs in part (Table 7.11 and 7.12), such as:

- BP 1: internal evaluation of research projects through seminars, workshops, peer review and demonstrations;
- BP 2: a regular system of external evaluation involving clients;
- BP 3: an international seminar; and,
- BP 4: dissemination of research findings through different publications.

With respect to internal evaluation the Institute holds quarterly performance review meetings: at which ongoing research projects are quarterly reviewed and

Table 8.1b Research management performance profile on TRIS

Evaluation (Tale 7.11)										Total score	Assessment
Best practices audit	1	2	3	4							
Allotted score	1	2.5	3	3.5							
Level of implementation	P	P	P	P							
Achieved score	0.5	1.25	1.5	1.75						5	Average
Technology dissemination and feedback (Table 7.13)											
Best practices audit	1	2	3	4	5	6	7	8	9		
Allotted score	0.75	0.75	1	1	1	2	1	1	1.5		
Level of implementation	Y	P	Y	Y	P	P	P	P	N		
Achieved score	0.75	0.375	1	1	0.5	1	0.5	0.5	0	5.63	Average
Publications (Table 7.15)											
Best practices audit	1	2	3	4	5	6	7				
Allotted score	1	0.5	2	2	2	1.5	1				
Level of implementation	Y	Y	Y	N	P	Y	Y				
Achieved score	1	0.5	2	0	1	1.5	1			7	Average
Library facilities (Table 7.17)											
Best practices audit	1	2	3	4	5						
Allotted score	1.25	1.25	2.5	3	2						
Level of implementation	Y	Y	P	Y	P						
Achieved score	1.25	1.25	1.25	3	1					7.75	Strong
Computer facilities (Table 7.19)											
Best practices audit	1	2	3	4	5						
Allotted scores	2	2	2	2	2						
Level of implementation	Y	P	N	P	N						
Achieved score	2	1	0	1	0					4	Average

progress is assessed by the Director and Deputy Director of Research. Individual departmental head sits with the Director and the Deputy Director of research where three of them discuss and assess the performance of the concerned department. The system has some drawbacks because of not being open where all the departmental heads and senior scientists may attend and discuss. Such an open system could be more effective and could stimulate new ideas regarding a particular point under review. In addition, this could help other departmental scientists to be aware of the nature of research and its progress and achievements. A closed system of performance review analysis clearly indicates a weakness in research co-ordination and lack of management vision regarding the advantage of participatory management.

Another weakness of the current evaluation procedure lies in the perception of the process. It appears that it is not clear who is responsible for personnel appraisal or staff appraisal and project evaluation functions. Such an approach will fail to tap the advantage of the evaluation process.

With respect to evaluation by the industry there are formal fora where evaluation could take place, such as:

- Regional scientific committee;
- Estate and extension forum;
- Research consultative committee; and,
- Open days.

But these forums are not contributing positively, reasons for which have been explained previously.

8.1.9 TECHNOLOGY DISSEMINATION AND FEEDBACK (TDF)

The score for TDF is 5.25 out of 10, which indicates that it is of ***average*** performance (Table 8.1b). The Institute is following these BPs in full (Table 7.13 and 7.14):

- BP 1: have farms and demonstration plots at the main research centre;
- BP 3: system of forecasting routine visits of advisory officers and scientists to the industry; and,
- BP 4: visiting clients on request by scientists and advisory officers.

In addition the following BPs are practised partially:

- BP 2: system of routine advisory visits by scientists and advisory officers;
- BP 5: formal fora where advisory and extension officer can met and discuss clients problems;
- BP 6: zonal, regional and local sub-stations which obtain information on area specific needs;
- BP 7: any formal body (committees) to obtain area specific information regarding client problems and constraints on technology adoption; and,
- BP 8: system of formal training for the clients, organising seminars, workshops, field days and demonstrations to disseminate technology.

However, BP 9, which is system of monitoring the adoption of advisory recommendations and follow-up of advisory visits, is not applied by TRIS.

Though all most all the BPs are there, the classification remains *average*. To understand the reason, a clear analysis of the process is essential, which is given below. Advisory and extension is the responsibility of the TDF, which can be analysed under the following headings:

a) Advisory, extension and its linkages with the industry: the advisory and extension department is one of the biggest and well organised departments with qualified experienced people. There are five regional research and extension centres at different agro-ecological zones and its headquarters is at Talawakele. Infrastructural facilities are strong. Since the inception of the Institute in 1958, advisory and extension work was carried out by scientists of the respective research divisions. Smallholders were served by a separate advisory service, which was later taken-over by the tea Smallholder Development Authority. The objective of the Department is to transfer the technology to industry and feedback the industry needs to research. The following systems are in operation:

- estate visits: while there is no system of routine advisory visits, advisory visits are arranged on request of the individual tea estates;
- training of supervisory and field staff of estates: mainly field level supervisory staff and workers are given skills training on nursery, grafting and fertiliser applications;
- advisory circulars and leaflets: these are produced in local languages for the lower level staff members of estates;
- recorded video programmes on particular techniques and sound slide programmes with recorded messages are made available;
- open day: every Wednesday of the week has been earmarked as open day for planters. This is potentially a good system and planters know that if they visit the Institute to discuss technical problems, scientists will be available on this day. Normally scientists try to be present on that day at the station assuming that any planters may come any time to discuss any problem. But the system is not effective, because response from the industry seems to be very poor.
- seminars and symposia are also arranged for technology dissemination.

b) Links between research and extension: There is hardly any effective link between research division and the Advisory and Extension services. In the research review, the Advisory Extension Head is not invited to the meetings of divisional heads, so that the department is ignorant about the latest experimental progress. There is no forum of interaction between the scientists and advisory / extension workers except through personal contacts. New findings are circulated to the industry without informing to the advisory department. As a result when advisory and extension officers visit the estates, they are ill informed if asked about a particular circular for clarification (Wimaladharma, 1994). This has created confusion and developed disregard towards the Institute by the clients. One senior planter reported that recent issues of circulars are more confusing than the older circulars (Saman, 1994). In addition he considered that minor variations are made in the recommended quantity of previous doses and new circulars are issued without any experimental basis. Further he added that when TRI have been asked about recommendations, the answer is that it is from experience. Because of such attitude, industry has limited faith in the quality and relevance of research currently under taken by the TRI.

When circulars are produced by the scientists, these are directly sent to the estates. The Advisory Department do not get them. Sometimes recommendations are updated, and advisory / extension is not informed which leads to the confusion described above. Sometimes seminar talks are arranged by the Institutes at different estates, without informing advisory / extension. There was a system of regular quarterly meetings of all the advisory officers of different centres to share their experience and discuss area specific issues with the scientists in presence of directorate. It is no longer held regularly, and occasionally it is held without the presence of the Director (Waningasundera, 1994).

There appears to be overlapping of advisory and extension activities between advisory / extension and researchers. In addition to advisory extension officers, some senior scientists also provide advice to the estates and advisors consider that too much weight is given to the extension work undertaken by the scientists. This has created deep resentment among the advisory / extension officers. They think that many scientists are specialists in a single field and lack the broader outlook about other practical problems prevalent in the field. Extension workers think that they should carry out the preliminary study and, if required, call the appropriate scientists to help on a particular problem as a subject matter specialist.

At present, scientists are producing audio-visual materials. Advisory / extension officers think that scientists are lacking knowledge in communications, resulting in sub-standard materials, which have never been evaluated properly. Further, these audio-visual materials are given to advisory / extension officers by the Institute who are compelled to use these in their extension work (Rajasingham, 1994). Such situation clearly indicates that there is a credibility tussle between advisory and research divisions. Scientists think that, as experts working on specific problems they have the authority to disseminate the technology directly.

c) Experimental sub-station network for zonal adaptability trials: this is strong because, the Institute follows BP 6 (Tables 7.13, 7.14 and 8.1b). Nevertheless, it is not effective because of various reasons as mentioned under technology dissemination.

Training to industry: At the Institute, there is no formal system of imparting training to the tea managers (Estate managers). However, instead of giving training to the manager, advisory / extension officers train the tea estate workers who are performing the job at the field level. During discussion with Advisory / extension head and other officers of the department it was claimed that there was a good success of such courses. However, the institute management stopped such training partially due to the difference of opinion between the scientists and advisory / extension officers. Nevertheless, training on tea culture is conducted by the National Institute of Plantation Management as a part of their Diploma in Plantation Management. During that course, participants come to the Institute for 2 to 3 weeks and obtain knowledge of tea culture.

Infrastructural facilities for demonstration are strong because there are five regional sub-stations, where region specific demonstrations can be carried out.

But because of weak linkages and lack of co-ordination between research and advisory / extension, demonstration is not as good as it should be. In addition, Waningasundera (1994) reported that there is a negative attitude of TRI management towards the demonstration.

8.1.10 PUBLICATIONS

Publications systems are strong because all the BPs are practised either in full or in part. The achieved score against the BPs are 7.5 out of 10 (Table 8.1b) which indicates that publications are ***strong***. TRIS regularly bring out a number of publications to disseminate technology to the clients. The following BPs are practised in full (Table 7.15 and 7.16):

- BP 1: journals are published regularly;
- BP 2: publications of monthly, quarterly and annual technical reports;
- BP 3: circulars and pamphlets;
- BP 6: publish findings to the international journals regularly; and,
- BP 7: publications of BP 1- BP 3 are regular and in time.

TRIS follows BP 5 in part, which is publications of popular articles in local languages for easy understandings. However, BP 4: publications of bulletins forecasting future important regular activities which need to be carried out by the industry are not practised by TRIS.

8.1.11 LIBRARY

Library facilities are ***strong***, because the TRIS library subscribed to most of the important journals. The achieved score is 7.6 out of 10 (Table 8.1b), because it practices all BP either in full or in part. Following are the BPs practised fully (Table 7.17 and 7.18):

- BP 1: system of regularly obtaining text books related to tea culture;
- BP 2: other text books on allied crops; and,
- BP 4: subscription to the abstracts and journals.

In addition following BPs are practised partially:

- BP 3: subscriptions journals of other tea producing countries; and,
- BP 5: borrowing books from other libraries within the country and outside the country.

8.1.12 COMPUTER FACILITIES

Scoring against the criteria computer facilities are 4 out of 10 (Table 8.1b) which gives an ***average*** classification. The Institute practice BP 1 in full, which is a minimum of one computer for each working unit or department or centrally controlled facility to work by all working units on a rota basis where computers are less than working units or departments. In addition the following BPs are practised in partial (Table 7.19 and 7.20):

- BP 2: regular supply of computer accessories; and,
- BP 4: recent version of different software.

However, TRIS does not have trained people for proper maintenance of computers (BP 3) and limited scope for upgrading facilities (BP 5) of different components of computers.

8.1.13 MANAGEMENT INFORMATION SYSTEM

This is ***weak*** because evaluated score against BPs are 2.9 (Table 8.1c). The Institute has following BPs partially in practice (Table 7.21 and 7.22):

- BP 1: data on financial resources (budgets and expenditure) and utilisation, physical and human resources are not complete and maintained properly;
- BP 2: maintenance of detailed information on human resource management and development (training needs and career development plan) are not complete or kept properly i.e. it is incomplete; and,
- BP 3: general information and survey data on industry such as total area, area under cultivation, area under different plant types, area facing specific problems, meteorological data on different regions, data on soil nutrition profile, and status of pest and diseases are incomplete.

Besides, following BPs are not in practised at all:

- BP 4: data and information on type of management, area under each management category are not kept; and,
- BP 5: the organisation does not keep data and information on rate of uptake of technology, constraints that affects the rate of uptake of technology and data and information on different agro-ecological region specific needs.

The information which is available at the institute is unorganised such that it is difficult to use for making decisions.

8.1.14 FUNDING ARRANGEMENTS AND INCOME GENERATING ACTIVITIES

This is particularly ***strong***, achieving score against BPs is 7.1 (Table 8.1c). TRIS practices following two important BPs in full (Table 7.23 and 7.24):

- BP 1: the Institute has system of obtaining funds through cess money from industry. For every kilogram of tea exported, the Government collects 2 Sri Lankan Rupees and deposits to the Tea Board Fund. Of this 35 cents (17%) is earmarked as a research component. The Tea Board places the money under the disposal of the Tea Research Management Board. The Tea Board does not interfere with allocation and spending of the money amongst research projects; and,
- BP 4: the Institute has a system of generating its own revenue from various sources like sale of tea produced by the estate and factory, and sales of planting materials and different publications.

In addition the following BPs are partially in place:

- BP 3: special subscriptions from clients to meet capital expenditures and, or to meet expenditures in case of emergency;
- BP 5: a system of obtaining funds from donors for collaborative projects; and,

Table 8.1c Research management performance profile on TRIS

Management information system (Table 7.21)							Total score	Assessment
Best practices audit	1	2	3	4	5			
Allotted score	1.5	1.25	3	1.25	3			
Level of implementation	P	P	P	N	N			
Achieved score	0.75	0.625	1.5	0	0		2.88	Weak
Funding arrangement and income generating activities (Table 7.23)								
Best practices audit	1	2	3	4	5	6		
Allotted score	3	1	1	2.25	1.25	1.5		
Level of implementation	Y	N	P	Y	P	P		
Achieved score	3	0	0.5	2.25	0.625	0.75	7.13	Strong
Committee system (guidance and interactions from different management committees) (Table 7.25)								
Best practices audit	1	2	3	4	5			
Allotted score	1	2	2.5	2.5	2			
Level of implementation	Y	Y	Y	Y	Y			
Achieved score	1	2	2.5	2.5	2		10	Strong
Human resource management and development (Table 7.27)								
Best practices audit	1	2	3	4				
Allotted score	2	2	3	3				
Level of implementation	N	N	P	Y				
Achieved score	0	0	1.5	3			4.5	Average
Internal communication and management approach (Table 7.29)								
Best practices audit	1	2	3	4	5			
Allotted score	2	3.5	1.5	1.5	1.5			
Level of implementation	Y	N	P	N	N			
Achieved score	2	0	0.75	0	0		2.75	Weak

- BP 6: system of obtaining funds from central agricultural research council of the country.

However, BP 2, which is a system to obtain regular funds from the Government is not in place.

8.1.15 COMMITTEE SYSTEM (INTERACTIONS AND GUIDANCE)

This is ***strong*** because the Institute practices most of the BPs (Table 7.25 and 7.26) for which the evaluated score is 10 (Table 8.1c). The following BPs are practised in full:

- BP 1: there is a Management Board consisting of client representatives;
- BP 2: different technical committees consist of client and subject specialists to help in research problem identification, priority setting, project evaluation and technology dissemination;
- BP 3: different regional committees;
- BP 4: joint committees consisting of clients, advisory officers and scientists to obtain industry feedback; and,
- BP 5: committees to facilitate interaction between advisory-extension and scientists.

However, there are some concerns about the effectiveness and output of such committees. Some of the clients consider that the objectives of these committees are not achieved, mainly because of political influence on different committees. In addition there are other factors such as insufficient co-ordination and feedback between the committees and the Institute management. Details of how these committees operates are described below: other than the Research Management Board, there are three Consultative Committees which help to manage R & D activities.

The Administrative and Finance Consultative Committee has responsibility to formulate financial policies and guide all financial and administrative affairs of the Institute. It looks into the budgetary affairs, and approves and allocates any capital expenditure involved in any projects. In addition, it helps to decide resource allocation amongst research projects.

The Research Consultative Committee has responsibility for helping and guiding the Director in the planning and formulation, implementation and evaluation of research projects.

The Extension and Estate Management Committee helps to guide the Institute to formulate and implement technology dissemination and determine estate management policies. A main responsibility is to assess industry needs and identify constraints to the adoption of recommended technologies. The committee is also responsible for the monitoring and evaluation of evolved technologies at the field level.

The Estate and Extension Forum consists of 72 representatives covering the whole industry. It meets every 3 to 4 months. It is a forum where senior scientists of the Institute directly meet with the industry. Seminars are arranged by the forum where scientists present their research findings and discussions are held. If participants feel that it is a worthwhile research finding, they request TRI management to issue a circular to disseminate information to the potential adopters. The forum also acts as an effective means of feedback between scientists and the industry.

The Regional Scientific Committee (RSC): tea growing areas of Sri Lanka have been divided into 7 tea districts, and within each district there are sub-districts. At each tea district, there is a regional scientific committee headed by a chairman, who is nominated by the Planters Association. The RSC consists of:

- representatives of tea sub-districts;
- advisory officer of the area; and,

- regional manager of the Tea Smallholdings Authority.

It is a well represented committee of senior members from different areas. The main purpose of this committee is to help in effective dissemination of TRI recommendations and obtain feedback on area specific research needs to the Institute. During case study it appeared that general feelings about the effectiveness of RSC is not positive. For example, industry representatives advisory / extension workers feel some of the suggestions and feedback from RSC is not properly addressed by the Institute authority. The result of the overall research management assessment also reflected this.

8.1.16 HUMAN RESOURCE MANAGEMENT AND DEVELOPMENT (HRMD)

HMRD is ***average***, because the achieved score is 4.5 (Table 8.1c). There is no sound strategic plan for HRMD at the TRIS. Nevertheless, BP 4 which is training of employees to develop potential skills of individual is followed in full. The Institute also practices BP 3 partially, which is performance management. But TRIS does not practice the following BPs (Tables 7.27 and 7.28):

- BP 1: demand forecasting, forecasting requirements, productivity and cost analysis, action planning, budgeting and control in light of future manpower requirement; and,
- BP 2: a clear and specific recruitment and selection policy.

For any organisation job analysis, job specification and a specific recruitment and reward management policy is one of the key components which helps to select and retain the right type of people it requires to achieve its objectives (Chapter 7). At the TRIS there is no clear job specification and defined recruitment criteria against specific hierarchical posts. Also there is no personnel appraisal system. As a result it is relatively easy to abuse the system. In absence of such systems, the Directorate can recruit or promote any one to any posts. It is observed that in the absence of a proper appraisal system, a technician has been given the responsibility of acting head of a division, though in the same division there are highly qualified and trained people even with the academic qualification of PhD. For example, the current acting head of Soil and Plant Nutrition Department does not have a BSc academic degree. During the case study it was observed that there was a strong sense of dissatisfaction among the researchers against such decisions of the Directorate.

8.1.17 INTERNAL COMMUNICATION AND MANAGEMENT APPROACH

Evaluated score against the criteria internal communication and management approach is 2.75, which indicates that it is ***weak*** (Table 8.1c). The Institute practices BP 1 in full which encourages interpersonal communication with in the organisation except for rules and regulation (Tables 7.29 and 7.30). In addition TRIS follows partially BP 3, which considers formal meetings with heads of research divisions to take their view in decision making.

However, the following BPs are not practiced:

- BP 2: which indicates less hierarchical management approach;
- BP 4: systems of meetings with the employee and top management to obtain employees view in decision making; and,
- BP 5: relates to flexibility in procedures, rules and regulations.

Reasons of such weakness in internal communication and management is that it is very formal and bureaucratic. The Director is the Head of the Institute and responsible for overall day to day management. There are three other Deputy Directors for Administration, Extension and Research of which the post of Deputy Director Extension has been vacant for long time. The Deputy Director Research and the Director are responsible for implementation of research programmes.

Because of the adoption of strong formal and bureaucratic approach, animosity has resulted between the Directorate and the research scientists. Senior scientists are not allowed to consult the Director and Deputy Director Research without an appointment. This type of rigid formal approach can restrict the openness of the organisational environment and creative thinking of the scientist. Also it may affect the productivity of the scientists (Chapter 7).

Procedures are also very bureaucratic. For example, for any discussion or consultation regarding research project related issues, a scientist must first go to the Deputy Director through an appointment, and if the Deputy Director allows only then is allowed to see the Director. The Institute may be characterised as having a strong closed culture: upward and lateral communication are absent. There is only a strong top down approach.

Lack of openness has developed lack of confidence and distrust in leadership both by the researchers and plantation managers. During discussion with researchers and plantation managers, it appeared that the overall organisational climate is not very conducive to efficiency. The formal and bureaucratic approach slows down the decision making process, which ultimately affects the implementation of research projects. Out of 114 qualified and experienced scientists, 45 left the Institute during the period 1982-92, which includes almost all heads of research divisions. However, it may be argued that other factors like poor pay structure, education facilities, medical and housing facilities may also have contributed to such staff high turnover.

For a research organisation the main activity is to carry out research and disseminate proven technology to the clients (Chapter 2) to achieve the organisational goal. Whilst administration is an important support service to the research, the importance of administration should not be over emphasised. There should be a balance of both. At the TRIS there is a huge administrative support service to help and support the R & D activities. Procurement of resources and transport is under the control of the Deputy Director Administration. Scientists reported that because of bureaucratic procedures procurement of research resources and movements of scientists are delayed, which is a major constraint in research work.

8.1.18 USE OF IMPROVED TEA CULTIVARS

Limited data have been collected from the tea industry of Sri-Lanka. Analysis (Tables V.8-V.12 and Figures V.15 to V.24.) reveals that there is not very much difference in the rate of uptake of improved tea cultivars between smallholders and estates. Under such circumstance, the Institute needs to put equal emphasis on the use of improved cultivars both in smallholdings and estates.

8.1.19 CONCLUSION

TRI-Sri Lanka is a well established organisation with strong infrastructural facilities, and equipped with modern sophisticated equipment. It has developed its research management systems over the years. It is an organisation with lots of intrinsic ability to support effective research. A summary profile on over all research management performance was compiled (Figure.8.1). This shows that at TRIS, publications, library facilities , funding arrangements and income generating activities, and committee culture are strong. Nevertheless, there are a number of acute problems preventing research from achieving its full potential, namely:

- formal, bureaucratic and close culture of the organisation;
  lack of proper personal management approach which refers to poor job analysis, recruitment and selection procedure, without a proper appraisal system. As a result it is relatively easy to abuse the system;.
- lack of trust and confidence on present leadership;
- lack of participatory management approach;
- weak co-ordination and linkage between research and advisory-extension;
- weak committee culture leads to weak and ineffective linkage with the industry;

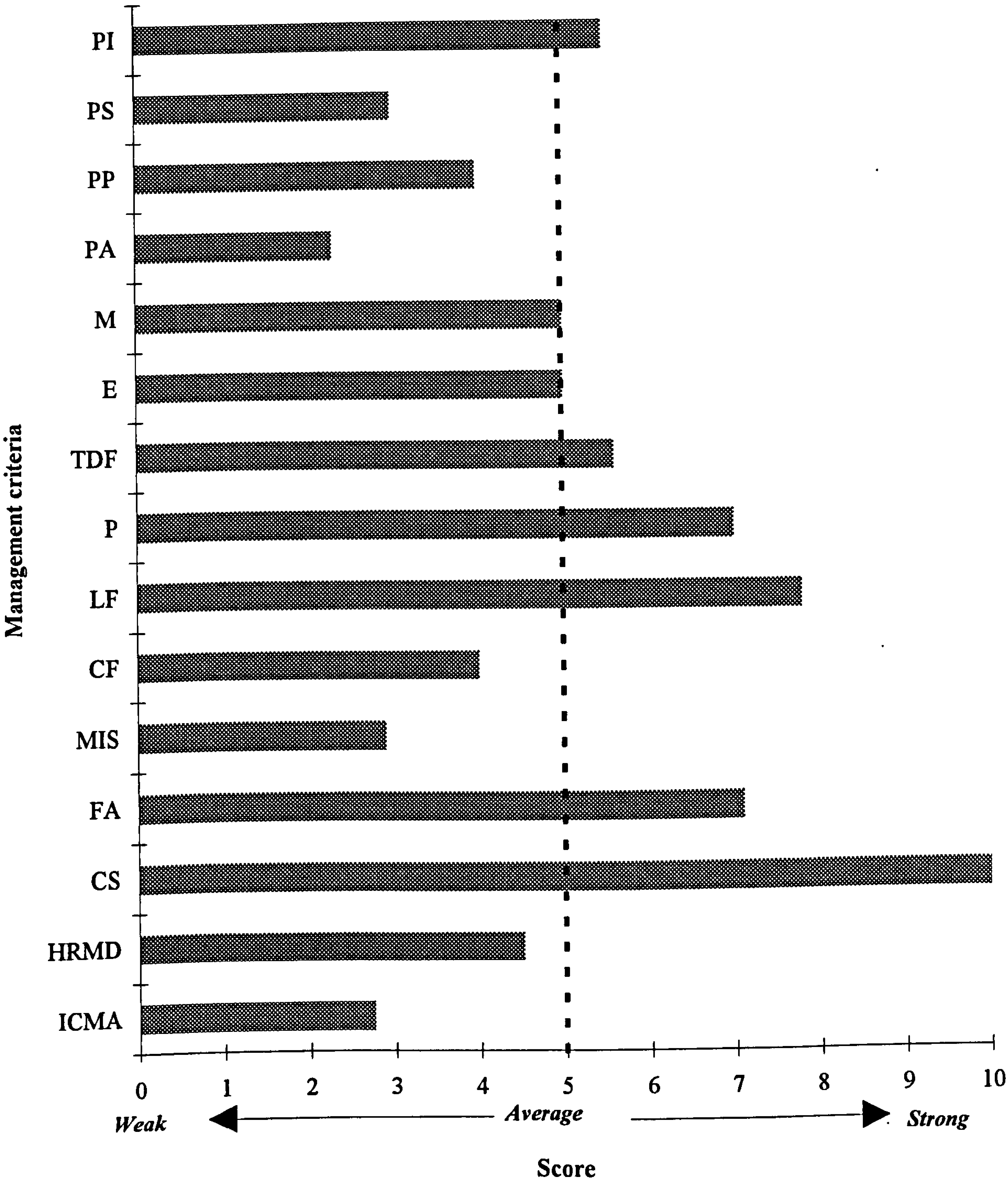


Figure 8.1 Summary profile on research management performance: TRIS

(PI= Problem identification, PS= Priority setting, PP= Project preparation, PA= Project appraisal, M= Monitoring, E= Evaluation, P= Publications, LF= Library facilities, CF= Computer facilities, MIS= Management information systems, FA= Funding arrangements and income generating activities, CS= Committee system, HRMD= Human resource management and development, ICMA= Internal communication and management approach.)

- closed system of internal evaluation; and,
- creditability gap between researchers and advisory / extension officers.

8.2 Case studies on United Planters Association of South India (UPASI)

This is the second case study that was grouped under the ***Phase Two*** case studies.

8.2.1 Tea and tea research in South India

Tea cultivation in South India started much later than in North East India. Tea plants were first brought from Calcutta in 1839. But commercial growing started during the 1850s. Muthiah (1993) reported that it was the coffee catastrophe which enhanced tea plantation in South India. The total area of tea is about 84000 ha. of which 64000 ha. are under the memberships of UPASI, (Satyanarayana, 1994). Research on tea started first at Nilgiris district during 1925 with a single man division. Later, in 1965, it was shifted to Cinchona in the rolling hills of Anamallai, at the district of Coimbatore. Under the management of UPASI, research on coffee was initiated first, working under Mysore Agricultural Department's Coffee Research Station at Balehonnur. Later, research on tea and rubber was also initiated. Over the years, the UPASI's coffee research unit was transferred to the Coffee Board and rubber research to the Rubber Board. UPASI continued with research on tea.

8.2.2 Mandate and organisation

The mandate of UPASI is to evolve technologies of immediate and long term use to increase productivity of tea and improve quality at an economic prices (Sharma, 1994). Though the Institute started its journey in 1925 with single man, it has grown to keep pace with the industry demands. At present a total of 63 staff members are working under UPASI scientific department including

KVK, of which 14 are supporting staff UPASI, 1993). At the main station, the total number of staff is 32 of which there are only 6 supporting staff. Research is organised by the following seven divisions:

Botany;

Chemistry;

Entomology;

Plant pathology

Plant physiology;

Technology; and ,

Advisory.

UPASI mostly carries out applied and adaptive research based on client need. Besides research, it disseminates various proven technologies to the industry through its strong advisory network spread over the South Indian planting districts. UPASI also imparts training on different aspects of tea culture to its clients. There is a small experimental estate (about 40-50 ha.) under the management of the tea scientific departments.

UPASI is the apex organisation of producers of tea, coffee, rubber and spices in South India. The organisation was founded in 1893. Memberships of the association comprises small and large holdings as well as corporate bodies. Affiliated to the UPASI are the three State Planters Association (SPA) in Tamil Nadu, Kerela, Karnataka and the many District Planting Associations (DPA) of these districts.

The headquarters of UPASI is located in the pictorial Glenview complex in Coonoor of the Nilgris districts. Other than the headquarters at Coonoor, TRI in Cinchona, it has also a liaison office in New Delhi. Though the organisation is responsible for tea, coffee, rubber and spices in South India, it has a research Institute for tea only. For other crops, research responsibilities are under the

Commodity Board (CB) of the Government of India. The affairs of the UPASI are managed by the Executive Committee (EC).

Using the criteria for assessing the performance of tea research, the profile on UPASI was compiled (Table 8.2a-8.2c). Elements of which are discussed below in detail.

8.2.3 PROBLEM IDENTIFICATION (PI)

The level of implementation of BPs against PI is high, for which the achieved score is 8.75 (Table 8.2a), which indicates that it is ***strong***. The Institute practices all BPs (Table 7.1 and 7.2), mostly in full such as obtaining information on and identification of problems through:

- BP 1: request from the industry, through correspondence and contact;
- BP 2: advisory and extension officers;
- BP 3: scientists following routine advisory visits;
- BP 4: workshops and seminars involving clients and discussions during demonstrations and training; and,
- BP 5: regional, zonal, local stations or sub-stations.

However BP 6, which is obtaining information from different Management Committees and Sub-committees is practised partially.

The main reasons for such strong problem identification are: close contact with clients, strong linkage between research advisory and extension, two way effective communication and feedback with the industry, strong interactions and guidance from the Tea Technical Committee (TTC). As a result industry demands and needs are well reflected.

8.2.4 PRIORITIES AND RESOURCE ALLOCATION (PSRA)

The evaluated score against PSRA is 4 (Table 8.2a) which means it is ***average***. BP 2 (Table 7.3 and 7.4), which is considering the importance of the problem

Table 8.2a Research management performance profile on UPASI

Problem identification (Table 7.1)							Total score	Assess-ment
Best practices audit	1	2	3	4	5	6		
Allotted score	1	1	1	2.5	2	2.5		
Level of implementation	Y	Y	Y	Y	Y	P		
Achieved score	1	1	1	2.5	2	1.25	8.75	Strong
Priority setting and resource allocation (Table 7.3)								
Best practices audit	1	2	3	4				
Allotted score	2	2	2	4				
Level of implementation	Y	P	P	N				
Achieved score	2	1	1	0			4	Average
Project preparation (Table 7.5)								
Best practices audit	1	2	3	4	5	6		
Allotted score	1	1.5	2.5	2	2	1		
Level of implementation	Y	P	P	P	P	N		
Achieved score	1	0.75	1.25	1	1	0	5	Average
Project appraisal (Table 7.7)								
Best practices audit	1	2	3	4	5			
Allotted score	1.5	3	3	1.5	1			
Level of implementation	Y	N	P	N	N			
Achieved score	1.5	0	1.5	0	0		3	Weak
Monitoring (Table 7.9)								
Best practices audit	1	2	3	4				
Allotted score	2	3	3	2				
Level of implementation on	Y	Y	Y	N				
Achieved score	2	3	3	0			8	Strong

obtained through the systems specified for problem identification (Table 7.1) is practised in full. The following two BPs are practised partially:

- BP 2: consideration of resource availability in the light of project requirement; and,
- BP 3: consideration of probability of project success and anticipated constraints;

However the main weakness of PSRA is that UPASI does not practice BP 4, which is the adoption of a systematic approaches such as checklists or scoring for setting priorities of research problems.

TTC and The Director are responsible for PSRA. Nevertheless, the adoption of a formal approach would certainly help in proper utilisation of resources.

8.2.5 PROJECT PREPARATION (PP)

PP is assessed as ***average*** because it achieved score of 5 (Table 8.2a). During PP, UPASI practices BP 1, which refers to clearly defined objectives. In addition the following BPs (Table 7.5 and 7.6) are practised partially:

- BP 2: statement of the problem with all pertinent data and information which signifies the importance of research;
- BP 3: plan of work (methodology) and time schedule including experimental site specification (special requirements), statistical design to be used, nature (root, shoot, leaf, soil analysis, biochemical analysis, insect or pest incidences, analytical methods to be used, which are appropriate to achieved proposed objectives;
- BP 4: indication of human resources with particular resources with particular skill needed, financial resources with realistic cost and budgets, other physical resources like equipment, transport, chemicals and fertilisers (with specific requirements if needed); and,
- BP 5: indication of monitoring techniques and reporting style of analytical results, type and parameters of evaluation techniques.

However, with respect to BP 6, there is no indication of expected results and anticipated constraints in prepared projects.

8.2.6 PROJECT APPRAISAL (PA)

This is *weak* because achieved score is 3 (Table 8.2a). PA is done partially without any systematic approach primarily because there is lack of proper understanding of the concept and benefit. Adoption of a systematic approach would help in making decisions on resource allocation and justification of resource utilisation.

UPASI practices BP 1 in full, which is the comparison of importance of the research problems according to the criteria specified for problem identification (Table 7.1). In addition the organisation partially follows BP 3, which involves selection of suitable methodology, and arranging of time schedules, work plans, estimates of cost and resource availability for the specified objectives. However, the organisation does not practice the following BPs specified for project appraisal (Table 7.7 and 7.8):

- BP 2: comparison of different systematic procedures specified under PSRA (Table 7.3);
- BP 4: comparison of likely benefit which could be achieved by individual research projects; and,
- BP 5: comparison of probability of success and anticipated constraints.

8.2.7 MONITORING

This is *strong* because evaluated score is 8 (Table 8.2a). UPASI practice following BPs (Table 7.9 and 10) in full:

- BP 1: undertaken projects have a work plan and time schedule;
- BP 2: the monitoring plan include all pertinent data requirement like, acquisition and allocation of physical resources, budget specification and

allocation of financial resources, specification and allocation of human resources; and,

- BP 3: the monitoring plan include the nature (qualitative / quantitative) of data collection, number and interval of reporting.

However, the organisation does not practice BP 4 which specifies report preparation from data analysis and transmit the same to relevant management authorities comparing achievements with targets highlighting bottle necks. There is, however, a system of preparing monthly reports. Individual heads of research divisions prepare monthly reports based on collected data. These report go to the chairman of the TTC.

Financial monitoring is particularly strong. A pro-forma has been developed to get clear up to date picture of the financial position. An accounts clerk fills in the pro-forma with divisional break-up and send it to the Director. By the 10th day of every month the Director knows the overall financial strength. If any division is about to cross their budgetary limits, they get an advance information. Financial monitoring report also goes to the chairman of TTC.

8.2.8 RESEARCH PROJECTS OR PROGRAMME EVALUATION

Evaluation at UPASI is ***strong***. The achieved score is 10 (Table 8.2b) because the organisation practice all BPs (Table 7.11 and 7.12) in full which is presented below:

- BP 1: the organisation has a regular system of internal evaluation of research projects through: seminars, workshops, peer review, demonstrations;
- BP 2. the organisation has a regular system of external evaluation involving clients through: seminars, workshops, peer review, demonstrations;
- BP 3. there are systems of holding international seminars involving clients and wider scientific community; and,

- BP 4. there are regular system of publication to disseminate research findings to the industry through: annual reports, journals, memorandums, technical reports, advisory bulletins, circulars.

There are different evaluation fora for research evaluation. All the divisional heads sit together and ask individual project leaders to present their findings. These will be critically examined and discussed in a constructive manner. After thorough analysis, if any departmental projects require more information, it will be suggested accordingly. Followings are the official fora through which evaluation is done:

a) Internal evaluation (within the Institute):

-monthly seminar;

-monthly head of research divisions meetings; and,

-research and extension meetings (REM).

b) Evaluation by the industry:

-review of TTC;

-Area Scientific Committee (ASC) meetings;

-Joint Area Scientific Symposia (JASS); and,

-UPASI annual conference.

The field evaluation and monitoring of released technologies and recommendations is an unique system which neither falls under demonstration nor under on farm research. During JASS all participants, advisory officers and scientists visits to the different estates where UPASI technologies and recommendations are adopted. Management of those estates highlight what are the benefits of adopting UPASI technologies. They discuss UPASI recommendations, point out the constraints. Based on these feedback if necessary, scientists modify their recommendations to suit area specific need.

c) Evaluation by the wider scientific community is weak. There is no formal system of conference involving scientists across the country.

Table 8.2b. Research management performance profile on UPASI

Evaluation (Tale 7.11)										Total score	Assess-ment
Best practices audit	1	2	3	4							
Allotted score	1	2.5	3	3.5							
Level of implementation	Y	Y	Y	Y							
Achieved score	1	2.5	3	3.5						10	Strong
Technology dissemination and feedback (Table 7.13)											
Best practices audit	1	2	3	4	5	6	7	8	9		
Allotted score	0.75	0.75	1	1	1	2	1	1	1.5		
Level of implementation	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Achieved score	0.75	0.75	1	1	1	2	1	1	1.5	10	Strong
Publications (Table 7.15)											
Best practices audit	1	2	3	4	5	6	7				
Allotted score	1	0.5	1.5	2	2	1.5	1.5				
Level of implementation	Y	Y	Y	Y	Y	Y	Y				
Achieved score	1	0.5	1.5	2	2	1.5	1.5			10	Strong
Library facilities (Table 7.17)											
Best practices audit	1	2	3	4	5						
Allotted score	1.25	1.25	2.25	3	2						
Level of implementation	P	P	N	N	P						
Achieved score	0.625	0.625	0	0	1					2.25	Weak
Computer facilities (Table 7.19)											
Best practices audit	1	2	3	4	5						
Allotted scores	2	2	2	2	2						
Level of implementation	P	P	P	N	N						
Achieved score	1	1	1	0	0					3	Weak

8.2.9 TECHNOLOGY DISSEMINATION AND FEEDBACK (TDF)

This ***strong*** because the evaluated score is 10 (Table 8.2b). The following BPs (Table 7.13 and 7.14) are practised by UPASI in full:

- BP 1: experimental farms and demonstration plots at the main centre;
- BP 2: systems of routine advisory visits by scientists and advisory officers;
- BP 3: system of forecasting routine visits of advisory officers and scientists to the industry;
- BP 4: systems of visiting clients on request by Scientists and advisory officers;
- BP 5: formal fora where advisory-extension officers can meet and discuss client problems;
- BP 6: zonal, regional and local sub-stations to obtain information on area specific problems;
- BP 7: formal body (Committees) to obtain area information regarding client problems and constraints on technology adoption;
- BP 8: system of formal training to the clients + organising seminars, workshops, field days and demonstrations to disseminate technology; and,
- BP 9: system of monitoring on adoption of advisory recommendations and follow-up of visits to the clients.

However, TDF is the responsibility of the advisory division, which may be analysed and described in detail under following headings for better understanding of the process:

a) The advisory service and its linkages with the industry: is strong and fairly well organised. The main function of the department to transfer technologies to industry and obtain industry feedback on its research needs. The work is accomplished through a strong network of 6 advisory stations. Out of 7 planting district of South India, 6 are served by the Advisory Department and the remaining one is served by the scientists of the main station.

Every individual advisory officer will cover an area of about 3500 ha. A routine visit is paid by the advisory officer to each estate at least once a year. Besides request visits are also made by the advisory officer on specific requests by the planters. Detailed reports are prepared on the visit findings and communicated to the gardens. Besides, advisory officers, the Director and the senior scientists of the Institute also visit the individual gardens at least once a year as a routine. In addition, the Director and scientists also visit on request from the clients on specific problems.

b)Training: UPASI through Krishi Vigyan Kendra (KVK) imparts training to the clients on different aspects of scientific culture of tea. Training programmes are structured to bridge the gap between available technologies at one end and their application for the increase of production at the other end. A speciality of the programme is learning by doing. The KVK conducts training courses of different duration throughout the year, which ranges from one week to one month. Mostly they impart training to the small grower and supervisory staff of corporate companies who are doing the job practically in the field. UPASI also conducts training courses for junior as well as senior level executives of corporate bodies .

c) The linkage between research, advisory and extension: is very strong. Advisory officers have the following forum to meet head of research divisions: <u>Research and extension meeting:</u> there is a week long meeting held at UPASI Tea Research Institute once or twice a year. All the advisory officers from all the centres come to UPASI. All research heads present the recent findings on their individual projects which are discussed and critically analysed. In addition, the results some of the experiments which have been carried out at different districts are also discussed. Research divisions receive feedback through the advisory officers regarding:

- performance of trials, which have been laid out in different locations;

- new problems encountered by area specific clients. When such problems are perceived as potentially common problems to all the districts, then UPASI decides to undertake projects in order to address these problems. This type of discussions particularly helps problem identification;
- area specific industry problems;
- constraints in implementing new recommendations; and,
- monitoring of implementation of the technologies.

In addition, the annual conference, joint area scientific conferences, and area scientific meetings and seminars also serve as fora for linkages between research, advisory and extension.

d) The experimental sub-station network for zonal adaptability trials: has good infra structural facilities. The whole South Indian tea district has been divided into 7 advisory centres based on different agro-climatic zones. All the advisory work and zonal adaptability trials are carried out through this network of advisory centres. There is either a senior advisory officer and one / two assistant advisory officers and one or two technical assistants depending on the area of tea districts covered by every advisory centres. For wide adaptability of experimental findings each experiment is separately carried out in each of the seven locations. One assistant advisory officer is absolutely responsible to implement all experiments and collect data according to the schedule prepared by the concerned head or the project leader. Their work is closely monitored by the Director and Head of Research Divisions.

e) Field demonstrations: are particularly strong. There are demonstration experiments of all divisional activities in all the planting districts. The experiments are carried out by the advisory officers under the guidance of the respective divisional heads. Sometimes respective divisional heads visit the experimental site to supervise the experiments at different districts.

f) Technical group discussions: there are some companies who want that their adopted policies should remain secret as their business policy. For such reason, they do not want to discuss their policies openly in the presence of other company planters, but at the same item they are interested to have the researcher's comments. Also scientists must know what is going on at individual company level. So, recently the UPASI has introduced the idea of technical group discussions, where only a group of one particular company planters attend and discuss their problems and ideas with the researchers. As a result of such discussions, scientists have been able to fine tune the recommendations and modified them according to the needs of specific clients.

g) Quarterly / bimonthly advisory bulletins: are useful routine publications produced by the local advisory officers from each planting district. The aim of these publications is to inform area specific planters in advance about the problems that might be encounter in the next few months with the recommended measures. Some of the common cultural practices are listed for the coming months in order to remind the managers.

8.2.10 PUBLICATION

The achieved score against publications is 10 (Table 8.2b) which indicates that it is ***strong***. UPASI practices all the BPs (Table 7.15 and 7.16) in full. It disseminates technologies to clients, and publishes research results as follows:

- BP 1: journals;
- BP 2: monthly, quarterly and annual technical reports;
- BP 3: circulars and pamphlets;
- BP 4: bulletins forecasting future regular activities which need to be carried out by the industry;
- BP 5: popular articles in local languages for easy understanding;
- BP 6: findings to the international journals; and,
- BP 7: publications are regular and timely published.

Publications play one of the key roles in successful technology dissemination. Regular publications through which technologies are disseminated to the clients are:

- the Planters Chronicle is the official monthly scientific journal of the association. It is one of the oldest industrial journals of India;
- the Hand book of tea culture is a binder containing different sections covering all the scientific aspects of modern tea culture. All the recommendations arising out of current research issued by the scientific departments are kept in it. It serves as a ready reference;
- Annual reports highlights the current position of all the on-going research projects;
- Bulletins are regularly published which arise out of different seminars and conferences; and,
- Advisory circulars are published regularly by all the advisory centres.

8.2.11 LIBRARY FACILITIES

The achieved score for library facilities is 2.25 (Table 8.2b), which indicates that it is *weak*. UPASI practices the following BPs (Table 7.17 and 7.18) partially:

- BP 1: systems of obtaining text books related with tea culture;
- BP 2: systems of obtaining other text books on allied crops; and,
- BP 5: borrowing books and journals from other libraries within the country and outside the country.

However, two of the important BPs are not practised. For example, the library does not have a system of subscribing journals related to tea research of other countries (BP 3) and a system of subscribing abstract journals (BP 4).

8.2.12 Computer Facilities

These are ***weak*** because evaluation score is 3 (Table 8.2b). At UPASI following BPs (Table 7.19 and 7.20) are practised in partial:

- BP 1: minimum one computer for each working units or centrally controlled facilities to work by all working units on a rota basis where number of computers are less than working units;
- BP 2: regular supply of computer accessories; and,
- BP 3: trained people for maintenance of computers.

However, UPASI does not have two of the important BPs in place such as, recent version of different software (BP 4) and facilities for upgrading different components of the computer system (BP 5).

8.2.13 Management Information System (MIS)

MIS is ***average*** because level of score is 3.62 (Table 8.2c). UPASI practice BP 1 in full, which is maintaining data on financial resources (budgets and expenditure) and utilisation, physical resources and human resources. In addition, the following BPs (Table 7.21 and 7.22) are partially practised:

- BP 2: maintenance of detailed information on human resource management and development (training needs and career development plan for individual) are incomplete; and,
- BP 3: general information and survey data on industry such as, total area, area under cultivation, area under different clones (cultivars), area facing specific problems, meteorological data on different regions, data on soil nutrition profile, and status of pest and diseases are incomplete.

The following BPs are not in practised at all:

- BP 4: data and information on type of management, area under each management category; and,

Table 8.2c. Research management performance profile on UPASI

Management information system (Table 7.21)							Total score	Assess-ment
Best practices audit	1	2	3	4	5			
Allotted score	1.5	1.25	3	1.25	3			
Level of implementation	Y	P	P	N	N			
Achieved score	1.5	0.625	1.5	0	0		3.6	Average
Funding arrangement and income generating activities (Table 7.23)								
Best practices audit	1	2	3	4	5	6		
Allotted score	3	1	1	2.25	1.25	1.5		
Level of implementation	Y	P	Y	Y	N	Y		
Achieved score	3	0.5	1	2.25	0	1.5	8.25	Strong
Committee system (guidance and interactions from different management committees) (Table 7.25)								
Best practices audit	1	2	3	4	5			
Allotted score	1	2	2.5	2.5	2			
Level of implementation	Y	Y	Y	Y	Y			
Achieved score	1	2	2.5	2.5	2		10	Strong
Human resource management and development (Table 7.27)								
Best practices audit	1	2	3	4				
Allotted score	2	2	3	3				
Level of implementation	N	Y	P	N				
Achieved score	0	2	1.5	0			3.5	Average
Internal communication and management approach (Table 7.29)								
Best practices audit	1	2	3	4	5			
Allotted score	2	3.5	1.5	1.5	1.5			
Level of implementation	Y	Y	Y	Y	Y			
Achieved score	2	3.5	1.5	1.5	1.5		10	Strong

- BP 5: data and information on rate of uptake of technology, constraints that affect the rate of uptake of technology and information on different agro-ecological region specific needs.

8.2.14 FUNDING ARRANGEMENTS AND INCOME GENERATING ACTIVITIES

This is *strong* because the achieved level score is 8.25 (Table 8.2c). UPASI has the following BPs (Table 7.23 and 7.24) in place:

- BP 1: systems obtaining funds from the clients / industry;
- BP 3: systems obtaining special subscriptions from clients other than the regular subscription to meet capital expenditures in case of sudden emergency;
- BP 4: there are systems of generating own income; and,
- BP 6: there are systems of obtaining funds from central agricultural research council of the country.

  However, BP 2, which relates to systems obtaining funds from the Government is partial in place.
- BP 5, which is system obtaining funds from donors are not in place

UPASI obtain funds from the following sources:

Core funds:

- membership subscription on per hectare basis, which is at present 100 rupees. The total amount collected as subscription is around 65 Lacks rupees;
- own revenue generated through sales of either green leaves or made tea produced from the experimental farm of the Institute, which is around 30 Lack rupees (a year);
- collection of fees against screening of different agro-chemicals soil analysis, around 5 Lack, rupees (a year); and,
- Government grants for providing advisory service to small growers, around 8 Lack rupees (a year).

Projects grant from national government:

- Indian Council of Agricultural Research (ICAR);
- National Tea Research Foundation (NTRF); and,
- Department of Bio-technology.

UPASI reserve funds: as and when required for emergencies; and,

Capital (membership) subscription: to meet capital expenses required for priority project, if normal subscription does not appear sufficient.

8.2.15 COMMITTEE SYSTEM (INTERACTIONS AND GUIDANCE)

The level of achieved score for committee system is 10 (Table 8.2c), which indicates that it is ***strong***. UPASI has all the BPs in practice. The organisation has the following committees and activities for efficient R & D management:

- BP 1: Management Board with client's representatives to formulate policies strategies for the organisation;
- BP 2: different Technical Committees consisting of clients, subject specialist people to help research problem identification, priority setting, project evaluation and technology dissemination;
- BP 3: different Regional Committees consisting of only client's, advisory and extension workers and scientists to obtain client's feedback;
- BP 4: Joint Committees consisting of only clients, advisory and extension workers and scientists to obtain client's feedback; and,
- BP 5: committee (s) to facilitate interaction between advisory and extension workers and scientists (where advisory and extension is separate).

However, details of the different committees and their activities are described in details. Other than the E C, there are Trustee Board, Tea Committee and Tea Technical Committee to help the management of UPASI Tea Research Institute.

The Executive Committee (EC) is an elected body formed through annual general election. Besides elected members, committee has the representatives of State planters associations, legal adviser and co-opted members. The co-opted members are grower's representatives in the CB. For overall smooth functioning of the organisation EC appoints different sub-committees (SC) to look after individual commodities as well as other general aspects of common interests of the members.

Presently the following SC are functioning:

- Tea sub-committee;
- Coffee sub-committee;
- Rubber sub-committee;
- Spices sub-committee;
- Labour liaison sub-committee;
- Taxation and finance sub-committee; and,
- Tea Technical Committee (TTC).

The President and vice-president of the EC are ex-officio members of all the SC. President is the head of the EC as well as the organisation. They meet four times a year. Main function is to formulate and implement the broad based management strategies and policy guide-lines for the organisation. Trustee Board and Tea Committees directly help EC in implementation of the policies.

The Trustee Board (TB) is a permanent structure and consists of the following members representing different planting associations:

- Chairman of Tamil Nadu Planters Association;
- Chairman of Karnataka Planters Association;
- Chairman of Kerala Planters Association;
- President of the UPASI;
- Vice President of the UPASI; and,

- former President of UPASI as ex-officio member.

The primary function of the TB is to help the EC in quick decision making. Any technical recommendation first goes to the EC through the TB. In addition, approval on any major policy, appointment or termination at senior level staff member, salary, budgets are primarily approved by the TB and recommended to the EC which is the final approving authority.

Tea Technical Committee consists of the senior executives of different plantation companies having long experience in tea culture and heads of R & D wings of those plantation companies who have their R & D wings. It is a very important forum where close interaction and feedback occurs between the industry and the research. The committee meets 2-3 times a year. This committee plays a key role in research management. They have the responsibility to formulate research strategies and guide and help the director in:

- research planning;
- problem identification;
- project appraisal and prioritisation;
- implementation, monitoring and evaluation of research projects;
- technology dissemination;
- monitor and feedback technology implementation and highlight constraints in technology adoption; and,
- financial management.

The TTC sits once or twice a year and scrutinises all the ongoing experiments of the Institute. Each of the divisional heads presents all the ongoing projects. Critical discussion occurs at this level. If the TTC are satisfied with the level of progress, then further work is continued. Otherwise, it may suggest to the Director to drop or terminate some of them based on their individual merits.

The Director in turn will communicate to the head and project leader concerned, not to continue these projects. In addition, if any recommendation is ready to release to the industry, the TTC is the official forum responsible for its evaluation and for approving or not approving the recommendation

Area Scientific Committees exist in 7 planting districts of South India. These are important fora where scientists, industry and advisory workers interact directly. The committees arrange scientific seminars or symposia, at least once a year. These are attended by senior scientists, the Director and the advisory officers of that area and all the planters. The seminar may involve a panel discussion, where planters select any topical problem and discuss. It may be a scientific presentation on a current project highlighting its findings. Some times a planter may present a paper based on a new experience or on a difficulty faced in implementation of a recommendation. During the course of discussions, sometimes new problems may come out. The Director may discuss such problem with the scientists, senior planters and advisory officer of the area and may decide to start an experiment to solve the problem. The main purpose of the committee is to help in :

- obtaining region specific industry information and feedback for problem identification and priority settings;
- evaluation of recommended technology;
- dissemination and monitoring the adoption of technology; and,
- monitoring constraints of technology adoption.

Joint Area Scientific Symposia (JASS) are held regularly, once in every two years. The venue of the symposium rotates every time. This forum gives an opportunity where all industry representatives, UPASI scientists and advisory / extension officers meet for 2-3 days. It facilitates close interaction and feedback between scientists, industry and advisory / extension officers, which is one of the prime requisites to determine industry needs. It is mainly field oriented and there may be a sit-down session on the last day. In the symposium, heads of departments present papers highlighting their achievements. Senior planters also present papers enumerating the success and constraints of previous UPASI recommendations and current problems. Each presentation is followed by discussion. In addition, certain gardens are selected and visits are arranged by all participants, where they discuss pros and cons of particular operations. The symposium helps in:

- obtaining industry feedback regarding new problems;
- dissemination of technology;
- ascertaining constraints in implementation of recommendations;
- evaluate research findings; and,
- monitor technology adoption.

Based on these factors, future research planning could be improved.

The UPASI Scientific Conference is another important forum where direct interactions between scientists, industry and advisors takes place. It is held once in every two years. Scientists present papers highlighting the experimental findings, followed by a discussion. Advisory officers of different planting districts also present their findings and feedback in the conference.

8.2.16 HUMAN RESOURCE MANAGEMENT AND DEVELOPMENT (HRMD)

This is of ***average*** nature because the level of achieved score is 3.5 (Table 8.2c). UPASI follows BP 2 (Table 7.27 and 7.28), which is a clear and specific recruitment and selection policy. In addition, it follows BP 3 partially, which refers to systems of performance management, including performance review, potential review, performance improvement programmes, career development programmes and reward review. But it does not practice the following two BPs

:

- BP 1: systems of demand forecasting, forecasting requirements, productivity and cost analysis, budgeting and cost control in light of future manpower requirements; and,
- BP 4: training systems to develop potential skills of individuals.

Since the place is physically isolated from other parts of the country, recreation and amusement facilities need improvement.

8.2.17 INTERNAL COMMUNICATION AND MANAGEMENT APPROACH

This is *strong* because the achieved score is 10 (Table 8.2c). UPASI practices following BPs (Table 7.29 and 7.30) in full:

- BP 1: internal communication mainly through interpersonal approach with less emphasis on written form, except for rules and regulations;
- BP 2: a participatory management style (informal, loosely controlled, less hierarchical and bottom up approach);
- BP 3: systems of formal meetings with heads of research divisions to take their views in decision making;
- BP 4: systems of meetings between top management and employees, to obtain employees view in decision making; and,
- BP 5: with respect to procedures, rules and regulations, there are some flexibility.

However, this is a small organisation with a minimum number of supporting staff. The Director adopts an informal open door policy. Decision making is participatory with a team spirit.

8.2.19 USE OF IMPROVED TEA CULTIVARS

Data were collected from two estates only. From the analysis (Tables V.13-V.14 and Figures V.25-V.28) a preliminary indication is that the rate of uptake of improved cultivars in these estates are inadequate. UPASI should put more thrust on encouraging the use of improved tea cultivars by estates.

8.2.20 Conclusion

An over all summary profile on the research management performance is graphically presented (Figure 8.2). This shows that at UPASI, problem identification, monitoring, funding arrangements and income generating activities, internal communication and management approach, evaluation, technology dissemination and publications are strong. However, the following are the main weaknesses which prevent UPASI from achieving its full potential:

The Institute is situated in an isolated place. This has a number of consequences:

- there is high turnover of scientific staff, partly due to limited social amenities and services;
- procurement of chemicals, spare parts of equipment in time is a great problem, and affects smooth running of research projects (Sharma, 1994); and,
- modern equipment facilities are limited,

In addition, there are following weaknesses which substantially influencing research performance in the organisation:

- poor library and computing facilities;
- limited transport facilities;
- closed culture of the organisation resulting in poor linkage with the out country knowledge systems;
- project preparation and project appraisal is weak; and,
- management information system is weak, particularly data on resource utilisation and on overall industry is poor.

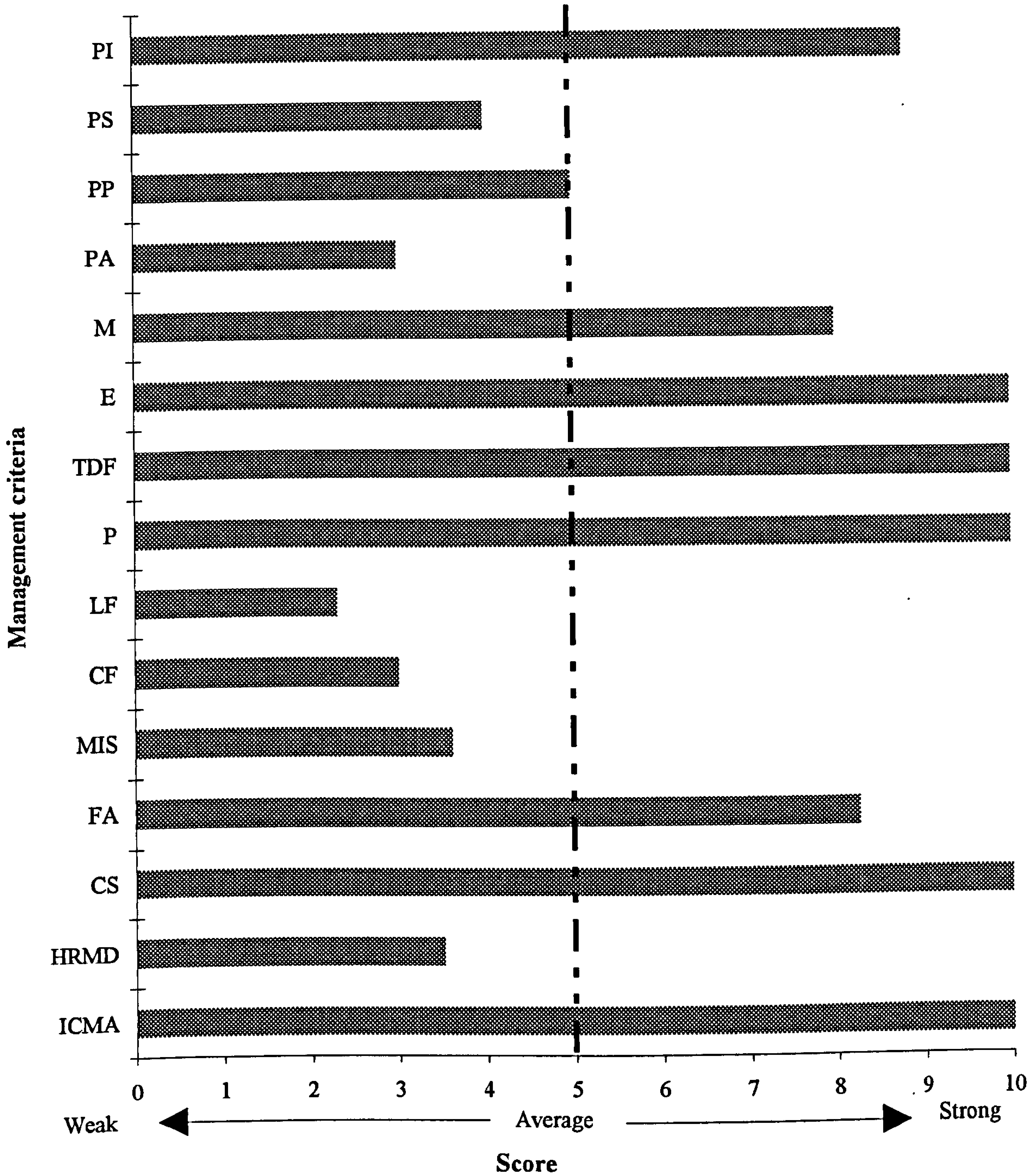


Figure 8.2 Summary profile on research management performance of UPASI

(PI= Problem identification, PS= Priority setting, PP= Project preparation, PA= Project appraisal, M= Monitoring, E= Evaluation, P= Publications, LF= Library facilities, CF= Computer facilities, MIS= Management information systems, FA= Funding arrangements and income generating activities, CS= Committee system, HRMD= Human resource management and development, ICMA= Internal communication and management approach.)

8.3 CASE STUDIES ON BANGLADESH TEA RESEARCH INSTITURE (BTRI)

This is the third of the case studies grouped under ***Phase Two***.

8.3.1 TEA AND TEA RESEARCH IN BANGLADESH

Tea plays an important role in the national economy of Bangladesh by earning valuable foreign exchange and providing employment. At present it is the second largest foreign exchange earner in agricultural sector. A total of 110,000 permanent workers and 20,000 part time workers are dependent on the industry for their livelihood. In addition about 10,000 employees are working in different tea concerns including garden management staff and tea traders (Alam, 1992a).

Cultivation of tea in Bangladesh dates back to 1840. However, the commercial cultivation started in 1854 (Rashid, 1987; Chowdury, 1990). Currently Bangladesh produces 31914 metric tons of made tea over an area of 47888 ha. (ITC, 1994). In comparison to other tea growing countries of the world, its position is eighth in respect of production and seventh in respect of area. But it occupies eighth position in the world tea market, in respect of export (Table 8.6).

8.3.2 MANDATE AND ORGANISATION

As described in the Tea Enquiry Committee report (1968), the mandate of BTRI is "to investigate and solve various problems connected with the growing and manufacturing of tea and, thus to place the tea industry on a sound scientific footing"(Hussain, 1968).

The industry is an extension of North East Indian tea. Hence, till 1947, it received scientific support from the Tocklai Experimental Station, Assam India (Alam, 1992a). After the creation of Pakistan, the Central Government (under the Ministry of Commerce in its 5th meeting) in 1952 adopted a resolution to create a separate tea research station for its own industry. Later, in 1957 Pakistan Tea Research Station (PTRS) was established at Srimangal. It started functioning in the same year from 28th February. In 1971 after the independence of Bangladesh (erstwhile East Pakistan), PTRS was renamed as Bangladesh Tea Research Station (BTRS). Later in 1973 (BTB, 1986) it became a research Institute and named as Bangladesh Tea Research Institute (BTRI).

BTRI has the responsibility of carrying out research and transferring of technology to the tea industry. Since its establishment, it has earned a level of moderate reputation and respect for research. Its research programme is mainly applied and adaptive in nature. Besides research, it has the responsibility of imparting training to the planters, field and factory supervisory staff on different aspects of scientific tea culture. Currently research is organised into following eight divisions:

- Advisory;
- Agronomy;
- Botany;
- Biochemistry;
- Soil chemistry;
- Pest management;
- Statistics and Economics; and
- Technology.

The Director is the administrative head of the organisation, reporting to the member R & D of Bangladesh Tea Board. Besides research divisions there is a large support service. The support service consists of administration, accounts and stores and medical. Administration and accounts helps the Director in day to day administrative and financial affairs, and medical looks after the medicare of Institute's staff members. All together there are 182 staff members of which 42 are scientists (Alam, 1992a).

BTRI is the research organ of Bangladesh Tea Board (BTB) which has the overall responsibility for the development of Bangladesh tea. Like other tea research Institutes of the world, it does not have a separate Board of Management. It is managed by the BTB, which is under the Ministry of Commerce, Government of the Bangladesh. The BTB is managed by an 11 member Board Committee, of which, there are:

- three permanent members from BTB (the Chairman of BTB, and two members: member finance and trade and member research and development);
- representatives of Tea Traders Association of Bangladesh (TTAB);
- Bangladeshio Cha Sangshad (BCS) which is the association for Bangladesh tea producers;
- representatives of tea industry owners;
- Chief Conservator of Forest; and,
- Divisional Commissioner of the Chittagong.

The Chairman of BTB is the Chairman of the Management Board. The board meetings are held in each month. Main function of the board is to formulate broad based strategic guidelines for smooth running of the BTB.

Analysis and recommendation on the research management systems of BTRI would not be justified without some discussion on the Bangladesh Tea Rehabilitation Project, because it has influenced tea research and the tea industry substantially.

8.3.3 BANGLADESH TEA REHABILITATION PROJECT (BTRP)

During early 1970s Pell Mission carried out a number of in-depth studies on the Bangladesh tea industry, and suggested ways and means to develop it. But there was little or no follow-up of these reports, primarily because of financial limitations and absence of co-ordinating bodies with necessary specialised expertise (DMC, 1979). However in April 1977, agreement was reached between the Government of Bangladesh and the UK Overseas Development Administration (ODA) for implementation of the Bangladesh Tea Rehabilitation Project. The BTB was the implementing agency on Bangladesh side. Following the agreement, ODA engaged Duncan Macneill and Company limited (DMC) as consultant to the BTB (Clayton, 1983). DMC was given the responsibility to initiate and thereafter to supervise and co-ordinate the project initially for a period of three years. Initiation of the project has created a new environment both in research and the industry.

During the first phase of the project, a Project Development Unit (PDU) was established to act as the executive arm of the BTB. Chaudhury (1983), and Carr (1988), reported that PDU had grown out of the Development division of BTRI, which was renamed as the Advisory Division. One of the most experienced persons of the Institute, who was heading the Advisory Division, was transferred to the newly created PDU as the Director. This disrupted the existing advisory service of BTRI. In addition to the Director, he was still holding the post of chief of the Advisory Division.

Murdoch (1980) reported that because of staff shortage and the secondment of its scientists to the consultants, planters were not getting the service of BTRI, for which they paid in the form of cess. In addition, five of the senior staff members of BTRI were nominated by the BTB as counterpart to the consultants. Islam (1981) reported that criticising the role of BTRI, this is the first adverse comments made by the industry regarding the performance of BTRI. The situation was characterised by the following factors:

- there was a chronic staff shortage;
- normal activities of the BTRI were severely affected, because of giving service to the PDU as counterpart consultants;
- transfer of head of Advisory to PDU created a big gap and disrupted the existing advisory service rendered to the industry; and,
- instead of promoting or appointing suitable personnel as head of Advisory department, the Director, PDU was allowed to continue as the in-charge of the Advisory.

Later, in a report to the ODA, Hainsworth (1983), severely criticised the Advisory activities of the BTRI. As an interim measure, it was suggested to transfer the advisory function to the PDU. In the same report, he further mentioned that, after the end of the project period, PDU would continue as an Advisory and extension service of BTRI, when consultants handed over their responsibility to the PDU.

Hainsworth (1983) suggested transfer of advisory service to the PDU, mainly to obtain the service of the most senior advisory personnel of BTRI, who had been transferred to the PDU. The process has hindered due to the resignation of the Director PDU (Carr, 1988). By the same token, the resignation has also created another gap at the PDU, because no other experienced people were available to replace the Director, particularly to look after the advisory functions effectively. BTRI had carried out the function since the inception of the Institute, which was valued highly by the industry prior to the start of BTRP. For example, in recognition of the contributions made by the Institute, a group of 4 scientists were jointly awarded gold medal and cash money which is known as "Zebunnessa and Kazi Mahbubullah Trust Award" in 1979. One year later, (1980) one of the ex-Director's of BTRI was awarded "Independence Day

Award" for valuable contribution in science and technology and tea in particular.

In the 1970s and 80s, Bangladeshio Cha Sangshad (BCS) has highly praised the role of research and its contributions to the industry (Cuthil, 1962; Mazumder, 1965; Uddin, 1970; Chowdhury, 1974; Hussain, 1976 and Chowdhury, 1979). Referring to the role of BTRI to the industry, the Commonwealth Development Corporation (1973), reported that the research work undertaken at the Institute was of high standard, mainly because of the realistic nature of research programme, which was highly relevant to the industry needs. In addition, it argued that it was the research station, which provided the background information for the rehabilitation and replanting programmes, particularly pest-disease and clonal planting materials. Hainsworth (1978) has appreciated BTRI, describing the research Institute as a practical, efficient and hard working unit. Mannan and Dawson (1980) carried out a review of the BTRI research programmes, facilities and resources with respect to how the Institute relates to national research network. They highly appreciated the performance of BTRI. In addition, they reported, a valid index for successful past programme performance is the degree of newly generated technology being adopted by producers. In this respect BTRI has achieved considerable success and in this regard is a credit to research, training on tea plantation projects. Visits to various tea gardens in the area confirmed the excellent efforts made by scientists and particularly the BTRI advisory section to validate technology under farm conditions. They further added that the two way flow of information between scientists and plantation managers as practised at BTRI provide a model to other research Institutes.

Islam (1981), carried out a study to quantify the benefits of tea research to the industry. The study used 24 years (1957-80) total investment on BTRI, and measured the benefit of some of the services rendered by BTRI to the tea estates. One such service was advice given by the Institute for the said period. He calculated the benefit in terms of cost reduction and yield increase. The study showed that advice alone gave a benefit 6 times higher than the total investment on BTRI over the period. The same study further showed that on fertiliser, the total cost saving out of research recommendation in a single division for 10 years alone, was more than the total investment on BTRI for 27 years. The study concluded that cumulated cost savings of fertiliser recommendation will undoubtedly become an appreciable one. One plain conclusion may be drawn that BTRI is undertaking commendable research

The function of PDU was to help draw up estate development plans, to supervise implementation, to monitor progress and to approve payments from ODA and European Economic Community (EEC) funds. Subsequently, following in part the recommendations of Hainsworth (1983), responsibility for advice and training was transferred to the PDU. This was a deviation from the original project proposal. However, BTRI still continued its advisory and training roles which it had been doing since the inception of the Institute. Carr (1988) reported that because of overlapping function between BTRI and PDU, particularly in advisory and training activities, animosity resulted between the two organisation. In addition, some of the contradictory advice went to the industry from PDU mainly due to lack of communication, between research and PDU.

Carr (1988) further reported that some of the PDU staff had little respect for quality and relevance of research work at BTRI. In addition, PDU staff had expressed doubt in the ability of scientists to communicate the results to the industry in an effective way. Such a situation clearly indicated that there was lack of trust, mutual respect and confidence between the two organisations. Because of overlapping functions two empires developed along side one the BTRI and the industry which has reflected in the analysis. Realising the consequence, BTB wanted to merge the two organisations to improve chain of command and facilitate better service to the industry. Three different studies (Carr, 1988; Mould, 1991 and Shaikh; 1991) were carried out to find ways and means to integrate two organisation under unified command. All three studies concluded that the two organisations should be merged together to be able to serve the industry better. In addition, Shaikh (1991) argued that training activities should be placed under the Advisory and extension service division of the newly proposed organisation. Such arrangement would offer a far reaching positive contribution to the tea industry. The above analysis clearly indicates that the BTRP design has not had the intended positive effect on the BTRI and industry. Rather it has widened the gap of linkages between research and the industry. However, to-date nothing has happened regarding the unification of two organisations, and the situation remains fragmented.

Analysis on research management activities of BTRI is presented below. Using the criteria for assessing the performance of tea research management, the profile for BTRI was compiled (Tables 8.3a-8.3c) elements of which are discussed below in detail.

8.3.4 PROBLEM IDENTIFICATION (PI)

Like other tea research organisations of the world, there is no formal system for obtaining industry feedback. As a result, there is limited contact with the industry. However, evaluated score is 3.25, which indicates that PI is of an ***average*** nature (Table 8.3a). The Institute practices BP 1, which is, obtaining information for PI through request from the industry regarding problems through correspondence and personal contacts. In addition the following BPs are considered partially (Table 7.1 and 7.2). PI is based on information from:

Table 8.3a Research management performance profile on BTRI

Problem identification (Table 7.1)							Total score	Assess-ment
Best practices audit	1	2	3	4	5	6		
Allotted score	1	1	1	2.5	2	2.5		
Level of implementation	Y	P	P	P	N	N		
Achieved score	1	0.5	0.5	1.25	0	0	3.25	Average
Priority setting and resource allocation (Table 7.3)								
Best practices audit	1	2	3	4				
Allotted score	2	2	2	4				
Level of implementation	P	P	P	N				
Achieved score	1	1	1	0			3	Weak
Project preparation (Table 7.5)								
Best practices audit	1	2	3	4	5	6		
Allotted score	1	1.5	2.5	2	2	1		
Level of implementation	Y	P	Y	P	N	N		
Achieved score	1	0.75	2.5	1	0	0	5.25	Average
Project appraisal (Table 7.7)								
Best practices audit	1	2	3	4	5			
Allotted score	1.5	3	3	1.5	1			
Level of implementation	P	N	P	P	N			
Achieved score	0.75	0	1.5	0.75	0		3	Weak
Monitoring (Table 7.9)								
Best practices audit	1	2	3	4				
Allotted score	2	3	3	2				
Level of implementation on	Y	P	Y	N				
Achieved score	2	1.5	3	0			6.5	Average

- 2: advisory and extension officers;
- 3: scientists following routine advisory visits; and,
- 4: workshops and seminars involving clients and discussions during demonstrations and training.

However, the following two important BPs are not practised:

- 5: information from regional, zonal, local stations or sub-stations; and,
- 6: information from different management committees, sub-committees, and technical committees which involve clients

Analysis of PI reflects the findings of other external reviews on BTRI. For example, Hainsworth (1983), Carr (1988) criticised the research programme on its relevance to the industry's requirement, which signifies the problem of limited contact. Later, Mould (1991) reported similar weakness in the research programmes. He further reported that insufficient contact has resulted in a lack of responsiveness to the needs of and accountability to the industry. Guidance from and interactions with the committees (RPSC and RPC) is weak.

8.3. 5 PRIORITY SETTING AND RESOURCE ALLOCATION (PSRA)

This is ***weak*** because achieved score against PSRA is 3 (Table 8.3a). One of the main reasons for such weakness is that there is no formal system of setting priorities. In addition, ineffective and weak committee culture is another prime reason of such weakness. Criticising the priority setting, South East Asia Development Divison (1991) reported that in setting priorities, industry has not been involved. Researchers themselves decide on research priorities based on limited personal contact during routine or request visits, formal interactions during annual short course or training during certificate modules. Nevertheless, the following BPs (Table 7.3 and 7.4) are partially practised by the Institute:

- BP 1: considering the relative importance of the problem based on information obtained through the system specified for problem identification (Table 7.1);
- BP 2: considering resource availability in light of the project requirement; and,
- BP 3: considering the probability of project success and anticipate constraints.

But the Institute does not follow BP 4, which involves systematic approaches such as checklists or scoring methods.

8.3.6 PROJECT PREPARATION (PP)

The achieved score is 5.25 (Table 8.3a), which indicate that PP is of an *average* nature. The Institute practices the following BPs (Table 7.5 and 7.6) in full. Prepared projects have:

- BP 1: clearly defined objectives; and,
- BP 3: a plan of work (methodology) and time schedule including: experimental site specification, statistical design, nature (root, shoot, leaf, soil analysis, biochemical analysis, insect or pest incidence, topographical or meteorological data), interval of data collection, analytical methods to be used which are appropriate to achieve the objectives.

However, for PP the following BPs are practised in partial by the Institute, such as:

- BP 2: PP including statement of the problem with all pertinent data and information which signifies the importance of the research; and,
- BP 4: PP with indication of all inputs required for the project, such as: human resource with particular skill needed, financial resources with realistic cost and budgets, other physical resources.

But the Institute does not consider following two BPs during PP:

- BP 5: indication on monitoring techniques and reporting style of analytical results, type and parameters of evaluation techniques; and,

- BP 6: indication of expected results and anticipated constraints.

8.3.7 APPRAISAL OF RESEARCH PROJECTS

This is *weak* because, evaluated score is 3 (Table 8.3a). None of the BPs are followed in full (Table 7.7 and 7.8). The Institute practices following BPs partially:

- BP 1: to assess the importance of research problems according to the criteria specified for problem identification (Table 7.1);
- BP 3: to consider the suitability of methodology, time schedule, work plans, cost estimates and resource availability for specified objectives; and,
- BP 4: activities on likely benefit which could be achieved by individual research projects.

Further, the Institute does not practice BP 2, which refers to the different systematic procedures specified under priority setting (Table 7.3), and BP 5, which considers probability of success and anticipated constraints.

In addition, during the preparation stage of research projects, availability of resources is not given due consideration. Consequently, at some stage, implementation of some of the ongoing projects are hampered.

8.3.8 MONITORING

Achieved score against monitoring is 6.5 (Table 8. 3a), which indicate that this is *average* nature. The Institute practices the following BPs (Table 7.9 and 7.10) in full:

- BP 1: projects have work plan and time schedule; and,

BP 3: monitoring plan include the nature (qualitative / quantitative) of data collection, number and interval of reporting.

In addition the Institute partially considers BP 2, which is the monitoring plan including all the pertinent data requirements (acquisition and allocation of physical resources, budget specification and allocation of financial resources, specification and allocation of human resources). However, the Institute does not practice BP 4. It does not specify report preparation from data analysis, nor required that results are transmitted to the relevant management authority comparing achievements with targets and highlighting bottlenecks

There is a reporting system where by each divisional head prepares a monthly report, based on the data collected and analysed for the reporting period. The style of reporting needs improvements, particularly with an indication of result trend. Besides the monthly reports, each division prepares a quarterly report for submission to the RPSC meetings. The style and standard of reporting should be improved by inclusion of specific results and their trends.

8.3.9 RESEARCH PROJECTS OR PROGRAMME EVALUATION

This is ***average*** because evaluated score is 3.5 (Table 8.3b). The Institute practices following BPs (Table 7.11 and 7.12) partially:

- BP 1: evaluation through seminars, workshops, peer review, demonstrations;
- BP 2: regular system of external evaluation involving clients through seminars, workshops, peer review, demonstrations; and,
- BP 4: system of publications to disseminate research findings through: annual reports, journals, memorandums, technical reports, advisory bulletins and circulars.

However, the Institute does not practice BP 3. It does not hold international seminars involving clients and the wider scientific community. The major weaknesses of the evaluation process are described below:

Internal evaluation: there is no system of regular monthly seminars, heads of research divisions meetings, regular annual technical conference involving scientists of the Institute to review research programmes. Before commencing

Table 8.3b. Research management performance profile on BTRI

Evaluation (Tale 7.11)										Total score	Assess-ment
Best practices audit	1	2	3	4							
Allotted score	1	2.5	3	3.5							
Level of implementation	P	P	N	P							
Achieved score	0.5	1.25	0	1.75						3.5	Average
Technology dissemination and feedback (Table 7.13)											
Best practices audit	1	2	3	4	5	6	7	8	9		
Allotted score	0.75	0.75	1	1	1	2	1	1	1.5		
Level of implementation	Y	P	P	Y	P	P	N	Y	N		
Achieved score	0.75	0.375	0.5	1	0.5	1	0	1	0	5.13	Average
Publications (Table 7.15)											
Best practices audit	1	2	3	4	5	6	7				
Allotted score	1	0.5	2	2	2	1.5	1				
Level of implementation	Y	Y	Y	N	N	N	N				
Achieved score	1	0.5	2	0	0	0	0			3.5	Average
Library facilities (Table 7.17)											
Best practices audit	1	2	3	4	5						
Allotted score	1.25	1.25	2.5	3	2						
Level of implementation	Y	Y	N	N	N						
Achieved score	1.25	1.25	0	0	0					2.5	Weak
Computer facilities (Table 7.19)											
Best practices audit	1	2	3	4	5						
Allotted scores	2	2	2	2	2						
Level of implementation	Y	P	N	N	N						
Achieved score	2	1	0	0	0					3	Weak

RPC and RPSC meetings, the Director and divisional heads prepare their reports and discuss between themselves. The system is weak because of a lack of proper review.

Evaluation by the industry: is of average nature because the only means of evaluation by the industry is through RPSC and RPC. But RPSC and RSC meet for a duration of three to four hours, which seems insufficient to review and analyse in detail the evaluations of research programmes. Their activities (RPC and RPSC) mainly concern the finalisation of current research projects.

In addition, there is no system of annual conference or symposium, like other tea research organisations of the world.

Evaluation by the wider scientific community: there is no system of organising seminars or conferences involving the scientific community inside or outside the country.

8.3. 10 TECHNOLOGY DIFFUSION AND FEEDBACK (TDF)

This is *average* because evaluated score is 5.13 (Table 8.3b). The Institute applies the following BPs (Table 7.13 and 7.14) in full:

- BP 1: there are experimental farm and demonstration plots at the main centre;
- BP 4: there are systems of visiting clients on request by scientist and advisory officers; and,
- BP 8: there are systems of formal training to the client group, organising seminars, workshops and arranging demonstrations to disseminate technologies.

In addition the Institute applies the following BPs partially:

- BP 2: the system of routine advisory visits by scientists and advisory officers;

- BP 3: the system of forecasting routine visits of advisory officers and scientists to the industry;
- BP 5: there are no formal fora where advisory officers and scientists can meet and discuss clients problems; and,
- BP 6: role of zonal, regional and local sub-stations in TDF.

But the Institute does not have the following two BPs in place for TDF:

- BP 7: any formal body (committee) to obtain area information regarding clients problems and constraints on technology adoption; and,
- BP 9: systems of monitoring adoption of advisory recommendations and follow-up of visits.

The situation at BTRI is quite different from other tea research Institutes studied. Therefore, a detailed description of the TDF systems and process are essential, which is given below.

In every organisation, there is a separate advisory and extension division responsible for technology dissemination to the clients. At BTRI there is a small Advisory Division. Dissemination of technology is mainly done by the scientists who are carrying out the research. This might be one of the reasons why Advisory Division has not developed and kept pace with other divisions. In addition, the other important reason may be differences in the structure of the industry. For example, unlike other tea growing countries of the world (India, Kenya, Malawi, Indonesia, China, Uganda) there is no smallholding tea cultivation in Bangladesh, where motivation and transfer of new technology is a critical factor and require extra thrust. The industry is characterised by the estate sector, which is fairly well organised.

Routine visits are one of the primary means of direct interaction with the scientists and planters. Visits are carried out every month. A fixed number of gardens are selected from each valley representing different management groups. Programmes are prepared in consultation with the Advisory Division and are circulated to the concerned gardens well advance. Accordingly, two senior scientists visit the gardens and advice is given on current problems which are observed in the garden.

Request visits are another means of direct contact between the industry and the Institute. When any problems are faced by gardens they inform BTRI. Scientists from related disciplines investigate the problem and suggest accordingly. In some cases laboratory investigation is carried out. Later, findings and specific control measures or recommendations for corrective action are sent to the relevant garden.

Special visits are made if a particular problem is observed over a large area or a region. A group of scientists including the Director of the Institute visit the area and make a detailed investigation to find out the cause and its remedies. During such investigations, help from other agencies is sometimes sought, for example from Dhaka University or the Agricultural University.

An annual short course: consisting of a 6 day course on 'Tea culture' has been held regularly at BTRI since 1965. All research divisions prepare lecture materials and participate in the course. It is a combination of both theory and practice. During the morning sessions, theoretical aspects of individual disciplines are discussed, while in the afternoon session there is a practice of what has been discussed in the morning session followed by a summing up discussion. The course is mainly designed to acquaint the participants on the basic principles of tea husbandry with the integration of recent findings. Though the course has been targeted for newly recruited Assistant managers, nevertheless, senior industry people can also refresh their knowledge. On the concluding day, there is a long open discussion session, where participants can raise any issue pertinent to tea culture. After discussion, opinion and suggestions are recorded for future planning of the course. Also if important questions arise which need research, these are duly taken into account for future research planning. The course serves as a good linkage and feedback for the industry.

Training: there is a Tea Management Certificate course, run jointly by the Project Development Unit of BTB and Bangladesh Management Development Centre (BMDC). This is a 600 hour course spread over 2 years period. Course is divided into 12 modules, of which 8 modules are run by BTRI. It is another forum where scientists directly interact with industry and obtain their views and ideas regarding industry problems.

Experimental Sub-station net work for zonal adaptability trials: there are three Sub-stations and one Experimental Farm. The latter is well managed and its facilities are good. The Director of the Institute frequently visits the farm. Besides representatives of almost all the research divisions who have their research projects visit the farm regularly in connection with supervision and data collection. But facilities at Sub-stations are very poor, for example, Alam (1992b) reported that Institute's Sub-stations have dire scarcity of staff and infrastructure for which technology transfer and feedback could not be effected properly. Further he suggested that interactions and feedback with the industry need to be improved through strengthening the Sub-stations.

8.3 11 PUBLICATIONS

Systems are ***weak*** because evaluated score is 3 (Table 8.3b). The Institute practices the following BPs in full (Table 7.15 and 7.16):

The Institute disseminates its findings to the clients through following publications:

- BP 1: journals;
- BP 2: monthly, quarterly and annual technical reports; and,
- BP 3: circulars and pamphlets.

However, the Institute does not have some of the important BPs in place, such as:

- BP 4: publications of bulletins forecasting future important regular activities that need to be carried out by the industry;
- BP 5: publications of popular articles in local languages for easy understanding;
- BP 6: publications of research findings to the international journals; and,
- BP 7: publications of BP 1 to 3 are not regular and in time.

The following are the publications used to disseminate technologies from the Institute to clients :

- Tea journals of Bangladesh. This is a biannual scientific journal;
- Annual reports, which highlight the current position of all the ongoing research projects; and,
- Advisory circulars and pamphlets. There is a backlog in case of the annual report and publication of journals.

8.3 12 LIBRARY

Recently the library has been up graded. Physical facilities have been improved with moderate increase in number of text books through a project grant from BARC. Yet the facility is poor, particularly in respect of journal holdings. It is unfortunate that the library does not even have the regular issues of tea journals published from the neighbouring countries. Without access to the current information on research of other tea Institutes and allied crops, there will always be chance of repetition of same work, and wastage of resources (Hainsworth, 1983; Carr, 1988). SEADD (1991) argue that, because of weak library facilities, productivity of its staff members are reduced.

The evaluated score against the criteria library facility is 2.5 which indicates that the library facility is ***weak*** (Table 8.3b). The following BPs are in place (Table 7.17 and 7.18):

- BP 1: text books related with tea culture; and,
- BP 2: other text books on allied crops.

But the Institute does not have some important BPs in place, such as:

- BP 3: subscription to journals related to tea research of other countries;
- BP 4: subscription to one or two abstract journals; and,
- BP 5: borrowing books and journals from other libraries within the country and out side the country

8.3.13 COMPUTER FACILITIES

This is ***weak*** because evaluated score is 3 (Table 8.3b). The Institute has BP 1 (Table 7.19 and 7.20), which is a minimum of one computer for each working unit or a centrally controlled facility accessible to all working unit on a rota basis. In addition it has BP 2 partially in place, which is regular supply of computing accessories. However, the Institute does not have following BPs in place:

- BP 3: trained people for maintenance of computers;
- BP 4: recent versions of selected software; and,
- BP 5: upgrading facilities of different component of computers.

8.3.14 MANAGEMENT INFORMATION SYSTEM (MIS)

Evaluated score against MIS is 5.5 (Table 8.3c), which indicates that it is ***Average***. The following BPs (Table 7.21 and 7.22) are practised at BTRI in full:

- BP 1: system of keeping data on financial resources (budgets and expenditures) and utilisation, physical resources, human resources;

- BP 2: information on human resource management and development, particularly the training aspects; and,
- BP 4: industry data on different types of management, area under different management category, specific problems faced by individual management.

In addition, BP 3, which refers to information on industry details such as total area, area under cultivation, area under different plant types, area facing specific problems, meteorological data on different regions, data on soil nutrition profile, pest and disease status are maintained partially. However, BP 5, which refers to data and information on the rate of uptake of technology, constraints that affect the rate of uptake of technology, and on agro-ecological region specific needs, are not in place.

8.3.15 FUNDING ARRANGEMENTS AND INCOME GENERATING ACTIVITIES

This is ***average*** because the achieved level of score against the BPs are 6.6 (Table 8.3c). The Institute has the following BPs (Table 7.23 and 7.24) in place:

- BP 1: obtaining funds from the clients / industry; and,
- BP 4: facility to generate own income;

In addition following BPs are partially in place:

- BP 5: system of obtaining funds from the donors; and,
- BP 6: system of obtaining funds from central agricultural research council;

However, BP 2, which is obtaining funds from the Government and BP 3, which is system of obtaining special subscription from clients other than the regular subscription, are not practised.

The main source of funding for the BTB and the BTRI is the cess money collected from the industry. BTB collects the cess @ 1% of sale price per kilogram of made tea. About 250 million taka is collected through cess money. The cess money collected is insufficient to fund the activities of BTB. Total

Table 8.3c. Research management performance profile on BTRI

Management information system (Table 7.21)							Total score	Assess-ment
Best practices audit	1	2	3	4	5			
Allotted score	1.5	1.25	3	1.25	3			
Level of implementation	Y	Y	P	Y	N			
Achieved score	1.5	1.25	1.5	1.25	0		5.5	Average
Funding arrangement and income generating activities (Table 7.23)								
Best practices audit	1	2	3	4	5	6		
Allotted score	3	1	1	2.25	1.25	1.5		
Level of implementation	Y	N	N	Y	P	P		
Achieved score	3	0	0	2.25	0.625	0.75	6.6	Average
Committee system (guidance and interactions from different management committees) (Table 7.25)								
Best practices audit	1	2	3	4	5			
Allotted score	1	2	2.5	2.5	2			
Level of implementation	P	Y	N	N	N			
Achieved score	0.5	2	0	0	0		2.5	Weak
Human resource management and development (Table 7.27)								
Best practices audit	1	2	3	4				
Allotted score	2	2	3	3				
Level of implementation	N	Y	N	Y				
Achieved score	0	2	0	3			5	Average
Internal communication and management approach (Table 7.29)								
Best practices audit	1	2	3	4	5			
Allotted score	2	3.5	1.5	1.5	1.5			
Level of implementation	Y	Y	Y	N	P			
Achieved score	2	3.5	1.5	0	0.75		7.75	Strong

budget for BTB including BTRI and Project development unit (PDU) is about double the revenue from cess. Yet its funding is strong, because:

a) BTB generates internal revenue from two large tea estates that are commercially managed.

b) BTRI generates internal revenue in the following ways:

- sales of made tea produced in the experimental farm, which is processed in the experimental factory;
- sales of green leaf produced at different Sub-stations;
- collection of fees against screening of different agrochemicals and soil analysis;
- sales of fresh, rooted clonal cutting and nursery plants; and,
- sales of published materials.

Internal revenue collected by BTRI alone is about half of the yearly budget requirements.

c) Reserve funds: income in the form of interest.

d) Other sources: income from permanent infrastructure in the form of rents.

Overall funding position of BTB is consistent and satisfactory. Though the BTB collects cess from the industry, there is no pre-condition that a fixed % of the collected cess money will be spent on research.

8.3.16 COMMITTEE SYSTEM (INTERACTIONS AND GUIDANCE)

This is *weak* because most of the BPs are not practised by the BTRI, for which evaluated score is 2.5 (Table 8.3c). However, only BP 2 (Table 7.25 and 7.26), which refers to different technical committees consisting of clients and subject specialists to help the Director in different research management activities is in place. BP 1, which is a Management Board with client's representatives to formulate policies and strategies is partially in place. The Management Board mainly formulate strategies and policies for BTB, which is the controlling authority of the BTRI. In practice, however, the present Board hardly formulates any guidelines to help the research management functions of the research process.

The different committees which help BTRI in research management are described below. Though the Institute started functioning about 40 years ago, it has not been able to develop a strong committee culture of its own. Nevertheless, there are two committees which help the Director in the planning, formulation, evaluation and management of research programmes:

- Research Production Committee (RPC); and
- Research and Production Sub-committee (RPSC).

Research Production Committee : RPC was formed in 1958. It is a high powered committee, headed by the Chairman of BTB. At present the committee consists of 22 members from the following sectors:

- University professors;
- senior research scientists from different research organisations of the country;
- experienced and senior tea planters; and
- representatives from the tea trade.

It has the following responsibility (Rashid, 1986a):

- to formulate the research programme of the Institute;
- to consider the priority of any particular field of research;
- to consider ways and means of assisting the proprietary tea estates in improving the production of their gardens; and,
- generally to consider such measures as would be in the interest of the industry.

This committee sits twice a year. Along with other activities, it evaluates the innovated technology. When any technology is ready for recommendation to the industry, it is done so only after the approval of this committee.

Research and Production Sub-committee was formed by BTB in 1962. At present it is a 19 member committee with a good level of representation from the industry. It consists of:

- Circle Chairman of seven Valley Circles of the industry;
- Director BTRI and Director Project Development Unit (PDU);
- heads of research divisions;
- some experienced planters (appointed by the Director in consultation with the BTB); and,
- University professors (as subject specialists).

Prime objectives of this committee is to help the Institute to:

- develop and approve industry need based research programme;
- identify the industry needs, monitor and feedback constraints in technology adoption; and,
- evaluate the research activities.

The Director of the Institute is the Chairman of this committee. Divisional heads draw out their research programmes, and place the same to the Director. The Director after thorough scrutiny, places recommendations to the RPSC. On the approval of the RPSC, proposals are then placed to the RPC for final approval. RPSC sits at least three times a year. At the beginning of the year, the committee evaluates the activities of the past year, and considers whether research results should be released to the clients for use, in which case recommendation is to the higher committee RPC. RPSC also evaluates the progress of current research projects.

The case studies have indicated that the organisations which have a strong committee system also have better linkage and feedback with the industry. The more strong and active are the different committees, the better is the research management, particularly problem identification, priority setting, evaluation, technology dissemination, monitoring of the technology adoption and its constraints. In principle, the research committees (RPC & RPSC) are supposed to help and guide R & D activities of the Institute, serving the interests of the industry. In practice, however, there is often ineffective interaction and guidance from RPSC as well as RPC. For example, Carr (1988), reported that the committee structure does not function well. BTRI seen to be responsible to the BTB and not to the industry. Furthermore, he reported that there is small influence of industry on BTB. Later, Mould (1991) expressed similar views. In addition he reported that RPC meets too infrequently for effective interactions, help and guidance for research management activities.

Valley Scientific Committees (VSCs): the tea area of Bangladesh has been divided into 7 valley circles partially depending on agro-climatic similarities and for administrative convenience. In each valley, there is a Valley Scientific Committee. The purpose of the committees are to facilitate close interaction and direct linkages to obtain:

- feedback on industry needs for identifying problems, setting priorities and help in technology dissemination;
- monitoring of technology adoption and feedback its constraints; and,
- identification and appraisal of specific problems.

VSC are responsible for organising seminars, workshops, opendays, group discussions and field visits on different topics based on their area specific needs. The scientists from the Institute participate and provide technical expertise. Potentially it could be one of the most effective fora where close linkage between research and industry, could occur. Thus the Institute could obtain the industry feedback. However, the VSCs do not make an impact because they function irregularly and are not sufficiently active. Another prime reason is lack of co-ordination between VSCs and the Institute. In addition, the Chairman of VSC who has the responsibility to organise the activities can not do this because of communication constraints, particularly transport facilities.

8.3.17 HUMAN RESOURCE MANAGEMENT AND DEVELOPMENT (HRMD)

This is *average* in nature because achieved score against the BPs is 5 (Table 8.3c). The Institute practices the following BPs in full (Table 7.27 and 7.28):

- BP 2: there is a clear and specific recruitment and selection policy at the Institute; and,
- BP 4: the Institute has training systems to develop the potential skills of individuals

However, BTRI does not practice following BPs:

- BP 1: strategic planning for HRMD including: demand forecasting, supply forecasting, forecasting requirements, action planning, budgeting and control (Table 7.27); and,
- BP 3: systems of performance management with performance review, potential review, performance improvement, career development programmes and reward review

However, in the perspective of HRMD, it is essential to consider views expressed by external reviews. For example, Carr (1988) reported that appraisal and reward system is weak. Seniority seems to be the prime criterion for promotion. Remuneration is poor in comparison with the industry which it serves. Scope of promotion is meagre, most of the scientists have worked in the same post for 10-15 years. In addition, in some of the departments, a few senior scientists are retired beyond retirement age. It is frustrating that proper steps are not taken to fill these posts with new recruitment or promotions. Scientists feel that the scope for promotion is meagre, while posts have been lying vacant for long time and the authority is not taking sufficient interest to recruit or promote suitable scientists into those posts.

Another weakness in the organisational structure is that there is no uniformity in structure (hierarchical position) among different departments. For example, in the Botany and Technology departments, the heads are Chief Scientific

Officers, while, in other cases departments have Principal Scientific Officers as heads of department. The Technology division, which is the biggest division in respect of number of employees; is suffering badly, because of a big gap in hierarchical structure. After Chief Scientific Officer, technical posts do not match with other departments. In the Biochemistry department, a Senior Scientific Officer is heading the department. The Pest management department, which is a combined department working on Entomology, Plant pathology, Nematology and Weedicides are headed by a Senior Scientific Officer. Though senior posts and suitable scientists in respective departments are available in some of these departments, authority is not taking measures to fill vacant posts. These circumstances are adversely affecting the productivity of research.

8.3.18 INTERNAL COMMUNICATION AND MANAGEMENT APPROACH

This is *strong* because, evaluated score is 7.75 (Table 8.3c). At BTRI following important BPs (Table 7.29 and 7.30) are practised in full:

- BP 1: internal communication is mainly done interpersonally with less emphasis on written forms except for rules and regulations;
- BP 2: management style is participatory (informal, loosely controlled, less hierarchical and bottom up approach); and,
- BP 3: there are systems of meeting with heads of research divisions to take their views in decision making.

In addition, BTRI partially considers BP 5 with respect to flexibility in procedures, rules and regulations. However, BTRI does not practice BP 4, which relates to the systems of meetings with the employees and top management to obtain emloyeede view in decidion manking.

The internal communication concerns relations between the Director, support service and technical staff: the relation between Director and staff is very informal and participatory. The Director has adopted an open door policy. Anybody can visit the Director at a convenient time and discuss pertinent questions. Nevertheless, there is opportunity for further improvements in the approach. For example, in all other tea research Institutes included under the case studies, the Director meets his technical staff specially in morning tea break. But in the TRFCA the Director meets his colleagues twice a day; once in the morning and once in the afternoon. In BTRI the relation between technical staff and support service (administration and accounts) is formal and fairly bureaucratic, which makes unnecessary delays in decision making.

Relation with the BTB is strongly bureaucratic. Though the Director is the organisational head, and responsible for day to day management of the Institute, he has not been given sufficient power to take decisions on some of the general as well as key issues. In addition, for about the last 4 years, there is no permanent Director at the Institute, which is run by the Director in-charge, which further limits decision making. Such an arrangement is one of the key constraints on effective R & D management and research productivity of BTRI. The Director has to seek the permission of the BTB, which is situated in Chittagong (about 225 km from the Institute). When any staff member of the Institute requires a decision he writes to the Director BTRI, and the Director sends his recommendations to the BTB. Again, there will be another processing, to obtain the required decision at the BTB. Thus the decision making process becomes very time consuming. Sometimes because of its internal workload BTB, may be unable to pay timely attention on the issues of BTRI, which further delays decision making. In addition, since the permission has to come from the BTB, it has to maintain similar records, which is a duplication of work, and leads to an unwilling wastage of resources.

8.3.19 USE OF IMPROVED TEA CULTIVARS

Total area under tea in Bangladesh is 47888 ha. and data were collected for 13490 ha. which is slightly more than 28% of the total planted area of tea. Analysis shows that out of 13490 ha. of tea, only 2123 ha. is under improved tea cultivars. This clearly indicates that the rate of uptake of improved tea cultivars is very poor in Bangladesh (Tables V.15-V.20 and Figure V.29-V.40). Such situation clearly indicates that extension activities are insufficient. Under this circumstance BTRI needs to put a great thrust through its advisory / extension for more use of improved tea cultivars among the estates in order to raise productivity.

8.3.20 CONCLUSION

Over all research management performance on BTRI is graphically presented in the Figure 8.3. This shows that internal communication and management approach is strong. However, problem identification, project preparation, monitoring, evaluation, management information systems, and funding arrangements and income generating activities are of average nature.

Research at BTRI is not attaining its full potential mainly because of following weakness in current research management systems:

- there has been no permanent Director for last 4 years, which is seriously affecting the management performance of the organisation. Measures need to be taken to fill up the post without delay;
- Tea Board policies are formulated and implemented under the guidance of the BTB Management Board, where BTRI does not have any direct representation. Unlike other tea research organisation in the world, the Director BTRI is not a member of the Management Board. Under such circumstance, there is sufficient ground to believe that it is difficult to represent fully the importance and technical impact of R & D at Board level;
- weak and ineffective committee culture has led to weak linkages with clients. Consequently there is weak problem identification, priority setting, evaluation and dissemination of technology and weak feedback;
- the best formal way of taking industry feedback and research needs is through the Valley Scientific Committee, which are not sufficiently active at present;

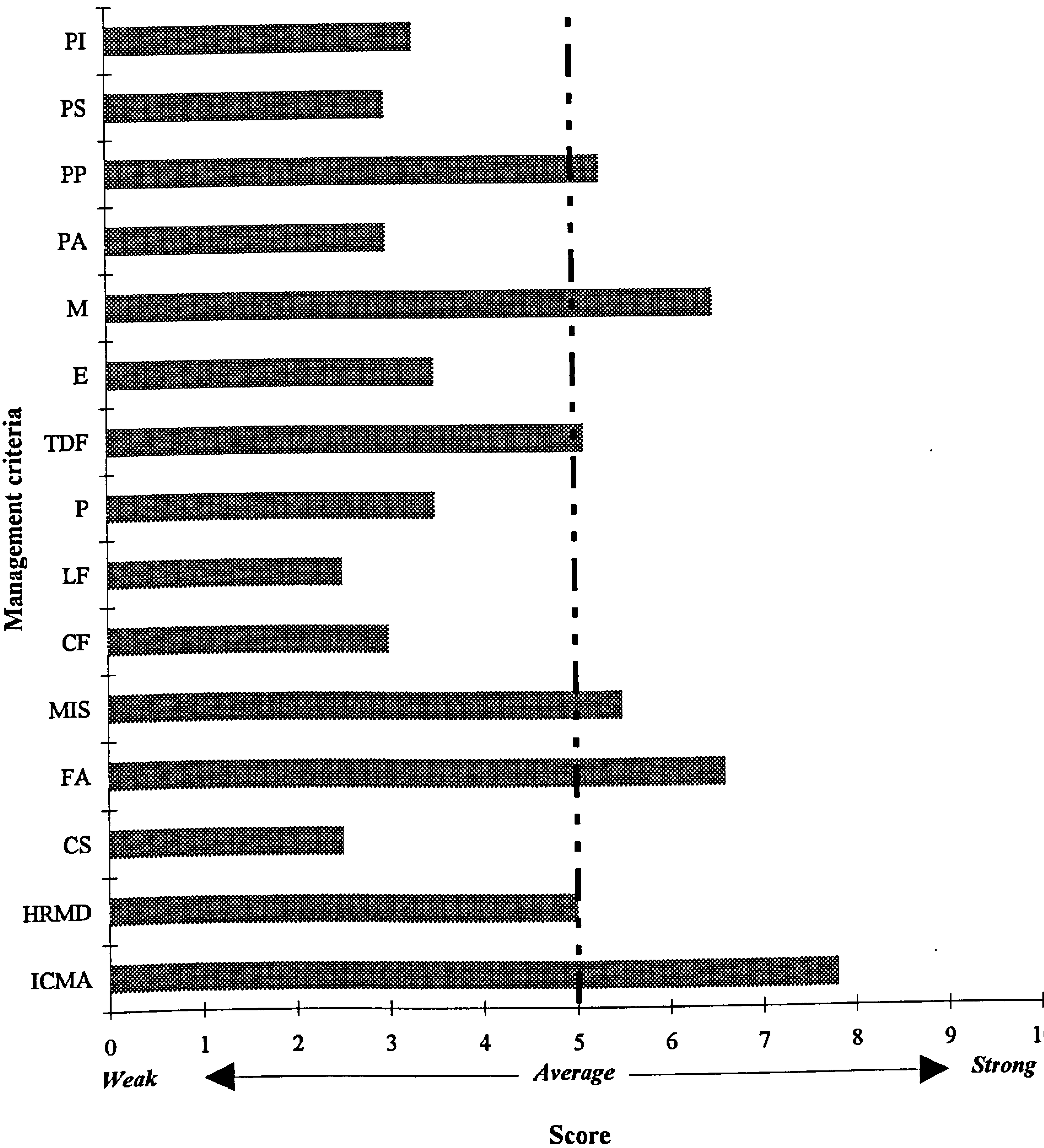


Figure 8.3 Summary profile on research management performance: BTRI

(PI= Problem identification, PS= Priority setting, PP= Project preparation, PA= Project appraisal, M= Monitoring, E= Evaluation, P= Publications, LF= Library facilities, CF= Computer facilities, MIS= Management information systems, FA= Funding arrangements and income generating activities, CS= Committee system, HMRD= Human resource management and development, ICMA= Internal communication and management approach.)

- mostly research programmes are mono-disciplinary;
- a shortage of manpower, coupled with staff vacancies, is a major constraint Some research topics such as drainage and irrigation can not be undertaken in sufficient detail;
- evaluation of research projects are weak;
- library facilities, especially journal facilities are limited;
- an acute shortages of transport facilities, seriously constrains the advisory service;
- there are no regular internal seminars within the Institute;
- there is no annual or technical conference, or symposium particularly involving clients;
- the approach of the authority in decision making is bureaucratic and time consuming;
- the influence of different committees on BTB is weak;
- the Production and Research Committee frequently considers the research programme after the start of the year (April), and members consider they are being presented with a pre determined programme for ratification; and,
- the irregular publication of journals and annual reports constrains the communication of research results to the industry.

Weaknesses that have been identified during the analysis were picked up and combined with BPs in order to recommend actions for improvement in research management at BTRI and addressed in Chapter 10.

8.4 CASE STUDIES ON TOCKLAI (TRA), NORTH EAST INDIA

This is the fourth and last case study that was grouped into ***Phase Two.***

8.4.1 TEA AND TEA RESEARCH IN NORTH EAST INDIA

Tea in India is grown into two distinct regions; north and south. North Indian tea areas are characterised by a wet and hot summer and a cold dry winter (Barua, 1989). Existence of tea plants was first reported in north India during 1823 (Muthia, 1993). However, commercial cultivation started only around the 1840s (Weatherstone, 1992). Like all other tea growing countries of the world, tea plays a key role in the country's economic development and is the largest employer of working force in the private sector. Apart from being the largest employer, it is the most remunerative form of large scale farming in India (Jain, 1986). Currently India produces 758,031 metric tons of tea over an area of 425,006 ha.. In comparison to other tea growing countries, its position is second in respect of area while fourth in respect of export among the tea exporting countries (Table 8. 6).

Research on tea in north east India was initiated by a joint committee of Indian Tea Association (ITA) and the Horticultural Society of Bengal in the year 1888 at Calcutta Museum. At the beginning, research on tea was on an ad hoc basis. It was organised in a proper manner in 1891 (Barbora, 1994; TRA, 1992). In 1911, a research complex was formed at the loop of the river Tocklai at Jorhat, Assam, which is presently known as Tocklai. Until 1963, the station was under the management of ITA. ITA ceased to manage the station because of a severe financial crisis between 1961-63. The cost of running the station increased substantially.

From 1st January, 1964 the management was taken-over by the Tea Research Association (TRA), a co-operative research body funded partly by the Council of Scientific and Industrial Research (CSIR), Tea Board and partly by the members of the Association through subscription. Since then the services of the station became available to the TRA member estates.

The entire tea of north India does not get the R & D benefits. Tocklai extends its service only to those who are members of Tea Research Association. About 75% of the tea area and 85% of north India's production comes from TRA member estates. However, from April, 1990 the CSIR de-linked its association with the TRA, and its place was taken by the Ministry of Commerce (TRA, 1992).

The Indian tea industry may be grouped into two sectors; the estate sector and the smallholder sector. Most of the tea in north east India is grown in the estate sector by the multinational and local companies. Smallholder schemes in north east India are of resent introduction.

8.4.2 MANDATE AND ORGANISATION

The mandate of Tocklai Experimental Station (TES) is to help the tea industry in steady growth and in terms of production and quality in a cost effective manner (Barbora, 1994). Tocklai is the oldest and biggest tea research station of the world. It has been engaged in carrying out mostly adaptive research based on the industry needs and is well respected among its clients. Presently research is organised and carried out under following 7 divisions:

Agronomy,
Biochemistry,
Botany,
Engineering and manufacturing technology,
Plant protection,
Soils and water management,
Statistical and agricultural economics.

Each of these divisions is headed by a senior scientist. Besides the research activities, it is also responsible for giving advice, disseminating technology and imparting training to the plantation managers and smallholders on emerging problems and the scientific culture of tea. In addition to research divisions, there is a big administrative and accounts units to support the Director in day to day management of the Institute. The Director of Tocklai is solely responsible for decisions involving R & D activities.

There are two experimental estates: Tocklai Tea Estate (350 ha.) and Barbota Tea Estate (110 ha.). In both estates 25% of the area is under different experiments, while rest is under commercial cultivation and management. At both the estates, the scientific departments lay out their experiments and the department concerned or project leader is responsible for operations within the experimental area. Though gardens are under control of the manager, there is co-ordination with the scientists. In addition the Director is also responsible for day to day management of the main station and 7 other Sub-stations spread over the north Indian tea region.

Tea Research Association (TRA), popularly known as Tocklai Experimental Station or simply Tocklai is under the Ministry of Commerce, Government of India. However, it is an autonomous organisation, which functions independently without any interference from the Ministry. It is managed by a Council of Management (CM), which consists of members from:

- the industry;
- representatives from tea growers association;
- separate representatives from weaker section of the industry; and,
- the Ministry of Commerce.

There are 22 members of which 18 are elected representatives from the industry, and 2 from the Ministry of Commerce and 2 from the Tea Board of

India. Besides the experimental station at Jorhat, Assam, there is a secretariat at Calcutta. The Council of Management functions through the secretariat, which is responsible for the overall management of TRA. It is also responsible to make liaison with other organisations and represent TRA's interests. Council of Management formulates strategies and broad based policy guidelines for smooth functioning of TRA. The Chairman of the TRA is the executive head. The Director and the secretary of TRA report to the Chairman.

Research management profile on TES (TRA) was compiled (Table 8.4a-8.4c) details of which are discussed below:

8.4.3 PROBLEM IDENTIFICATION (PI)

PI is ***average*** because achieved score for this is 7 (Table 8.4a). The Institute practices all the BPs either fully or partially (Table 7.1 and 7.2). The following BPs are practised in full. For problem identification the Institute obtains information through:

- BP 1: request from the industry, through correspondence and contact;
- BP 2: advisory and extension Officers; and,
- BP 5: regional, zonal, local Stations or Sub-stations.

Besides, the following BPs are practised partially. For PI by obtaining information through:

- BP 3: scientists following routine advisory visits,
- BP 4: workshops and seminars involving clients and discussions during demonstrations and training, and
- BP 6: through different Management Committees and Sub-committees

8.4.4 PRIORITY SETTING AND RESOURCE ALLOCATION (PSRA)

The evaluated score against PSRA is 5 which indicates that PSRA is of an ***average*** nature (Table 8.4a). TES practices the following BPs in full (Table 7.3 and 7.4):

Table 8.4a.Research management performance profile on TES (TRA)

Problem identification (Table 7.1)							Total score	Assess-ment
Best practices audit	1	2	3	4	5	6		
Allotted score	1	1	1	2.5	2	2.5		
Level of implementation	Y	Y	P	P	Y	P		
Achieved score	1	1	0.5	1.25	2	1.25	7	Average
Priority setting and resource allocation (Table 7.3)								
Best practices audit	1	2	3	4				
Allotted score	2	2	2	4				
Level of implementation	Y	Y	P	N				
Achieved score	2	2	1	0			5	Average
Project preparation (Table 7.5)								
Best practices audit	1	2	3	4	5	6		
Allotted score	1	1.5	2.5	2	2	1		
Level of implementation	Y	P	P	Y	P	N		
Achieved score	1	0.75	1.25	2	1	0	6	Average
Project appraisal (Table 7.7)								
Best practices audit	1	2	3	4	5			
Allotted score	1.5	3	3	1.5	1			
Level of implementation	Y	P	P	N	N			
Achieved score	1.5	1.5	1.5	0	0		4.5	Average
Monitoring (Table 7.9)								
Best practices audit	1	2	3	4				
Allotted score	2	3	3	2				
Level of implementation on	Y	Y	Y	N				
Achieved score	2	3	3	0			8	Strong

- BP 1: TES considers the relative importance of the problem based on the information obtained through the systems specified for PI (Table 7.1); and,
- BP 2: TES considers the resource availability in light of the project requirement, such as, human resource with particular reference to skills, physical and financial resources required.

In addition TES partially practices BP 3, which considers the probability of project success for PSRA. However, TES does not practice BP 4, which is the adoption of any systematic procedure for prioritisation of R & D.

8.4.5 PROJECT PREPARATION (PP)

PP is of ***average*** nature because the evaluated score is 6 (Table 8.4a). To prepare PP, TES considers the following BPs (Table 7.5 and 7.6) in full:

- BP 1: prepared projects have clearly defined objectives; and,
- BP 4: in the prepared projects, TES indicates required inputs, such as, human resource with particular skill needed, financial resource with realistic cost and budgets, and other physical resources like equipment, transports, chemicals and fertiliser, with specific requirements if needed.

In addition, TES practice following BPs partially:

- BP 2: statement of the problem with all pertinent data and information which signifies the importance of the research;
- BP 3: relating to plan of work (methodology) and time schedule;
- BP 5: indication of monitoring techniques and reporting style for analytical results, and parameters of evaluation (Table 7.5 and 8.4),.

But TES does not practice BP 6 which is the indication of expected results and anticipated constraints (Table 7.5 and 8.4a).

8.4.6 PROJECT APPRAISAL (PA)

PA is of ***average*** nature because, achieved score is 4.5 (Table 8.4a). For project appraisal TES practices BP 1 (Table 7.7 and 7.8) in full, which involves a comparison of the importance of the research problems according to the criteria specified for problem identification (Table 7.1). In addition two BPs are practised in part:

- BP 2: comparison of different systematic procedures specified under PSRA (Table 7.3); and,
- BP 3: suitability of methodology, time schedule, work plans, cost estimates and resource availability for the specified objectives.

However TES does not practice following two BPs for PA:

- BP 4: comparison of likely benefit which could be achieved by individual research projects, and
- BP 5: comparison of probability of success and anticipated constraints.

However, inadequate MIS appear to be another contributing factor for such low score against PA..

8.4.7 MONITORING

This is *strong* because evaluated score is 8 (Table 8.4a). TES practices following BPs (Table 7.9 and 10) in full:

- BP 1: implemented projects have a work plan and time schedule;
- BP 2: the monitoring plans includes all pertinent data requirements like, acquisition and allocation of physical resources, budget specification and allocation of financial resources, specification and allocation of human resources, and
- BP 3: the monitoring plan includes the nature (qualitative / quantitative) of data collection, number and interval of reporting.

However, the organisation does not practice BP 4, which specifies report preparation from data analysis and transmission to relevant management authorities comparing achievements with targets, highlighting bottle necks. But there is system of regularly producing monthly reports. Individual divisional heads prepare monthly reports, showing the latest position of each project. Advisory centres also prepare monthly reports and send them to the Chief

Advisory Officer. Information Officer collects and compiles them for the Director. The Director presents that to the Council of Management. At the end of each year, these reports are placed in the annual general meetings of TRA members. Some times these are discussed with the scientists and the technical committee members. However, this process could be further improved, if a monitoring schedule is prepared during research project preparation.

8.4.8 RESEARCH PROJECTS OR PROGRAMME EVALUATION

Evaluation at TES is ***strong***. Achieved score is 10 (Table 8.4b) because the organisation practices all BPs (Table 7.11 and 7.12) in full, which is described below:

- BP 1: the organisation has a regular system of internal evaluation of research projects through seminars, workshops, peer review, demonstrations;
- BP 2: the organisation has a regular system of external evaluation involving clients through seminars, workshops, peer review, demonstrations;
- BP 3: international seminars are held involving clients and wider scientific community; and,
- BP 4: there is system of regular publications to disseminate research findings to the industry through: annual reports, journals, memorandums, technical reports, advisory bulletins, and circulars

The followings are the official fora and processes through which evaluation is carried out:

a) Internal evaluation (within the institute):

- Monthly seminar;
- Monthly or bimonthly heads of research division meetings.

b) Evaluation by the industry:

- Council of Management review;
- Technical Committee review;
- Area Scientific Committee meetings;

- Joint Area Scientific Committee meetings;
- Annual general meetings by TRA members; and,
- Tocklai annual conference.

c) Field evaluation and monitoring of released technologies and recommendations are of average nature. However, it is done through the sub-stations. Advisory Officers of individual sub-stations are responsible for keeping such information and during formal meetings with the scientists they communicate the situation to the respective division. When scientists and other Advisory Officers visit a particular area, they also obtain information regarding the released technologies.

d) Evaluation by the wider scientific community is of average nature, because it is done once in a while, usually during international conference.

8.4.9 TECHNOLOGY DIFFUSION AND FEEDBACK (TDF)

This ***strong*** because the evaluated score is 10 (Table 8.4b). Following are the BPs (Table 7.13 and 7.14) which are practised by the TES in full:

- BP 1: experimental farms and demonstration plots at the main centre;
- BP 2: systems of routine advisory visits by scientists and Advisory officers;
- BP 3: a system of forecasting routine visits of Advisory Officers and scientists to the industry;
- BP 4: systems of visiting clients on request by Scientists and advisory officers;
- BP 5: formal fora where advisory-extension officers can meet and discuss client problems;
- BP 6: zonal, regional and local sub-stations to obtain information on area specific problems;
- BP 7: a formal body (committees) to obtain area information regarding client problems and constraints on technology adoption;

Table 8.4b Research management performance profile on TES (TRA)

Evaluation (Tale 7.11)										Total score	Assess-ment
Best practices audit	1	2	3	4							
Allotted score	1	2.5	3	3.5							
Level of implementation	Y	Y	Y	Y							
Achieved score	1	2.5	3	3.5						10	Strong
Technology dissemination and feedback (Table 7.13)											
Best practices audit	1	2	3	4	5	6	7	8	9		
Allotted score	0.75	0.75	1	1	1	2	1	1	1.5		
Level of implementation	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Achieved score	0.75	0.75	1	1	1	2	1	1	1.5	10	Strong
Publications (Table 7.15)											
Best practices audit	1	2	3	4	5	6	7				
Allotted score	1	0.5	2	2	2	1.5	1				
Level of implementation	Y	Y	Y	Y	Y	Y	Y				
Achieved score	1	0.5	2	2	2	1.5	1			10	Strong
Library facilities (Table 7.17)											
Best practices audit	1	2	3	4	5						
Allotted score	1.25	1.25	2.5	3	2						
Level of implementation	P	P	N	N	P						
Achieved score	0.625	0.625	0	0	1					2.25	Average
Computer facilities (Table 7.19)											
Best practices audit	1	2	3	4	5						
Allotted scores	2	2	2	2	2						
Level of implementation	Y	P	Y	N	N						
Achieved score	2	1	2	0	0					5	Average

- BP 8: a system of formal training to the clients + organising seminars, workshops, field days and demonstrations to disseminate technology; and,
- BP 9: a system of monitoring the adoption of advisory recommendations and follow-up of visits to the clients.

However, TDF is the responsibility of the Advisory Division, which may be analysed and described in detail under following headings for better understanding of the process:

a) The linkages between Advisory / extension and the industry are strong. and well organised with strong infrastructural facilities. The aim of the Advisory Department is to ensure the transfer of technology and feed back the problems of the industry to the research scientists. It is accomplished through a strong network of 8 advisory centres spread all over north India. Depending on the area under individual advisory centres, there are either 2 or 3 Advisory Officers. The following systems are in operation:

Routine estate visits are one of the important and effective means of direct contact and feedback with the industry and the Advisory Officer. The system is well planned and organised, where a minimum 3 routine visits are paid to each member garden every year. Tentative yearly programmes are prepared and circulated to member estates. At least 6 weeks before the scheduled visits, letters are sent to estates reminding of the date and time of visits in a particular area by the Advisory Officers. If gardens have any problem and they want a visit, they will inform the Advisory Officers. If any gardens do not reply within three weeks, a reminder is given to the gardens. On reply, visits are arranged accordingly.

During such visits, advice is given on time specific problems and various aspects tea husbandry. The Advisory Officer also point out any lapses which might have gone unnoticed or unattended by the estate manager and are affecting productivity. In addition, the Advisory Officer also helps the manager in future planning for the development work of the garden. This visit helps tremendously to obtain feedback from the industry. After such visits, all the Advisory Officers prepare a diary pointing to the level of implementation of previous recommendations given during earlier visits which works as monitoring of adoption of recommended technology.

Special visits are also paid to attend to problems which were not covered in routine visits and advice is given accordingly.

b) Training: the training systems for supervisory and field staff of estates are good and effective. Grassroots level training is arranged for supervisory staffs of member gardens through field demonstration and group discussions. This training helps the participants in improving their perception of systems technical information received from the manager. This ultimately helps in better implementation of the TRA recommendations.

Three month courses are designed for comparatively young executives of tea. Two such courses are held each year on basic principles of tea culture. On completion of such courses the participants get a certificate from TRA. In future TRA is thinking of providing hostel accommodation to participants.

For tea executives who have certain experience on modern tea culture, short courses of 3-5 days duration are arranged in two groups: one for senior manager and one for assistant managers both at main and Sub-stations. Lectures cover basic principles of tea culture and recent research findings and recommendations.

In addition, field days are arranged where participants are taken to see some of the good commercial practices adopted by estates. Some of the visits are arranged in gardens which have specific problems, and discussions are held on how to tackle the problem. This helps managers to understand, and address such problems in their own gardens.

c) Field demonstrations well organised by local Advisory Officers of different regions in order to disseminate technology, and to train manual and management staff.

Area scientific seminars are an effective way of obtaining industry feedback. These are organised by the Area Scientific Committee where an area specific Advisory Officer is the Secretary of the Committee. All senior planters of the area are members. They arrange seminars at least twice a year; once on agricultural subjects and once on engineering aspects. It is an important forum which gives opportunity to the scientists to meet and interact directly with the senior planters who are working in a particular agro-climatic region. In the seminar, the scientists focus on their achievements, and planters put forward different questions. This helps the scientists to identify industry problems and constraints in implementation of a particular technology.

In-house seminars are organised by either individual companies or by a group of estates with a common interest. Scientists, managers and assistant managers attend the seminar in groups, where in-depth discussions and exchange of ideas occurs. This helps estate management to review their policy decisions and make necessary modifications wherever necessary.

d) Links between research and extension are strong because the advisory centres are responsible for the regional adaptability trials of research departments. Any technology found promising through research departments will be tested for its performance in different agro-climatic regions under the supervision of Regional Advisory Centres. Experiments are laid out by the individual departments, and the performance of the experiments are closely monitored by the Advisory Officers. Depending on the regional trial results, research findings are transformed into technology packages which go to the industry as a recommendation if appropriate.

The Chief Advisory Officer is the member secretary of the Agricultural Committee, where senior scientists and industry representatives are present. The chief Advisory Officer is also a member of the editorial board of the scientific journal "Two and a Bud" published by the Institute. Any article based on new findings or recommendations comes to his notice and he further communicates this to the other Advisory Officers at main and regional stations. Area Scientific Committee and Joint Area Scientific Committees represent two strong and formal fora which act as a means of strong links among research, advisory and extension and the industry.

e) Experimental sub-station network for zonal adaptability trials. This is well established with a main station supported by 7 Sub-stations covering different agro-ecological zones.

f) Quarterly Advisory Bulletins are regular bi-monthly publications from the local Advisory Officers. The purpose of these bulletins is to inform the area specific planters in advance about the problems that they might encounter in next few months with the recommended measures. Sometimes, important operations are listed to act as a timely reminder.

8.4.10 PUBLICATION

The achieved score against publications are 10, which indicates that publications are ***strong*** (Table 8.4b). TES practices all the BPs (Table 7.15 and 7.16) in full. TES disseminates the technologies to the clients by publishing:

- BP 1: journals;
- BP 2: monthly, quarterly and annual technical reports;
- BP 3: circulars and pamphlets;

- BP 4: bulletins forecasting future regular activities need to be carried out by the industry;
- BP 5: popular articles in local languages for easy understanding;
- BP 6: publications to the international journals; and,
- BP 7: publications are regular and timely published.

However details of all publications are given below: the publications play one of the key role in successful technology dissemination. Regular publications through which technologies are disseminated to the clients are:
Two and a Bud is the official monthly scientific journal of the TES. It is one of the oldest industrial journal of India. Tea Encyclopaedia is a binder containing different sections covering all the scientific aspects of modern tea culture. All the recommendations arising out of current research issued by the scientific departments are kept in it. It serves as a ready reference.
Annual reports published regularly highlight the current position of all the on-going research projects.
Bulletins are regularly published which arise out of different seminars and conferences.
Advisory circulars are published monthly by all the advisory centres.

8.4.11 LIBRARY FACILITIES

Achieved score for library facilities are 2.25 (Table 8.4b), which indicates that these are ***weak***. TES practices the following BPs partially (Table 7.17 and 7.18):

- BP 1: systems of obtaining text books related with tea culture;
- BP 2: systems of obtaining other text books on allied crops; and,
- BP 5: borrowing books and journals from other libraries within the country and outside the country.

However two of the important BPs are not practised. For example, the library does not have a system of subscribing to journals related to tea research of other countries (BP 3) and system of subscribing to abstract journals (BP 4).

8.4.12 COMPUTER FACILITIES

This is ***average*** because evaluation score is 5 (Table 8.4b). At TES the following BPs are practised in full (Table 7.19 and 7.20):

- BP 1: refers to a minimum one computer for each working units or centrally controlled facilities to work by all working units on a rota basis where number of computers are less than working units; and,
- BP 3: trained people for maintenance of computers.

In addition, TES practice BP 2 in part, which is regular supply of computer accessories. However, TES does not have two of the important BPs in place such as a recent version of different software (BP 4) and upgraded facilities of different components of computer (BP 5).

8.4.13 MANAGEMENT INFORMATION SYSTEM (MIS)

Achieved level of score against MIS is 4.9 (Table 8.4c), which indicates that MIS is of ***average*** nature. TES practice the following BPs (Table 7.21 and 7.22) in full:

- BP 1: there are systems maintaining data on financial resources (budgets and expenditure) and utilisation, physical resources and human resources.
- BP 2: systems of maintaining detailed information on human resource management and development (training needs and career development plan for individual);

In addition, the following BPs are partial in practice:

- BP 3: general information and survey data on industry such as, total area, area under cultivation, area under different plant types, area facing specific problems, meteorological data on different regions, data on soil nutrition profile, and status of pest and diseases are incomplete; and,

Table 8.4c.Research management performance profile on TES (TRA)

Management information system (Table 7.21)							Total score	Assess-ment
Best practices audit	1	2	3	4	5			
Allotted score	1.5	1.25	3	1.25	3			
Level of implementation	Y	Y	P	P	N			
Achieved score	1.5	1.25	1.5	0.625	0		4.88	Average
Funding arrangement and income generating activities (Table 7.23)								
Best practices audit	1	2	3	4	5	6		
Allotted score	3	1	1	2.25	1.25	1.5		
Level of implementation	Y	P	N	Y	N	Y		
Achieved score	3	0.5	0	2.25	0	1.5	7.25	Strong
Committee system (guidance and interactions from different management committees) (Table 7.25)								
Best practices audit	1	2	3	4	5			
Allotted score	1	2	2.5	2.5	2			
Level of implementation	Y	Y	Y	Y	Y			
Achieved score	1	2	2.5	2.5	2		10	Strong
Human resource management and development (Table 7.27)								
Best practices audit	1	2	3	4				
Allotted score	2	2	3	3				
Level of implementation	N	Y	P	P				
Achieved score	0	2	1.5	1.5			5	Average
Internal communication and management approach (Table 7.29)								
Best practices audit	1	2	3	4	5			
Allotted score	2	3.5	1.5	1.5	1.5			
Level of implementation	Y	Y	Y	Y	Y			
Achieved score	2	3.5	1.5	1.5	1.5		10	Strong

- BP 4: data and information on type of management, area under each management category are incomplete.

Nevertheless, TES does not practice BP 5. There is very limited data and information on the rate of uptake of technology, constraints that affect the rate of uptake of technology, and information on different agro-ecological region specific needs.

8.4.14 FUNDING ARRANGEMENTS AND INCOME GENERATING ACTIVITIES

This is *strong* because achieved level of score is 7.25 (Table 8.4c). TES has following BPs (Table 7.23 and 7.24) in place:

- BP 1: systems of obtaining funds from the clients / industry;
- BP 4: there are systems of generating own income; and,
- BP 6: there are systems of obtaining funds from central agricultural research council of the country.

In addition, BP 2 which is obtaining funds from the Government is practised partially. The following two BPs are not practised at all by TES:

- BP 3: systems for obtaining special subscriptions from clients other than the regular subscription to meet capital expenditures in case of sudden emergency, and
- BP 5: systems for obtaining funds from donors.

However, TES obtains its core funds from a number of sources:

Memberships subscription is the major funding source for Tocklai providing 70% of its funds. Membership is voluntary, and about 75% of north Indian tea area is covered under its memberships. Subscription rates vary. Members pay the subscription on the basis of last three years average production. Depending on production, the average rate of subscription could be 5, 7.5 or 10 paisa per kilogram of made tea.

TES also generates internal revenue through sales of cuttings, scions and different publication materials to the members of TRA. Royalties of seed baries

(seed initially grown by the estates with the materials supplied from Tocklai), once such seed baries are raised, depending on the number of trees in each orchard or individual companies, royalty is raised by Tocklai.
Some times TES obtains project grants from national Government which may cover up-to 28-30% of the yearly budget. In addition, income comes from TES reserve funds.

Until recently, the funding arrangements of the station were very satisfactory. But when CSIR withdrew from the joint management (1990), the Government reduced its funding support from 45% to 25%. This has resulted in a 20% reduction in total funding. The industry has been passing through a lull, so TRA is not in a position to ask its members to raise subscriptions to cover the 20% deficit due to the reduction in funding by the Government. For the last few years, the deficit of the budget has been covered from the reserve fund, which has gradually been depleted. Recently, the secretariat has asked TRA members to raise subscriptions to cover the deficit. If industry cannot give its support, then research programmes might face a set back. Alternatively, Tocklai can look for a donor to cover some of the ongoing projects until industry is in a position to support TES through higher subscription.

8.4.15 Committee System (Interactions and Guidance from Different Management Committees)

The level of achieved score for committee system is 10 (Table 8.4c), which indicates that it is ***strong***. TES has all the BPs (Table 7.25 and 7.26) in place. The organisation has the following committees and activities for efficient R & D management:

- BP 1: Management Board with clients representative to formulate policies and strategies for the organisation;

- BP 2: different Technical Committees consisting of clients, subject specialists to help research problem identification, priority setting, project evaluation and technology dissemination;
- BP 3: different Regional Committees consisting of only clients, advisory and extension workers and scientists to obtain clients feedback;
- BP 4. Joint Committees consisting of clients, advisory and extension workers and scientists to obtain clients feedback; and,
- BP 5. committee (s) to facilitate interaction between advisory and extension workers and scientists (where advisory and extension is separate).

There is strong committee system in R & D management of Tocklai. Other than the Council of Management, other committees help in R & D management:

- Executive Committee (EC);
- Agricultural Committee (AC);
- Engineering Committee (EC); and,
- Crop Diversification Committee (CDC).

Besides the Executive Committee, other committees are known as the Technical Committees. These consists of industry representatives and are selected by the Chairman of the Council of Management. Most of the committee members are the senior executives of different multinational companies, smallholding authority or senior scientists of other agricultural research Institutes.

Executive committee: It is a seven member committee, and consists of following members:

- the Director of Tocklai;
- the Chairman of the Agricultural Committee;
- the Chairman of the Engineering Committee;
- the Chairman of the Crop Diversification Committee;

- one representative from Tea Board of India; and,
- one representative from Indian Tea Association.

The Executive Committee works on behalf of the Council of Management. The Council of Management sits 3-4 times a year, while Executive Committee sits regularly every 2 months. The Executive Committee has been empowered to help in quick decision making. In case of emergencies, the Chairman of the Council of Management seeks help, discusses the emerging management related issues with the Executive Committee and takes necessary decisions.

The main functions of the Agricultural Committee and engineering Committee are to help and guide the Director in:

- research programme formulation;
- finding out industry needs and helping in proper research problem identification;
- project appraisal, prioritisation and resource allocation;
- implementation and evaluation of research projects; and,
- technology dissemination.

The Agricultural Committee is responsible for advice on crop production related issues, while the Engineering Committee is entrusted with similar responsibility on crop processing only.

The Crop Diversification Committee helps the Council of Management to formulate policies for the industry regarding the use of land which is not suitable for cultivation of tea. Instead of keeping the unsuitable area fallow, other suitable crops are identified and cultivated on those lands.

The Scientific Advisory Committee dates back to 1935 when a commission of enquiry was formed by Professor Sir Frank L Engledow for the necessary orientation of the research programmes. Until 1976, this committee was known as the London Advisory Committee. Later in 1976 the work of London

Advisory Committee was taken-up by the Scientific Advisory Committee. Currently members of this committee are selected by the Council of Management. This committee consists of eminent scientists of Director level from other Research Institutes of India. They are specialists in their respective fields of science. Their main function is to help and guide the Director and working scientists of Tocklai in developing a scientifically sound research programmes. Thus the Director formulates the research programme in consultation with 3 Technical Committees, and the Scientific Advisory Committee.

In 1966, nine Area Scientific Committees were formed in different regions to suggest ways and means in which the advisory service could be improved and select areas of research considered to be of importance to specific regions. The Committees consisted of 8 planters of the area, and the local Advisory Officer as the secretary of the Committee. This committee particularly helps to obtain feedback from the industry on various problems and research needs; and helps dissemination of technology and information amongst members of TRA through seminars and field visits.

The Joint Area Scientific Committee is another forum where strong interactions and direct feedback occurs among scientists, planters and extension agents. A seminar is arranged by the committee where scientists present their recent findings, discuss current problems and recommendations. Participants critically analyse the topic and recommendations and sometimes raise questions, or suggest modifications. If problems require further investigation, additional research is carried out.

8.4.16 HUMAN RESOURCE MANAGEMENT AND DEVELOPMENT (HRMD)

This is of *average* nature because the level of achieved score is 5 (Table 8.4c). TES follow BP 2 in full (Table 7.27 and 7.28), which refers to a clear and

8.4.16 HUMAN RESOURCE MANAGEMENT AND DEVELOPMENT (HRMD)

This is of ***average*** nature because the level of achieved score is 5 (Table 8.4c). TES follow BP 2 in full (Table 7.27 and 7.28), which refers to a clear and specific recruitment and selection policy. In addition, following two BPs are practised in part:

- BP 3: systems of performance management with performance review, potential review, performance improvement programmes, career development programmes and reward review; and,
- BP 4: training systems to develop potential skills of individuals.

However, TES does not practice BP 1. It does not have a system of demand forecasting, forecasting requirements, productivity and cost analysis, budgeting and cost control in light of future manpower requirements.

8.4.17 INTERNAL COMMUNICATION, WORKING RELATION AND MANAGEMENT APPROACH

This is ***strong*** because the achieved score is 10 (Table 8.7c). TES practices the following BPs (Table 7.29 and 7.30) in full:

- BP 1: internal communication is done mainly through interpersonal approach with less emphasis on written form except for rules and regulations;
- BP 2: management style is participatory (informal, loosely controlled, less hierarchical and bottom up approach);
- BP 3: there are systems of formal meetings with heads of research divisions to take their views in decision making;
- BP 4: there are systems of meetings between top management and employees, to obtain employees view in decision making; and,
- BP 5: there are flexibility in procedures, rules and regulations.

Every day the Director meets with the scientists during morning tea where effective internal discussion and feedback occurs.

8.4.19 CONCLUSION

Tocklai is one of the oldest and the biggest tea research organisations which was studied during the case studies. Most of the research management systems at UPASI and TRIS are similar to that of Tocklai. Performance analysis on research management activities for TRA (TES) is graphically presented (Figure 8.4). This shows that at TRA, research monitoring, evaluation, technology dissemination, publications, funding arrangements and income generating activities, and committee systems are strong.

However, the followings are the major weaknesses which are hindering the optimum output of research at TES:

- the external environment of the organisation is not congenial. Currently the organisation is facing the influence of political and ethnic problems which are directly affecting organisational performance. Consequently, a number of senior members of the organisation have left the Institute. In addition, trained and young potential researchers are hesitant to join the organisation.
- between 1980-90, the organisation experienced a leadership crisis. Political and ethnic problem contributed substantially towards such crisis which severely affected the performance of the organisation and research management.
- research project preparation and co-ordination between research division within the Institute is unsatisfactory.
- there is a budgetary shortfall of around 20-25% of total budget. Currently because of inadequate marketing the industry is finding it difficult to raise revenue from subscriptions. As an alternative, management is looking for donors to supplement the fund shortage (Sharma, 1994).
- human resource management and development, particularly the training aspects, are not given due importance.
- interactions with the international knowledge system is very weak.

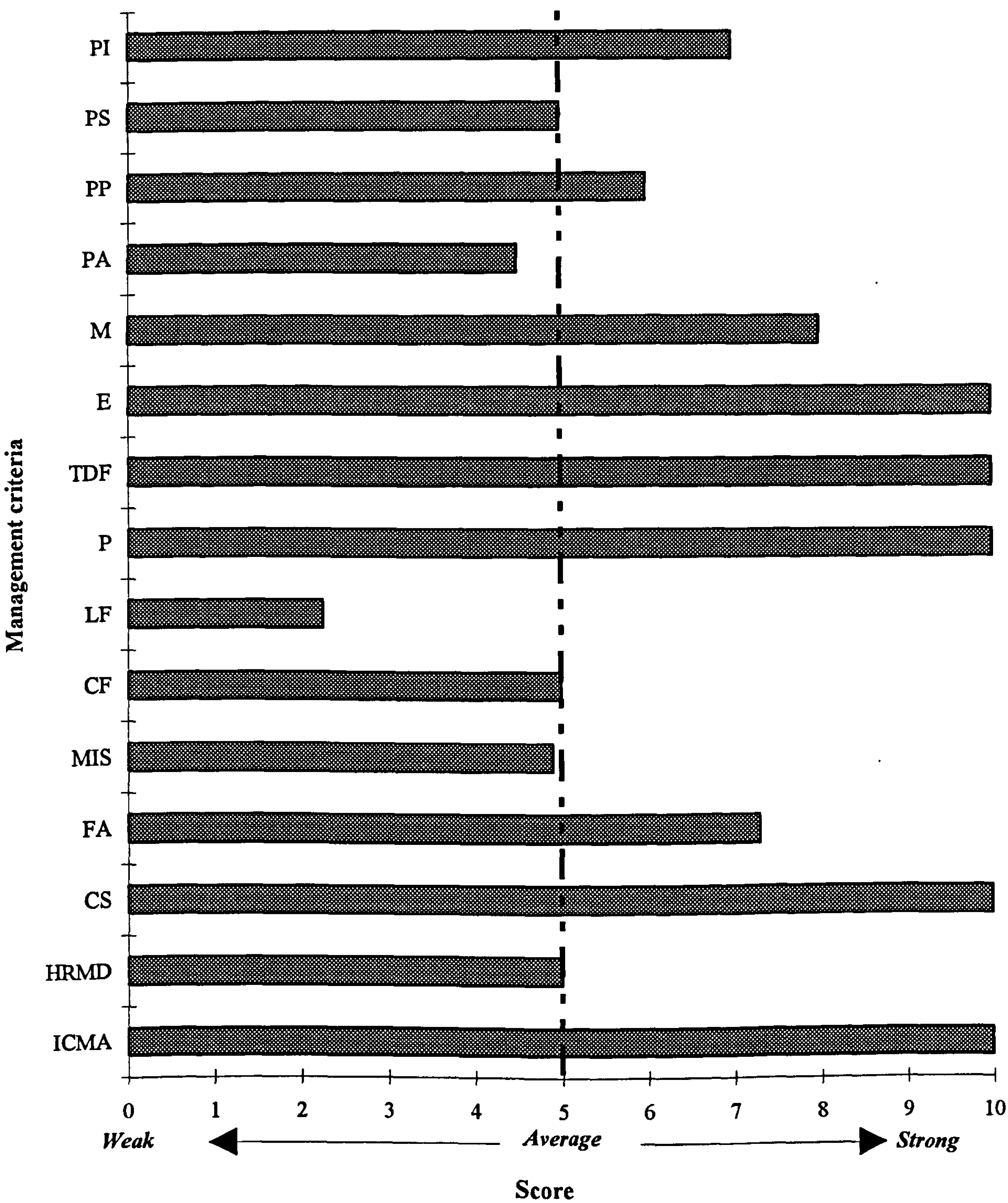


Figure 8.4 Summary profile on research management performance: Tocklai

(PI= Problem identification, PS= Priority setting, PP= Project preparation, PA= Project appraisal, M= Monitoring, E= Evaluation, P= Publications, LF= Library facilities, CF= Computer facilities, MIS= Management information systems, FA= Funding arrangements and income generating activities, CS= Committee system, HRMD= Human resource management and development , ICMA= Internal communication and management approach.)

8.5 Comparison of Industry Information, Management Systems, and Performance Assessment (Organisations Studied During Phase Two Case Studies).

8.5.1 Comparison of Industry Information and Management Systems

Among the organisations studied under *Phase Two* case studies, Tocklai is the oldest. It was established in 1888. TRIS and UPASI were both established 1925, and BTRI in 1957. All of the organisations are mainly funded by the industry through cess money. Except for BTRI, all organisations are managed by a separate Board of Management. In respect of number of research divisions TRIS is the biggest with 10 research divisions. Tocklai and UPASI are the smallest with 7 research divisions (Table 8.5). However, in respect of area and per hectare production, among the countries studied, India has the largest area and per hectare production of tea (Table 8.6).

Table 8.5 Comparison of general management information on organisations grouped under phase two case studies

Name of the country	Sri Lanka	India		Bangladesh
		South	North	
Name of the organisation	TRI, Sri Lanka	UPASI	TES	BTRI
Establishing year	1925	1925	1888	1957
Type of management	RB (mostly industry representatives)	EC (industry representatives)	CM (industry representatives	TB (no industry representatives)
Nature of funding	Cess by the industry	Cess by the industry	Cess by the industry	Cess by the industry
Number of research division	10	7	7	8

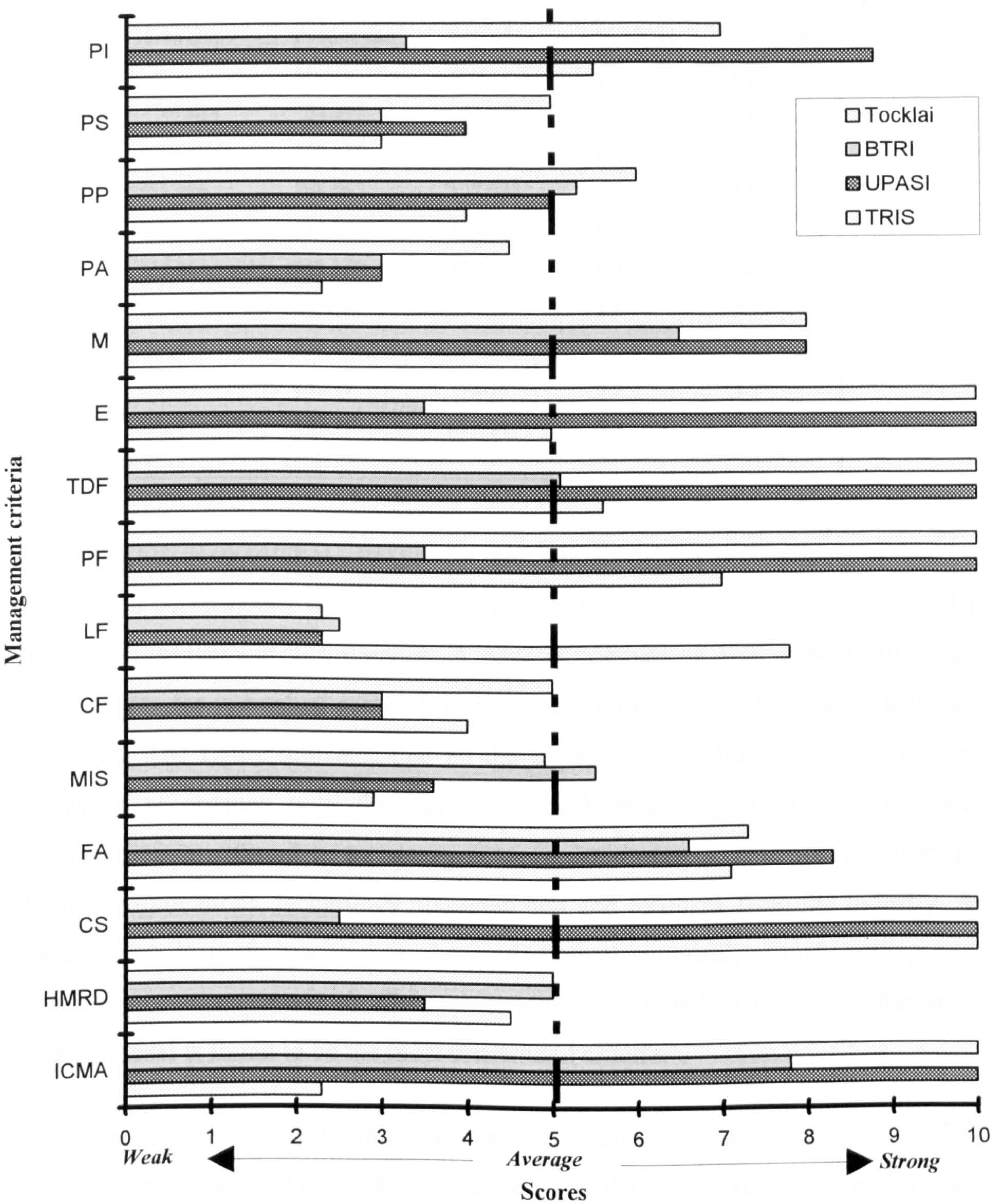


Figure 8.5 Comparison of research management performance (Absolute scores): TRIS, UPASI, BTRI and Tocklai

(PI= Problem identification, PS= Priority setting, PP= Project preparation, PA= Project appraisal, M= Monitoring, E= Evaluation, P= Publications, LF= Library facilities, CF= Computer facilities, MIS= Management information systems, FA= Funding arrangements and income generating activities, CS= Committee system, HRMD= Human resource management and development, ICMA= Internal communication and management approach.)

Table 8.6 Tea statistics on major producing countries of the world

Country	Area (ha.)	Production Metric Ton	Export Metric Ton	% Share production	% share export
Bangladesh	47,888	51,291	31,914	2	2.8
China	1,170,800	599,941	201,435	23.2	17.6
India	425,006	758,063	177,935	29.4	15.5
Indonesia	125,000	134,631	123,926	5.2	10.8
Kenya	104,864	211,168	188,390	8.2	16.5
Malawi	18,705	39,479	35,269	1.5	3.1
Sri Lanka	221,836	233,276	209,942	9	18.3
Tanzania	19,410	23,249	19,378	0.9	1.7
Turkey	Not available	127,715	39,611	4.9	3.5

Source: ITC 1994

8.5.2 COMPARISON OF OVERALL RESEARCH MANAGEMENT PERFORMANCE

Two different comparisons were done with respect to the achieved scores (Table 8.7.) on research management performance. A general comparison was carried out using absolute scores for individual research management criteria of each research institute (Figure 8.5). The figure indicates that all the organisations follow some of the best practices in accordance with the developed guidelines. Organisations which are performing best are found to be strong in committee system, research monitoring, evaluation, publications, technology dissemination and feedback from the industry. A lot of variation in performance was observed. Project appraisal, priority setting and human resource management in all organisations were found to be below standard. Project appraisal is found to be the most unattended criteria.

Another comparison of performance was carried out showing the deviation of the BP score from mean (Figure 8.6). It shows that some of the organisations are performing consistently well above the average for all criteria. Organisations when performing consistently above average tend to be strong in committee system.

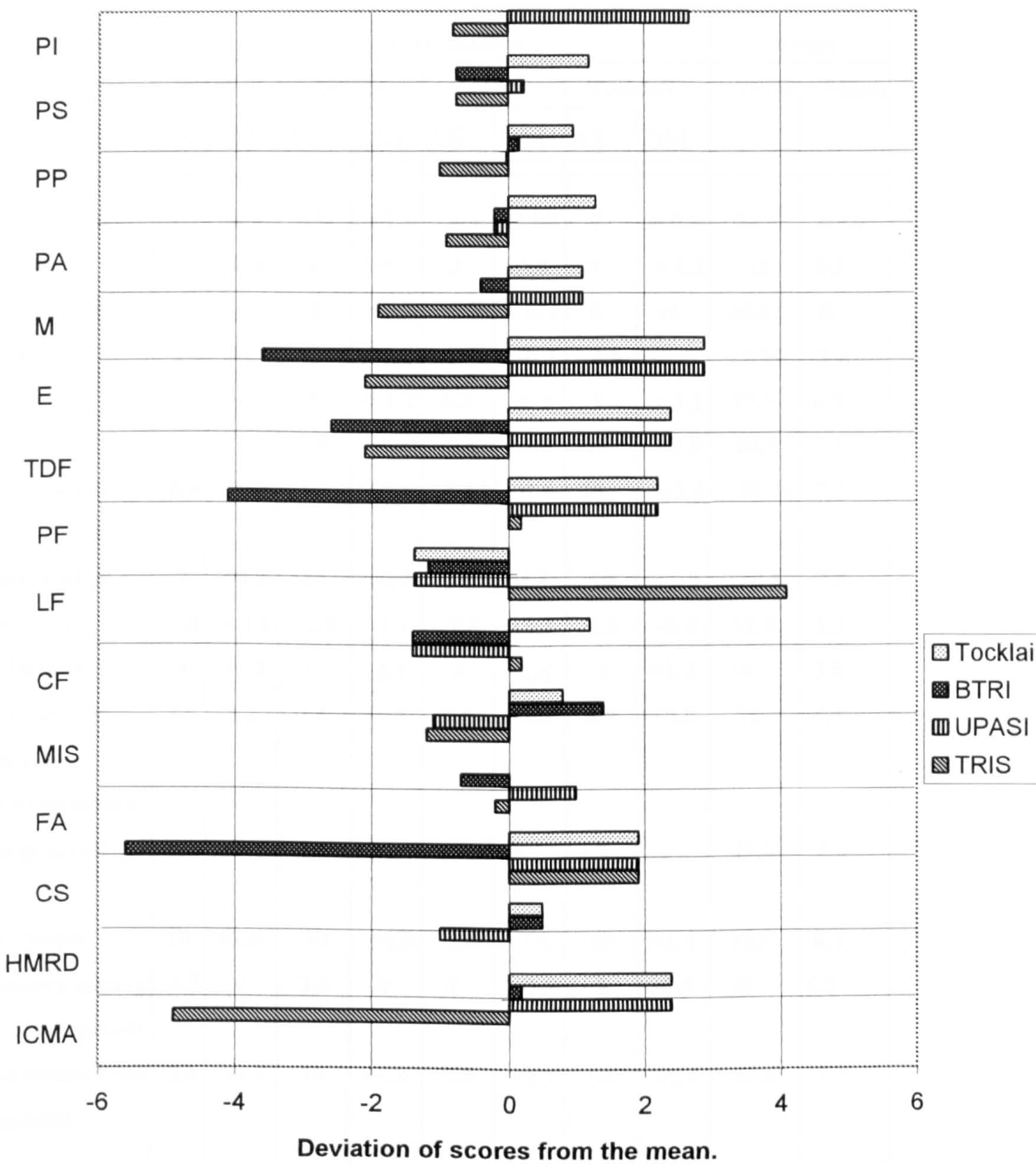


Figure 8.6 Comparison of research management performance (Deviation from the mean): TRIS, UPASI, BTRI and Tocklai

(PI= Problem identification, PS= Priority setting, PP= Project preparation, PA= Project appraisal, M= Monitoring, E= Evaluation, P= Publications, LF= Library facilities, CF= Computer facilities, MIS= Management information systems, FA= Funding arrangements and income generating activities, CS= Committee system, HRMD= Human resource management and development, ICMA= Internal communication and management approach.)

Table 8.7 Comparison of research management performance score for TRIS, UPASI, BTRI and Tocklai (Absolute score and deviation from mean).

Management Criteria	Case studies								Score	
	TRIS		UPASI		BTRI		Tocklali		Total	Mean
	AS	DM	AS	DM	AS	DM	AS	DM		
Problem identification	5.5	-0.8	8.8	+2.7	3.3	-2.83	7	+ 0.9	24.5	6.13
Priority setting	3	-0.8	4	+ 0.3	3	-0.8	5	+ 1.2	15	3.8
Project preparation	4	-1.	5	0	5.3	+ 0.2	6	+1	20.03	5.
Project appraisal	2.3	-0.9	3	-0.2	3	-0.2	4.5	+1.3	12.75	3.2
Monitoring	5	-1.9	8	+ 1.1	6.5	-0.4	8	+ 1.1	27.5	6.9
Evaluation	5	-2.1	10	+2.9	3.5	-3.6	10	+2.9	28.5	7.1
Technology dissemi-nation and feedback	5.6	-2.1	10	+2.4	5.13	-2.6	10	+2.4	30.76	7.7
Publication facilities	7	+0.2	10	+2.2	3.5	-4.1	10	+2.2	30.5	7.6
Library facilities	7.8	+4.1	2.3	-1.4	2.5	-1.2	2.3	-1.4	14.9	3.7
Computer facilities	4	+0.2	3	-1.4	3	-1.4	5	+1.2	15	3.8
Management infor-mation systems	2.9	-1.2	3.6	-1.1	5.5	+1.4	4.9	+0.8	16	4.1
Funding arrangements and income generating activities	7.1	-0.2	8.3	+1	6.6	-0.7	7.3	0	29.3	7.3
Committee system	10	+1.9	10	+1.9	2.5	-5.6	10	+1.9	32.5	8.1
Human resource manag-ement and development	4.5	0	3.5	-1	5	+0.5	5	+0.5	18	4.5
Internal communication and management approach	2.8	-4.9	10	+2.4	7.8	+0.2	10	+2.4	30.6	7.7

AS = Absolute score, DM = Deviation from mean

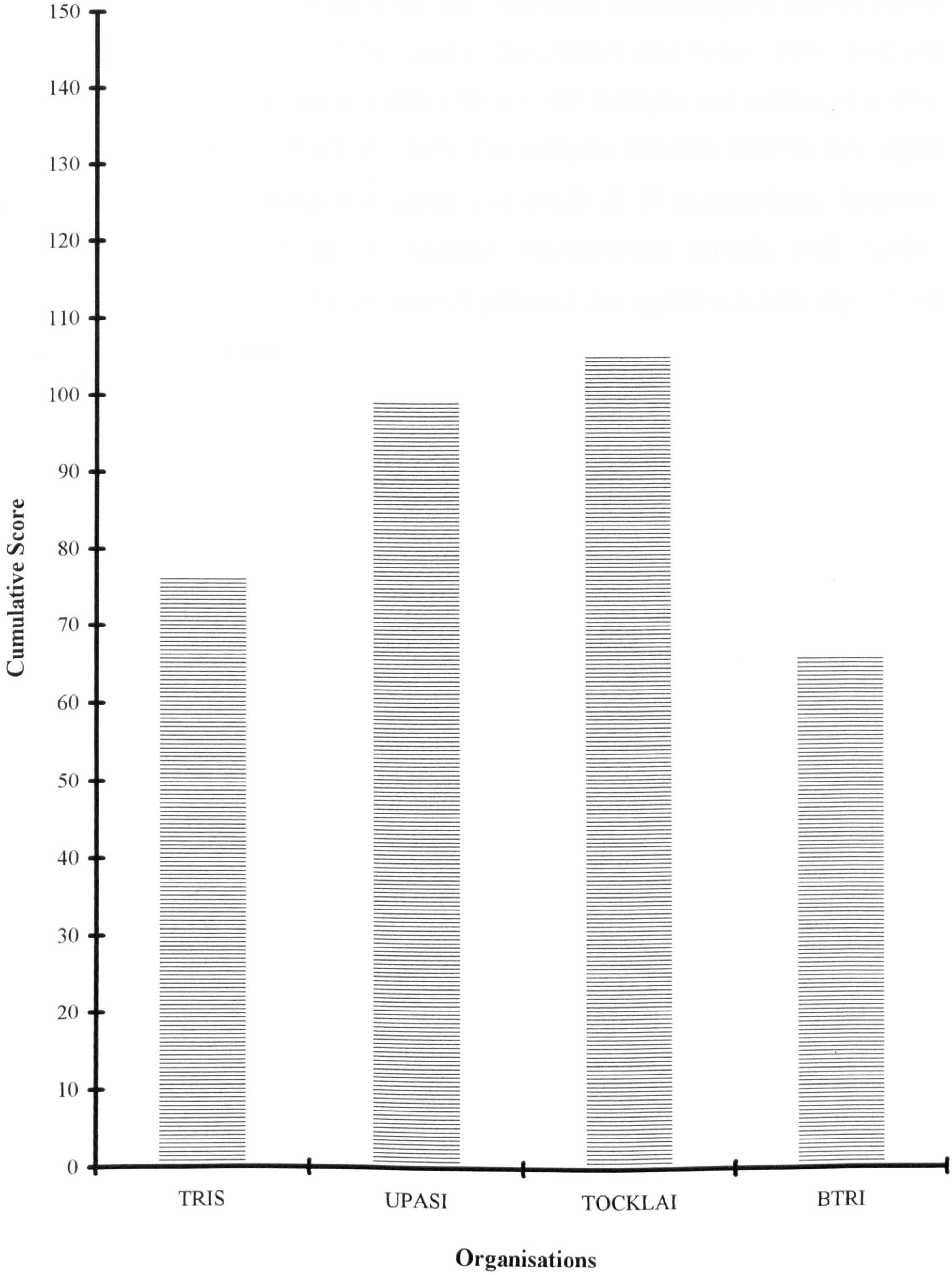


Figure 8.7 Comparison of research management performance

8.6 SUMMARY

This Chapter examined and described the application of the conceptual framework to four tea R & D organisations of Sri Lanka, Bangladesh and India. Thus, research management performance was analysed and the current strengths and weaknesses were identified for TRIS, UPASI, BTRI and TES. The analysis indicates that the developed conceptual model for improved management of tea R & D organisations functions well. However, Chapter 9 reports research management criteria with further improvements done in light of the experience gathered during the practical application of the conceptual framework.

CHAPTER 9

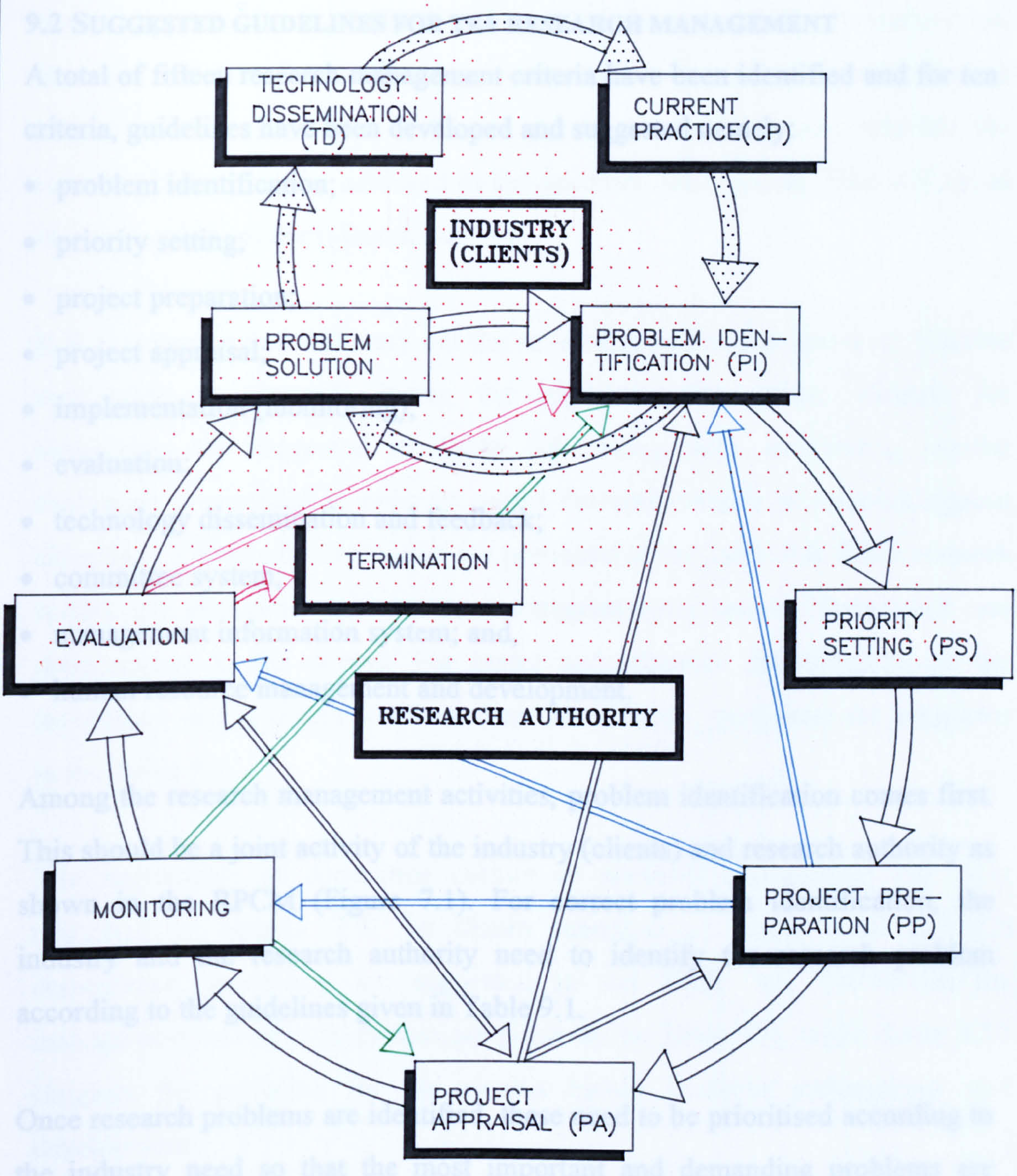
SUGGESTED GUIDELINES FOR TEA RESEARCH MANAGEMENT

Chapter 7 described the conceptual framework for research management in tea. The previous Chapter examined the application of the conceptual framework in a range of tea R & D organisations of various size, structure and management, including one of the largest organisations of its kind (Tocklai), in order to observe how it performs. Thus, the performance of research management on four tea R & D organisations was analysed under a wide range of situations.

This Chapter suggests guidelines against major research management criteria with additional improvements made in light of the experience gained during the application of conceptual framework and analysis of management performance of tea R & D organisations. This fulfils objective two of the study. Suggested guidelines are mainly based on the developed BPs (Chapter 7).

9.1 RESEARCH PROJECT CYCLE MANAGEMENT (RPCM)

Prior to the start of any research programme it is helpful to think, arrange and structure the sequence of activities which need to be carried out in order to achieve the target. This helps management in the implementation of the programme and ensures that the work proceeds in a sequence. Formal structuring of activities helps management to think clearly about the activities and steps involved in the total operational process. This in turn helps management to realise the consequences of any weakness, to identify dislocation in the sequence, locate the bottlenecks in the operational process, and improve the decision making. It is suggested therefore, that research activities should be carried out as outlined in the RPCM (Chapter 7, Figure 7.1) which is reproduced



(**Shaded area shows interaction between clients and research**)

Figure 7.1 RESEARCH PROJECT CYCLE MANAGEMENT (RPCM) below. In addition, the following guidelines are suggested for major research management functions.

9.2 SUGGESTED GUIDELINES FOR TEA RESEARCH MANAGEMENT

A total of fifteen research management criteria have been identified and for ten criteria, guidelines have been developed and suggested namely:

- problem identification;
- priority setting;
- project preparation;
- project appraisal;
- implementation (monitoring);
- evaluation;
- technology dissemination and feedback;
- committee system;
- management information system; and,
- human resource management and development.

Among the research management activities, problem identification comes first. This should be a joint activity of the industry (clients) and research authority as shown in the RPCM (Figure 7.1). For correct problem identification, the industry and the research authority need to identify the research problem according to the guidelines given in Table 9.1.

Once research problems are identified, these need to be prioritised according to the industry need so that the most important and demanding problems are addressed first in terms of resource allocation. To enable the management to set priorities, guidelines are suggested in Table 9.2 which focuses on the participation of clients.

Project preparation is the next step after priority setting which should be carried out as suggested in the Table 9.3. Subsequent management activity should be project appraisal against prepared research projects, which should be carried out as suggested in the Table 9.4. This will help management to analyse and find out whether the methodology proposed during project preparation is suitable, to check whether sufficient funds are available and whether the intended benefit can be achieved in the specified time period. This will be an internal activity of the research authority.

R & D organisations will carry out the selected projects after appraisal. Regular monitoring is essential during the implementation phase. Criteria for monitoring are suggested in Table 9.5. Along with monitoring, regular evaluation is essential in order to assess the performance of research against objectives. Criteria for evaluation are presented in the Table 9.6. Once research results are evaluated, appropriate recommendations can be formulated and disseminated to the clients. For better and effective dissemination of the technology and to obtain feedback from the industry, guidelines are suggested in the Table 9.7.

The importance of committee culture in research management has been described in Section 7.3. To obtain management inputs from different committees, guidelines are suggested in the Table 9.8. Guidelines for management information system are given in the Table 9.9, while Table 9.10 suggests the guideline for the criteria human resource management and development.

Table 9.1 Suggested criteria for Problem identification:

Objectives are to determine the actual need of the industry / clients and identify research problems through good linkage and feedback.

Process (function and activities)	**Means of verification (specified in terms of number, type, duration and relevant period)**
Obtain information and data regarding problems through:	
• **Correspondence;**	**Records at the Institute and tea estates;**
• **Contact of scientists, advisory-extension officers, different management committee members**	
• **Visits by: advisory-extension officers, and scientists;**	**Visit programmes and subsequent visit reports at tea gardens and Institute;**
• **Seminars, workshops, opendays, group discussions with clients;**	**Programmes + proceedings and participants attendance records;**
• **Demonstrations at: main station and sub-stations;**	**Programmes + participants attendance records at the Institute + sub-stations;**
• **Training of different client groups;**	**Training programmes + participants attendance records at the Institute;**
• **Formal interactions (different meetings): Forum of clients + scientists + different management + technical committees + advisory-extension officers.**	**Minutes and attendance records at the Institute.**

Table 9.2 Suggested criteria for priority setting and resource allocation (PSRA)

Objectives are to determine priorities among the identified research problems

Process (function and activities)	**Means of verification (specified in terms of number, type, duration and relevant period)**
The Institute needs to carryout the following activities:	
• **Determine the importance of problems through criteria specified under problem identification**	**Means of verification specified for problem identification**
• **Carry out a systematic study to determine likely benefit among identified research problems**	**Project documents;**
• **Consider the availability of resource needed to carryout the research**	**Project documents;**
• **Consider the probability of success and apprehend likely constraints**	**Project documents; and,**
• **Consider the knowledge status of the research problem**	**Project documents,**

Table 9.3 Suggested criteria for Project preparation

Objectives are the transformation of individual identified research problems into projects

Process (function and activities)	Means of verification (specified in terms of number, type, duration and relevant period)
The Institute needs to prepare research projects which must have: • Clearly defined objectives • Clear statement of the problems with pertinent data and information to substantiate the significance of the research • Clear and specific plan of work to achieve the objectives including methodology, reasoning for such methods, time schedule, break down of work plan • Indication of all the inputs: Human resource + skill needed, financial resources (cost & budget), physical resources • Statistical design, nature of data (root, shoot, leaf and interval of data collection,) data source, type of data(qualitative / quantitative) requirement • Probability of success, indication of expected results and anticipated constraints • Monitoring system, frequency and nature of result reporting • Evaluation techniques and interval of evaluation and system of reporting	Project documents at the Institute

Table 9.4 Suggested criteria for Project appraisal

Objectives are to ensure management that the project is designed in such a way that it will achieve its objectives within the time specified by relevant authority, it is profitable to under take the project compared with other projects, and adequate funding is available.

Process (function and activities)	Means of verification (specified in terms of number, type, duration and relevant period)
The Institute needs to carryout the following activities • Comparison of different designed projects against the following parameters (as suggested): • Problem identification (to ensure correct problem is identified) • Priority setting (clients need and urgency for research + comparative merits in terms of benefit) • Monitoring format and technique, • Evaluation techniques • Probability of success and anticipated constraints	Documented records of different research projects

Table 9.5 Suggested criteria for Monitoring

Objectives are to observe or check on research activities to ensure that activities are proceeding according plan through recording input use and comparing achievements with targets + highlight bottlenecks and warn any deviation from initial goal and expected outcomes

Process (function and activities)	**Means of verification (specified in terms of number, type duration and relevant period)**
The Institute needs to carryout the following activities: Develop monitoring plan (format) which must have: • Work plan and time schedule for individual activities • All pertinent data requirement, such as: site specification, experimental design and layout, nature of data requirement (qualitative / quantitative), type of data recording (weight / length of shoot, root, leaf, soil data, disease, insect, nematodes attack, chemical efficiency against herbicides, fertiliser response, processing quality, bio-chemical aspect • Interval of data collection and reporting • Specification of resource and skill needed • Record on different input utilisation • Report preparation by whom to whom, comparing achievements against target and highlighting specific constraints	**Survey and physical verification on monitoring formats for data on: Financial records and statements; data on resource utilisation; Publish reports: Monthly; Quarterly; and, Annual and Technical reports.**

Table 9.6 Suggested criteria for Evaluation

Objectives are the assessment of ongoing and completed research projects through strong interactions with scientists, advisory-extension officers and clients

Process (functions and activities)	Means of verification (specified in terms of number, type duration and relevant period)
The Institute needs to carryout the following activities:	
• Internal seminars within the Institute: Monthly, Quarterly, Annually	Seminars proceedings and participants records
• Internal seminars, workshops involving clients, advisory-extension and scientists: Quarterly, Annually	Seminars proceedings and participant records
• Demonstrations (field and factory): involving clients, advisory-extension and scientists (when suitable): Monthly, Quarterly, Annually	Participants records
• External seminars, workshops and demonstrations involving wider scientific community and clients: Annually or Biannually	Proceedings and participant records
• Internal peer review (modified): Half yearly, Annually	Reports
• External peer review: every 3-5 years	Reports
• International seminars: every 5-7 years	Proceedings and participant records.

Table 9.7 Suggested criteria for Technology dissemination and feedback

Objectives are the effective transfer of developed technologies + obtaining information on clients needs through the following strong interactions

Process (function and activities)	Means of verification (specified in terms of number, type, duration and relevant period)
The Institute needs to carryout the following activities: • Routine and request visits by : Advisory - extension officers and scientists to achieve specified objectives • Demonstrations: to different client groups on developed improved technologies	Records of visit programmes and of visit reports (contents) by advisory-extension officers + scientists (both at the garden and Institute) Survey of demonstration plots at main station and sub-stations + participants attendance records at main and different sub-stations
• Training: of different client groups highlighting newly developed technology	Participants attendance records, training programmes + prepared handouts
• Seminars, workshops, opendays and group discussions involving: clients + scientists and advisory-extension officers	Proceedings (contents) + participants attendance records
• Formal meetings: involving scientists + management committees + technical committees + advisory - extension officers	Minutes of the meetings (contents) + attendance records
• Publications: Annual reports, Journals Memorandums Circulars Advisory bulletins Popular articles Articles in local language Technical reports	Contents of different publications in the library
• Monitoring and evaluation of adoption of technologies by different client groups	Survey of adopters and non adopters, Survey of areas brought under different technologies (recommendations). Farmer focus groups

Table 9.8 Suggested criteria for Committee system

Objective is to develop strong committee system to help the research manger to make rational decisions for effective and efficient management of the function and activities of the organisation

Process (function and activities)	Means of verification (specified in terms of number, type duration and relevant period
The Institute needs to form the following:	
• Committees and sub-committees according to the criteria specified under best practice audit for Committee system:	Documented records
• Management Board or Trustee Board	Documented records
• Different technical committees and sub-committees	Documented records
• Different regional committees	Documented records
• Joint committees	Documented records
• Committee to facilitate interaction between advisory-extension officers and scientists	Documented records

Table 9.9 Suggested criteria for Management information system

Objectives are to develop and maintain of a central data and information retrieval system

Process (function and activities)	Means of verification (specified in terms of number, type, duration and relevant period)
The Institute needs to collect and maintain the following basic information	
Research management:	
Detailed research project specific information like: (number of projects, nature of projects)	Project document records at the Institute
• Meteorological data	Meteorological stations + research stations
• Soil nutrition profile data of the industry	Analytical data at the research Institute + soil survey
• Pest and disease status data of the industry	Survey data on: pest and disease incidences
• Index of different recommended technologies: Soil and climate specific suitability	Record at the Institute and individual department
• Data and information on: cost and budgets, resource utilisation, physical facilities and human resources with specific skill	Budget, purchase and store records, recruitment and office records
• Industry data: Survey records on: total tea area, area under tea, area under different plant types,	Records at the Institute
• Different type of management, area under each management category, rate of uptake of technology and constraints face by each management category	Records at different tea garden management head office and Institute
• Agro-ecological region specific needs	Data at main station and sub-stations

Table 9.10 Suggested criteria for Human resource management and development

Objectives are to select, retain, and motivate the quantity and quality of people it needs + improve individual and therefore organisational performance in order to achieve the organisational goal

Process (function and activities)	Means of verification (specified in terms of number, type, duration and relevant period)
The Institute needs to carryout the following activities: Human resource planning: according to the criteria as specified in number one under the best audit practice for HRMD. The planning must contain:	
• Job analysis	Job specification: function and responsibilities
• Clear and specific recruitment and selection policy	Contracts of employment, terms and
• Employment practice and procedures	conditions of service
• Staff welfare	Mission statements of the organisation
• Performance management (performance review, potential review, performance improvement programmes, career development programmes, reward review)	Appraisal systems Filled in pro-forma for different reviews
• Training	Training programmes and participants
• Management development	records
• Reward management	
• Career management	
• Job evaluation	

9.3 CHAPTER SUMMARY

This chapter has reproduced the RPCM which was shown in Chapter 7 in order to emphasise that research management activities need to be carried out in a structured way. Further, the Chapter has suggested guidelines for major tea research and management activities mainly based on the refinement achieved during their application on *Phase Two* case studies. The next chapter examines the application of conceptual framework and suggested guidelines in specific context of BTRI.

CHAPTER 10

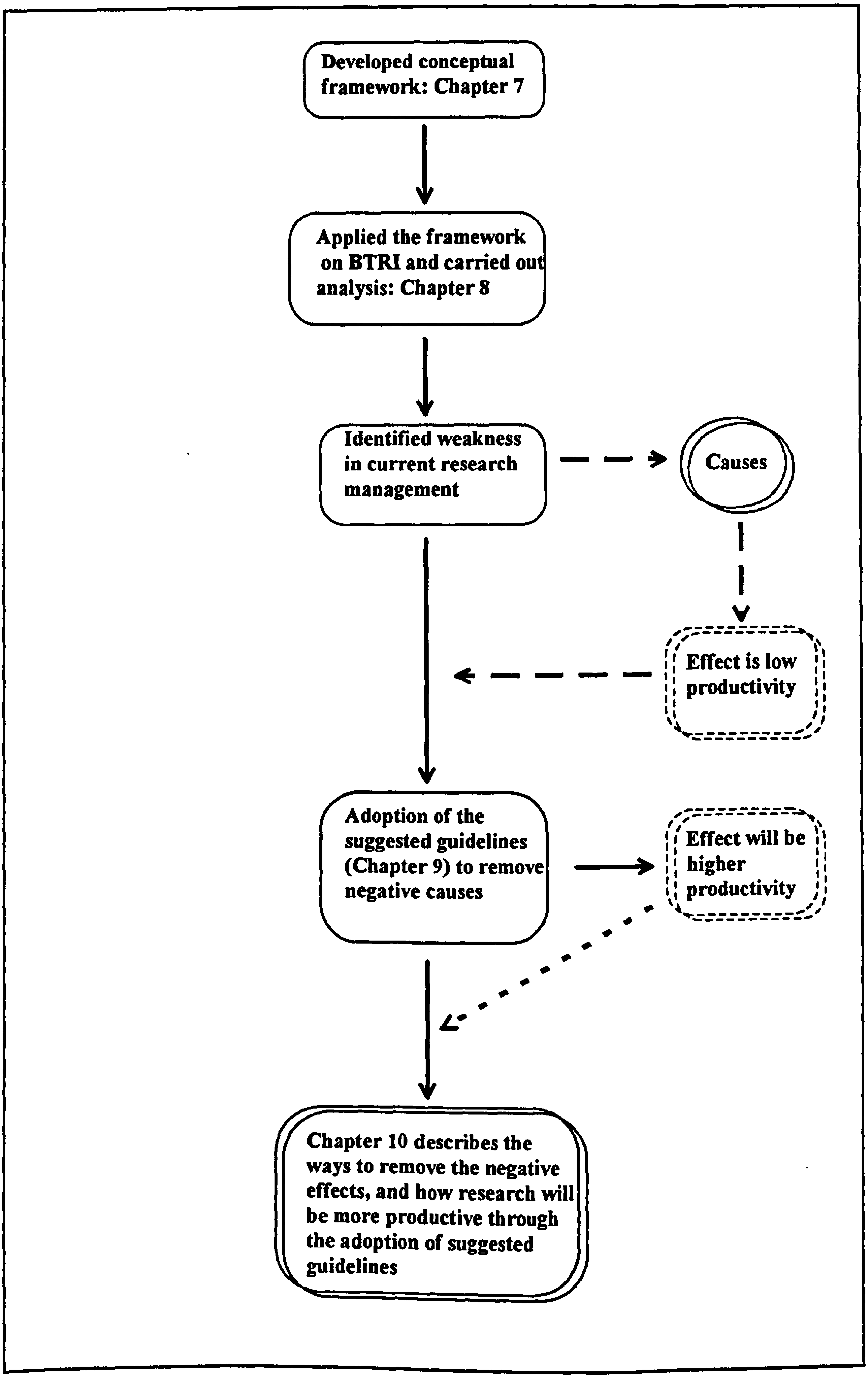
IMPACT OF SUGGESTED GUIDELINES FOR MANAGEMENT OF THE BANGLADESH TEA RESEARCH INSTITUTE

This particular study has been carried out to develop guidelines for the improved management of tea research. In order to achieve the study objectives, performance criteria were developed from the literature review (Chapters 2-4) and case studies carried out in Phase One (TRFCA and TRFK Chapter 6). Subsequently, best audit practices, objective verifiable indicators and their means of verification for management criteria were identified (Chapter 7). In addition, a scoring model was developed to assess the performance of research management functions.

In the perspective of the developed conceptual frame work, Phase Two case studies (TRI-Sri Lanka, UPASI, BTRI and Tocklai) were carried out. Analyses have been done (Chapter 8). Based on all the case studies, specific systems, criteria and activities have been suggested (Chapter 9) to improve the performance and productivity of research management functions. Also a new management cycle has been proposed (Section 7.2) to perform the research activities in a sequential and coherent way to make the research more productive and responsive to the industry needs.

This Chapter reports the impact of applying the developed conceptual framework in the specific context of BTRI, thus fulfilling the third and last objective of the project. For better clarity and easy understanding the logical flow of this Chapter is shown in Figure 10.1.

Figure 10.1 Flow diagram of the Chapter 10



10.1 SUMMARY OF FINDINGS BASED ON APPLICATION OF CONCEPTUAL FRAME WORK ON BTRI.

Detailed case study analysis on BTRI is presented in Section 8.1.3. Though the overall research management score is below the average (Figure 8.4), internal communication and management approach is strong. Monitoring, technology dissemination, management information system are of average nature. However, the following key weakness in the current research management system of BTRI require to be addressed urgently in order to make the research more productive:

- inadequate linkage and feedback with the industry;
- weak advisory and extension service;
- weak publication system (irregular publication of journals and annual reports; no monthly or quarterly bulletins like Tocklai and UPASI).
- inadequate Sub-station facilities;
- weak systems of research evaluation; and
- weak committee system.

These weaknesses have significant negative effects on the productivity of research at BTRI. Among all weaknesses, linkage between industry and the advisory / extension service seem to have a common and wider influence on a range of research management activities, such as: problem identification, priority setting, technology evaluation, technology dissemination, rate of uptake of technology and monitoring of adoption constraints. The overlapping relation between linkage of advisory / extension and the industry is diagramatically shown below (Figure 10.2)

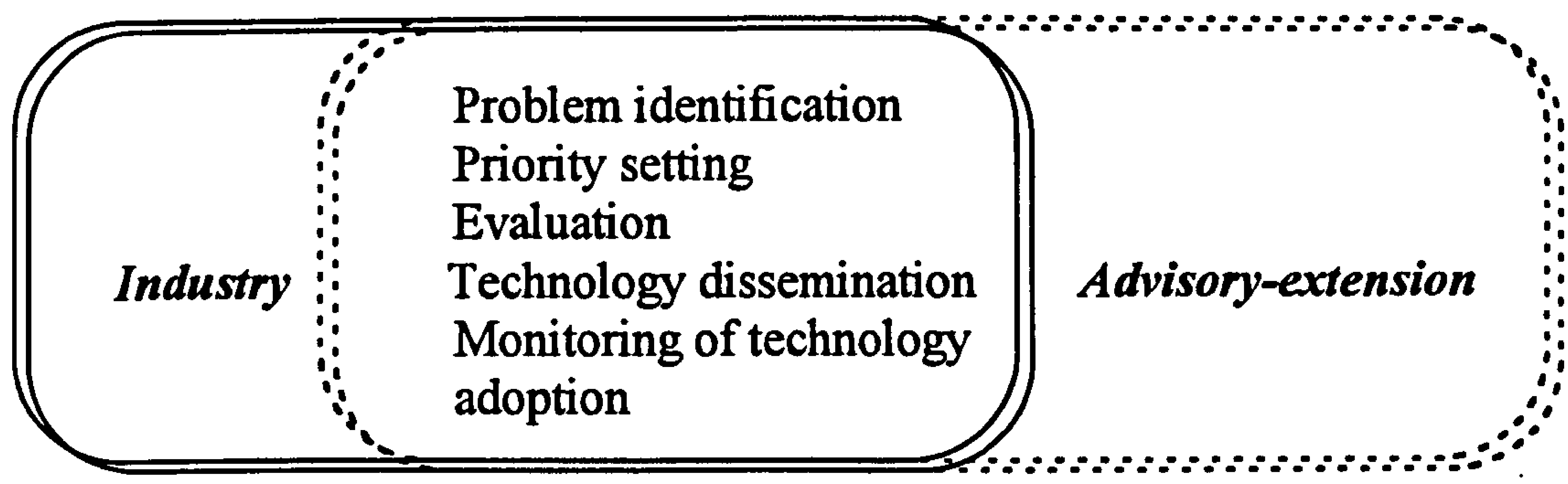


Figure 10.2 Relation between the industry and advisory and extension

10.2 CORRECTIVE ACTIONS IN LIGHT OF DEVELOPED GUIDELINES

The adoption of suggested guidelines as described in chapter 9 (Tables 9.1-9.10) can help to improve the linkages between research, advisory / extension and the tea industry in order to make research more productive and responsive to the industry needs.

10.2.1 STRENGTHENING OF LINKAGE AND FEEDBACK WITH THE INDUSTRY

BTRI needs to carryout the following activities on a regular basis in order to strengthen the linkages between research, advisory / extension and industry.

Routine and request visits by advisory / extension officers and scientists

Such visits are very important because, they enable the Institute to interact with the industry directly. This helps to solve currently emerging problems of the industry. Strong linkage will help the Institute to obtain feedback on industry needs and circumstances where evolved technology will be used. It will also help the Institute to identify area specific industry needs and modify technologies to suit specific client requirements. Consequently, problem identification will be improved. Further more, this will help in effective dissemination of technology, and monitoring of adoption constraints. This information can be used later by the Institute in future planning of research programmes.

Demonstration

Demonstrations provide an important forum where scientists, advisory / extension officers and industry can meet closely. Demonstration on current research trends and new technology among different client groups at the main station and sub-stations will facilitate close interactions with the industry participants. Thus linkages with the industry will be strengthened. Discussions during such demonstrations will help the Institute to obtain client's views and identify research needs. Through such demonstrations industry will witness the benefit of demonstrated technology. It will help to motivate the industry to adopt the technology quickly. This will facilitate the evaluation of technology by the industry directly. Thus industry will develop confidence in research recommendations.

Training

Training different client groups will help them to understand and implement the technology in an efficient way. Training will enable the Institute to interact with the participants closely. Discussion during such training will create the opportunity to obtain industry feedback, and help in the evaluation of technology indirectly. Training activities will help to develop skill and broaden the knowledge of participants, which is essential in understanding basic facts of recommended technology. Consequently, implementation of research recommendations will be easier and more effective.

Seminars, workshops, open days and group discussions involving industry, scientists and advisory / extension officers

These could be arranged in a way suggested under strengthening of advisory / extension (Chapter 10.2.2). They will provide strong and effective fora where industry, research and advisory can come very close to each other and exchange views. Institute would be able to obtain industry feedback during these activities. This will also help in problem identification, evaluation and dissemination of technology as well as finding out adoption constraints of technology.

Formal meetings with different management committees (industry representatives) involving scientists and advisory / extension officers

Management committee members are mostly senior representatives from different groups of the industry. They are responsible to formulate strategic policy guidelines for individual companies. It is one of the best fora to influence industry management. Formal meeting will create the opportunity for the research authority to interact closely with industry representatives. Hence, this forum will strengthen the linkage with industry. Consequently, problem identification, priority setting, evaluation and dissemination of technology would be easier and effective. If the Institute can convince and influence these committee members, it will have positive effect on the industry through the adoption of specific research recommendations.

Experience showed that sometimes some of the multi-national companies in Bangladesh tea do not readily take some recommendations of research on the grounds of having their individual company policy. In such situation, formal meetings will create the opportunity to convince multi-national companies regarding adoption of BTRI recommendations. In addition, it will help to obtain their views, which could be used in future planning of research programmes.

10.2.2 STRENGTHENING OF ADVISORY / EXTENSION

The advisory / extension division plays a key role in developing and maintaining close industry linkage and feedback with the research. Case study analysis showed that only those organisations having strong advisory / extension systems, particularly area specific (valley based) are having strong linkage and feedback from the industry, such as Tocklai and UPASI (Chapter 8). Since linkages with the industry is a main weak point for BTRI, to improve the linkage and feedback with the industry in light of suggested criteria (Table 9.7), the present Advisory Division of the Institute needs a change of structure and function. Therefore it is essential to know the present structure of the Advisory Division with its human and physical resources and operational systems. This is described below.

Advisory Division and its physical resources

At present there are three Sub-stations, namely: Udalia in Chittagong, Kaliti in Kulaura, and Sylhet in the Sylhet District. These sub-stations are under the control of Advisory Division of the main station of BTRI (Figure 10.3).

Figure 10.3 Working relation between the Advisory Division and Sub-stations

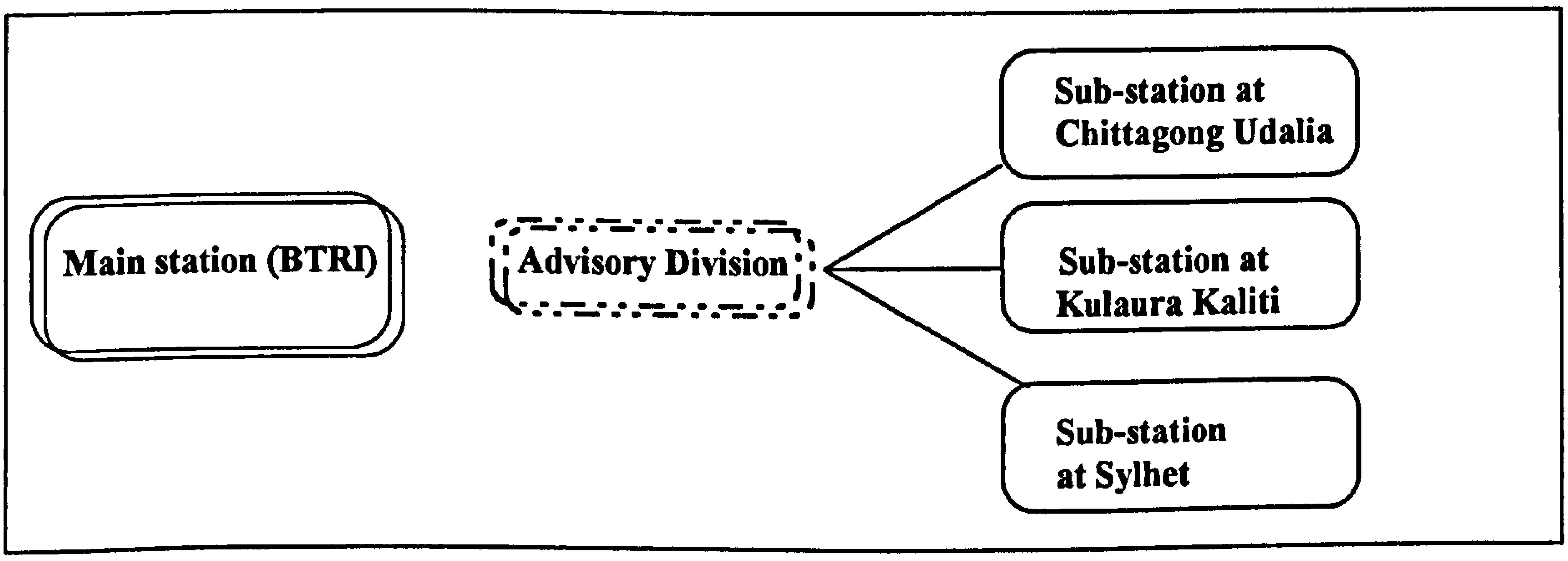


Table 10.1 Distribution of human resources under the Advisory Division of BTRI

	Main station station	Udalia sub-station	Kaliti sub-station	Sylhet sub-station	Total
Chief Scientific Officer	X	X	X	X	0
Principal Scientific Officer	1	X	X	X	1
Senior Scientific Officer	1	1	X	X	2
Scientific Officer	*2	X	X	1	1
Senior Field Assistant	1	X	1	X	2
* Vacant					

The detailed operational process and weaknesses of the present Advisory Division have been described in Sections 8.3.9 and 8.3.15. However, this could be summarised as:

- acute shortage of human resources, transport and infrastructural particularly in Sub-stations;
- advisory services are mainly done from the main station (BTRI). Often because of physical distance of gardens from the main station, it is difficult to render effective advisory service to all tea estates; and,
- linkages with the industry are inadequate.

Strong linkage could be achieved by strengthening the Advisory Division and adopting valley based advisory-extension service. In the past it has been observed that, present valley scientific committees are not effective in generating ideas and suggestions regarding industry research needs (Carr, 1988 and Mould, 1991). Moreover, because of physical distance and transport facilities, communication became a constraint for which VSC can not readily communicate with the BTRI. Past activities have revealed that, for various reasons, VSCs could not perform their function properly (Section 8.3.15). Strengthening of advisory / extension will provide the opportunity to introduce valley based advisory / extension service. If valley based advisory service is introduced, the advisory officers responsible for an individual valley could act as member secretaries for that valley and streamline VSC activities. Co-ordination between VSC and the Institute will improve.

In addition, with the provision of valley based advisory service system, valley based demonstration could be introduced. This arrangement will help:

- quick and effective technology dissemination;
- monitoring of adoption constraints;
- to obtain feedback on area specific industry needs;

- to bring research and industry closer and improve problem identification; and,
- the Institute to carry out region specific trials for wider adaptability of evolved technology.

To develop linkage and obtain area specific clients needs, in light of suggested criteria, the present BTRI management needs to find ways and means of organising different valley scientific committees and joint area valley scientific committees like UPASI, Tocklai and Sri Lanka. Their main function will be to arrange:

- training and demonstration;
- area scientific seminars;
- joint area scientific seminars; and,
- valley workshops, special events.

These arrangements will provide opportunity to interact between research, advisory-extension and the industry. Hence these will help in obtaining information on industry feedback and client's circumstance, which in turn will help in problem identification, evaluation and technology dissemination.

In order to perform outlined activities and achieve these in reality the following consequential changes are essential:

- the division should be renamed as Advisory and Extension Division (AED) instead of its present name of Advisory Division.
- a committee needs to be formed to co-ordinate the activities of AED;
- system of advisory activities need to be reorganised to cover all valleys effectively; and,
- human resources and transport facilities need to be increased.

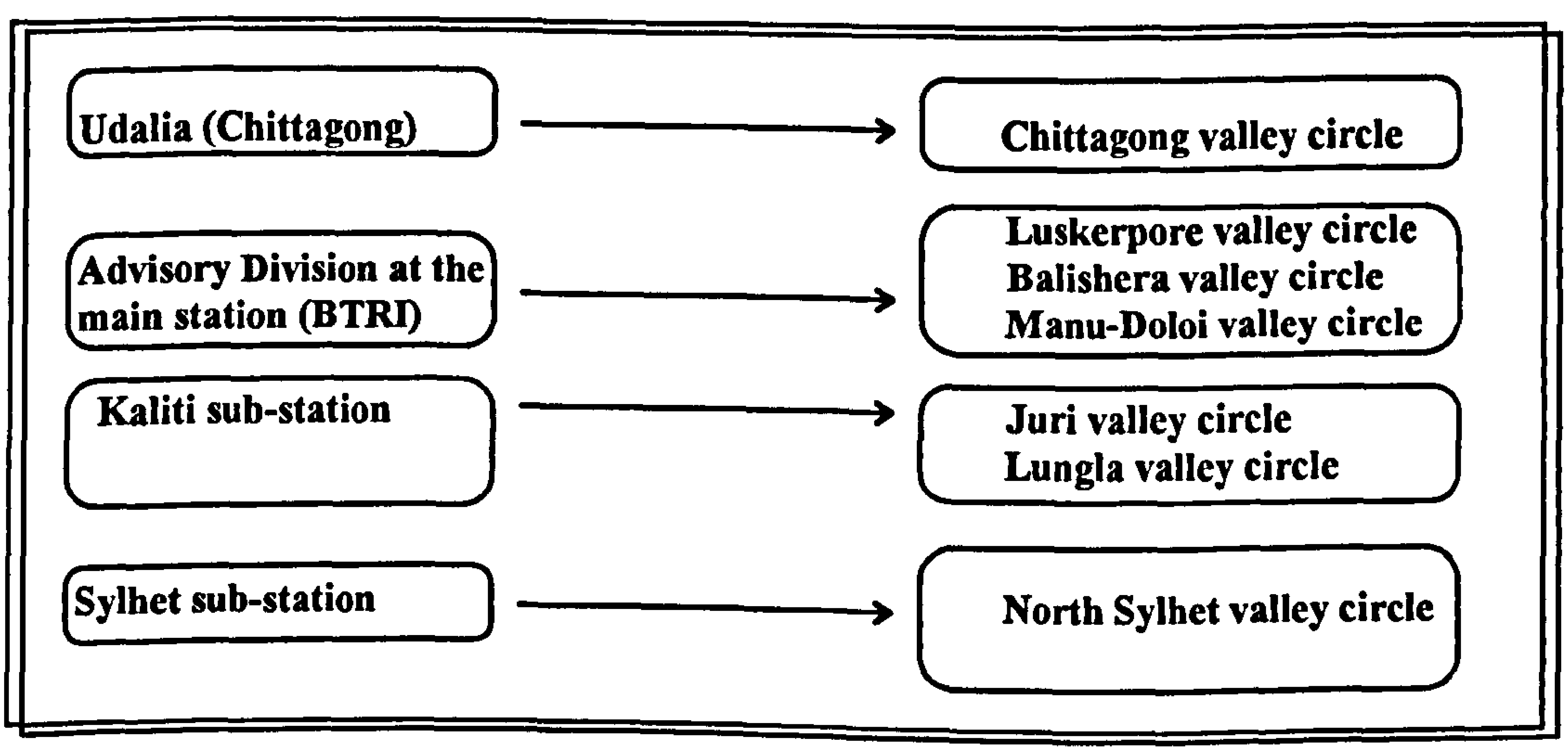
Table 10.2 Increase of human resources under Advisory Division

	Main station station		Udalia sub-station		Kaliti sub-station		Sylhet sub-station		Total	
	CS	SI	CS	SI	CS	SI	CS	SI	CS	SI
Chief Scientific Officer	X	1	X	X	X	X	X	X	X	1
Principal Scientific Officer	1	X	X	X	X	X	X	X	1	X
Senior Scientific Officer	1	X	1	X	X	1	X	1	2	2
Scientific Officer	*2	X	X	1	X	1	1	X	3	2
Senior Field Assistant	1	X	X	1	1	X	X	I	2	2

* Vacant, CS= Current strength, SI= Suggested increase

Bangladesh tea area has been divided into 7 valley circles (Section 8.3.15) namely :Chittagong, Luskerpore, Balishera, Manu-Doloi, Juri, Lungla, and North Sylhet. Currently advisory activities to all valleys are conducted from the main station BTRI. With the provision of increased human resources, all sub-stations will be strengthened and advisory activities can be rearranged as follows:

Figure 10.4 Proposed arrangement of main station, sub-stations valleys for advisory activities



New arrangement and operational system of Advisory Division will enable the Institute to serve the industry better. It will help to strengthen the linkages with the industry more and two way flow of information between research authority and the industry will take place. Consequently, identification of research problems and their prioritisation, evaluation and dissemination will be more effective. Ultimately research will be more productive.

To manage the activities of a new operational system for the Advisory Division, there will be a great need of co-ordination which can be achieved by the creation of a new Advisory and Extension Committee (AEC). This arrangement will also help substantially to overcome the problem of weak committee culture.

This committee will co-ordinate the activities of the new Advisory and Extension Division of the Institute. The structure of the committee will consist of the Director of the Institute as the Chairman with the following members:

- heads or in-charge of the three Sub-stations (3);
- BCS valley circle Chairman of 7 valleys (7);
- R & D representatives of individual companies who have separate R & D cells;
- heads of BTRI research divisions (8).

Head of the AEC will act as the Member-Secretary of the committee.

The responsibility of AEC will be to:

- prepare and circulate the Advisory / extension programme (routine visits, seminars, workshops, opendays, group discussions, training) for the coming year. Consequently, it will help to gear the activities of the present VSC;
- identify, prioritise and suggest researchable problems according to region / valley specific industry needs for preliminary inclusion in new research programmes. This arrangement will help to overcome the weaknesses regarding the research programme formulation identified by Mould, 1991 and Shaikh, 1991 (Section. 8.3). Further, this will enable the Institute to

obtain industry views regarding problem identification and priority setting as suggested in the RPCM (Section 7.2);

- monitor constraints of technology adoption and feedback the information to the Institute for future planning of research programmes;
- co-ordinate the activities of present VSC particularly regarding organising seminars, workshops, opendays, and demonstrations;
- organise annual conference and joint valley scientific symposium; and,
- prepare proceedings from different workshops, seminars, symposium and annual conferences.

The AEC should meet at least three times a year (January to December), first meeting in November-December, second meeting in March- April, and third meeting in July-August.

The objectives of first meeting in the research year will be to:

- prepare and circulate the programmes for the next year;
- identify and recommend research problems for preliminary inclusion in the new research programmes;
- decide about the valley specific adaptive trials; and,
- co-ordinate and arrange annual conference and or joint area valley symposium.

Other meetings will:

- monitor and review the activities according to the approved programme; and,
- identify constraints and suggest remedial measures to the Chairman of AEC, and,
- suggest any change of topics in the programme according to the current need, for inclusion in seminar, workshops.

Most importantly, these meetings will facilitate close co-ordination between research, AEC and the industry, which is at present lacking.

10.2.3 IMPROVING EVALUATION

In order to improve the evaluation by adopting suggested guidelines (Table 9.6) the following activities should be undertaken:

a) Internal reviews: these are open meetings where researchers and managers review research activities, identify achievements and deficiencies in research programmes, and establish directions for the future. Internal reviews could be carried out through:

Monthly seminar: Management must consider actions to revive its system of monthly seminars which have become irregular. They will provide the opportunity, where close interaction, open and critical discussion among the scientists and advisory-extension officers could be held. In addition this forum would serve as an evaluation of on going research projects, and will strengthen the internal evaluation system.

Quarterly review: all the departmental heads and working scientists can prepare upto date reviews of departmental research for internal discussion. Such discussion will help to find out what has been left and what needs to do to perform the activities timely. Such forum and critical discussion can help as an ongoing project evaluation, and will strengthen the internal evaluation of research.

Annual technical conference: this should be an internal activity which may be conducted every year with the participation of all scientific and advisory-extension officers. It could be for a duration of minimum 4-5 days where individual researchers will present the progress of their research projects. This could act as internal peer review on ongoing research, hence strengthening the evaluation process. Lessons and experience from such technical conference will also help in improving future planning research programmes.

b) External peer reviews: are evaluations of research systems, programmes, units or projects carried out by relevant experts from outside the unit or the Institute. Peterson and Horton (1993) suggested that in such evaluation clients and stakeholders could be included. The objectives of external review include accountability, planning, monitoring of research implementation, or measurement of achievement or impacts. Besides the individual external peer reviews, the following activities could be seen as serving same purpose.

An annual conference should be organised in one year and joint valley scientific symposium in alternate yeas involving clients, research and advisory-extension. In this conference, divisional detailed research activities could be presented. In such forum, the Institute can explain the progress and any significant findings which are ready to go as recommendations. This will give the opportunity to obtain industry views before considering them as recommendations. Most importantly it will facilitate closer interaction between research, advisory-extension and the industry.

A Joint Valley Scientific Symposium could be arranged where all industry representatives, BTRI scientist and advisory / extension can meet for 2-3 days, as at UPASI and Tocklai. This will enable close interactions and feedback between scientists, industry and advisory / extension officers. This can be a mainly field oriented activity. During the first half of each day, theory of technologies may be discussed followed by practice in the field in the afternoon. In the symposium heads of BTRI research divisions can present papers highlighting their achievement. Senior industry representatives may present papers enumerating the success and constraints of previous recommendations and current problems. In addition AEC can select certain tea estates for better performance and the managers of those gardens may discuss the practice and achievements. Participants and scientists can learn these practical management operations. This will particularly help in:

- obtaining industry feedback regarding new problems, which in turn will help in problem identification;
- dissemination of technology;
- finding out about constraints in implementations of BTRI recommendations;

and,
- evaluating research findings and monitoring technology adoption.

Institute needs to arrange a *International Scientific Conference* at least once every 5-7 years. This will help the Institute to exchange ideas with other similar organisations of the world. It will also help the evaluation of its own research by the wider scientific community, there by addressing one of the weak points of the institute.

A Modified internal peer review system will broaden the range of evaluation criteria beyond the quality and scientific merit of the research to include social and economic considerations. It is often use to evaluate the potential uses of the output and the socio-economic impact of research. In such reviews research clients and policy makers may be included on review committees and panels (Gapasin and Uribe, 1993).

10.2.4 STRENGTHENING PUBLICATIONS

Publication of bimonthly bulletins by individual sub-stations need to be introduced to serve as a reminder to the industry regarding important regular operations. They also help in technology dissemination. There is a backlog at BTRI in publishing journals and annual reports. The Institute needs to put more effort to bring its current publications of journals and annual reports upto date and in time.

10.3 SUMMARY.

This Chapter has described the consequence of applying the conceptual framework in the specific context of the BTRI. Thus, it has enumerated how problem identification, priority setting, research evaluation, technology dissemination, monitoring of the technology adoption and adoption constraints can be improved. In particular, it has recommended how linkages with the industry can be improved and strengthened. In so doing it has suggested the changes and discussed how adoption of suggested guidelines can help to remove the present weaknesses of research management in order to make the research efficient, more productive and client oriented. However, the financial and infra structural requirements of the recommendations have not been addressed because these are beyond the scope of this study.

CHAPTER 11

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

11.1 SUMMARY

This study has been carried out to develop criteria for assessing the performance of research management in tea and to develop guidelines for effective management of tea research. This has been done with respect to: problem identification, priority setting and resource allocation, implementation, evaluation and dissemination of technologies among potential clients. The study has also examined the likely impact of applying the guidelines in the specific context of BTRI.

In order to achieve the set objectives, methodologies have been developed from the literature review and selected case studies. A case study approach has been adopted for the research. Six tea R & D organisations of varied nature in respect of size, structure and management were selected from Asia and Africa. Case studies were conducted in two phases. ***Phase One*** case studies were mainly exploratory in nature, which were targeted principally to acquaint with current research management practices.

Following the ***Phase One*** case studies, methodologies were refined, and research management criteria were identified. Subsequently, best practices audit, objective verifiable indicators and their means of verification were developed. In order to assess the performance of research management functions, a scoring model was developed. To carry out the research management functions in a more productive, efficient, logical and coherent manner, a new participatory approach (RPCM) was suggested.

The RPCM consists of two different but interrelated cycles. One is an *innovation cycle* and the other is a *project cycle*. During the *innovation cycle*, research problems are identified, and prioritised by the research authority and the industry (clients). Once problems are prioritised, research proposals are developed and appraised. The next management activity is the implementation and monitoring of research projects. At this stage evaluation starts which if appropriate, leads to recommendations. Subsequently, technologies are disseminated by the research authority. If widely adopted, these recommendations become the current practices in the industry from where new problems are identified. The RPCM provides strong linkages and good feedback between the industry and research authority. Consequently, research becomes more responsive to the industry needs.

To validate the conceptual framework and scoring model, ***Phase Two*** case studies were carried out. The developed conceptual framework was applied on four tea R & D organisations. In so doing, the performance of these organisations has been analysed and assessed, and their current weaknesses and strengths have been identified. The conceptual framework was refined after each case study, by incorporating the ideas and experience gathered. Following ***Phase One*** and ***Phase Two*** case studies, guidelines for tea research management have been suggested.

The research management performance of BTRI was assessed by applying the framework. During analysis, some weaknesses were identified which were preventing optimum output from research. The impact of applying conceptual framework in the specific context of BTRI was identified. Thus the study showed how suggested guidelines can remove the negative effects on research management at BTRI. As a consequence, some changes in the present organisational structure and functions have been suggested to management in the light of the identified weaknesses and opportunities.

11.2. CONCLUSIONS

The study has covered a wide range of research management issues. Overall findings from this study can be summarised as follows:

With respect to existing management practices in tea R & D

- lack of systematic approach in setting research priorities;
- there is a lack of structured approach in carrying out research management activities;
- systems of research project appraisal are not followed by tea R & D organisations when selecting research projects;
- research management performance criteria, objective verifiable indicators and their means of verifications are not available;
- there is a great deal of variations in the management performance of tea R & D organisations;
- data on resource utilisation and benefit obtained through specific research projects are not available. In such a context incremental cost benefit analysis can not be carried out;
- there is a lack of awareness about the importance of studying the rate of uptake of technologies which is much needed for assessing the impact of research. However, data on the rate of uptake of technologies are not kept in tea R & D organisations;
- management information systems for the most part are inadequate. Data and record keeping are not systematic. Consequently, it is difficult to make any effective decisions;
- there are good correlation between evidence of best practices suggested by the guidelines and the research performance of Tea R & D organisations. Organisations which adopted the developed best practices and suggested guidelines are performing better in respect of research management. For example, Tocklai carried out a preliminary study to find the difference in productivity between the subscribing estate members and non members. The

study indicated an increase 58% in productivity by the member estates who are adopting Tocklai's recommendations.

With respect to the formation of guidelines for research management

- research management criteria have been identified in order to carry out research and analyse the research management performance in tea;
- research management activities can be carried out in a more structured and logical sequence if it is done according to the suggested RPCM. The RPCM especially highlights the importance and facilitates the participation of clients in some of the critical research management processes, namely problem identification, priority setting, evaluation and finally technology dissemination and feedback;
- the scoring model, objective verifiable indicators and their means of verification which have been identified and developed can be used to assess the performance of research management in tea;
- the developed audit of best practices and suggested guidelines can be used to conduct and manage the tea research;
- more emphasis should be placed on data collection and analysis to support the research management function, especially regarding up take of technologies and benefits generated;
- Research organisations can perform well without adopting systematic research management system because of strong leadership or the commitment and enthusiasm of researchers. There are however dangers if research systems are totally reliant on individual personalities. In such situations, changes in personnel can seriously affect research performance. This risk is reduced when organisations have a research management system in place. A systematic approach to R & D management is likely to make research more efficient and productive, but of course it cannot guarantee that this will be the case.

With respect to BTRI

Administrative policy issues

- in absence of permanent Director, management performance of BTRI is gradually deteriorating, therefore immediate steps should be taken to fill the post;
- like all other tea research Management Boards, the Director of BTRI should be a member of the Tea Board's Management Board;
- the post of Member Research and Development should immediately be filled;
- maintaining personnel files of BTRI employees, both at the BTB and BTRI should be stopped. To prevent waste of resources and avoid duplication of works, Director BTRI should be given more authority to decide on some of the basic and fundamental staff welfare issues. This will help in quick decision making;
- existing vacant posts should be filled immediately; and, steps should be taken to procure new vehicles and develop infrastructural facilities at sub-stations.

Research management issues:

- there is lack of structured approach in research management;
- problem identification, priority setting and research project appraisals are not addressed adequately;
- linkages and feed back with the industry are insufficient; evaluation of research is weak; and,
- library and publication facilities need to be up graded.

This work should be of value to the R & D managers and research sponsors, especially in the tea industry. It highlights that research must be carried out in a logical and coherent manner with greater participation from the beneficiary. Identified management criteria and developed model can be used to analyse the performance of research and there by increase its potential beneficial impact.

11.3 RECOMMENDATIONS

R & D activities are considered to be successful to the extent that they give benefit to society greater than the cost involved. At present there is inadequate awareness within R & D organisations regarding the importance of monitoring and evaluating the impact of research. The present study could not determine the benefits and impacts of research because of limited data. R & D organisations need to put more emphasis on monitoring and evaluation of effectiveness and impacts in order to justify research spending. Proposals for monitoring and evaluation should be built into the designs of research projects.

Organisational performance and productivity are greatly influenced by the external environmental factors. The study of R & D management requires substantial amounts of data and information from within and outside of research organisation. This study could not address adequately this issue, because data and information were not readily available. In addition, availability of time was a major constraint for such data and information collection during case studies. However, it is felt that particular studies need to be carried out to determine the applicability and performance of the developed model with respect to the influence of environmental factors on the developed conceptual framework.

Though the study concentrated on tea R & D management alone, the results are applicable to other agricultural R & D management situations, particularly for the R & D management of plantation crops. Whilst ISNAR has developed broad based guidelines, agricultural R & D management issues have not been studied in detail. In such context, the results of this study go a long way to increasing our understanding of management aspects of agricultural research and should help to manage agricultural R & D functions more efficiently.

The study points to the need for research organisations to place greater emphasis on management information systems to support decision making. In particular, tea R & D organisations need to make their own data base and information system according to the suggested guidelines in order to be able to retrieve information easily to make quick decisions.

Research organisations must keep data and information on the rate of uptake of technologies in order to be able to monitor the adoption of technology and study the impact of research.

This study has pointed to the need to further develop concepts of the quality of research management and related indicators applicable to tea sector. This recognises that not only must systems exist but they must also be effective in meeting organisational objectives.

This study was mainly exploratory in nature. It is suggested, therefore, that further study is needed to apply the conceptual framework and suggested guidelines on specific tea research institutes, possibly with some donor assistance from ODA or ISNAR.

Tea R & D organisations which have been used as case studies have shown keen interest in the subject. In this regard, it will be helpful to organise an international seminar on plantation crop research management, for tea in particular. The publication of a tea R & D management guide would help and enable the interested organisations to use the results of this study. Thus it will help in improving the management decision making in the plantation R & D sector, and tea R & D in particular. This is especially so as many elements of the plantation sector and tea in particular under go rationalisation and privatisation. This process will emphasis the need for client focused research.

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APPENDIX I CHECK-LISTS (QUESTIONNAIRE) TO OBTAIN INFORMATION ON RESEARCH AND RESEARCH MANAGEMENT ACTIVITIES

This appendix reports the checklists that have been developed from the literature review and personal experience. They were used during case study interviews to obtain information on tea R & D management issues. Interviews were recorded on a small cassette recorder. Later on, information from interview was used to identify research management criteria, objective verifiable indicators, their means of verification and suggested research management guidelines.

BACKGROUND DATA (*Country and Organisation under study*).

1. Name of the country
2. Map of the country
3. Research organisations' structure in the country (all agricultural research organisations, ministries)
4. Role of agriculture in the country
5. Agricultural goals in the most recent five years plan
6. Organisational structure (*chart*) of tea the industry
7. Major constraints in the industry in respect of production and export (commodity ranking, importing, agro-chemicals, export policy etc.)

STRUCTURE, ORGANISATION, ADMINISTRATION & MANAGEMENT

8. Organisational structure of: TRFK / TRFCA / TRI (Sri Lanka, Bangladesh, North India and South India):
   a. Year established (Founded)
   b. Mandate of the organisation/Objective ?:
   c. Its role in the agriculture
   d. Status (government, semi-government, autonomous etc.)

9a. Under which ministry does it work ?

b. What are the linkages with other ministries ?

10 From where does the Institute obtain its budget/fund ?

a. Government (G)

b. Industry (I)

c. Aid (A)

d. Joint G %, I %, A %

11a. What are the formalities involved to obtain the fund ?

b. Are the processes simple or complex in respect of time and procedures ?

c. If the process is complex, what would you suggest to make the processes simpler ?

12a. What is the total budget for the year 1993-1994,..........

b. Who approves the budget for the organisation ? (*Flow chart of budget approval*)

13a. At present are there any foreign aided projects ? If yes in which particular area of tea research ?

b. What are the steps and process involved to get a foreign aided project i.e. the protocol ?

c. What are the objectives and how long will each foreign aided project continue ?

d. To what extent are the present programs dependent upon external financing ?

14a. How is the research organisation managed (Is it by a governing / trustee board / another structure) ?

b. How many members are there in the board?

15a. Who selects the governing body member and who do they represent?

b. What are the functions of board members (Admin. & Research) ?

c. Who are the important members? (most influencing in decision making)

16a. What are the criteria used to select a board member(s) ?

b. Are there any fixed no of member(s) from a particular group/company/sector ?

c. How frequently do the Board Members meet ?

17a. If decisions require management board permission, how are the permission obtained ?

b. What are the procedures of communication between research director and board members ?

c. Do the board members meet research workers i.e. is there any communication and feed back between board members and research workers ?

18. How many people are working in the *Institute(I)* and in the *sub-stations(S.Stn.)*?

a. No. of scientific personnel:(I) = (S.Stn.) =

(B.Sc. and above).

b. No. of technical people (I) = (S.Stn.) =

(H.S.C / Diploma).

c. No. of other people (I) = (S.Stn.) =

19a. Designation of scientific personnel in hierarchical order

b. Job description according to the designation in hierarchical order

c. Degrees/Training etc.(no. of people)

Ph.D =

M.Sc. =

B.Sc. =

Diploma =

Technical *(working in scientific department)*=

20. How many research divisions are there ?, Names of research divisions:

a) f)

b) g)

c) h)

d) i)

e) j)

21a. Is there any on farm /farming system research division ?

b. What are the physical resources available to the Institute? i.e. no. of sub-stations/farms etc. Map of tea growing area also map showing the locations of farms and sub-stations.

C) PLANNING, PROGRAMMES FORMULATION & RESOURCE ALLOCATION:

Priority setting

22. What are the systematic procedure you follow for priority setting?

22.a) How are research problems identified ?

b) Who are the people involved in problem identification?. i.e. who brings the problem to the Institute:

- plantation manager
- extension people
- researchers
- others (please specify):

c. Approximately what percentage of problems are brought by whom ?

23a. Are research proposals subjected to initial screening ? If so, who does this and how is this accomplished (What are the criteria considered at this level) ?

b. What information is included in the research proposal ?.

c. Were any of the proposed projects rejected ? If yes, what were the reasons ?

d. What are the criteria used for acceptance or rejection of a research project?

e. In priority setting process to determine the importance of the problem and the needs of the industry, what are the different sources used to obtain information ?

e. Do you verify these information to come to a conclusion ?

f. How do you verify these ?

h. What are the different systems through which you obtain industry feedback ?, and

i. How effective are those systems ?

24a. What are the priority research areas for tea in terms of short, medium, and long term experiments ?

b. What are the current research priorities ?

c. What is the mechanism for determining them (process involved/stages) ?

25a. What are the criteria (factors) considered for priority settings ?

b. What are the most important ones (which factors have most influence) ?

c. Who are the people responsible for priority setting?

26a. What kind of consultation is involved in the process of priority setting with:

- policy maker at Institute level and higher level (director, board members, ministry representatives etc.)
- industry,
- extension service, and
- plantation people ?

b. Does the priority setting take into account the availability of Human, Physical and Financial resources ?

c. Does the priority setting take into account the information based on economic analysis of imperical models ?

Program formulation

27a. What process within the Institute is used to formulate research programmes ?

b. How are research programs formulated ? i.e. the process within the Institute ?

b. Who are the people involved in this process (Institute & others) ?

28a. How & who decides what research activities (project/program) will be carried out in each priority areas ?

b. What are the duration of : long, medium and short term experiments ?

29a. Are there any rules that out of 'x' no of experiments (......) should be long, (......) medium and (......) short term ?

b. To what extent does the amount of resources vary between: long, medium, and short term experiments ?

30a. Is there any set form/pro-forma for research program (describing, starting and finishing time, objectives, methodology etc.) ?

b. Before undertaking a project do you carryout any literature review ?

c. How many research projects are presently carried out ?

d. Are there any fixed no. of research projects carried out every year ?

31a. Is there a balance between applied and basic research in the current research program ?

b. To start a new program what are the factors considered to be important ? i.e. why are new projects undertaken taken ?

c. Are there any set rules that out of 'x' no. of projects (.....) would be on basic research ?

Resource allocation

32a. What are the steps /processes involved in resource allocation against the research projects ?

b. What are the criteria used for resource allocation ?

33a. If some 'x' project needed extra resources to continue how are those managed ?

b. Are there any set criteria that each project will get fixed no of scientific worker (how human resources are distributed against projects) ?

34a. How does the program relate to the resources available to the Institute ?

b. Is the budget sufficient for the planned program of work?

c. To what extent are there multi-year budgeting ?, what are the aspects included in this ?, what continuity of funding exists other than for staff salaries ?

d. How are unexpected cuts (or additions) to the budget dealt with ?

35a. How does the current research program relate to the objectives and priorities ?

b. Are there any objectives not covered by the current research programs ?

36a. Are there an appropriate program of work and budget linkage ?, are funds tied with the project, and is it possible to use funds which have been fixed for other specific projects ?

b. How are the individual units within the Institute co-ordinated in multi-disciplinary research projects ?

MONITORING & EVALUATION

Monitoring

37a. What are the processes of monitoring (how is monitoring done) ? in respect of:

- research progress
- expenditure control

b. How frequently is monitoring done ?

c. Who are the people responsible for monitoring ?

d. To whom monitoring results are reported ?

38a. How is the research progress information obtained ?

b. What type of decisions are taken as a result of this information ?

Evaluation

39a. What are the processes of evaluation ?

b. At what stage of a program does evaluation begin ?

c. How are the evaluation criteria determined (selected) ?

40a. Who selects the evaluation criteria ?

b. What are the criteria used for evaluations of research projects ?

c. How frequently is evaluation done ?

d. Who selects the evaluators ?

41a. Are there any internal processes of evaluation within the Institute?

b. How is that carried out ?

c. Are completed research projects evaluated ?, if so how are actual outcomes and resource expenditures compared with planned outcomes and expenditures ?, in what way are these information applied to subsequent research planning and control ?

d. Who has the responsibility for terminating an unsuccessful project ?, what criteria are used in coming to such a decision ?

COMMUNICATION (LINKAGES)

42. Within the Institute:

What *channels* of *communication* exists:

a. Within the program ?

b. With scientists of other programs ? and

c. How effective are they in both directions ?

43. With other organisations:

What *channels* of *communication* exists with:

a. Other research Institutes in the country ?

b. Universities ?

c. Private sectors ?

d. International Institutes ?, and

e. How effective are they in both directions ?

44. With extension service and plantation management people (farmers):

What *channels* of *communication* exists with:

a. Field extension workers ?

b. Plantation management (Farmers) ?,and

c. How effective are they in both directions ?

45. With policy makers:

What *channels* of *communication* exists with:

a. Institute and its headquarters ?

b. Extension services ?

c. Regulatory agencies ?, and

d. How effective are they in both directions ?

TECHNOLOGY TRANSFER, CONSTRAINTS AND RATE OF UPTAKE:

46a. Does the Institute carry out any zonal/regional adaptability trial(s) ?. How long is it ?

b. Which division of the Institute is responsible for transferring technology to the industry ?

c. What are the processes involved between extension /on farm research when technologies are ready for dissemination ?

d. How are the technologies disseminated to the industry ?

47a. How many of the research projects under taken during last 3,5,10,15,20 years have given tangible results ?

b. What are these results ?

c. To what degree have the results been adopted (rate of adoption) ?

d)What are the major constraints to the adoption of technology by the industry ? Is it availability of inputs/cost of inputs / motivation problems etc.?

48a. What are the criteria used to determine the rate of uptake of a technology?

b. Is there any particular sector / company /group who are adopting technology more than the other groups ? If yes, what are the reasons ?

49a. Are there any provisions of training to the tea management people by the Institute ?

b. What level of people are allowed in the training (i.e. field worker, assistant manager, manager etc.) ?

c. What is the duration of the training courses ?

d. What is the nature of training program (i.e. annual, biannual, quarterly) ?

e. Is it compulsory to have training to serve in the tea industry ?

50a. What are the publications through which technologies are disseminated ?:

- Scientific: Journal / annual report,
- Popular: Circulars, pamphlets, leaflets, booklets memorandum

  b. How often those are published ?. Other ways like: Seminars, workshops, open day sessions, visits, group discussions, and

  c. How often those are done ?

51 Is there any day to day correspondence between the industry and the research Institute ?

52. What are the other informal ways of communication between research and the industry ?.

APPENDIX II DIFFERENT QUESTIONNAIRE

Three different questionnaires were developed to obtain specific information from researchers, members of Management Boards, Trustee Boards, Technical Committees, Sub- Committees and Research Committees.

II. 1 QUESTIONNAIRE FOR RESEARCHERS

This questionnaire was developed to take information on research management activities of different TRI(s) from the researcher's point of view. Most of the questions were answered in short by respondents putting their ideas in the space provided.

(If needed please use extra paper).

Name of the organisation: Date

Name: Position:

1. What are your objectives as a researcher ?

2. As a researcher what are the main constraints that you face ?

3. To whom do you communicate these problems? and how are they solved ?

4. Do you take part in any decision making process ?. If yes, at what level, and what are those ?

5. Do you play any role in research planning ? i.e.:

- problem identification: Yes No

- prioritisation: Yes No

- program formulation: Yes No

- appraisal: Yes No

- resource allocation: Yes No

- monitoring: Yes No

- evaluation: Yes No

- technology dissemination: Yes No

6. Do you have any suggestions as to how to improve the above mentioned steps ?

7.a) How do you get your research resources ?

b). Do you find the process time consuming ?

8. Does the resource allocation process hinder your research progress / activities?, if yes, how ?

9. Do you have any suggestions as to how research could be made more responsive to the clients' needed ?

Thanking you for your co-operation.

II. 2 QUESTIONNAIRE FOR MEMBERS OF MANAGEMENT BOARD / TRUSTEE BOARD, TECHNICAL COMMITTEES, SUB-COMMITTEES, RESEARCH COMMITTEES.

This questionnaire was designed and used to obtain research management information from members of the Management Board and other committees who help the research manager in R & D management activities.

(If require please use extra paper)

Place Date

Name Position

Group / Company / Sector

1. How long have you been working in tea ?
2. Which tea countries have you visited ?
3. When did you become a member of BM / TB / TC / TSC / RC

4.a) What are the objectives of this committee ?

b) Up to now how many meetings have you attended (approx. %) ?.

5. Do you think that industry needs are well focused in the meetings ? and if not ,why , if yes how ?

6. Could you please focus on some of the achievements of this committee

7. Do you consider that sufficient technologies are available to the industry for improvement in both quality and quantity of tea ? : YES / NO

8. In the present context what would be your option between quality and quantity of tea ?, why ? (reasons; cost / benefit , availability of technology, time factor , other limitations)

9. Could you please list down the areas where you feel that more research should be carried out , and list them according to priority :

10. What are the new areas do you suggest to be researched on and why ?.

11. What are the ways through which you get information regarding the research findings / proven technologies ?.

12. Do you consider that present system of transfer of technology / dissemination of information by respective Institute / organisation are :

- very effective
- effective
- satisfactory (but needs improvement)

13. Do you have any new ideas for the improvement of present technology transfer / dissemination of technology ?

Thanking you for your co-operation.

II. 3 QUESTIONNAIRE FOR TEA MANAGEMENT PEOPLE (MANAGERS AND ASSISTANT MANAGERS OF TEA ESTATES.

This questionnaire was used to obtain information from Managers and Assistant Managers. Questions are mainly focused on the type of training they receive, nature of advice they obtain, ways and means of communication and feedback between the industry and research. This also helped to verify and clarify some of the information obtained from the research institutes regarding tea industry and vice versa.

(If require please use extra paper)

1. Place Date
2. Name of the company/group/sector:
3. Name of the estate:
4. Position : Senior Manager / Manager/ Manager in Charge/ Assistant Manager
5. When did you join tea : 199
6. Where do you work : Field / Factory ?
7. Have you ever attended any annual short course organised by the T R I in your country ?.
8. Do you find the TRI courses useful ? :Yes /No

   Why : Reasons

9. Have you attended management courses on tea ? : Yes / No
10. Do you consider that sufficient technologies are available to you for improvement in both quality and quantity of tea ?

    YES /NO
11. In the present context what would be your option between quality and quantity ?

    Quality / Quantity. Why (reasons: cost/benefit, availability of technology, time factor, other limitations) ?

12a. Could you please list down the areas where more research should be carried out and list them according to priority

b. What are the new areas you suggest to be researched ?, and why ?

13. Do you consider that present system of technology transfer by your organisation is :

- very effective
- effective
- satisfactory (but needs improvement)

14. Do you have any new ideas for improvement of present technology transfer?

Thank you for your co-operation.

APPENDIX III EXAMPLES OF COST BENEFIT ANALYSIS

During the case studies, data on resource utilisation and benefit was derived from different research projects. However, it appeared that in most of the research organisations data on resource utilisation and benefit derived were scanty, incomplete and unorganised. As a result, cost benefit analysis was not possible. A modified CBA (incremental cost benefit analysis) of research projects was carried out where data allowed.

Name of the experiment: Effect of Nitrogen on mature tea.
Source of Nitrogen: Urea and Sulphate of ammonia
Plant type: Indian seedling
Design used: Randomised block design
Location: Mimosa Tea Research Station
Area: 2.709 ha

Control (Without extra fertiliser)

FIRST YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Design & layout	3.00	1.00	22.15	66.45			
Pegging Labour	6.00	1.00	3.19	19.14			
Clearing Labour	6.00	1.00	3.19	19.14			
Weeding Labour	25.00	1.00	3.19	79.75			
Yield Benefit	1928.00	5.28				10179.84	
Total Cost					184.48		
							9995.36

Experiment with extra fertiliser

Design & layout	3.00	1.00	22.15	66.45
Pegging Labour	6.00	1.00	3.19	19.14
Clearing Labour	6.00	1.00	3.19	19.14
Weeding Labour	25.00	1.00	3.19	79.75
				0.00
Yield Benefit	1928.00	5.28		10179.84
Total Cost				184.48
Benefit				9995.36

Incremental Cost	Initiating year
Incremental Benefit	
Net Cash Flow (N.C.F)	

Control (Without extra fertiliser)

SECOND YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Pruning Labour	30	1.00	3.19	95.70			
Plucking	18	26.00	3.19	1492.92			
Weeding	25	1.00	3.19	79.75			
Spraying	5	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2	1.00	22.15	44.30			
Manufact. Cost				1048.87			
Output = kg made tea (MT)	1979						
Sale price /kg.	5.28						
					3056.89		
						10449.12	
							7392.23

Experiment with extra fertiliser

Pruning Labour	30.00	1.00	3.19	95.70			
Plucking	23.96	26.00	3.19	1987.24			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser	489.00	1.10	0.00	537.90			
Supervision	3.66	1.00	22.15	81.07			
Manufact. Cost				1401.32			
Output = kg made tea (MT)	2644.00						
Sale price /kg.	5.28						
					4262.73		
						13960.32	
							9697.59

Incremental Cost	1205.84
Incremental Benefit	2305.36
Net Cash Flow (N.C.F)	1099.52

Control (Without extra fertiliser)

THIRD YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18.00	26.00	3.19	1492.92			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2.00	1.00	22.15	44.30			
Manufact. Cost				650.6916			
Output = kg made tea (MT)	1227.72						
Sale price /kg.	5.28						
					2563.01		
						6482.3616	
							3919.35

Experiment with extra fertiliser

Plucking	38.76	26.00	3.19	3214.75			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser	489.00	1.10	0.00	537.90			
Supervision	6.00	1.00	22.15	132.90			
Manufact. Cost				1401.32			
Output = kg made tea (MT)	2644.00						
Sale price /kg.	5.28						
					5446.37		
						13960.32	
							8513.95

Incremental Cost	2883.36
Incremental Benefit	4594.60
Net Cash Flow (N.C.F)	1711.23

Control (Without extra fertiliser)

FOURTH YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18.00	26.00	3.19	1492.92			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2.00	1.00	22.15	44.30			
Manufact. Cost				650.6916			
Output = kg made tea (MT)	1227.72						
Sale price /kg.	5.28						
					2563.01		
						6482.3616	
							3919.35

Experiment with extra fertiliser

Plucking	38.76	26.00	3.19	3214.75			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser	489.00	1.10	0.00	537.90			
Supervision	6.00	1.00	22.15	132.90			
Manufact. Cost				1401.32			
Output = kg made tea (MT)	2644.00						
Sale price /kg.	5.28						
					5446.37		
						13960.32	
							8513.95

Incremental Cost	2883.36
Incremental Benefit	4594.60
Net Cash Flow (N.C.F)	1711.23

Control (Without extra fertiliser)

FIFTH YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Pruning Labour	30.00	1.00	3.19	95.70			
Plucking	18.00	26.00	3.19	1492.92			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2.00	1.00	22.15	44.30			
Manufact. Cost				1376.94			
Output = kg made tea (MT)	2598.00						
Sale price /kg.	5.28						
					3384.96		
						13717.44	
							10332.48

Experiment with extra fertiliser

Pruning Labour	30.00	1.00	3.19	95.70			
Plucking	23.18	26.00	3.19	1922.55			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				537.90			
Supervision	5.00	1.00	22.15	110.75			
Manufact. Cost				1773.38			
Output = kg made tea (MT)	3346.00						
Sale price /kg.	5.28						
					4599.78		
						17666.88	
							13067.10

Incremental Cost	1214.82
Incremental Benefit	2734.62
Net Cash Flow (N.C.F)	1519.80

Control (Without extra fertiliser)

SIXTH YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18.00	26.00	3.19	1492.92			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2.00	1.00	22.15	44.30			
Manufact. Cost				1513.15			
Output = kg made tea (MT)	2855.00						
Sale price /kg.	5.28						
					3425.47		
						15074.4	
							11648.93

Experiment with extra fertiliser

Plucking	26.80	26.00	3.19	2222.79			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser	489.00	1.10	0.00	537.90			
Supervision	5.00	1.00	22.15	110.75			
Manufact. Cost				2174.59			
Output = kg made tea (MT)	4103.00						
Sale price /kg.	5.28						
					5205.53		
						21663.84	
							16458.31

Incremental Cost	1780.06
Incremental Benefit	4809.38
Net Cash Flow (N.C.F)	3029.32

Control (Without extra fertiliser)

SEVENTH YEAR output = kg.	Net benefit workers	Number operation	Times cost	Per unit (MK)	Cost in MK (a)	Total cost MT*Sale price (b)	Gross = b-a
Plucking	18.00	26.00	3.19	1492.92			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2.00	1.00	22.15	44.30			
Manufact. Cost				1179.78			
Output = kg made tea (MT)	2226.00						
Sale price /kg.	5.28						
					3092.10		
						11753.28	
							8661.18

Experiment with extra fertiliser

Plucking	26.00	26.00	3.19	2156.44			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser	489.00	1.10	0.00	537.90			
Supervision	5.50	1.00	22.15	121.83			
Manufact. Cost				1685.93			
Output = kg made tea (MT)	3181.00						
Sale price /kg.	5.28						
					4661.60		
						16795.68	
							12134.09

Incremental Cost	1569.50
Incremental Benefit	3472.91
Net Cash Flow (N.C.F)	1903.41

Control (Without extra fertiliser)

EIGHTH YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Pruning Labour	30.00	1.00	3.19	95.70			
Plucking	18.00	26.00	3.19	1492.92			
Weeding	25.00	1.00	3,19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2.00	1.00	22.15	44.30			
Manufact. Cost				1162.29			
Output = kg made tea (MT)	2193.00						
Sale price /kg.	5.28						
					3170.31		
						11579.04	
							8408.73

Experiment with extra fertiliser

Pruning Labour	30.00	1.00	3.19	95.70			
Plucking	24.62	26.00	3.19	2041.98			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser	489.00	1.10	0.00	537.90			
Supervision	6.56	1.00	22.15	145.30			
Manufact. Cost				1589.47			
Output = kg made tea (MT)	2999.00						
Sale price /kg.	5.28						
					4569.86		
						15834.72	
							11264.86

Incremental Cost	1399.55
Incremental Benefit	2856.13
Net Cash Flow (N.C.F)	1456.59

Control (Without extra fertiliser)

NINTH YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18.00	26.00	3.19	1492.92			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2.00	1.00	22.15	44.30			
Manufact. Cost				1247.62			
Output = kg made tea (MT)	2354.00						
Sale price /kg.	5.28						
					3159.94		
						12429.12	
							9269.18

Experiment with extra fertiliser

Plucking	29.42	26.00	3.19	2440.09			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser	489.00	1.10	0.00	537.90			
Supervision	5.98	1.00	22.15	132.46			
Manufact. Cost				2039.44			
Output = kg made tea (MT)	3848.00						
Sale price /kg.	5.28						
					5309.39		
						20317.44	
							15008.05

Incremental Cost	2149.45
Incremental Benefit	5738.87
Net Cash Flow (N.C.F)	3589.42

Control (Without extra fertiliser)

TENTH YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18.00	26.00	3.19	1492.92			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser				215.60			
Supervision	2.00	1.00	22.15	44.30			
Manufact. Cost				1023.43			
Output = kg made tea (MT)	1931.00						
Sale price /kg.	5.28						
					2935.75		
						10195.68	
							7259.93

Experiment with extra fertiliser

Plucking	30.85	26.00	3.19	2558.70			
Weeding	25.00	1.00	3.19	79.75			
Spraying	5.00	5.00	3.19	79.75			
Fertiliser	489.00	1.10	0.00	537.90			
Supervision	5.98	1.00	22.15	132.46			
Manufact. Cost				1701.3			
Output = kg made tea (MT)	3210.00						
Sale price /kg.	5.28						
					5089.86		
						16948.8	
							11858.94

Incremental Cost	2154.11
Incremental Benefit	4599.01
Net Cash Flow (N.C.F)	2444.91

EFFECT OF NITROGEN ON MATURE TEA,

Site of experiment: South down T.E.
Area = 0.8958 (ha.)
Year: 1982-1988

*All prices are in Malawi Kawacha (MK).

Control (Without extra fertiliser) FIRST YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Pruning	30	1	5	150			
Plucking	18	20	5	1800			
Weeding	15	1	5	75			
Spraying	5	5	5	125			
Fertiliser cost				130.5			
Supervision	2	1	30	60			
Manufact. cost				1577.76			
Output = kg made tea (MT)	3287						
Sale price /kg.	6.57						
					3918.26		
						21595.59	
							17677.33
Experiment with extra fertiliser							
Pruning	30	1	5	150			
Plucking	22	20	5	2200			
Weeding	15	1	5	75			
Spraying	5	5	5	125			
Fertiliser cost				287.1			
Supervision	2.4	1	30	72			
Manufact. cost				1781.76			
Output = kg made tea (MT)	3712						
Sale price /kg.	6.57						
					4690.86		
						24387.84	
							19696.98

Incremental Cost	772.6
Incremental Benefit	2019.65
Net Cash Flow	1247.05

Control (Without extra fertiliser)

SECOND YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5	1800.00			
Weeding	15	1	5	75.00			
Spraying	5	5	5	125.00			
Fertiliser cost				130.50			
Supervision	2	1	30	60.00			
Manufact. Cost				1493.76			
Output = Kg	3112			20445.84			
made tea (MT).					3684.26		
Sale price /Kg	6.57			2190.50		20445.84	
							16761.58

Experiment with extra fertiliser

Plucking	21.15	20	5	2115.00			
Weeding	15	1	5	75.00			
Spraying	5	5	5	125.00			
Fertiliser cost				287.10			
Supervision	3	1	30	90.00			
Manufact. Cost				1956.00			
Output = Kg	4075						
made tea (MT).							
Sale price /Kg	6.57						
					4648.10		
						26772.75	
							22124.65

Incremental Cost	963.84
Incremental Benefit	5363.07
Net Cash Flow (N.C.F)	4399.23

Control (Without extra fertiliser)

THIRD YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5	1800			
Weeding	15	1	5	75			
Spraying	5	5	5	125			
Fertiliser cost				130.5			
Irrigation				443			
Supervision	5	1	30	150			
Manufact. Cost				2303.04			
Output = Kg made tea (MT).	4798						
Sale price /Kg	6.57						
					5026.54		
						31522.86	
							26496.32

Experiment with extra fertiliser

Plucking	21	20	5.00	2100.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				287.10			
Irrigation				443.00			
Supervision	7	1	30.00	210.00			
Manufact. Cost				2613.6			
Output = Kg made tea (MT).	5445.00						
Sale price /Kg	6.57						
					5853.70		
						35773.65	
							29919.95

Incremental Cost	827.16
Incremental Benefit	3423.63
Net Cash Flow (N.C.F)	2596.47

Control (Without extra fertiliser)							
Fourth year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5	1800.00			
Weeding	15	1	5	75.00			
Spraying	5	5	5	125.00			
Fertiliser cost				130.50			
Irrigation				443.00			
Supervision	5	1	30	150.00			
Manufactc. Cost				2284.32			
Output = Kg made tea (MT).	4759.00						
Sale price /Kg	6.57						
				31266.63		5007.82	
						31266.63	
							26258.81
Experiment with extra fertiliser							
Plucking	19	20	5.00	1900.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				287.10			
Irrigation				443.00			
Supervision	8.00	1	30.00	240.00			
Manufact. Cost				2371.20			
Output = Kg made tea (MT).	4940.00						
Sale price /Kg	6.57						
					5441.30		
						32455.8	
							27014.50

Incremental Cost	433.48
Incremental Benefit	755.69
Net Cash Flow (N.C.F)	322.21

Control (Without extra fertiliser)

Fifth year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				130.50			
Irrigation				443.00			
Supervision	5.00	1.00	30.00	150.00			
Manufact. Cost				2413.92			
Output = Kg made tea (MT).	5029.00						
Sale price /Kg	6.57						
					5137.42		
						33040.53	
							27903.11
Experiment with extra fertiliser							
Plucking	21	20	5.00	2100.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				287.10			
Irrigation				443.00			
Supervision	8.00	1.00	30.00	240.00			
Manufact. Cost				2745.6			
Output = Kg made tea (MT).	5720.00						
Sale price /Kg	6.57						
					6015.70		
						37580.4	
							31564.70

Incremental Cost	878.28
Incremental Benefit	3661.59
Net Cash Flow (N.C.F)	2783.31

Control (Without extra fertiliser)

Sixth year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				130.50			
Irrigation				443.00			
Supervision	2	1	30.00	60.00			
Manufact. Cost				1551.36			
Output = Kg made tea (MT).	3232.00						
Sale price /Kg	6.57						
					4184.86		
						21234.24	
							17049.38

Experiment with extra fertiliser

Plucking	23	20	5.00	2300.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				287.10			
Irrigation				443.00			
Supervision	9	1	30.00	267.00			
Manufact. Cost				1924.8			
Output = Kg made tea (MT).	4010.00						
Sale price /Kg	6.57						
					5421.90		
						26345.7	
							20923.80

Incremental Cost	1237.04
Incremental Benefit	3874.42
Net Cash Flow (N.C.F)	2637.38

Name of the experiment: Effect of Murate of Potash on Mature tea,
Site of the experiment: South Down Tea Estates,
Area = 0.8958 (ha.).
Year: 1982-1987.

Control (Without extra fertiliser)

FIRST YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Pruning	30	1	5	150			
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Supervision	2	1	30.00	60.00			
Manufact. Cost				1595.04			
Output = Kg made tea (MT).	3323.00						
Sale price /Kg	6.57						
					3805.04		
						21832.11	
							18027.07
Experiment with fertiliser							
Pruning Labour	30	1	5	150.00			
Plucking	23	20	5	2300.00			
Weeding	15	1	5	75.00			
Spraying	5	5	5	125.00			
Fertiliser cost				80.00			
Supervision	5	1	30.00	150.00			
Manufact. Cost				1773.12			
Output = Kg made tea (MT).	3694.00						
Sale price /Kg	6.57						
					4653.12		
						24269.58	
							19616.46

Incremental Cost	848.08
Incremental Benefit	1589.39
Net Cash Flow (N.C.F)	741.31

Control (Without extra fertiliser)

Second year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Supervision	2	1	30.00	60.00			
Manufact. Cost				1655.04			
Output = Kg made tea (MT).	3448.00						
Sale price /Kg	6.57						
					3715.04		
						22653.36	
							18938.32

Experiment with fertiliser

Plucking	22	20	5.00	2200.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				80.00			
Supervision	5	1	30.00	150.00			
Manufact. Cost				1875.36			
Output = Kg made tea (MT).	3907.00						
Sale price /Kg	6.57						
					4505.36		
						25668.99	
Total cost				2630.00			
							21163.63

Incremental Cost	790.32
Incremental Benefit	2225.31
Net Cash Flow (N.C.F)	1434.99

Control (Without extra fertiliser)

Third year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Irrigation				443.00			
Supervision	2	1	30.00	60.00			
Manufact. Cost				2325.12			
Output = Kg made tea (MT).	4844.00						
Sale price /Kg	6.57						
					4828.12		
						31825.08	
							26996.96

Experiment with fertiliser

Plucking	21	20	5.00	2100.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				80.00			
Irrigation				443.00			
Supervision	5.36	1.00	30.00	160.80			
Manufact. Cost				2603.04			
Output = Kg made tea (MT).	5423.00						
Sale price /Kg	6.57						
					5586.84		
						35629.11	
							30042.27

Incremental Cost	758.72
Incremental Benefit	3045.31
Net Cash Flow (N.C.F)	2286.59

Control (Without
Control (without fertiliser)

FOURTH YEAR	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Irrigation				443.00			
Supervision	2	1	30.00	60.00			
Manufact. Cost				2189.28			
Output = Kg made tea (MT).	4561						
Sale price /Kg	6.57						
					4692.28		
						29965.77	
							25273.49

Experiment with fertiliser

Plucking	21	20	5.00	2100.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				80.00			
Irrigation				433.00			
Supervision	6	1	30.00	180.00			
Manufact. Cost				2418.72			
Output = Kg made tea (MT).	5039.00						
Sale price /Kg	6.57						
					5411.72		
						33106.23	
							27694.51

Incremental Cost	719.44	
Incremental Benefit		2421.02
Net Cash Flow (N.C.F)		1701.58

Control (Without fertiliser)

Fifth Year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Supervision	2	1	30.00	60.00			
Manufact. Cost				2457.6			
Output = Kg made tea (MT).	5120						
Sale price /Kg	6.57						
					4517.60		
						33638.4	
							29120.80

Experiment with fertiliser

Plucking	24	20	5.00	2400.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				80.00			
Supervision	2	1	30.00	60.00			
Manufact. Cost				2723.52			
Output = Kg made tea (MT).	5674						
Sale price /Kg	6.57						
					5463.52		
						37278.18	
							31814.66

Incremental Cost	945.92
Incremental Benefit	2693.86
Net Cash Flow (N.C.F)	1747.94

Control (Without fertiliser)

Sixth year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Pruning Labour	30	1	5.00	150.00			
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Supervision	2	1	30.00	60.00			
Manufact. Cost				1656			
Output = Kg made tea (MT).	3450						
Sale price /Kg	6.57						
					3866.00		
						22666.5	
							18800.50

Experiment with fertiliser

Pruning Labour	30	1	5.00	150.00			
Plucking	23	20	5.00	2300.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				80.00			
Supervision	6	1	30.00	180.00			
Manufact. Cost				1872.48			
Output = Kg made tea (MT).	3901.00						
Sale price /Kg	6.57						
					4782.48		
						25629.57	
							20847.09

Incremental Cost	916.48
Incremental Benefit	2046.59
Net Cash Flow (N.C.F)	1130.11

Name of the experiment: Effect of Murate of Potash on Mature tea, Effect of Single Supper Phosphate

Site of the experiment: South Down Tea Estates,
Area = 0.8958 (ha.).
Year: 1982-1987.

Control (Without fertiliser)

First year	**Number workers**	**Times operation**	**Per unit cost**	**Cost in (MK)**	**Total cost MK (a)**	**Gross output = kg. MT*Sale price (b)**	**Net benefit = b-a**
Pruning Labour	**30**	**1**	**5.00**	**150.00**			
Plucking	**18**	**20**	**5.00**	**1800.00**			
Weeding	**15**	**1**	**5.00**	**75.00**			
Spraying	**5**	**5**	**5.00**	**125.00**			
Fertiliser cost	**0**	**0**	**0.00**	**0.00**			
Irrigation	**0**	**0**	**0.00**	**0.00**			
Supervision	**2**	**1**	**30.00**	**60.00**			
Manufact. Cost				**1626.72**			
Output = Kg made tea (MT).	**3389.00**						
Sale price /Kg	**6.57**						
					3836.72		
						22265.73	
							18429.01

Experiment with fertiliser

Plucking	**22**	**20**	**5.00**	**2200.00**			
Weeding	**15**	**1**	**5.00**	**75.00**			
Spraying	**5**	**5**	**5.00**	**125.00**			
Fertiliser cost				**79.00**			
Supervision	**5**	**1**	**30.00**	**150.00**			
Manufact. Cost				**1757.28**			
Output = Kg made tea (MT).	**3661.00**						
Sale price /Kg	**6.57**						
					4386.28		
						24052.77	
							19666.49

Incremental Cost	**549.56**
Incremental Benefit	**1237.48**
Net Cash Flow (N.C.F)	**687.92**

Control (Without fertiliser)

Second year	**Number workers**	**Times operation**	**Per unit cost**	**Cost in (MK)**	**Total cost MK (a)**	**Gross output = kg. MT*Sale price (b)**	**Net benefit = b-a**
Plucking	**18**	**20**	**5.00**	**1800.00**			
Weeding	**15**	**1**	**5.00**	**75.00**			
Spraying	**5**	**5**	**5.00**	**125.00**			
Supervision	**2**	**1**	**30.00**	**60.00**			
Manufact. Cost				**1734.72**			
Output = Kg made tea (MT).	**3614.00**						
Sale price /Kg	**6.57**						
					3794.72		
						23743.98	
							19949.26
Experiment with fertiliser							
Plucking	**21**	**20**	**5.00**	**2100.00**			
Weeding	**15**	**1**	**5.00**	**75.00**			
Spraying	**5**	**5**	**5.00**	**125.00**			
Fertiliser cost				**79.00**			
Supervision	**6**	**1**	**30.00**	**180.00**			
Manufact. Cost				**1835.52**			
Output = Kg made tea (MT).	**3824.00**						
Sale price /Kg	**6.57**						
					4394.52		
						25123.68	
							20729.16

Incremental Cost	**599.80**
Incremental Benefit	**779.90**
Net Cash Flow (N.C.F)	**180.10**

Control (Without fertiliser)

Third year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Irrigation				443.00			
Supervision	4	1	30.00	120.00			
Manufact. Cost				2410.08			
Output = Kg made tea (MT).	5021.00						
Sale price /Kg	6.57						
					4973.08		
						32987.97	
							28014.89

Experiment with fertiliser

Plucking	21	20	5.00	2050.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				79.00			
Irrigation				443.00			
Supervision	6	1	30.00	180.00			
Manufact. Cost				2560.32			
Output = Kg made tea (MT).	5334						
Sale price /Kg	6.57						
					5512.32		
						35044.38	
							29532.06

Incremental Cost	539.24
Incremental Benefit	1517.17
Net Cash Flow (N.C.F)	977.93

Control (Without fertiliser) Fourth year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Pruning Labour	30	1	5.00	150.00			
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Irrigation				443.00			
Supervision	4	1	30.00	120.00			
Manufact. Cost				2309.28			
Output = Kg made tea (MT).	4811.00						
Sale price /Kg	6.57						
					5022.28		
						31608.27	
Experiment with fertiliser							26585.99
Pruning Labour	30	1	5.00	150.00			
Plucking	20	20	5.00	2000.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				79.00			
Irrigation				443.00			
Supervision	6	1	30.00	180.00			
Manufact. Cost				2358.24			
Output = Kg made tea (MT).	4913.00						
Sale price /Kg	6.57						
					5410.24		
						32278.41	
	26868.17						

Incremental Cost	387.96
Incremental Benefit	282.18
Net Cash Flow (N.C.F)	-105.78

Control (Without fertiliser)

Fifth year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Irrigation				443.00			
Supervision	5	1	30.00	150.00			
Manufact. Cost				2611.2			
Output = Kg made tea (MT).	5440.00						
Sale price /Kg	6.57						
					5204.20		
						35740.8	
							30536.60

Experiment with fertiliser

Plucking	20	20	5.00	2000.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				287.10			
Irrigation				443.00			
Supervision	6	1	30.00	180.00			
Manufact. Cost				2745.6			
Output = Kg made tea (MT).	5720.00						
Sale price /Kg	6.57						
					5855.70		
						37580.4	
							31724.70

Incremental Cost	651.50
Incremental Benefit	1188.10
Net Cash Flow (N.C.F)	536.60

Control (Without fertiliser)

Sixth year	Number workers	Times operation	Per unit cost	Cost in (MK)	Total cost MK (a)	Gross output = kg. MT*Sale price (b)	Net benefit = b-a
Plucking	18	20	5.00	1800.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				130.50			
Irrigation	5			443.00			
Supervision	4	1	30.00	120.00			
Manufact. Cost				1551.36			
Output = Kg made tea (MT).	3232.00						
Sale price /Kg	6.57						
					4244.86		
						21234.24	
							16989.38

Experiment with fertiliser

Plucking	23	20	5.00	2300.00			
Weeding	15	1	5.00	75.00			
Spraying	5	5	5.00	125.00			
Fertiliser cost				287.10			
Irrigation				443.00			
Supervision	7	1	30.00	210.00			
Manufact. Cost				1924.8			
Output = Kg made tea (MT).	4010.00						
Sale price /Kg	6.57						
					5364.90		
						26345.7	
							20980.80

Incremental Cost	1120.04	
Incremental Benefit		3991.42
Net Cash Flow (N.C.F)		2871.38

APPENDIX IV PRO-FORMA TO OBTAIN DATA ON USE OF IMPROVED TEA CULTIVARS

(If require please use extra sheet)

Name of the country:

Date:............../................./199....................

Name of the tea estate(s) / smallholder(s):...

Name of the management (company)

Section number ....Year of planting:.............Plant type: ....@ yield / ha...................

Planting year	Area under seedlings (ha.) (a)	Area under clones (ha.) (b)	Total area (ha.) seedlings + clones. = (a + b)
1970			
1971			
1972			
1973			
1974			
1975			
1976			
1977			
1997			
1980			
1981			
1982			
1983			
1984			
1985			
1986			
1987			
1988			
1989			
1990			
1991			
1992			
1993			
1994			
1995			

APPENDIX V RATE OF UPTAKE OF TECHNOLOGY ON IMPROVED TEA CULTIVARS: CASE STUDIES

This Appendix focuses on the rate of uptake of new technologies by the clients. A main reason for research is to help to solve specific problems faced by the clients. Technology packages are one of important output of researchs (Chapter 2). However, technologies developed by research need to be used by the potential client groups, otherwise there will be a waste of resources (Chapter 7).

Feedback on the rate of uptake of new technologies plays an important role in the planning and appraisal of research. It is essential to know the technologies which are available and how far these have been taken up by the clients in order to prioritise and justify the allocation of resources to new research activities. Where it appears that new technologies are already available, but not taken up by the clients then the managers need to find out why. This may be because clients or industry are not convinced of the benefits of the technology or because they do not know about them. If it is the latter, greater effort can be placed on extension. In addition, knowledge on the rate of uptake of technology helps to identify technology adoption constraints by the clients.

Resources for research is limited, and different agencies who support research have become critical about the beneficial output of research (Chapter 3). In order to satisfy the funding concerns, and obtain continuous support for research, the impact and benefits of research need to be assessed. Without assessing the rate of uptake of technologies it is difficult to determine the benefit accrued by the research projects. Therefore, during the case studies, data on the rate of uptake of improved planting materials as an example of research impact have been collected and analysed. This is presented below.

At the Institute level availability of data on the rate of uptake of technologies are scanty. In addition, wherever data have been recorded, it is unorganised and analysis and conclusions are difficult. Further, data collection by the author was constrained by time and transport availability during individual case studies.

Some limited data was collected and analysed. The result is only a preliminary indication of the use of improved tea cultivars in different countries.

V.1 USE OF IMPROVED PLANTING MATERIALS (MALAWI)

Data on Smallholder's tea cultivation was collected for different districts: Mulanje and Thyolo.

V.1.1 SMALLHOLDER SECTOR: data for 28 years (1965-92) were collected and presented below:

Mulanje: data are presented in the Table V.1. The table indicates that seedlings tea were planted in-between 1965 and 1967, afterwards clones. Over the period, the total tea area increased by 59 thousand % (Figure V.1) The proportion of tea planted with clones increased from 38% of the total tea area in 1968 to 95% in 1992, with a constant increase of more than 2% per annum (Figure V. 2).

Thyolo: as in Mulanje, before 1968 all the planted tea was seedlings, afterwards clones Table V.2. Over the period, the total tea area increased by over 11 thousand % (Figure V.3). Proportion of clonal tea increased from 8% of the total area in 1968 to 92% in 1992 with a constant increase of more than 3% (Figure V.4) per annum.

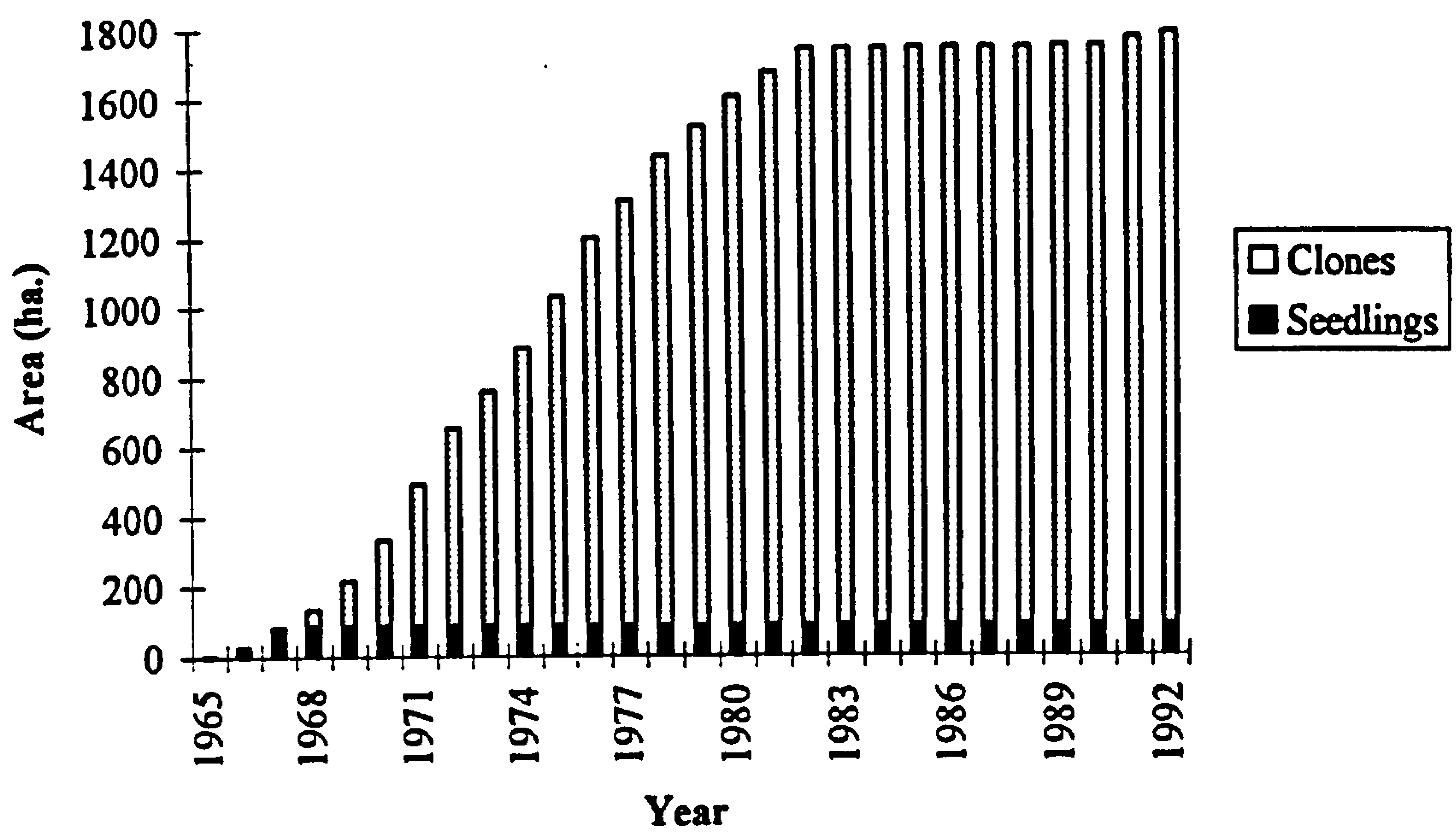

Figure V.1 Smallholders (Mulanje, Malawi), 1965-1992
Area of seedlings and clonal tea

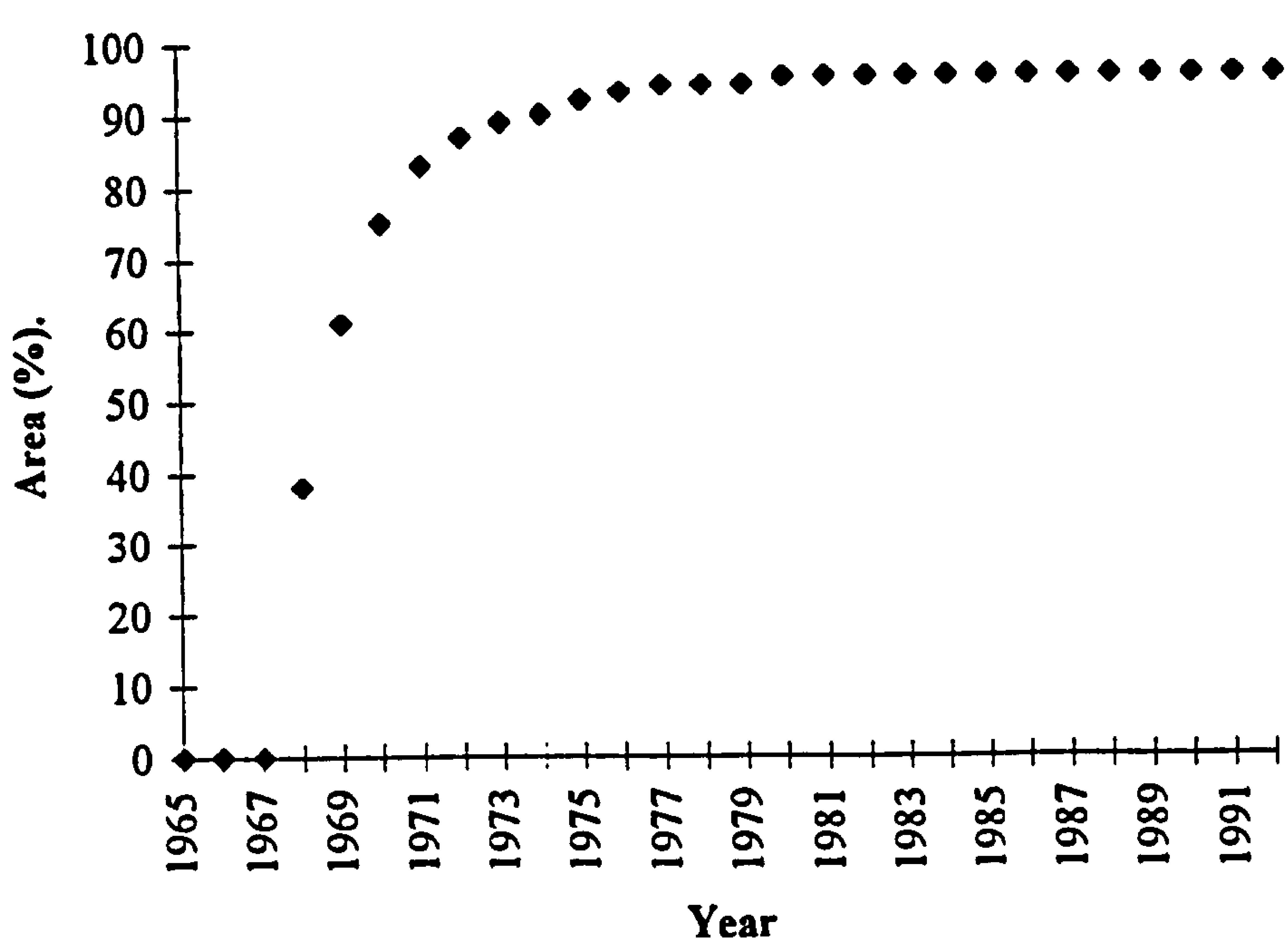

Figure V.2 Smallholders (Mulanje, Malawi), 1965-1992
Area of clones as proportion of total planted area

Table V.1 Area under tea, Smallholders, Mulanje district,(Malawi), 1965-1992.

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1965	3	3	0	0
1966	29	29	0	0
1967	84	84	0	0
1968	135	84	51	38
1969	217	84	132	61
1970	333	84	249	75
1971	492	84	407	83
1972	652	84	568	87
1973	775	84	671	89
1974	879	84	795	90
1975	1025	84	941	92
1976	1194	84	1110	93
1977	1300	84	1216	94
1978	1430	84	1345	94
1979	1515	84	1430	94
1980	1600	84	1516	95
1981	1671	84	1587	95
1982	1736	84	1652	95
1983	1737	84	1652	95
1984	1738	84	1653	95
1985	1739	84	1655	95
1986	1739	84	1655	95
1987	1740	84	1655	95
1988	1741	84	1656	95
1989	1743	84	1659	95
1990	1744	84	1660	95
1991	1767	84	1683	95
1992	1782	84	1698	95

Thyolo:

Table V.2 Area under tea, Smallholders, Thyolo district (Malawi), 1965-1992.

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1965	52	53	0	0
1966	52	52	0	0
1967	53	53	0	0
1968	58	53	5	8
1969	71	53	17	24
1970	89	53	35	40
1971	109	53	55	51
1972	141	53	87	62
1973	173	53	119	69
1974	211	53	157	75
1975	256	53	202	79
1976	311	53	258	83
1977	390	53	337	86
1978	445	53	392	88
1979	481	53	427	89
1980	524	53	470	90
1981	556	53	503	90
1982	591	53	538	91
1983	600	53	546	91
1984	610	53	557	91
1985	610	53	557	91
1986	622	53	569	91
1987	626	53	572	91
1988	629	53	576	92
1989	633	53	580	92
1990	634	53	581	92
1991	639	53	586	92
1992	650	53	597	92

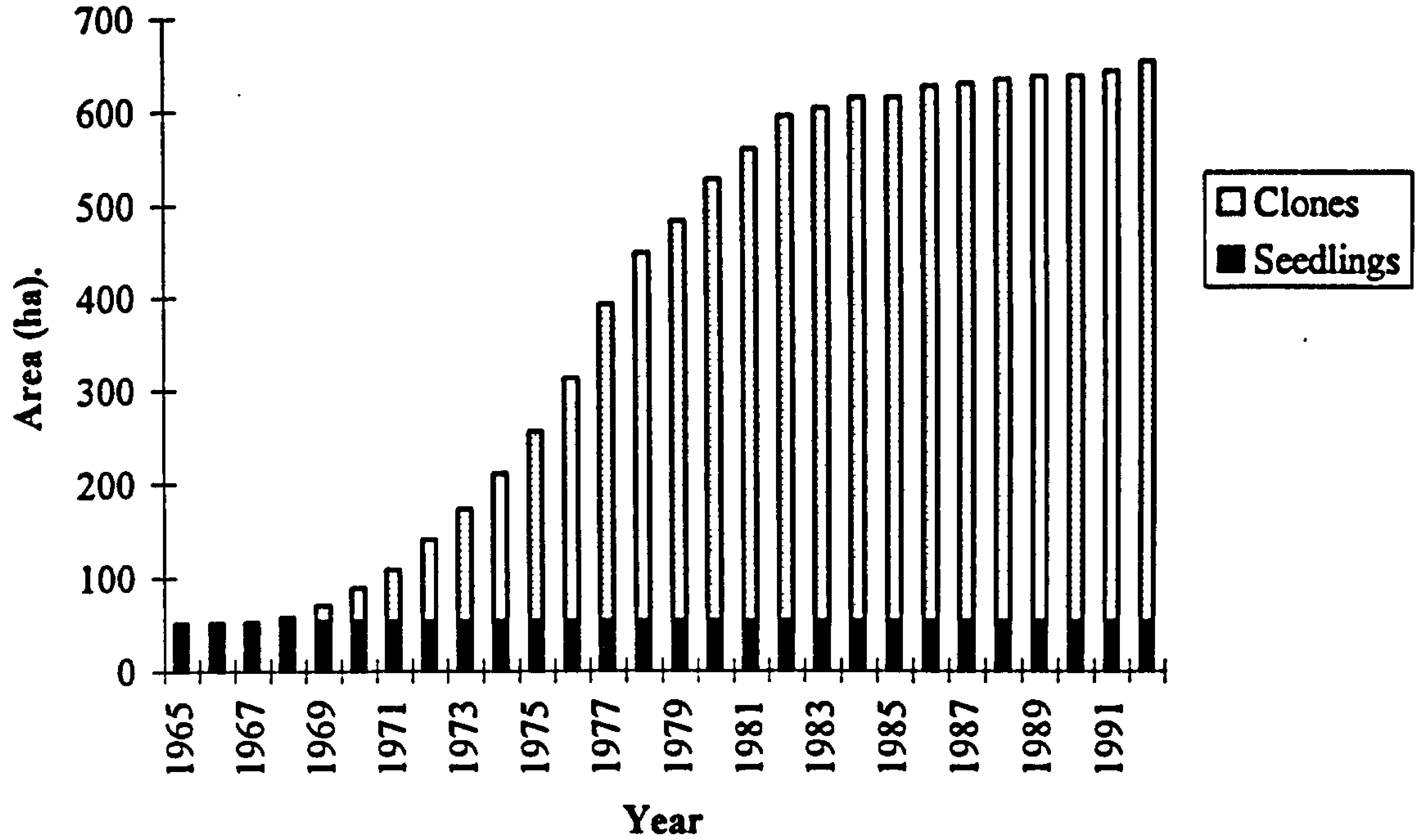

Figure V.3 Smallholders (Thyolo, Malawi), 1965-1992
Area of seedlings and clonal tea

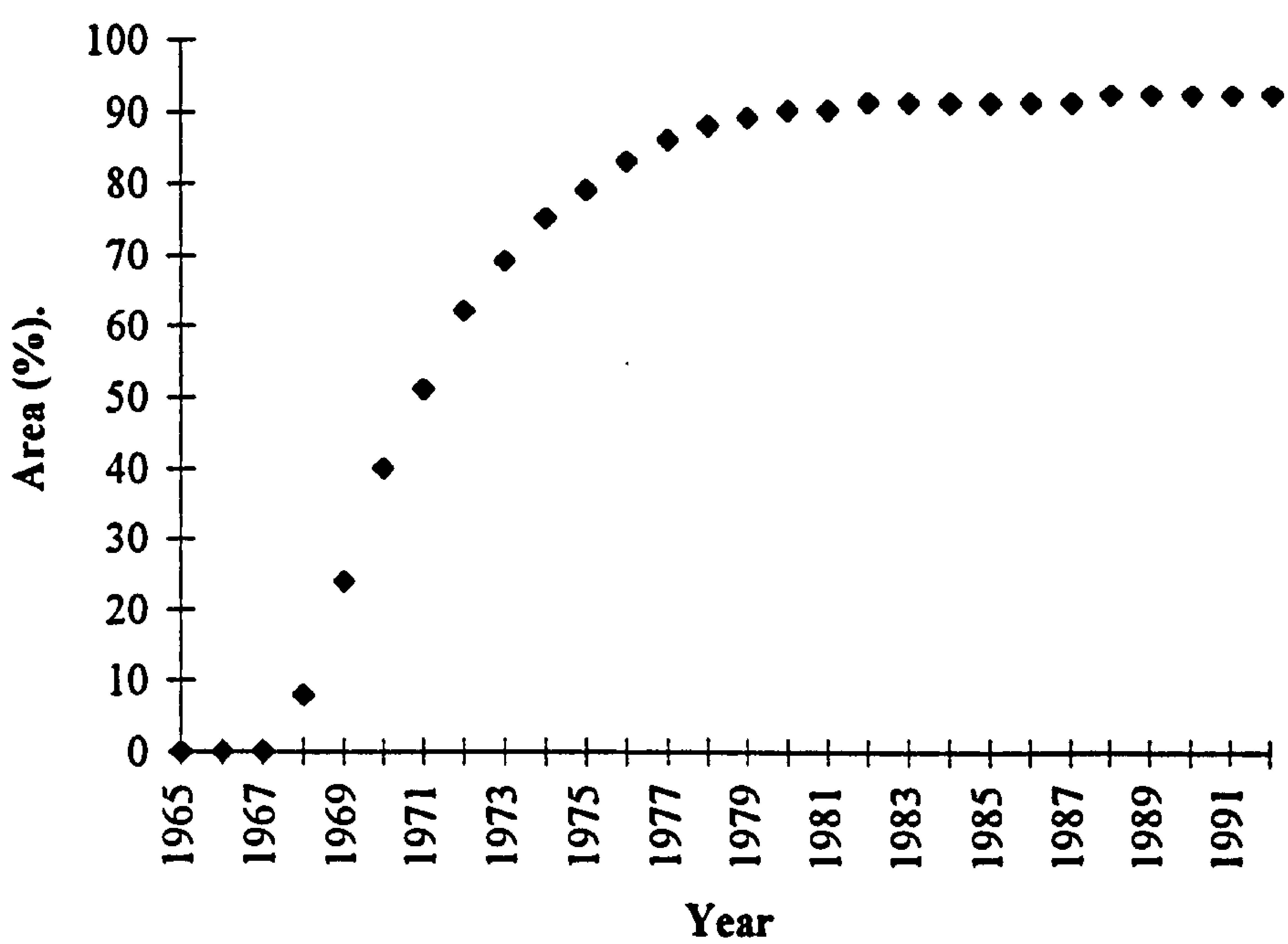

Figure V.4 Smallholders (Thyolo, Malawi), 1965-1992
Area of clones as proportion of total planted area

V.1.2 ESTATE SECTOR: data on the use of different planting materials were collected from the following estates.

Esperanza: data was collected for 21 years (1972-92) and presented in Table V.3. The table shows that over the period, area under seedlings tea decreased by 43%. On the other hand, clonal area increased by 300%. No suitable area left for plantings. So, the company took the policy of uprooting the old seedlings and replaced them with clones (Figure V.5). The proportion of tea planted with clone increased from 11 % to 47 % over the period , with a constant increase of about 2% per annum (Figure V.6).

Table V.3 Area under tea, Esperanza Estate (Malawi), 1972-1992

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1972	350	310	40	11
1973	350	304	46	13
1974	350	298	52	15
1975	350	292	58	16
1976	350	286	64	18
1977	350	284	66	19
1978	350	280	70	20
1979	350	274	76	22
1980	350	268	82	23
1981	350	262	88	25
1982	350	256	94	27
1983	350	250	100	28
1984	350	244	106	30
1985	350	238	112	34
1986	350	232	118	37
1987	337	213	124	38
1988	337	201	136	40
1989	337	195	142	42
1990	337	189	148	44
1991	337	183	154	46
1992	337	177	160	47

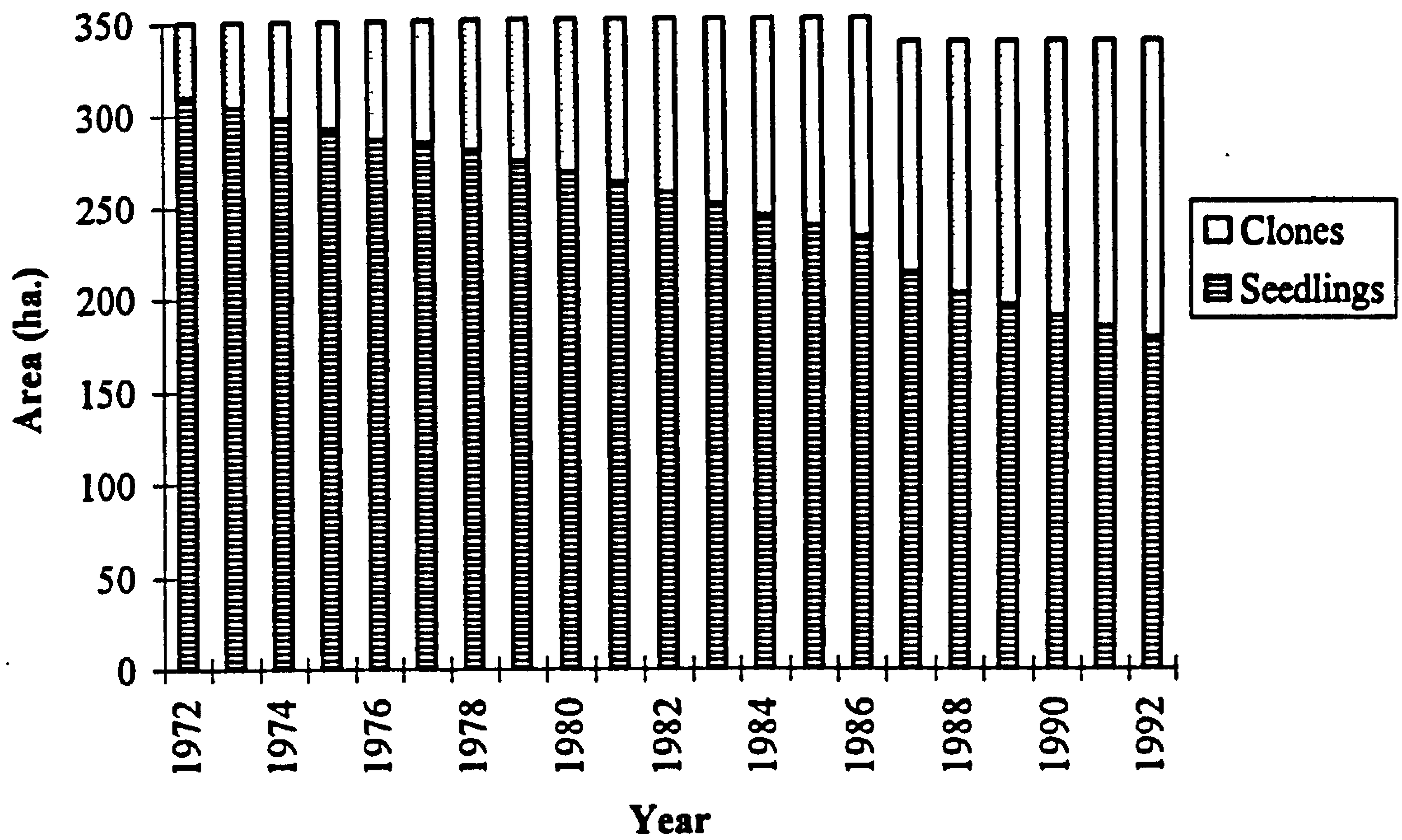

Figure V.5 Esperanza estate (Malawi), 1972-1992
Area of seedlings and clonal tea

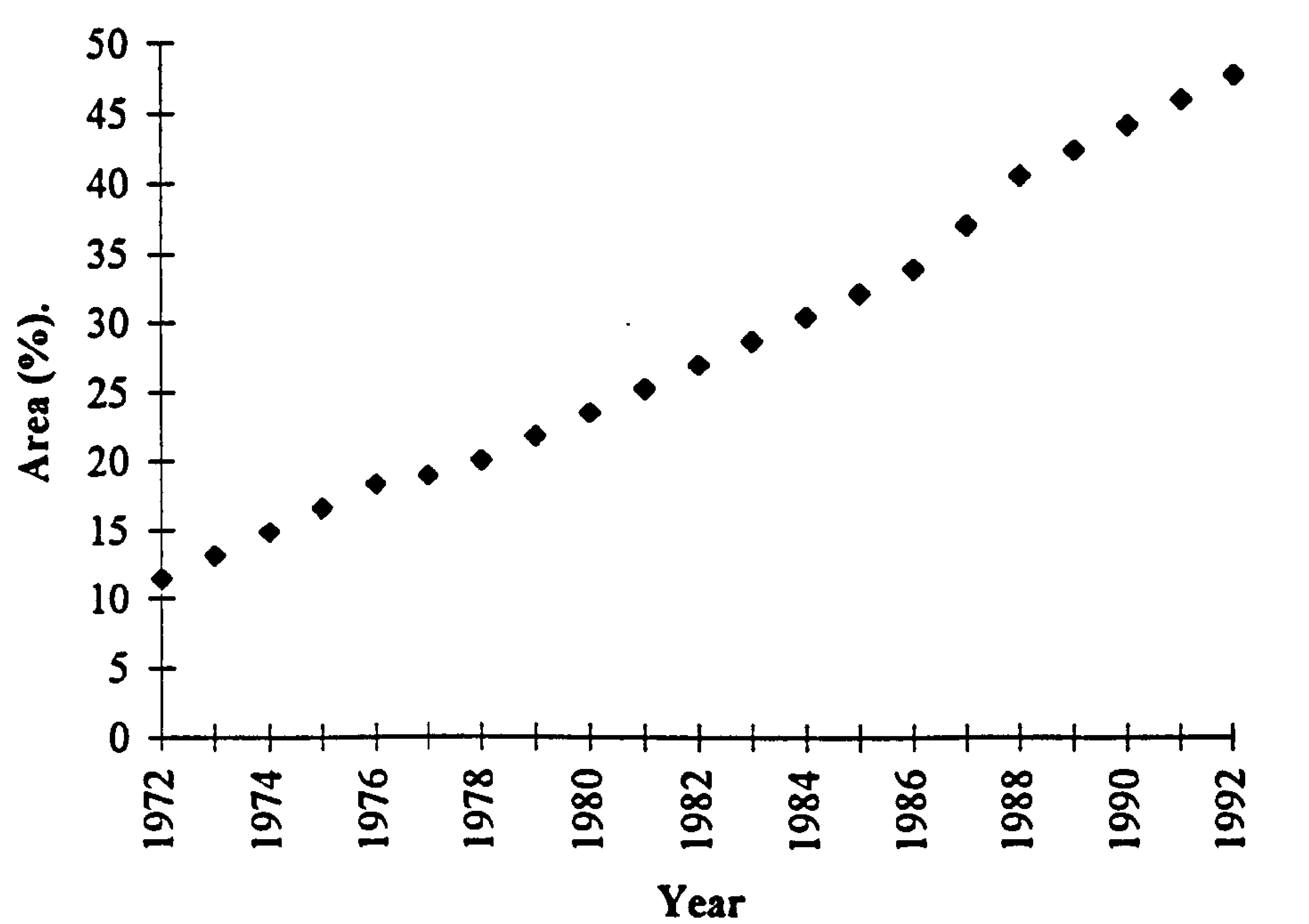

Figure V.6 Esperanza estate (Malawi), 1972-1992
Area of clones as proportion of total planted area

Lujeri: data were obtained for 10 years (1985-94) and presented in Table V.4. The table shows that over the period area under tea increased by 11%, because of availability of suitable area for tea. By contrast seedlings tea area decreased by 9% (Figure V.7), because of similar company policy like Esperanza (uprooting seedlings and replace them by clones). The proportion of tea planted with clones increased from 1% of total tea area in 1985 to 18% in 1994, with a constant increase of about 2% per annum (Figure V.8).

Table V.4 Area under Lujeri Estate (Malawi), 1985-94

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1985	1741	1726	15	1
1986	1726	1690	36	2
1987	1745	1701	44	3
1988	1728	1677	51	3
1989	1706	1631	75	4
1990	1731	1635	96	6
1991	1740	1623	117	7
1992	1760	1573	187	11
1993	1845	1573	272	15
1994	1930	1573	357	18

V.2 USE OF IMPROVED PLANTING MATERIALS (KENYA)

V.2.1 SMALLHOLDER SECTOR: it is organised by the KTDA. Data for 23 years (1965-87) from collected from KTDA head office on the use of seedlings and clonal materials, and presented in Table V.5. Seedlings tea were planted between 1965-67, afterwards clones. Over the period, total tea area increase by 10% (Figure V.9). The proportion of clones increased from 8% of total tea area in 1968 to 89% in 1987, with a constant increase of about 4% per annum (Figure V.10).

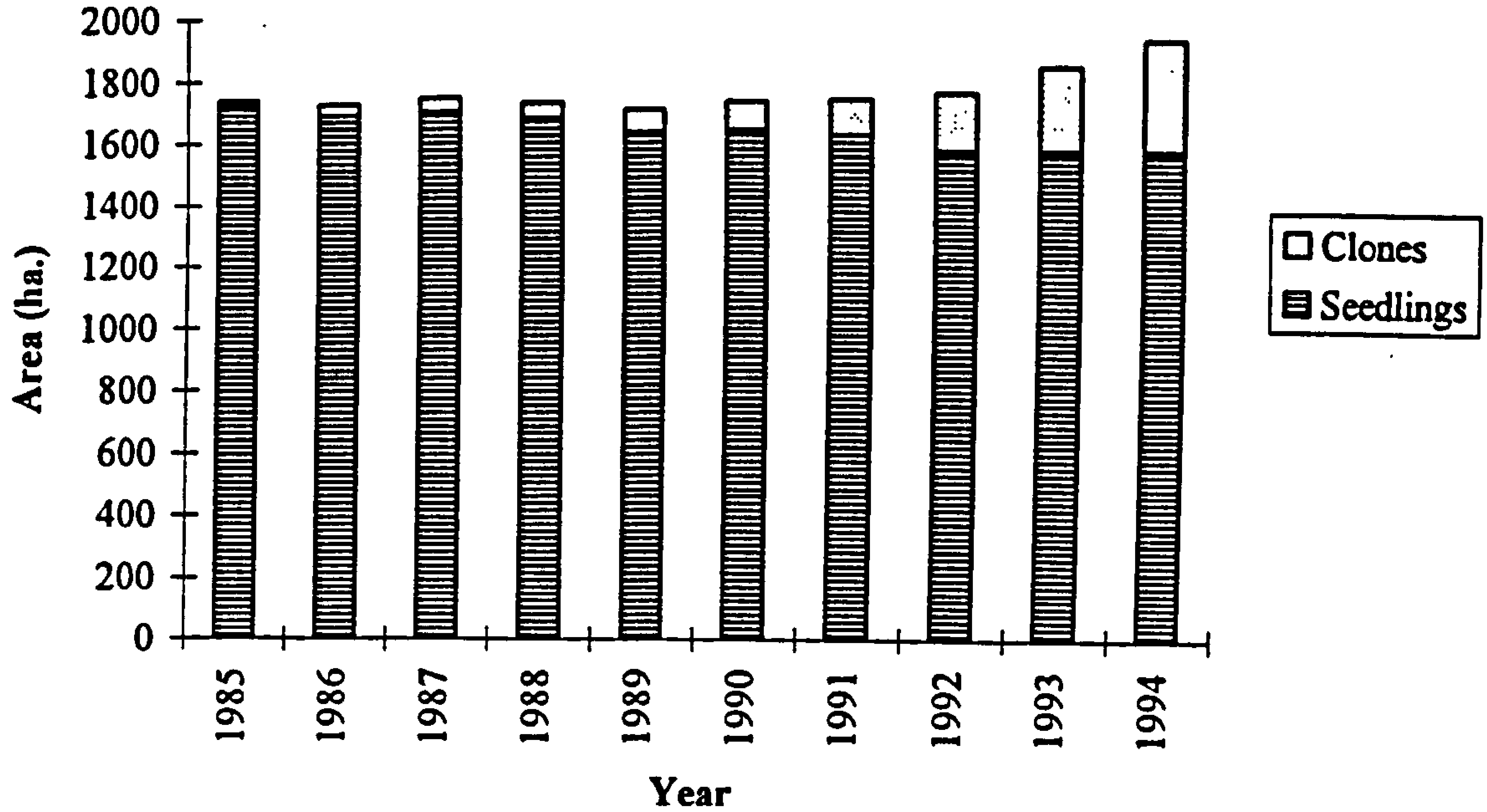

Figure V.7 Lujeri estate (Malawi), 1985-1994
Area of seedlings and clonal tea

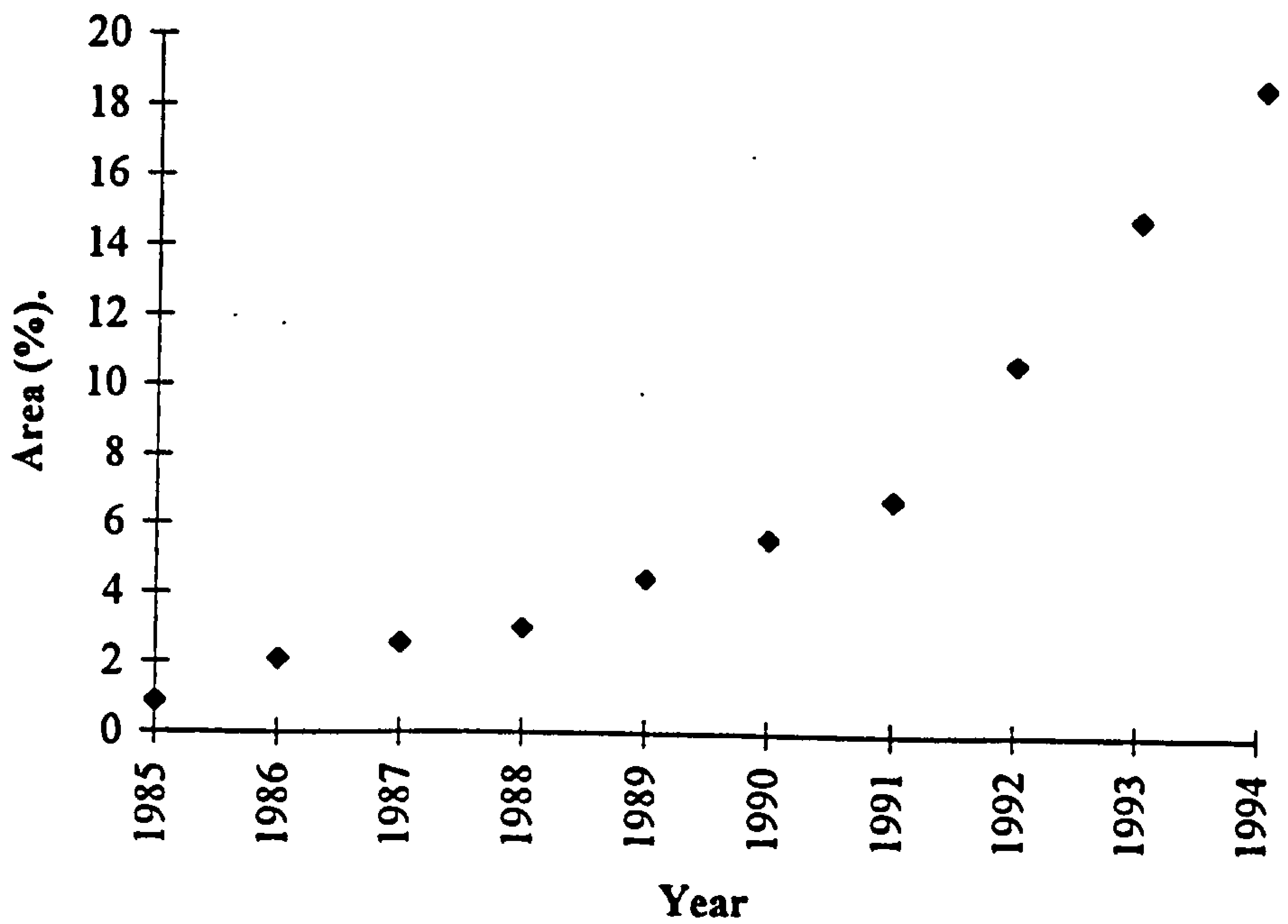

Figure V. 8 Lujeri estate (Malawi), 1985-1994
Area of clones as proportion of total planted area

V5 Area under tea, Smallholders (Kenya), 1965-87

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1965	5412	5412	0	0
1966	5948	5412	0	0
1967	6483	5948	536	8
1968	7058	5948	1111	16
1969	13006	5948	7058	54
1970	17985	5948	12037	67
1971	20528	5948	14580	71
1972	26493	5948	20545	78
1973	31161	5948	25213	81
1974	34648	5948	18700	83
1975	37205	5948	31257	84
1976	41442	5948	35494	86
1977	43641	5948	37693	86
1978	46910	5948	40962	87
1979	48876	5948	42928	88
1980	50691	5948	44743	88
1981	52743	5948	46795	89
1982	54698	5948	48750	89
1983	54969	5948	49021	89
1984	56499	5948	50551	89
1985	56505	5948	50557	89
1986	56546	5948	50598	89
1987	56891	5948	50943	90

V.2.2 ESTATE SECTORS: consolidated data from two of the major companies; the Brooke Bond Kenya and the African Highland Produce were obtained.

Brooke Bond Kenya (BBK): data was collected for 12 years (1984-95) and presented in Table V.6. Over the period, tea area increased by 29%. Increase in clonal and seedlings area are 300% and 3% respectively (Figure V.11). The proportion of area planted with clones increased from 4% of total tea area in 1884 to 24 % in 1995, with a constant increase of about 2% (Figure V.12).

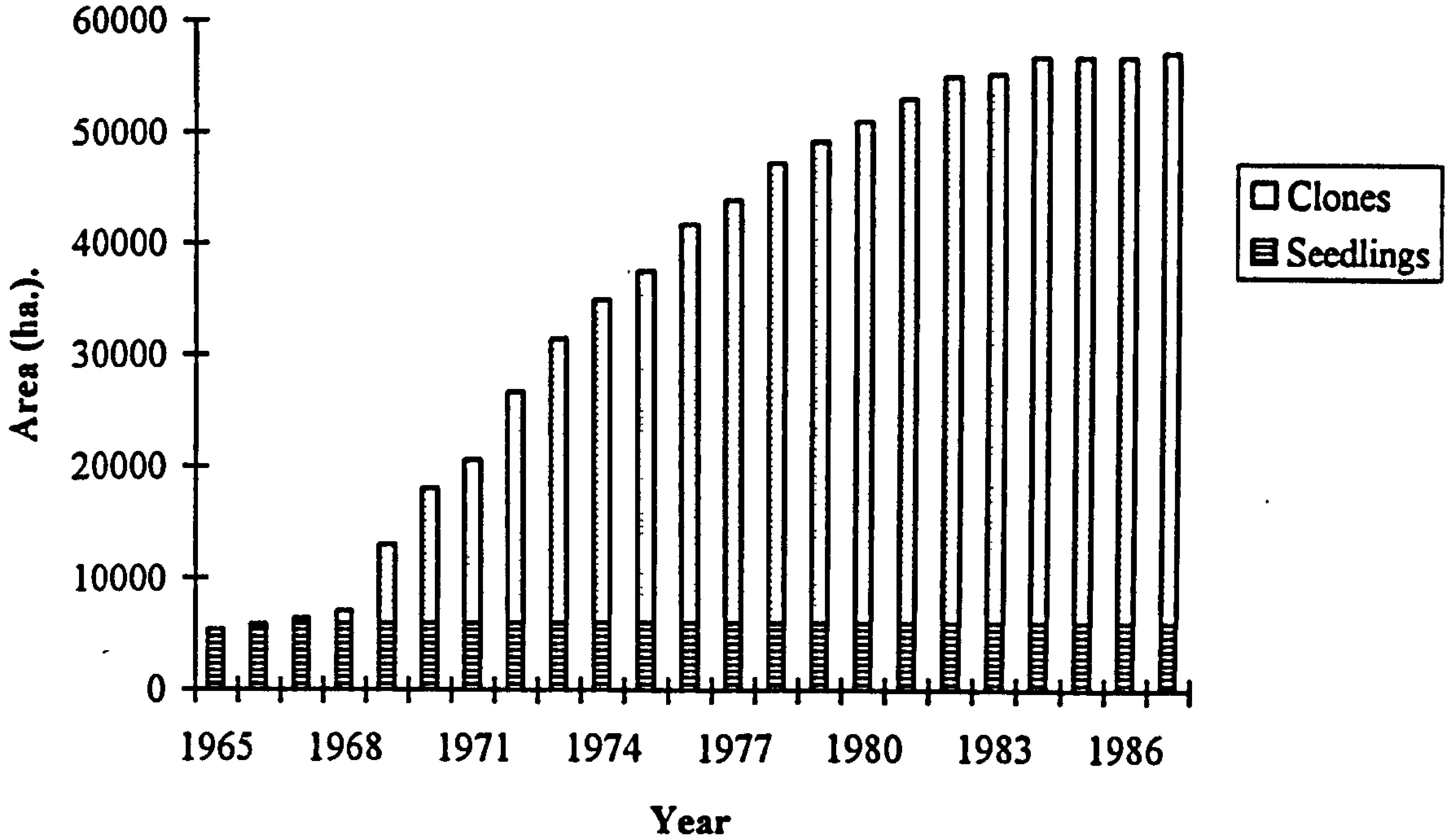

Figure V.9 Smallholders (Kenya), 1965-1987
Area of seedlings and clonal tea

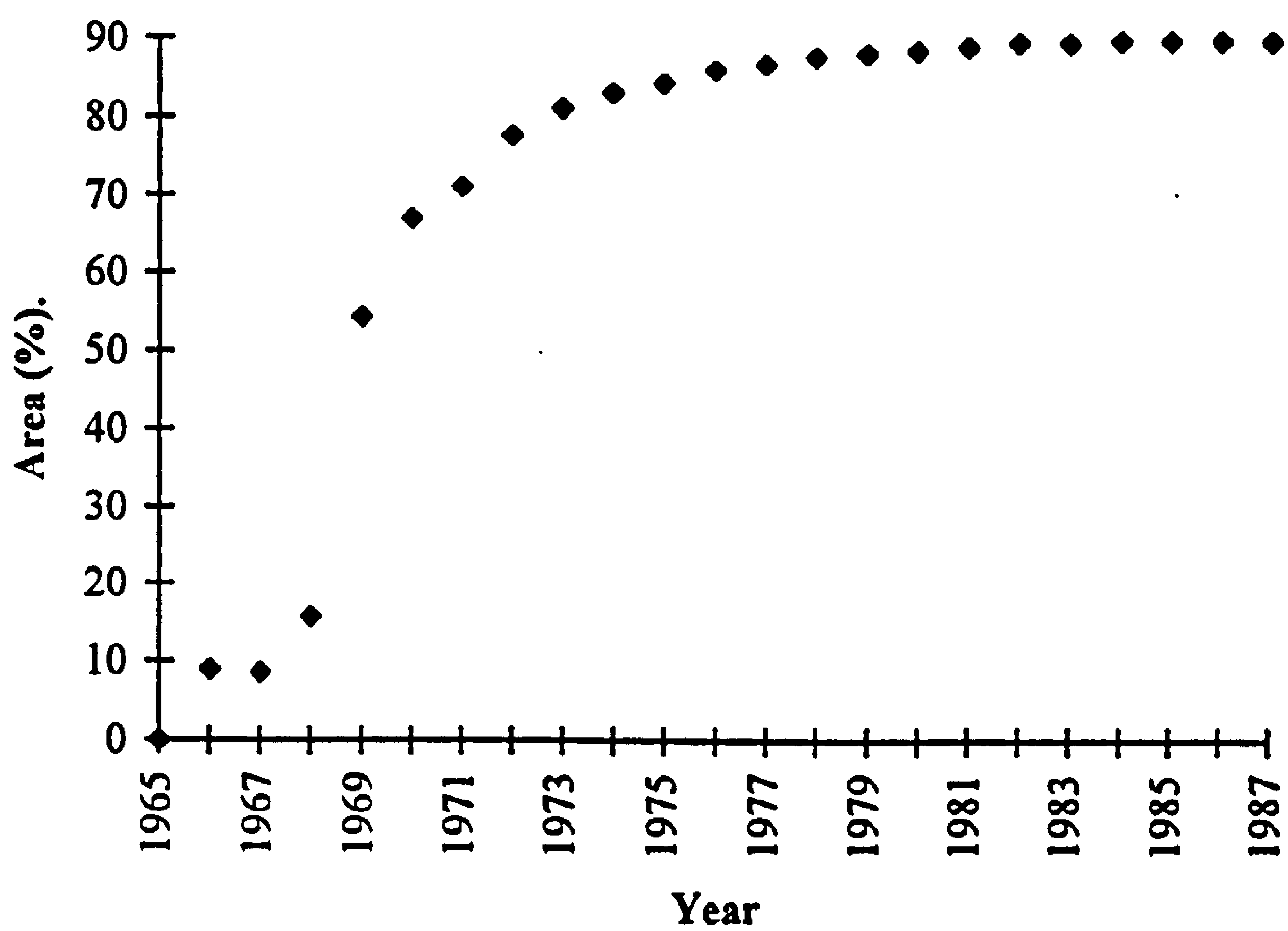

Figure V.10 Smallholders (Kenya), 1965-1987.
Area of clones as proportion of
total planted area.

Table V. 6 Area under tea, Brooke Bond (Kenya), 1984-95

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1984	5898	5609	289	5
1985	6188	5810	378	6
1986	6276	5788	488	8
1987	6387	5745	641	10
1988	6540	5740	800	12
1989	6698	5747	951	14
1990	6796	5747	1049	15
1991	6924	5747	1177	17
1992	7067	5685	1382	20
1993	7245	5747	1498	21
1994	7426	5747	1679	23
1995	7607	5747	1860	24

African Highland Produce (AHP): data were collected for 26 years (1967-92) and presented in Table V.7. Seedlings tea were planted before 1968, afterward clones. Over the period, total tea area increased by more than 35%. On the contrary, seedlings area decreased by over 9% but clonal area increased by more than 18 thousand % (Figure V.13). The proportion of area planted with clone increased from 2% of total tea area in 1968 to 32% in 1992, with a constant increase of more than 1% per annum (Figures V.14).

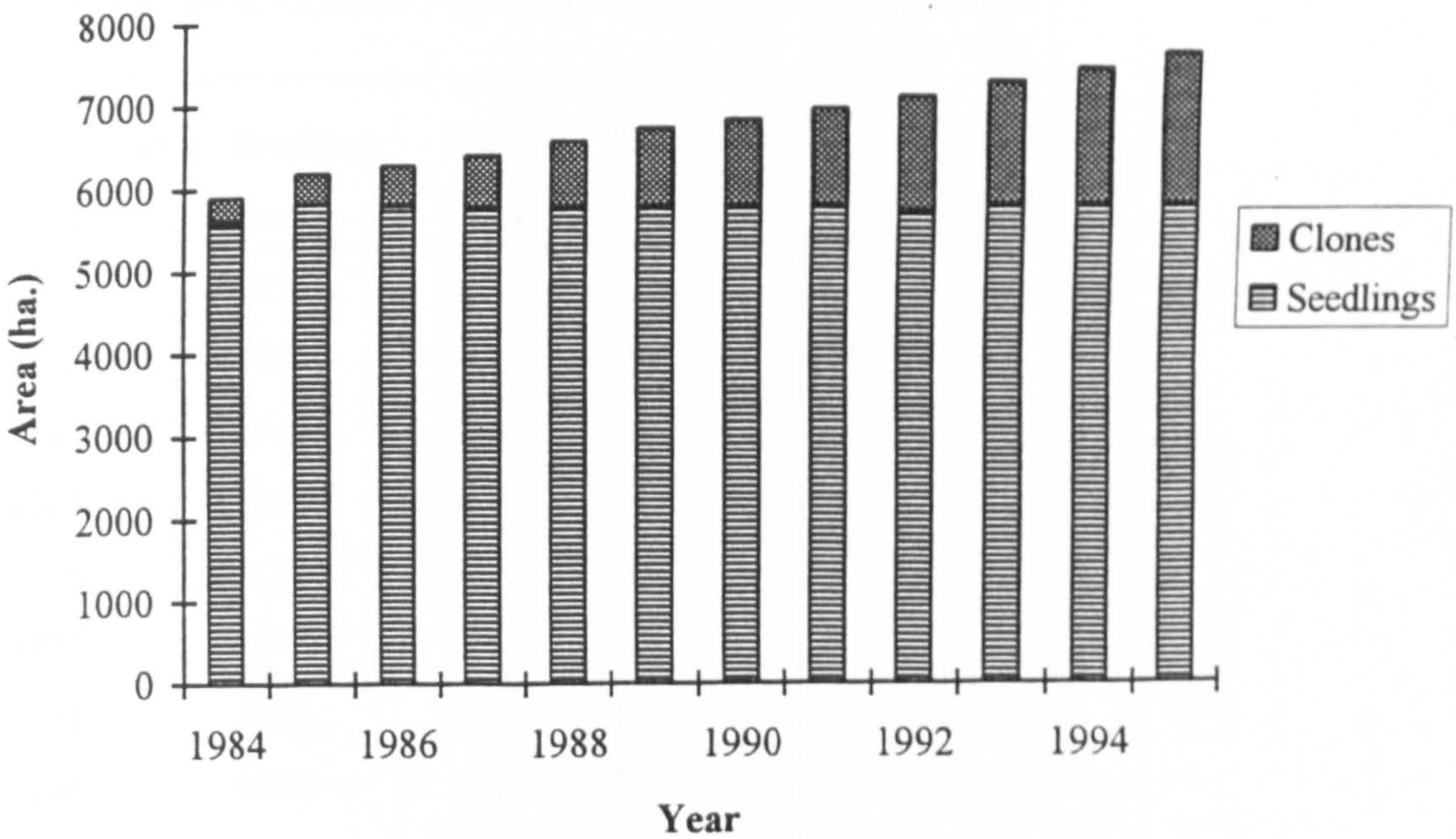

Figure V.11 Brooke Bond Estates (Kenya), 1984-1995
Area of seedlings and clonal tea

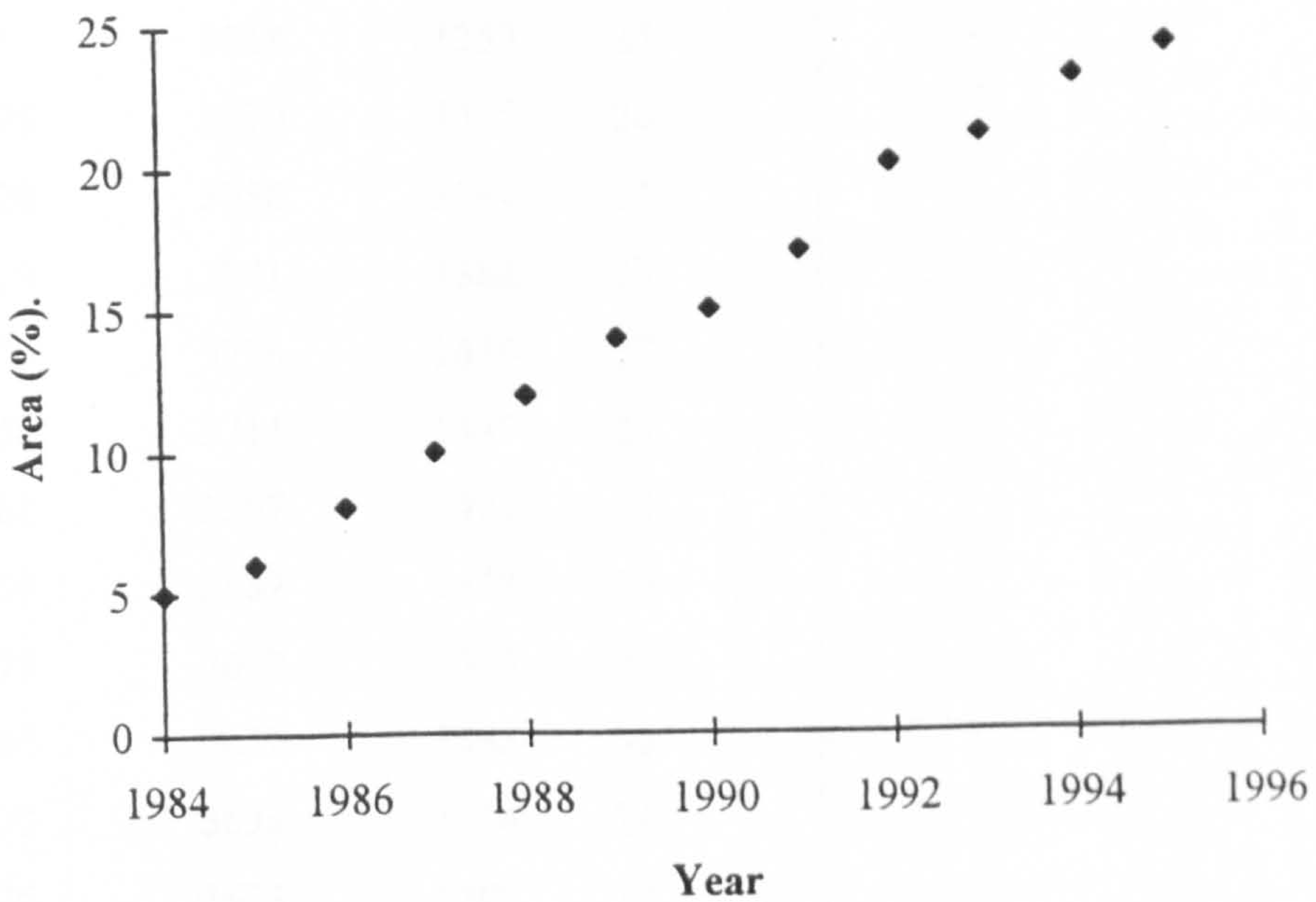

Figure V.12 Brooke Bond Estates (Kenya), 1984-1995
Area of clones as proportion of total planted area

Table V.7 Area under tea African Highland Produce (Kenya), 1967-92

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1967	3977	3977	0	0
1968	4068	3977	91	2
1969	4212	3962	250	6
1970	4303	3947	365	8
1971	4358	3933	425	10
1972	4471	3920	551	12
1973	4481	3903	578	13
1974	4501	3888	613	14
1975	4582	3874	708	15
1976	4663	3844	819	18
1977	4745	3829	916	19
1978	4875	3815	1060	22
1979	4937	3800	1137	23
1980	5011	3758	1253	25
1981	5075	3770	1305	26
1982	5120	3756	1364	27
1983	5129	3741	1388	27
1984	5136	3726	1410	27
1985	5158	3711	1447	28
1986	5168	3697	1471	28
1987	5159	3682	1477	29
1988	5175	3667	1508	29
1989	5240	3652	1588	30
1990	5272	3638	1634	31
1991	5326	3623	1703	32
1992	5373	3608	1765	33

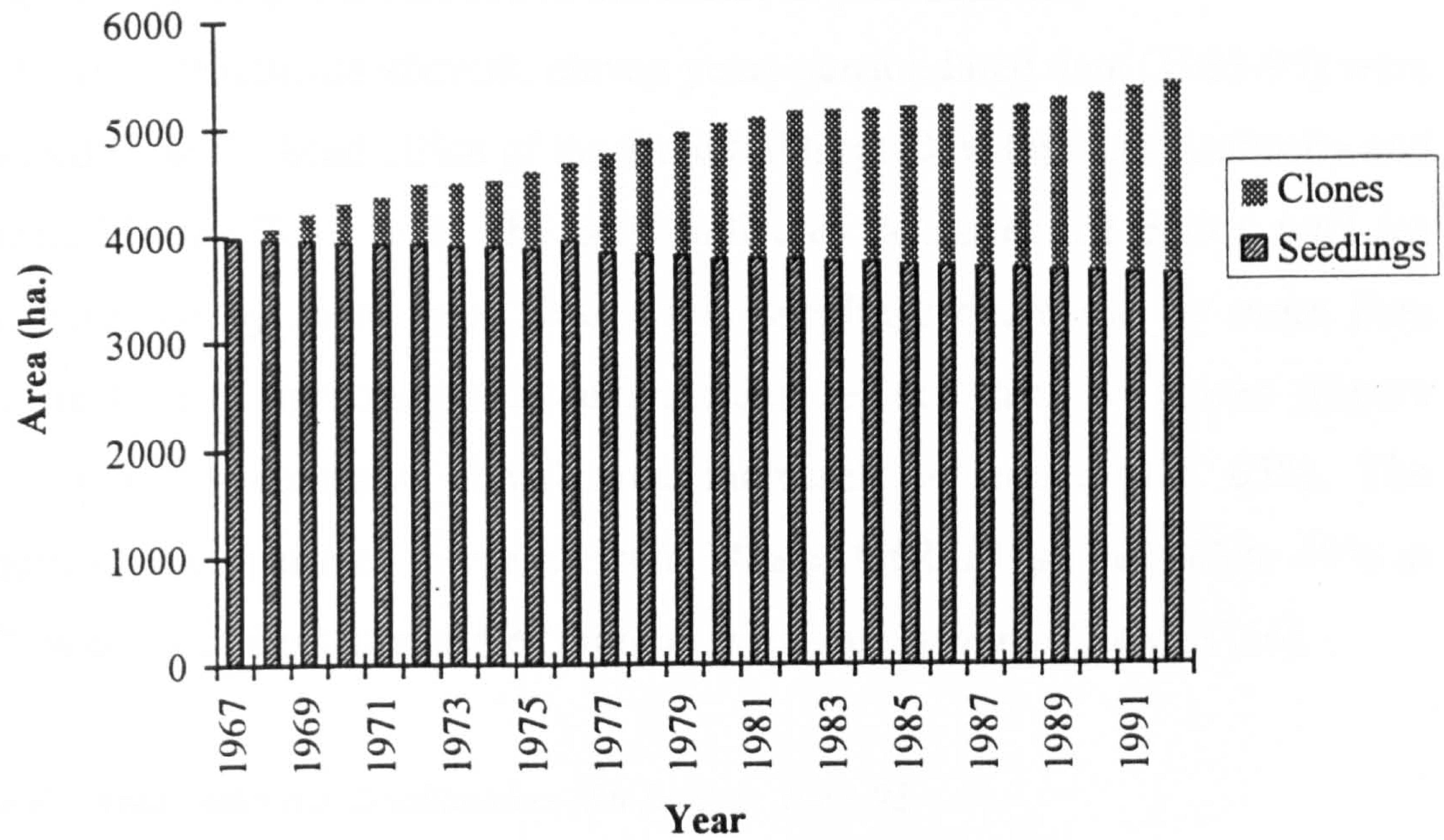

Figure V.13 African Highland Produce (Kenya), 1984-1995
Area of seedlings and clonal tea

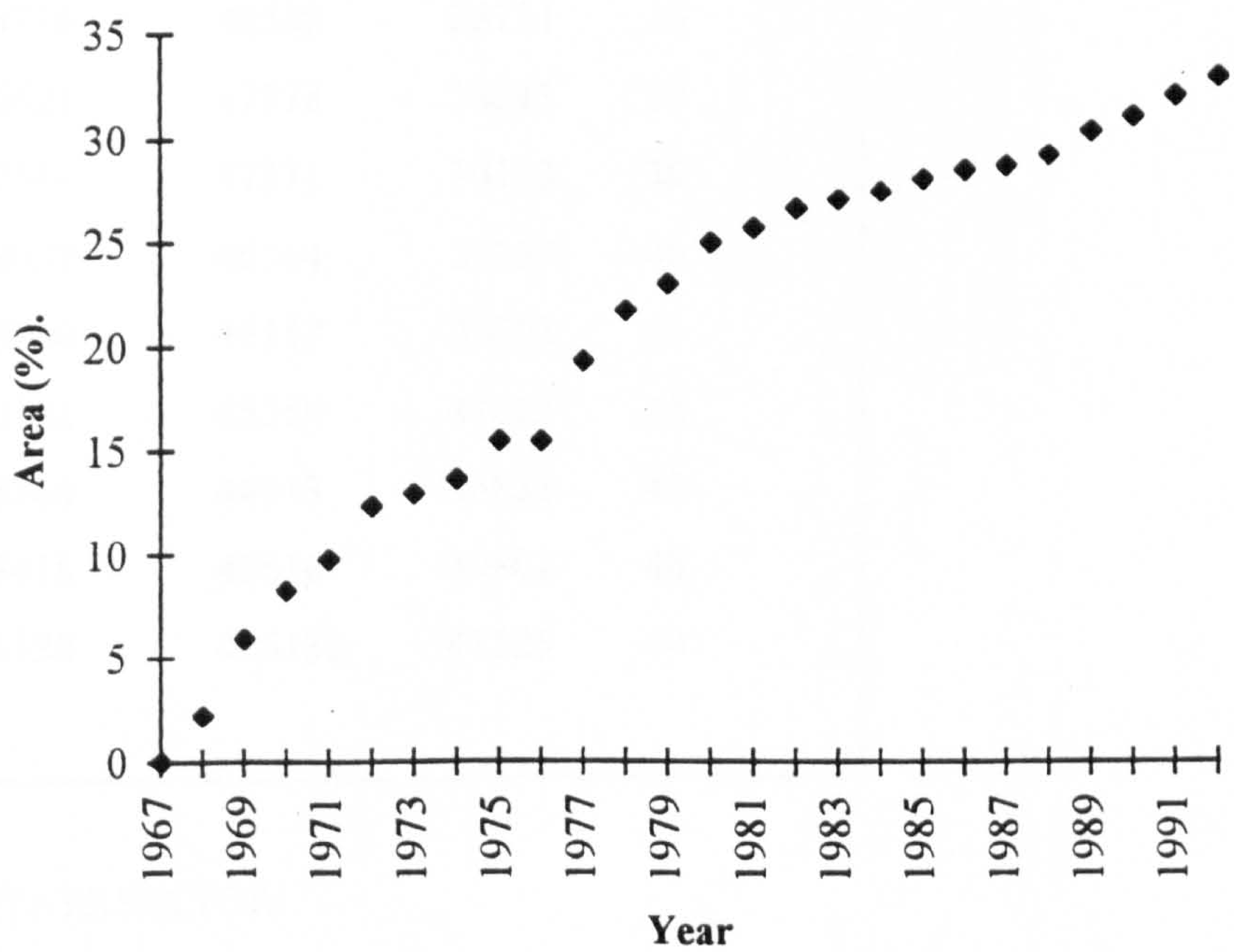

Figure V.14 African Highland Produce (Kenya), 1984-1995
Area of clones as proportion of total planted area

V.3 USE OF IMPROVED PLANTING MATERIALS (SRI LANKA)

V.3.1 SMALLHOLDINGS SECTOR: eleven years consolidated data (1983-93) were collected from the head office of the Smallholdings Development Authority and presented in the Table V.8. The table indicates that over the period total tea area increased by more than 12%, while seedlings decreased by more than 14%, because of uprooting the seedlings and replace them by clones (Figure V.15). On the contrary, clonal area increased by more than 65%. The proportion of clonal area increased from 34% of total tea are in 1983 to 49% in 1993, with a constant increase of more than 1% per annum (Figure V.16).

Table V.8 Area under tea, Smallholders (Sri Lanka), 1983-93

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1983	74920	49799	25121	34
1984	74930	49192	25738	34
1985	75336	48585	26751	36
1986	76621	47978	28643	37
1987	77544	47371	30173	39
1988	78032	46764	31268	40
1989	78760	46157	32603	41
1990	80162	45550	34612	43
1991	81764	44943	36821	45
1992	83418	43616	39802	48
1993	84138	426132	41525	49

V.3.2 ESTATE SECTOR:

St.Coomb estate: ten years data were collected and presented in the Table V.9. The table shows that over the period tea area increased slightly over 2%, but seedlings decreased by about 33% because of uprooting and replacing them with improved clonal materials. Clonal area increased by about 29% (Figure

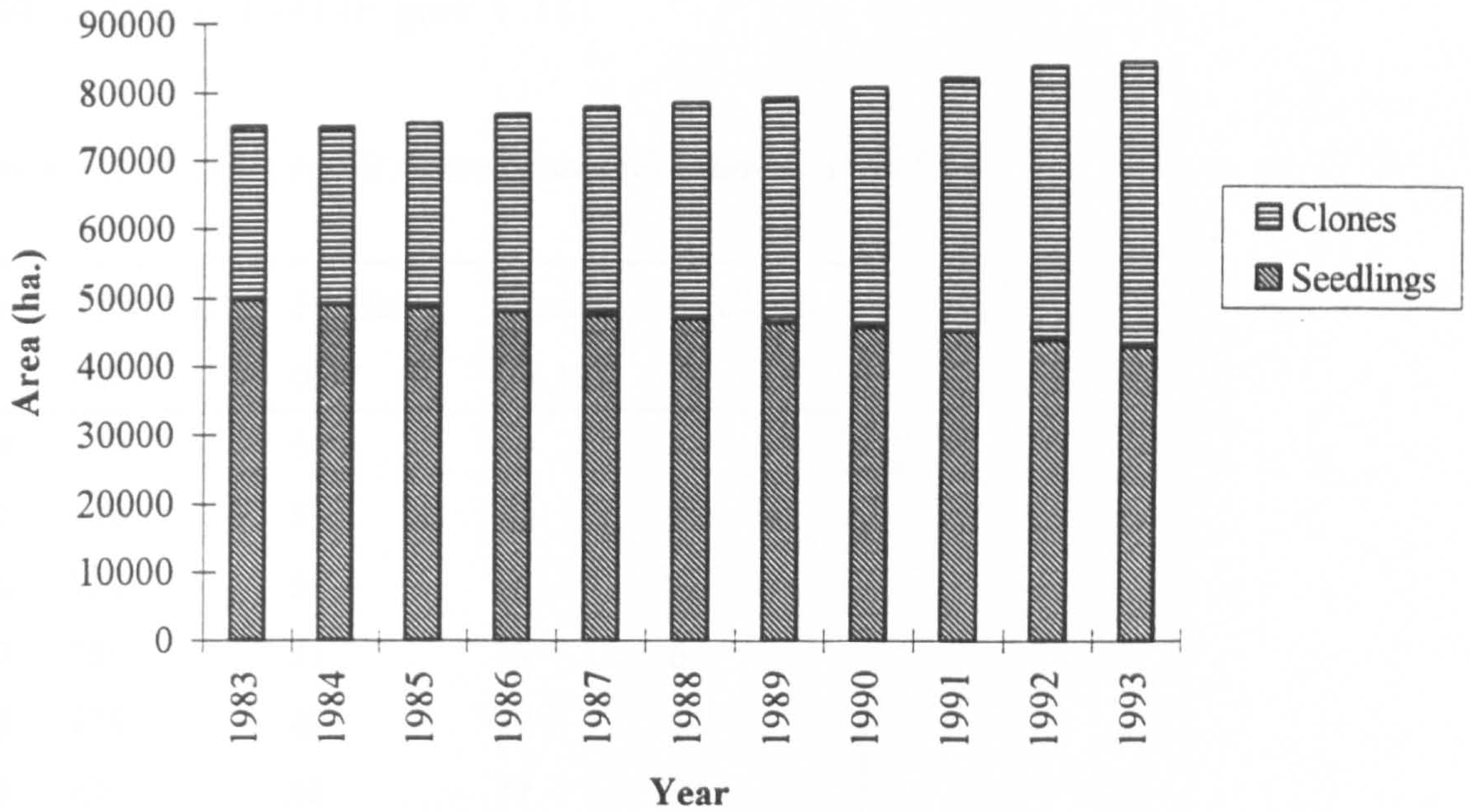

Figure V.15 Smallholders (Sri Lanka), 1983-1994
Area of seedlings and clonal tea

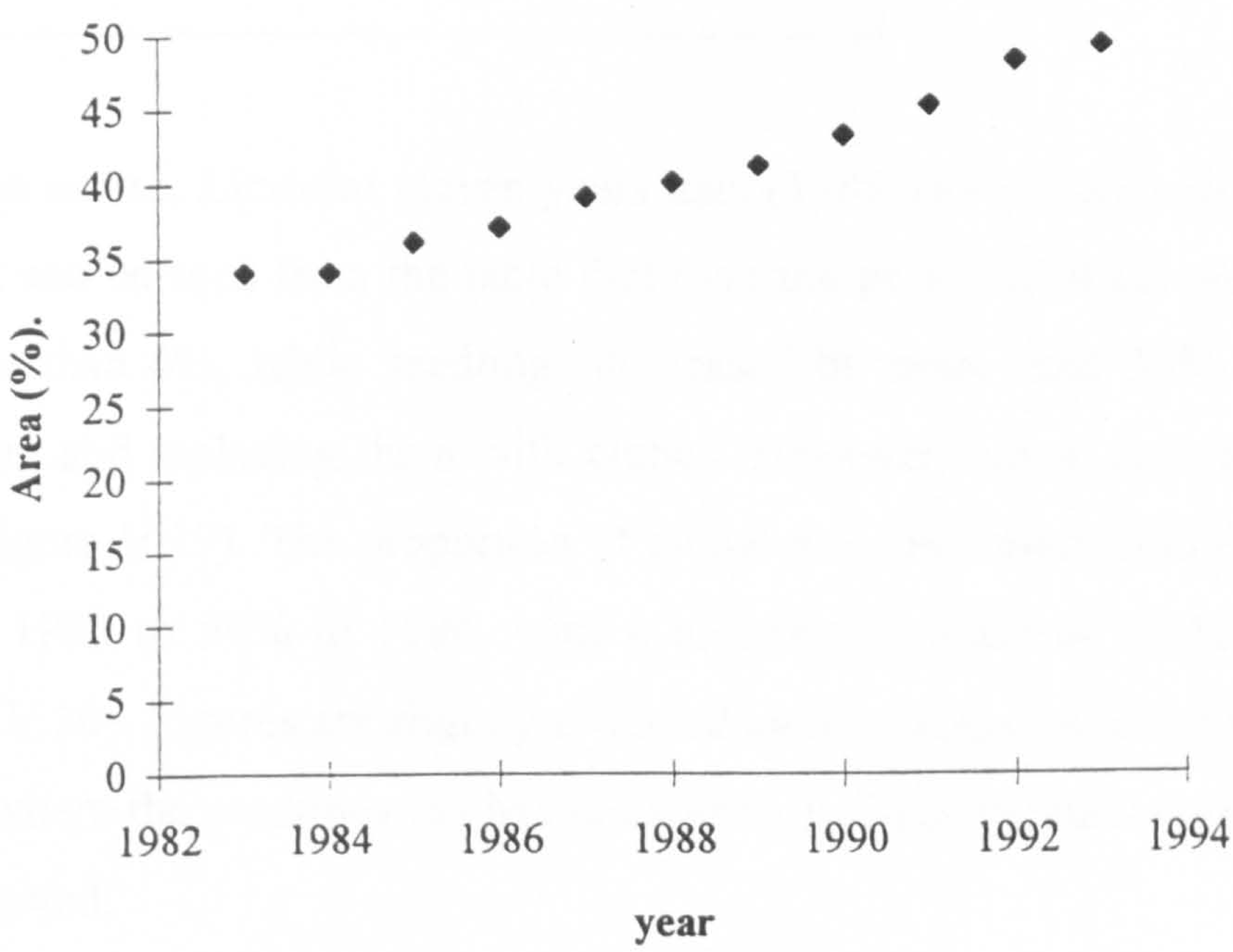

Figure V.16 Smallholders (Sri Lanka), 1983-1994
Area of clones as proportion of total planted area

V.17). The proportion of clonal area increased from 56% of total tea area in 1984 to 72% in 1993 (Figure V.18).

Table V.9 Area under tea, St.Coomb estate (Sri Lanka), 1983-93

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1984	140	61	79	56
1985	138	59	79	57
1986	138	55	83	60
1987	136	35	83	61
1988	136	49	87	64
1989	136	49	87	64
1990	139	49	91	65
1991	142	45	98	69
1992	143	43	101	70
1993	145	41	105	72

Waltrim estate, Lindula: eleven years data (1985-1994) were collected, Table V.10. It can be seen from the table that over the period total tea area increased by more than 6%, while seedlings decreased by more than 30%, because of uprooting and replacing them with clones. However, clonal area increased by 24% (Figure V.19). The proportion of clonal area increased from 44% of total area in 1985 to 59% in 1994, with a constant increase of 1.5% per annum (Figure V.20). Figures are slightly distorted by the exclusion of land in the total figure, where the seedlings tea has been uprooted, but the new clones have yet to be planted.

Diagama West tea estate: twelve years (1983-94) data were collected and showed in Table V.11. Over the period total tea area and seedlings area decreased by about 6% and 13% respectively. On the other hand clonal area

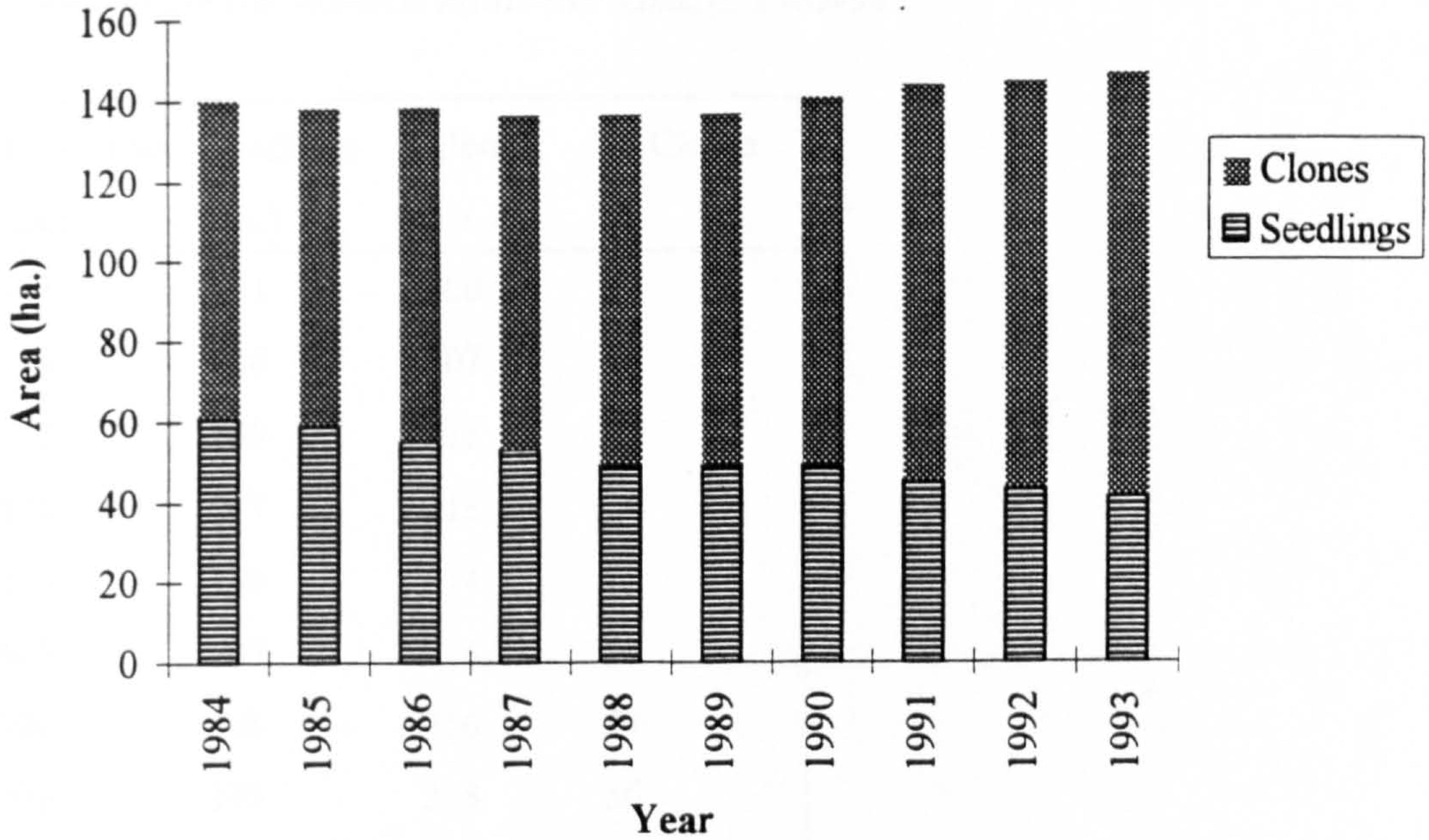

Figure V.17 St.Coomb estate (Sri Lanka), 1984-1993
Area of seedlings and clonal tea

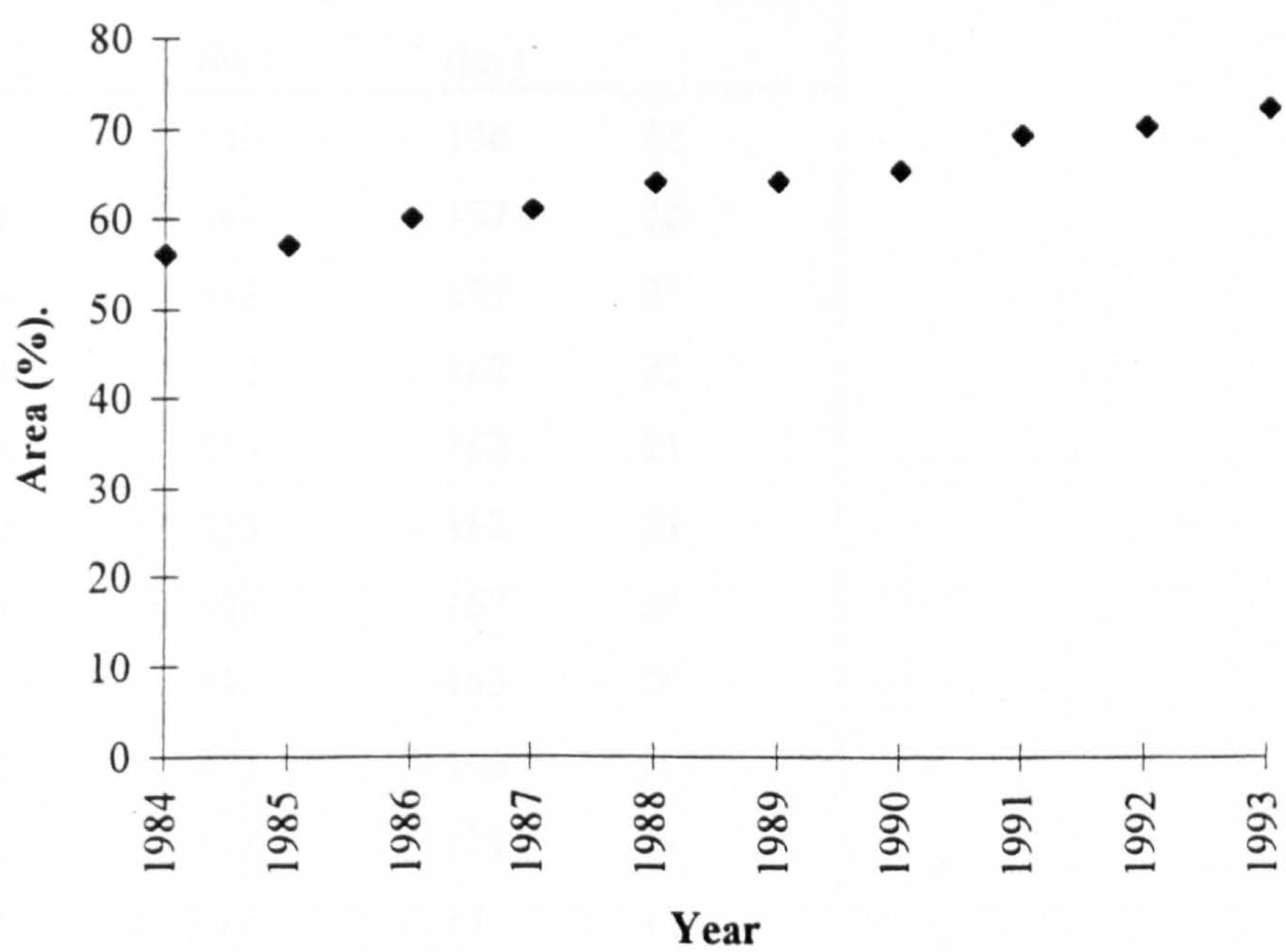

Figure V.18 St.Coomb estate (Sri Lanka), 1984-1993
Area of clones as porportion of total planted area

Table V.10 Area under tea, Waltrim estate (Sri Lanka), 1985-94

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1985	451	251	200	44
1986	453	246	207	46
1987	452	239	213	47
1988	431	217	213	50
1989	413	199	214	52
1990	400	187	214	53
1991	399	148	216	54
1992	393	175	218	56
1993	407	175	233	57
1994	423	175	248	59

Table V.11 Area under tea, Diagama West tea estate (Sri Lanka), 1983-94

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1983	699	543	156	22
1984	701	543	157	22
1985	696	538	157	23
1986	694	532	162	23
1987	693	530	162	23
1988	689	526	162	24
1989	665	503	162	24
1990	644	481	163	25
1991	645	479	166	26
1992	645	475	171	26
1993	651	476	175	27
1994	660	476	183	28

increased by more than 17% (Figure V.21). The proportion of clones increased from 22% of total tea area in 1983 to 28% in 1994, with a constant increase of

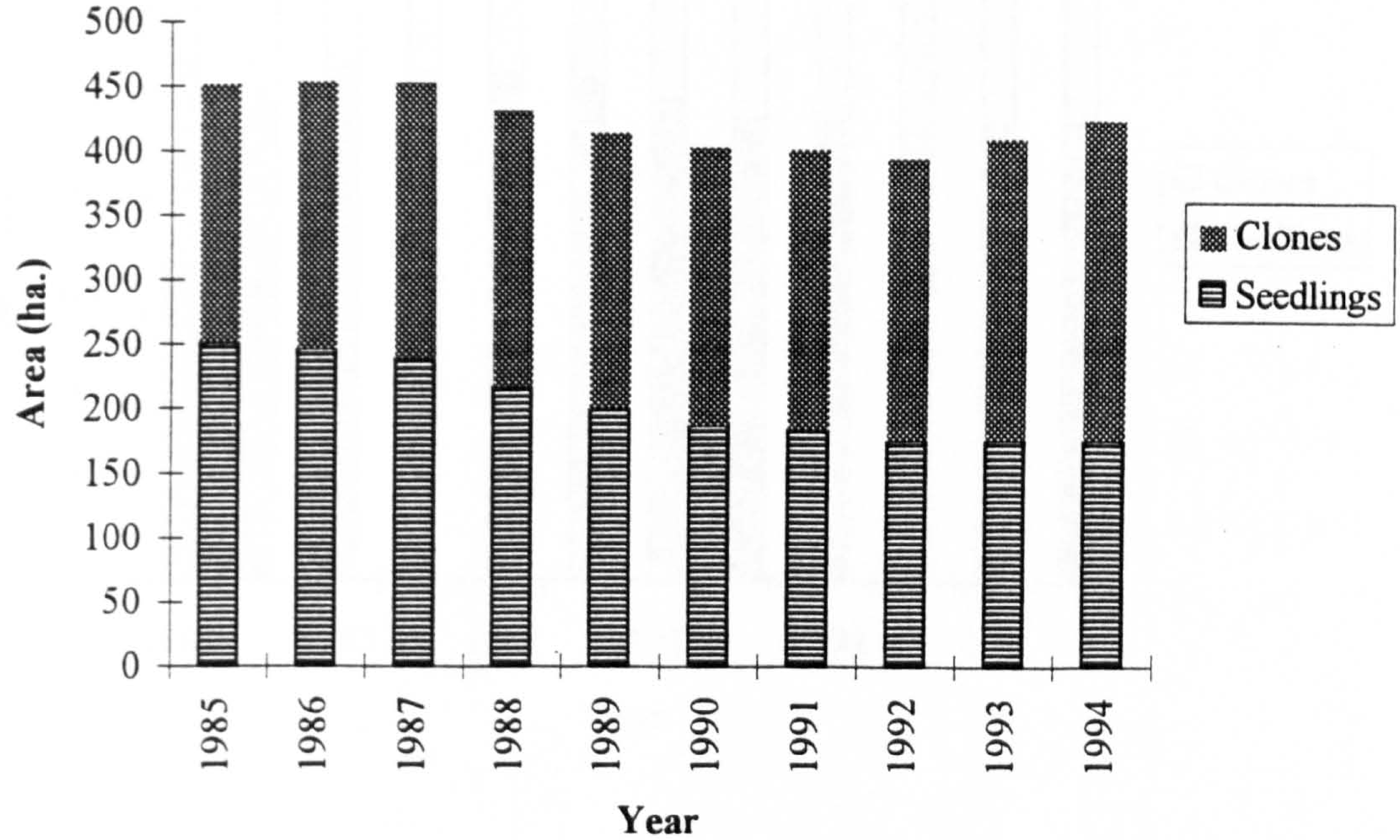

Figure V.19 Waltrim estate (Sri Lanka), 1985-1994
Area of seedlings and clonal tea

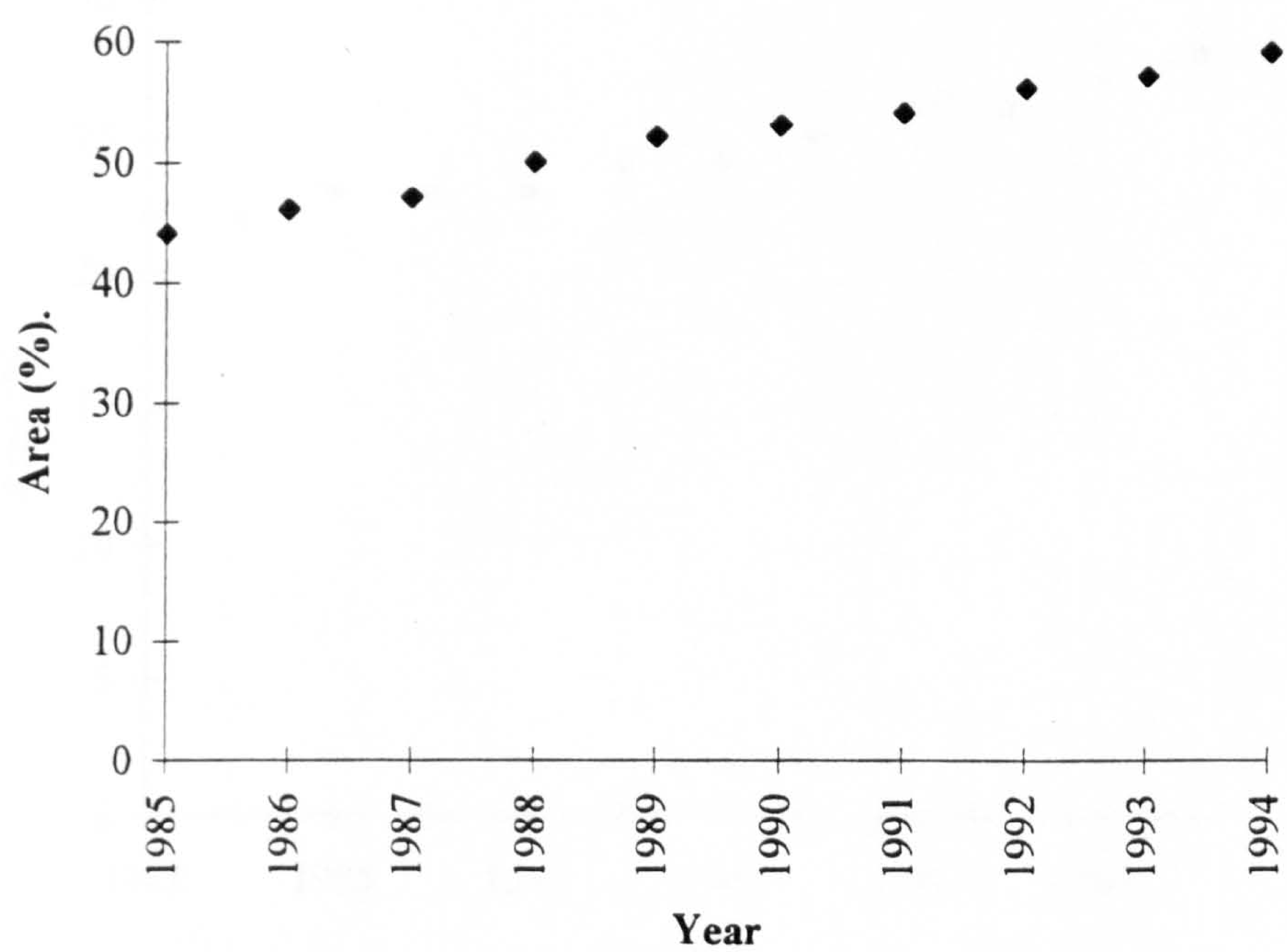

Figure V.20 Waltrim estate (Sri Lanka), 1985-1994
Area of clones as proportion of total planted area

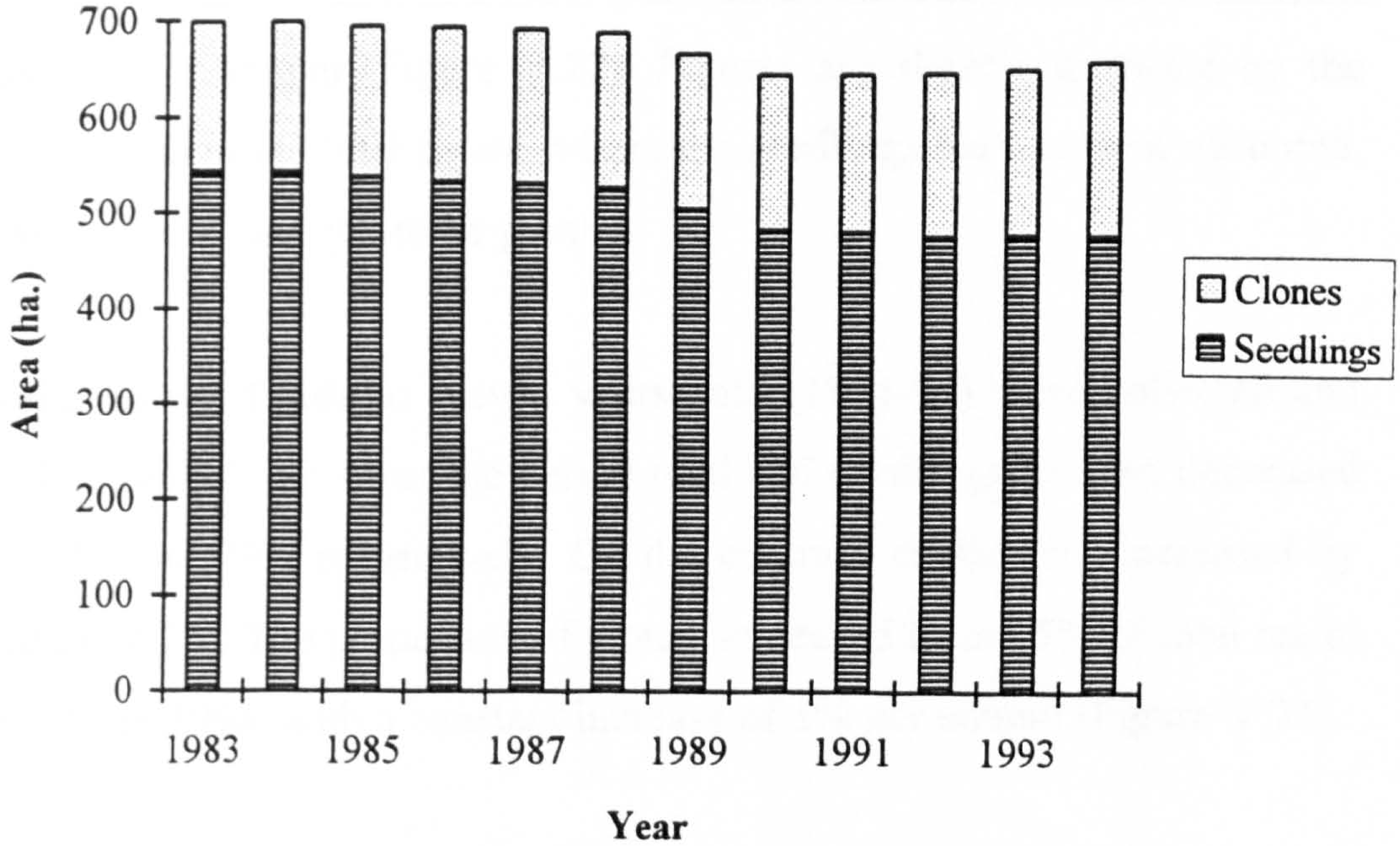

Figure V.21 Diagama westtea estate (Sri Lanka), 1983-1994
Area of seedlings and clonal tea

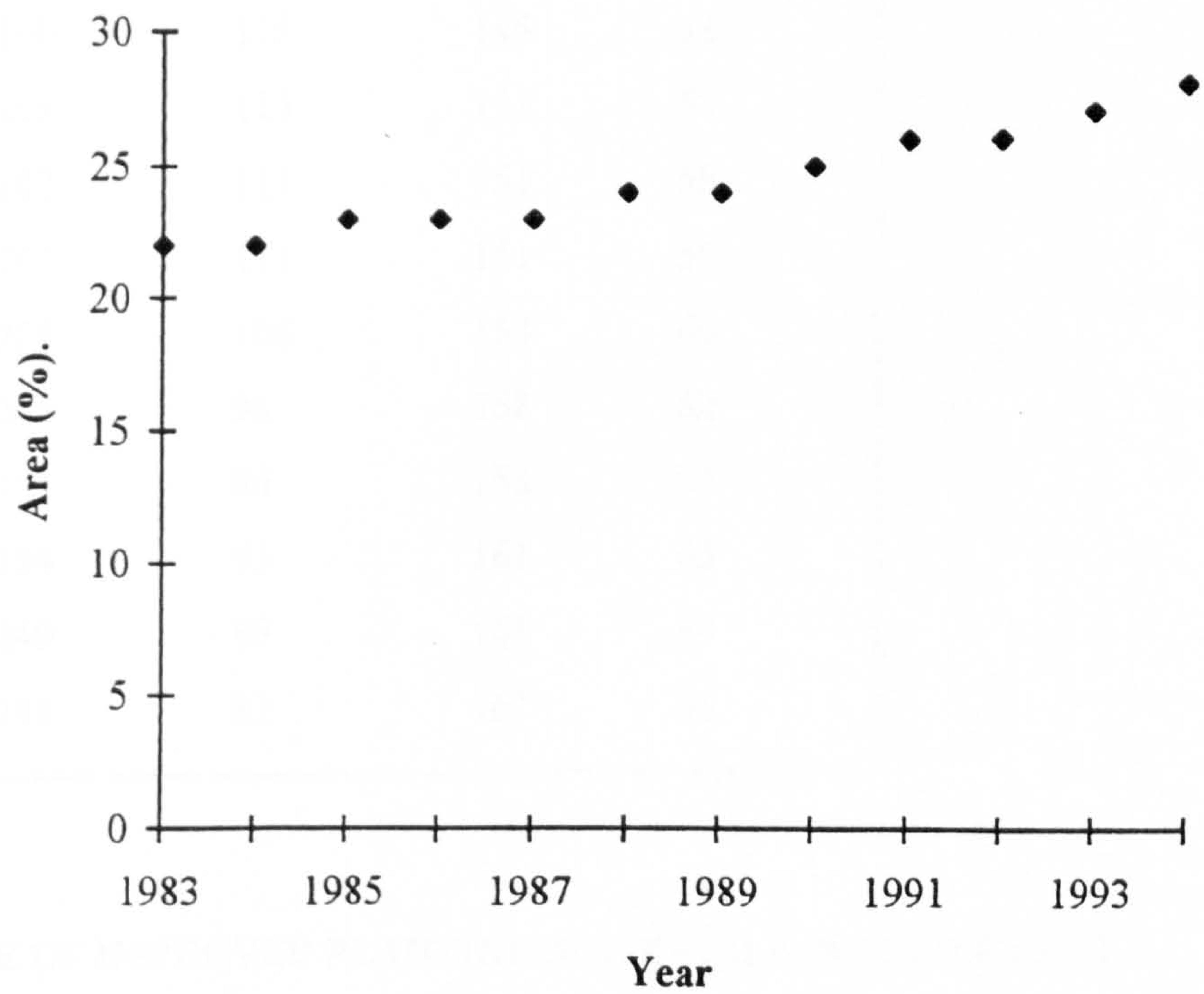

Figure V.22 Diagama west tea estate (Sri Lanka), 1983-1994
Area of clones as porportion of total planted area

less than 1% per annum (Figure V.22). Figures are slightly distorted by the exclusion of land in the total figure, where the seedlings tea has been uprooted, but the new clones have yet to be planted.

Mattakelle estate, Lindula: eleven years data (1984-94) were collected and presented in Table V.12. Over the period total and seedlings tea area decreased by about 4% and 29% respectively. On the contrary clonal area increased by 20% (Figure V.23). The proportion of clones increased from 55% of total tea in 1984 to 66% in 1994, with a constant increase of 1% per annum (Figure V.24).

Table V.12 Area under tea, Mattakelle estate (Sri Lanka), 1984-94

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1984	253	115	138	55
1985	260	115	146	56
1986	265	115	151	57
1987	262	111	151	58
1988	261	111	151	58
1989	264	106	158	60
1990	265	98	158	62
1991	253	95	158	62
1992	254	93	161	63
1993	249	89	161	64
1994	243	82	161	66

V.4 USE OF IMPROVED PLANTING MATERIALS (SOUTH INDIA)

Data were collected from only 2 estates, one belongs to Brooke Bond, India limited and the other one is under Khotari group.

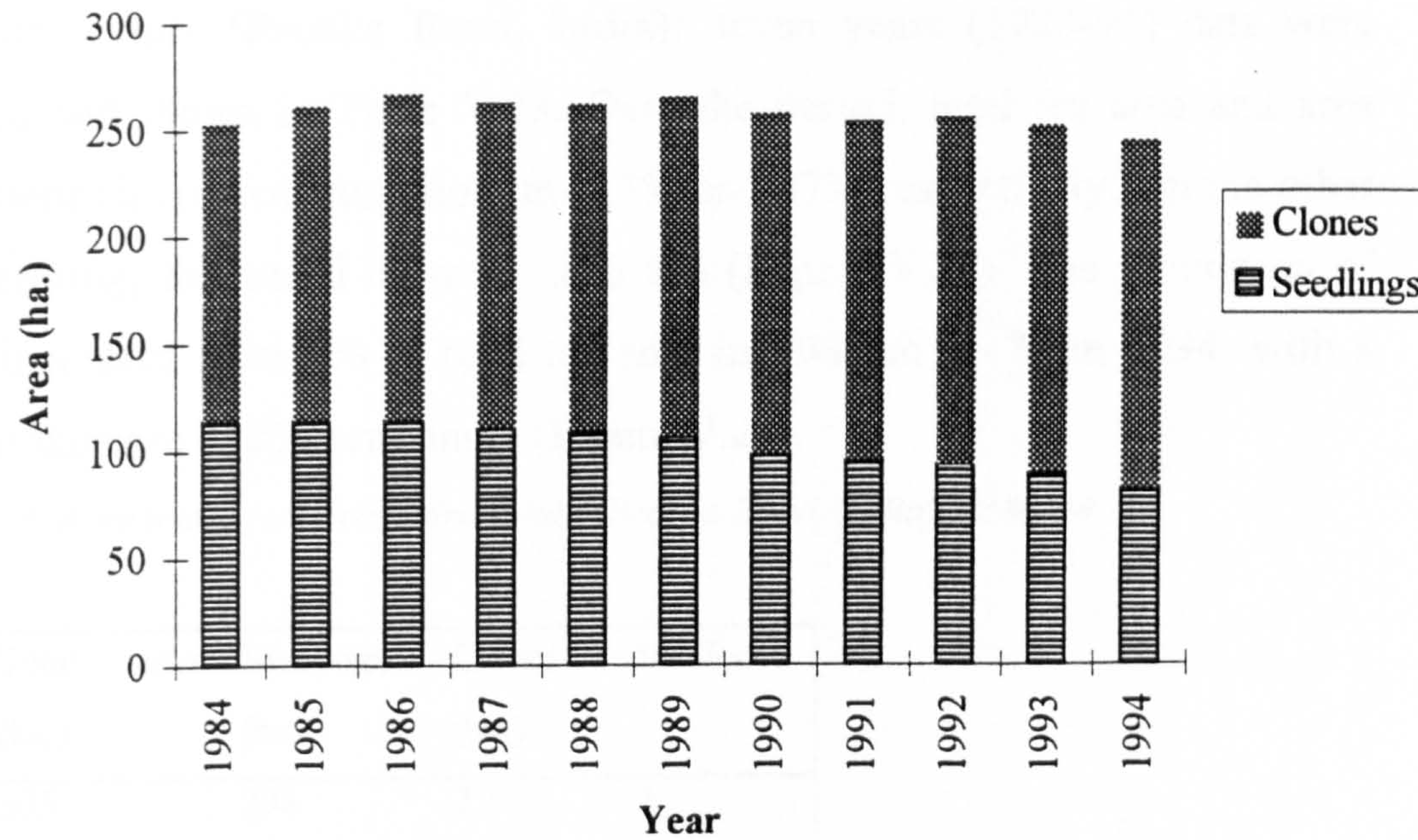

Figure V.23 Mattakelle estate (Sri Lanka), 1984-1994
Area of seedlings and clonal tea

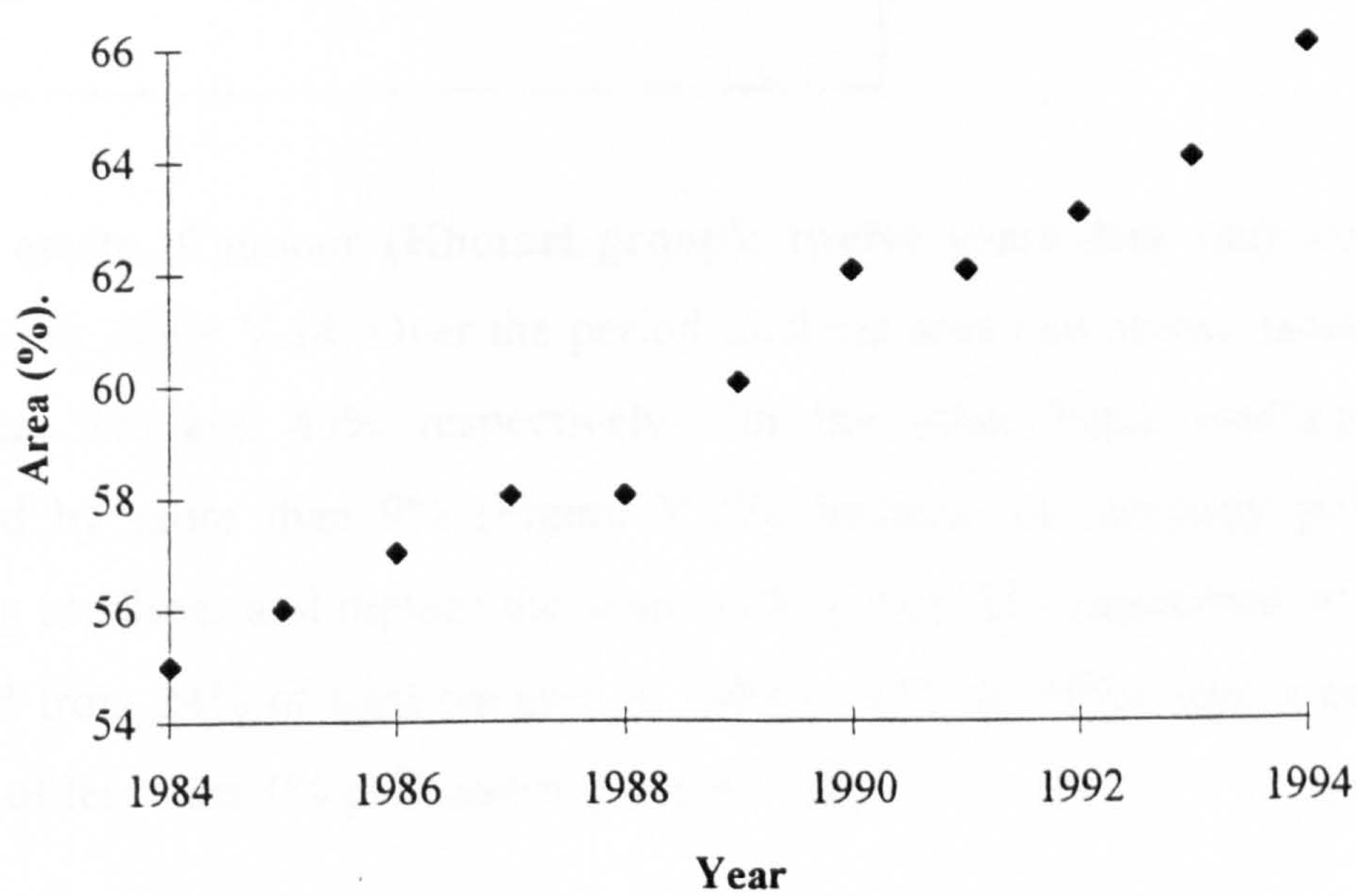

Figure V.24 Mattakelle estate (Sri Lanka), 1984-1994
Area of clones as proportion of total planted area

V.4.1 ESTATE SECTOR

Srikundra estate (Brooke Bond, India): seven years (1988-94) data were collected and shown in Table V.13. Over the period, total tea area and area under clones increased from more than 3% and 37% respectively. On the other hand seedlings decreased by more than 8% (Figure V.25). The proportion of clones increased from 2% of total tea area in 1988 to 16 % in 1994, with a constant increase of 2% per annum (Figure V.26).

Table V.13 Area under tea, Srikundra estate (Brooke Bond, India), 9188-94

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1988	305	298	7	2
1989	305	291	15	5
1990	305	276	30	10
1991	305	273	33	11
1992	311	273	39	12
1993	323	273	51	16
1994	323	273	51	16

Glendle estate, Coonoor (Khotari group): twelve years data were collected and given in Table V.14. Over the period total tea area and clones increase by more than 3% and 43% respectively. On the other hand seedlings area decreased by more than 9% (Figure V.27), because of company policy of uprooting seedlings and replace the same with clones. The proportion of clones increased from 24% of total tea area in 1982 to 33% in 1993, with a constant increase of less than 1% per annum (Figure V.28).

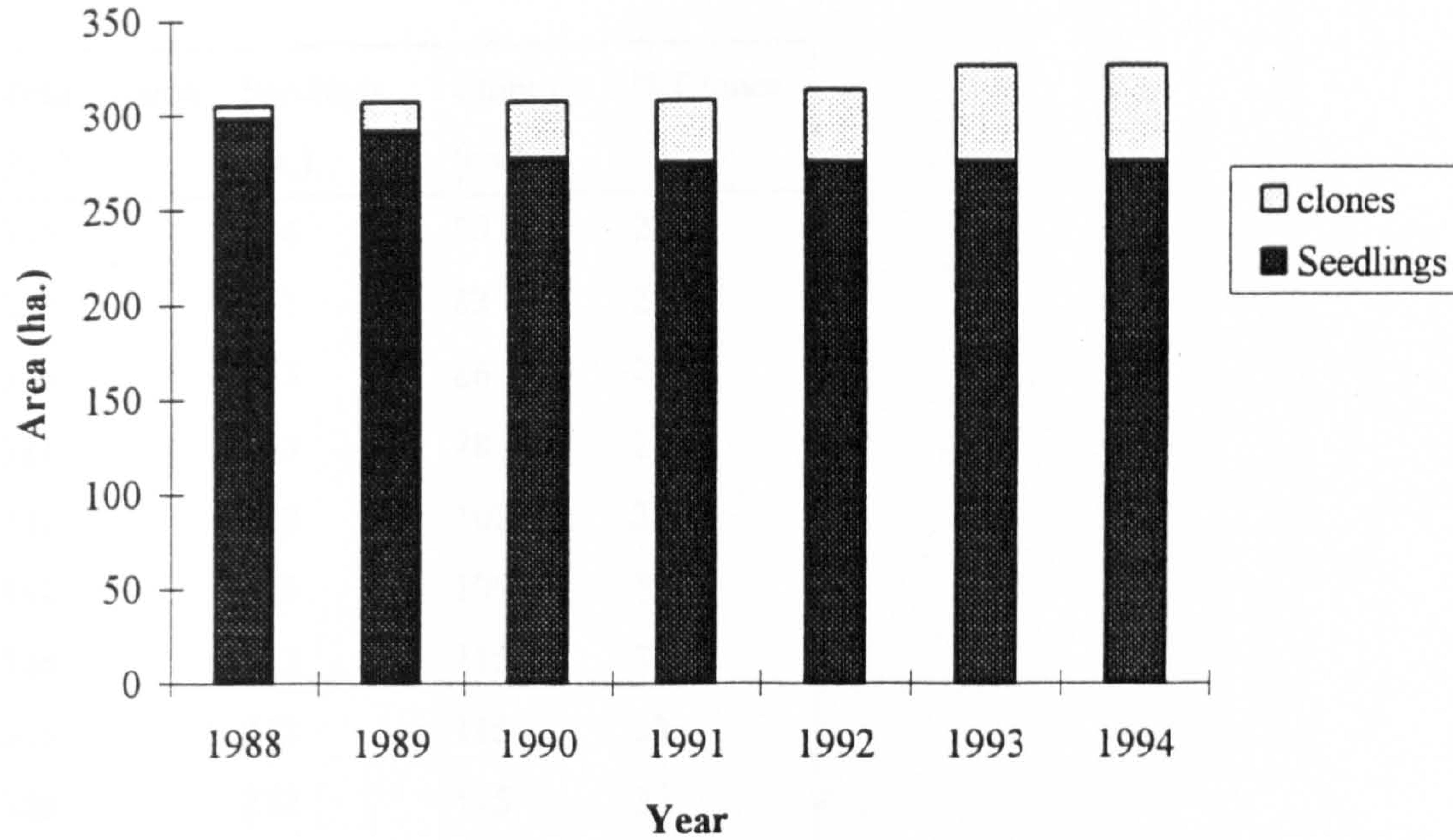

Figure V.25 Srikundra estate, Brooke Bond (South India), 1988-1994
Area of seedling and clonal tea

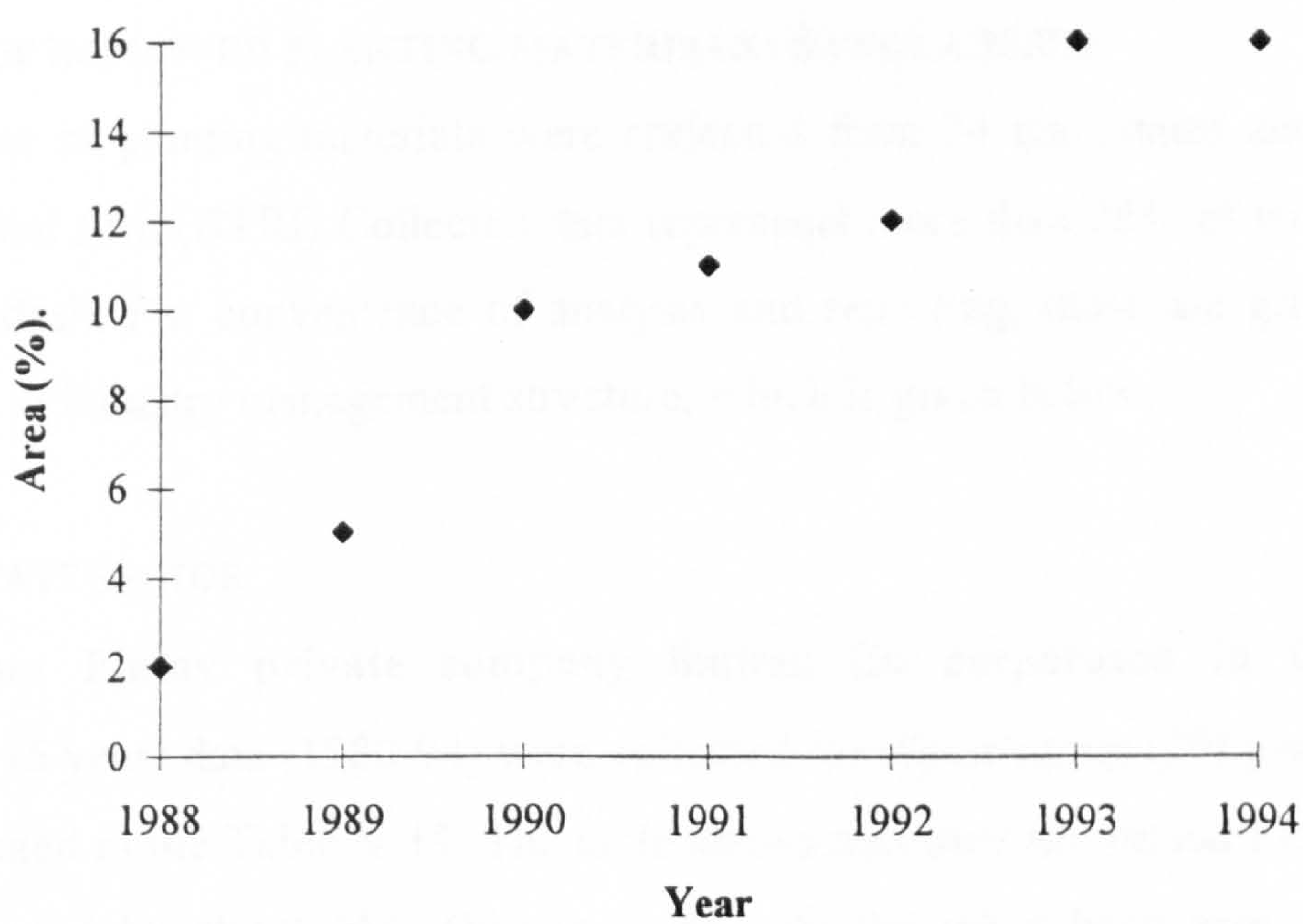

Figure V.26 Srikundra estate, Brooke Bond (South India), 1988-1994
Area of seedlings and clonal tea

Table V.14 Area under tea, Glendle estate (South India),1982-93

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1982	334	254	80	24
1983	325	242	83	25
1984	319	233	86	27
1985	321	233	88	27
1986	341	233	108	32
1987	341	233	108	32
1988	348	233	115	33
1989	346	232	115	33
1990	346	232	115	33
1991	346	232	115	33
1992	345	230	115	33
1993	345	230	115	33

V.5 Use of improved planting materials (Bangladesh)

data on use of planting materials were collected from 34 tea estates and one experimental firm (BTRI) Collected data represents more than 25% of tea area of Bangladesh. For convenience of analysis and reporting, these are grouped according to industry management structure, which is given below.

V.5.1 Estate sector

The James Finlay private company limited (in corporated in Great Britain): 15 years data (1980-94) were collected for whole group (20) gardens, and presented in the Table V.15. The table shows that over the period total tea area increased by about 16% (Figure V.29). On the other hand area under clonal tea increased from 1% of total tea area in 1980 to 10% in 1994, with a constant rate of increase by less than 1% per annum (Figure V.30). The figures

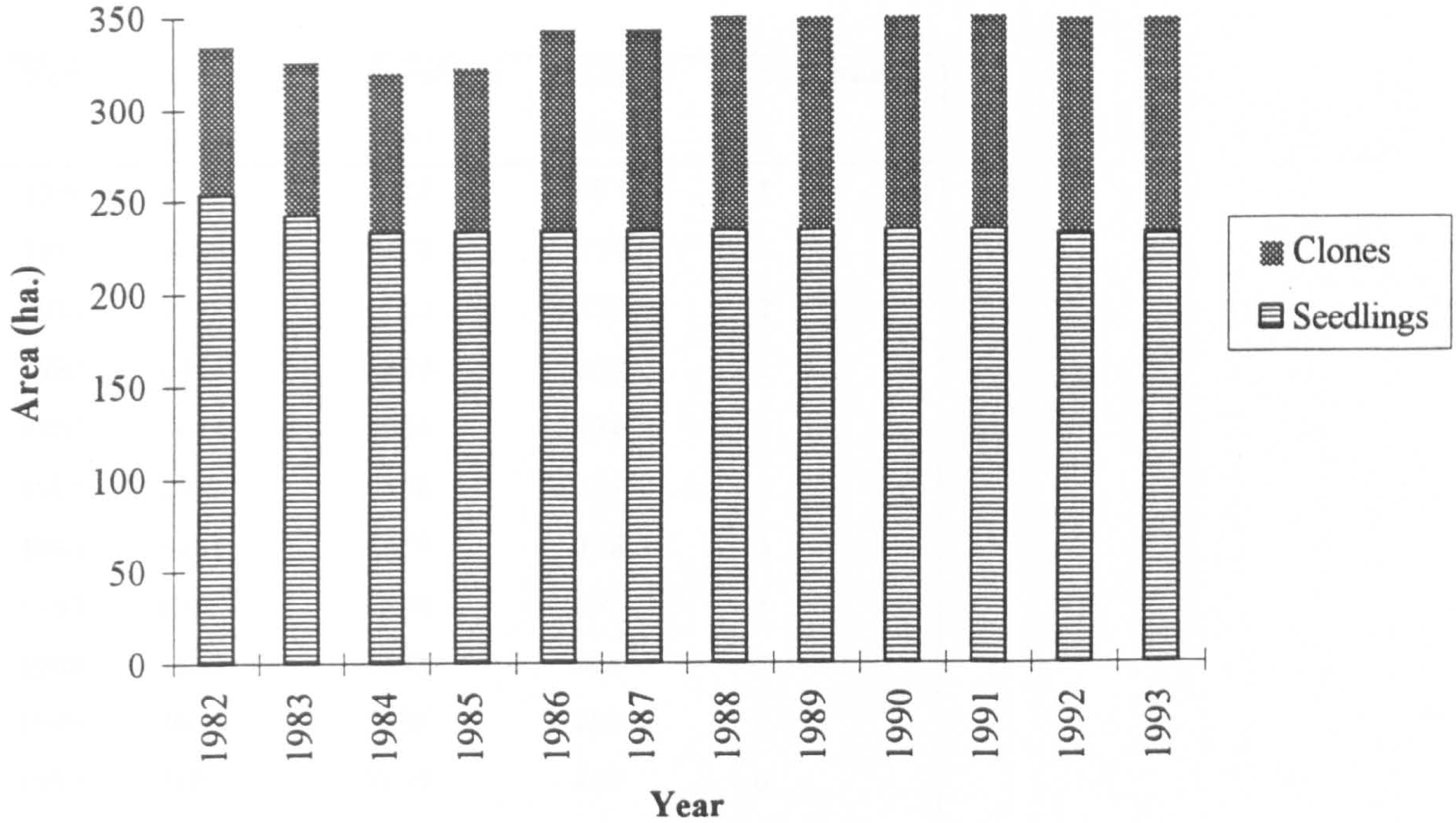

Figure V.27 Glendle estate (South India), 1982-1993
Area of seedlings and clonal tea

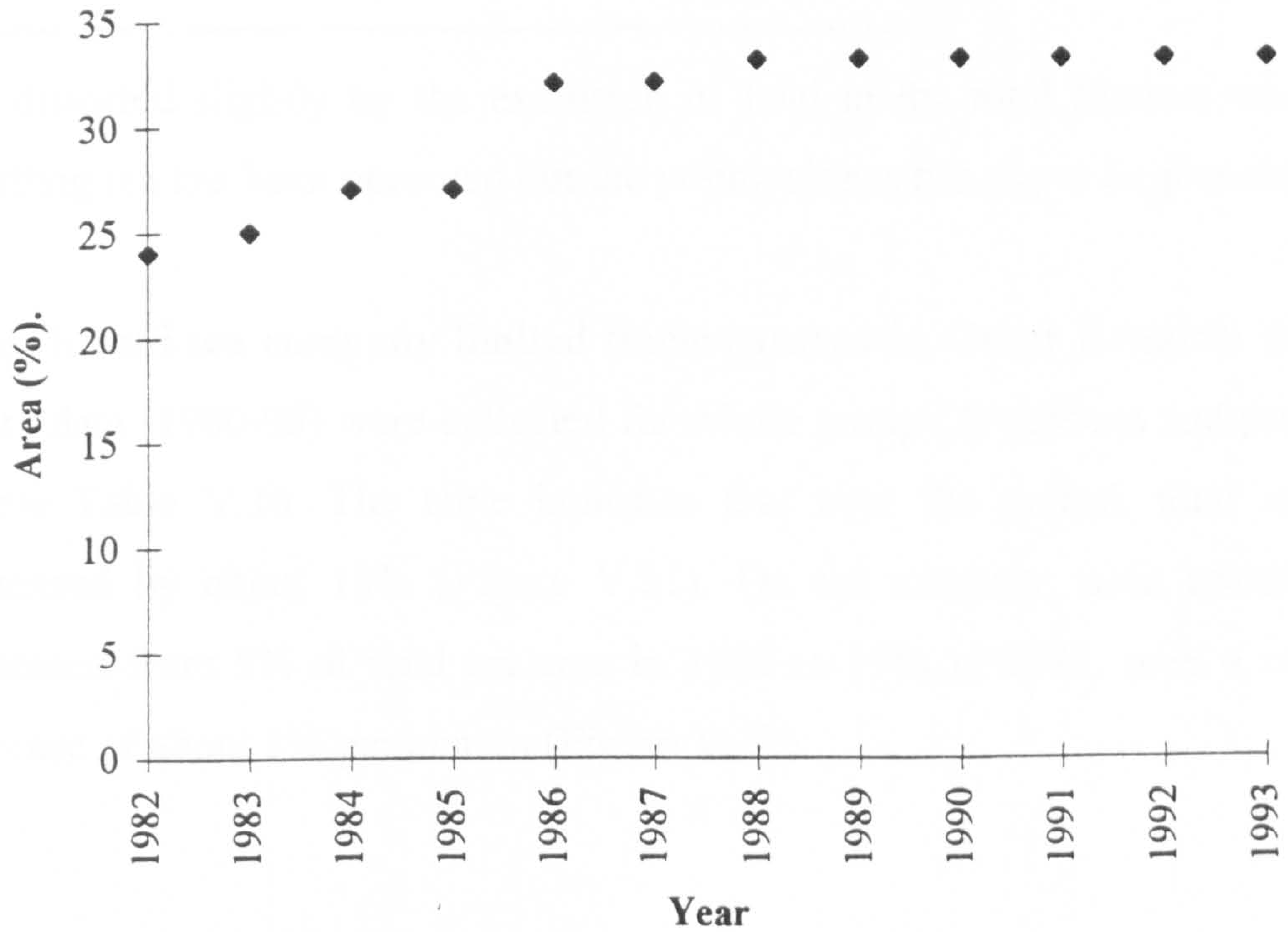

Figure V.28 Glendle estate (South India), 1982-1993
Area of clone as proportion of total planted area

Table V.15 Area under tea, James Finlay private company limited (Bangladesh), 1980-94

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1980	6028	6027	90	1
1981	6480	6478	110	2
1982	6505	6503	138	2
1983	6499	6497	159	2
1984	6607	6604	174	3
1985	6453	6450	204	3
1986	6682	6679	218	3
1987	6839	6835	298	4
1988	7138	7133	358	5
1989	7082	7076	413	6
1990	7181	7175	457	6
1991	6973	6966	505	7
1992	6976	6968	564	8
1993	6953	6944	640	9
1994	6988	6978	706	10

are distorted slightly by the exclusion of land in the total figures, where the seedling tea has been uprooted but the young clones has yet to be planted.

The Deundi tea company limited (incorporated in Great Britain): fourteen years data (1980-93) were collected for whole group (3) gardens and presented below Table V.16. The table indicates that over the period, total tea area increased by about 13% (Figure V.31). On the contrary, area under clone increased from 5% of total tea area in 1980 to 17% in 1993, with a constant increase of about 1% per annum (Figure V.32).

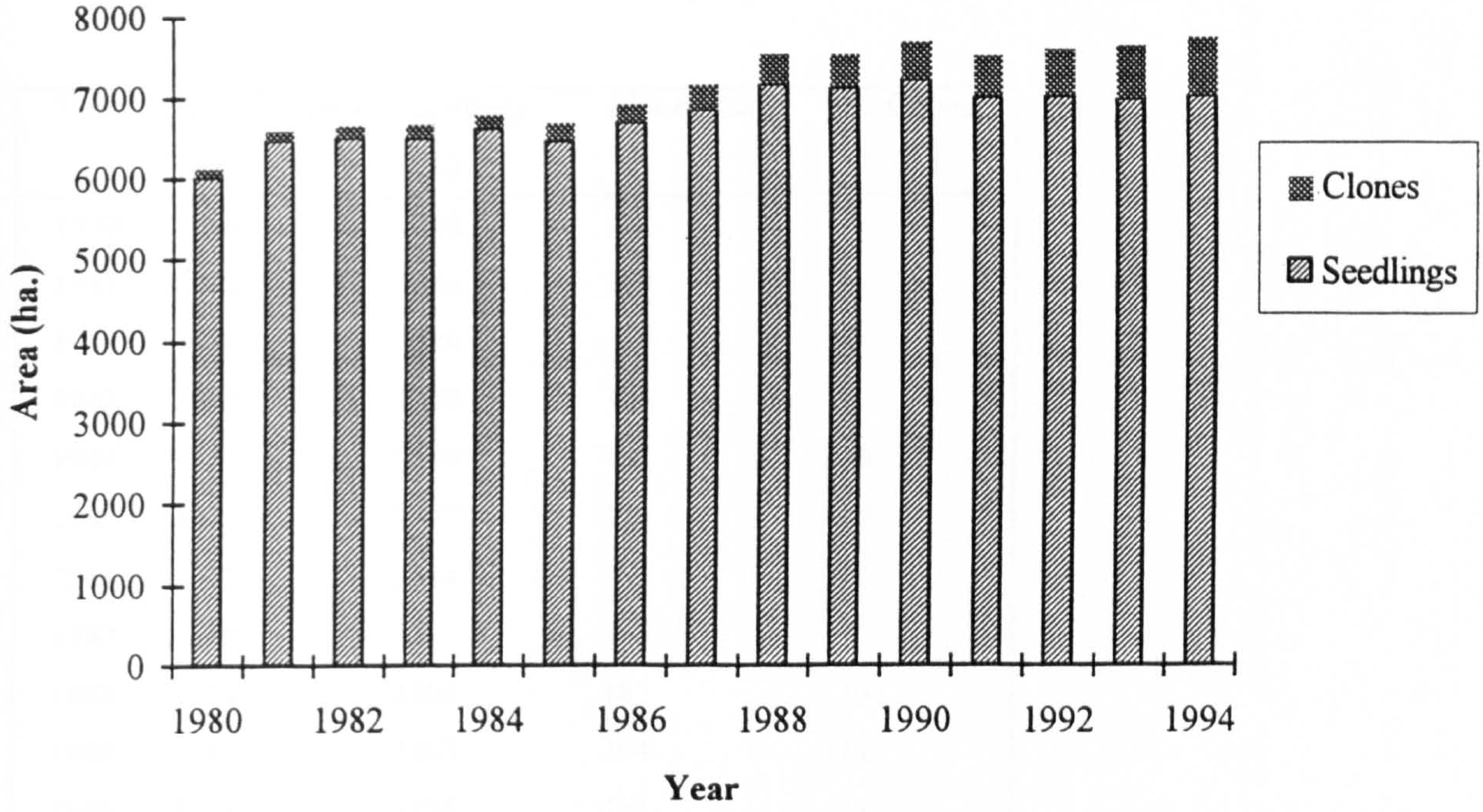

Figure V.29 James Finlay Private Company LTD. (Bangladesh), 1980-1994. Aera of seedlings and clonal tea

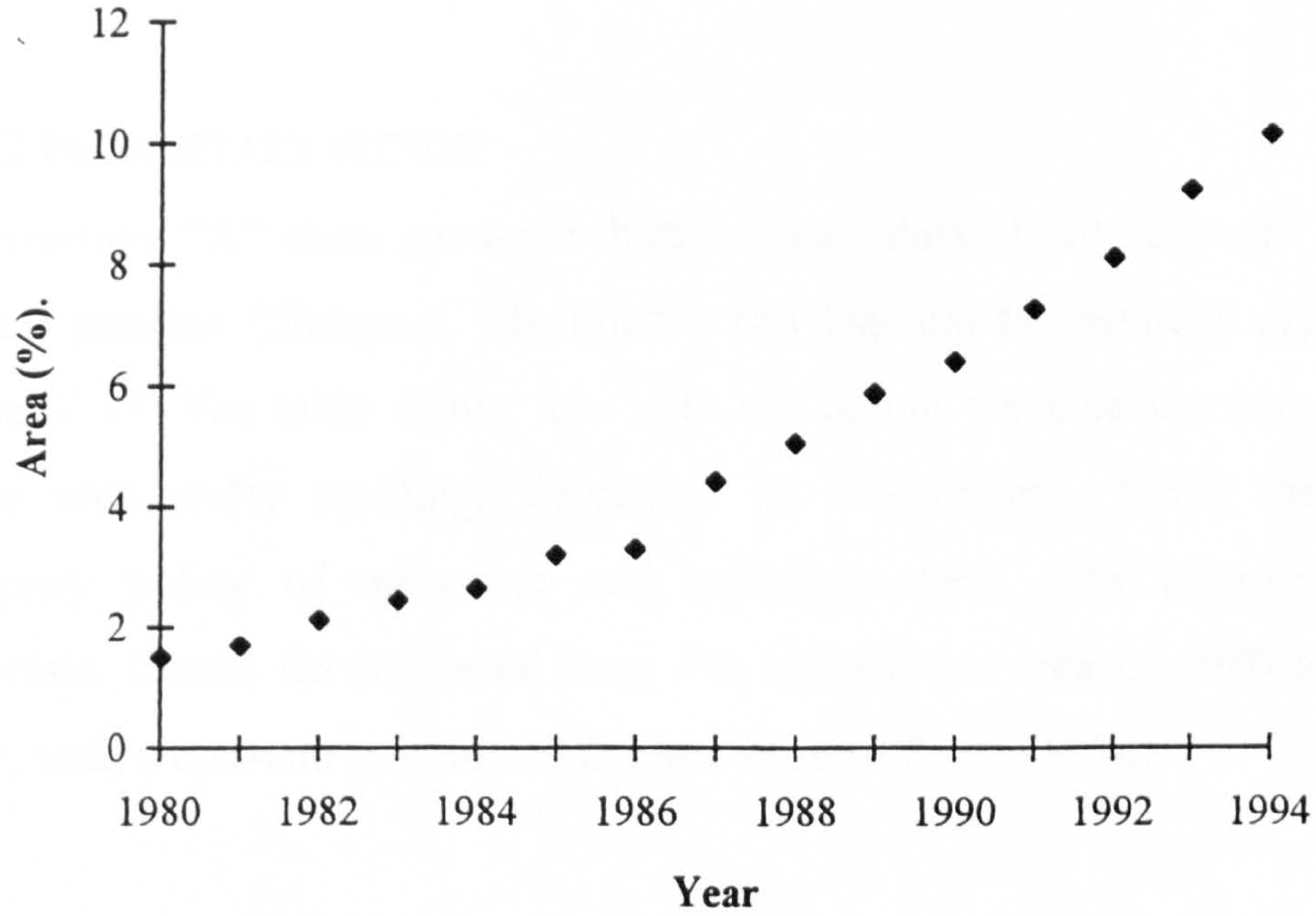

Figure V.30 James Finlay Private Company LTD. (Bangladesh), 1980-1994. Area of clones as proportion of total planted area

Table V.16 Area under tea, Deundi tea company limited (Bangladesh), 1980-93

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1980	1391	1315	76	5
1981	1426	1318	108	8
1982	1438	1320	118	8
1983	1438	1309	129	9
1984	1435	1298	137	10
1985	1447	1307	140	10
1986	1471	1314	157	11
1987	1459	1294	165	11
1988	1493	1306	187	13
1989	1511	1307	204	14
1990	1511	1295	216	14
1991	1548	1318	230	15
1992	1558	1309	249	16
1993	1578	1306	272	17

V.5.2 PROPRIETARY SECTOR

Proprietary "A" class gardens: thirteen years data (1980-93) were collected from 3 gardens (Shatgaon, Madhupore and Dhamai tea estates) and given in Table V.17. The table shows that over the period tea area increase by 28%, while area under seedlings decreased by 5% (Figure V.33), because of company policy of uprooting and replacing them with improved clonal materials. Clonal tea increased from 9% of total tea area in 1980 to 33% in 1993, with a constant increase of 2% per annum (Figure V.34).

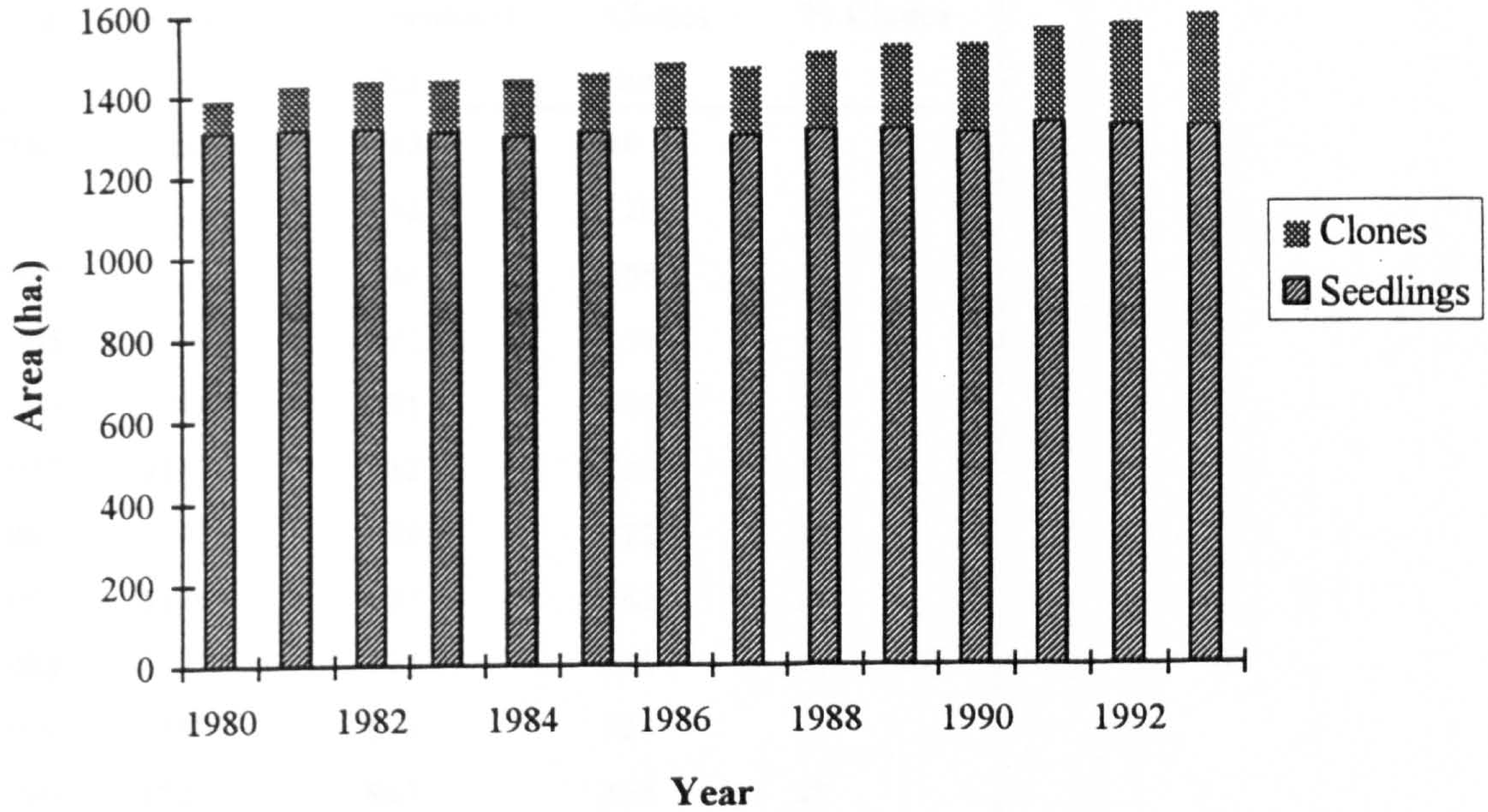

Figure V.31 Deundi Tea Company Ltd. (Bangladesh), 1980-1993
Area of seedlings and clonal tea

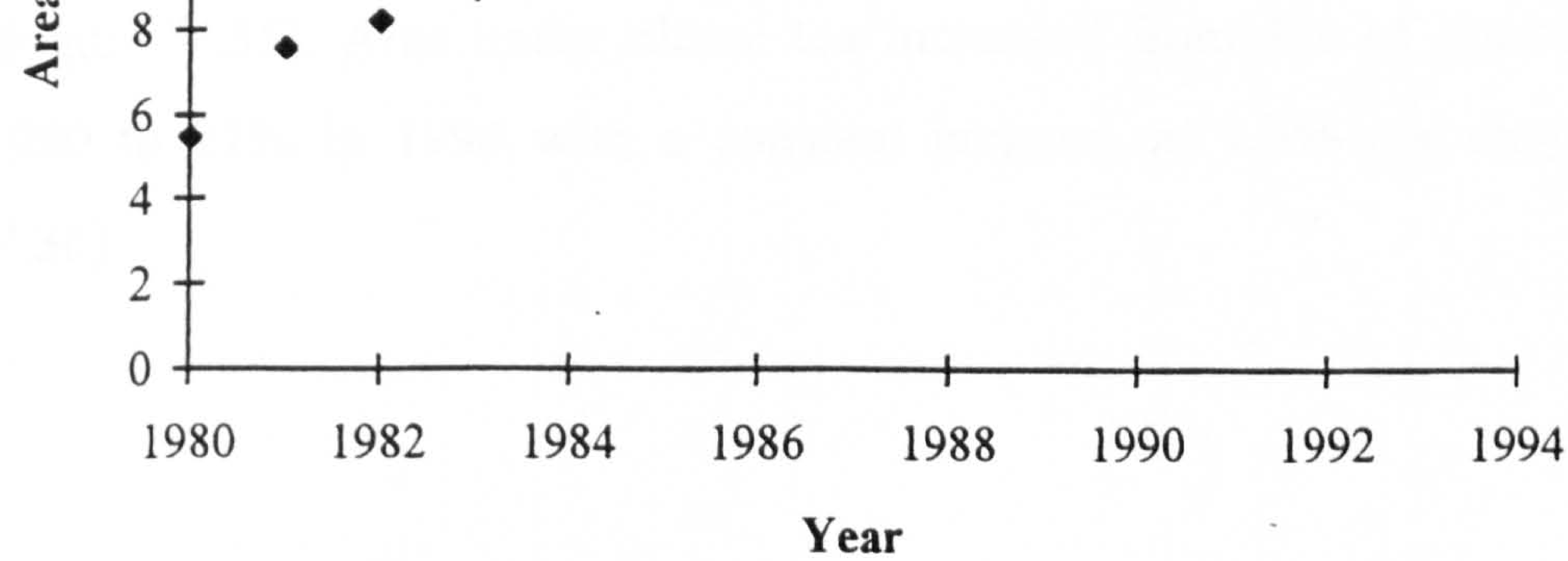

Figure V.32 Deundi Tea Company Ltd. (Bangladesh), 1980-1993
Area of clones as proportion of total planted area

Table V.17 Area under tea, Proprietary "A" class gardens (Bangladesh), 1980-93

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1980	983	893	90	9
1981	1006	886	120	12
1982	1039	844	155	15
1983	1066	890	176	17
1984	1086	891	195	18
1985	1117	912	205	18
1986	1160	938	222	19
1987	1189	937	252	21
1988	1197	912	285	24
1989	1198	874	324	27
1990	1222	867	355	29
1991	1228	843	385	31
1992	1245	844	401	32
1993	1259	849	410	33

The National tea company (joint Government and public enterprise): fourteen years data (1980-94) were collected for 5 gardens of Doloi valley and presented below Table V.18. The table shows that over the period total tea area increased by 4%. However, seedling area decreased by 17%, because of uprooting the old seedlings and replacing them with improved clonal tea (Figure V.35). Area under clonal tea increased from 1% of total tea area in 1980 to 21% in 1994 with a constant increase of 1.5% per annum (Figure V.36).

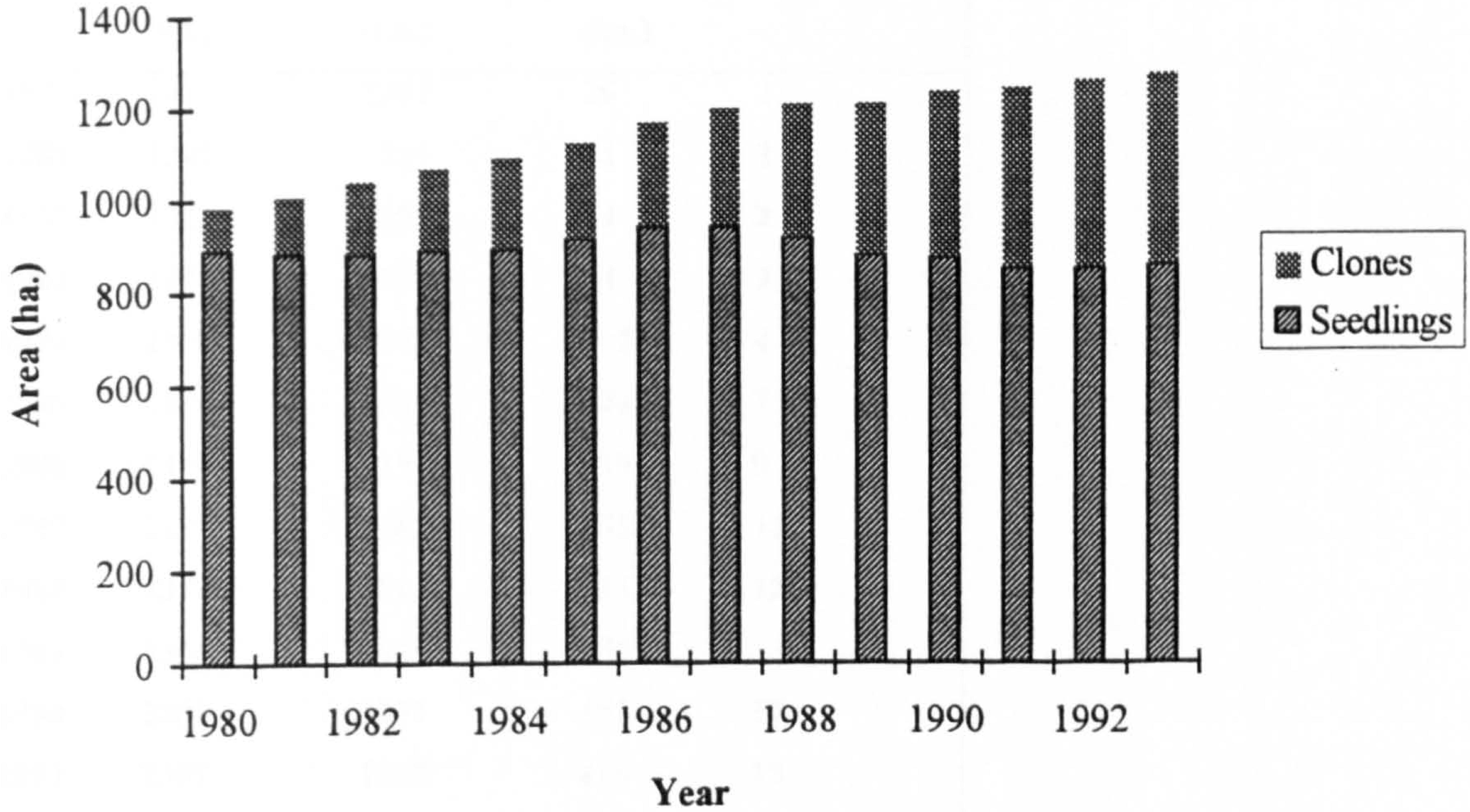

Figure V.33 Proprietary "A" class estates (Bangladesh), 1980-1993. Area of seedlings and clonal tea

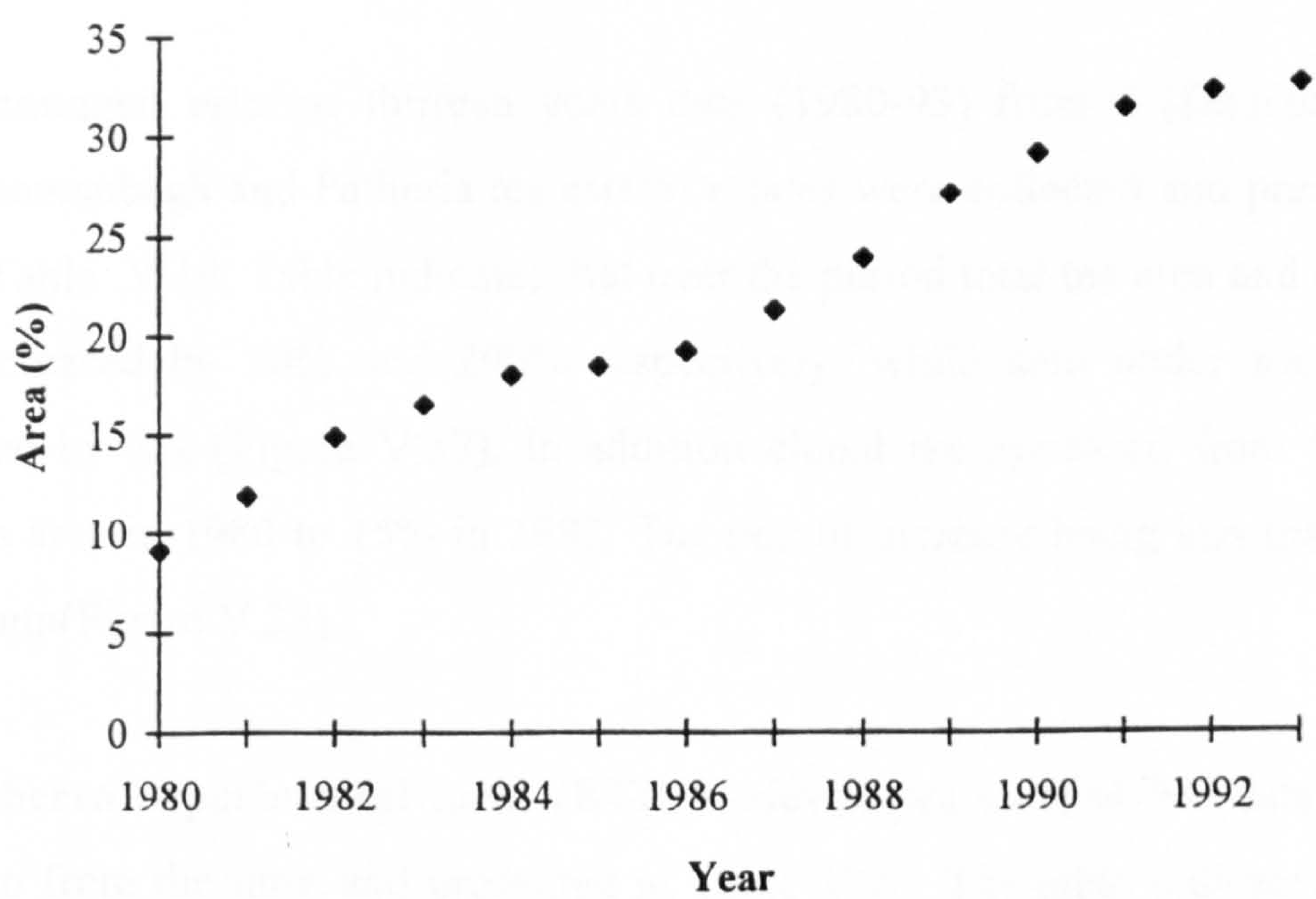

Figure V.34 Proprietary "A" class estates (Bangladesh), 1980-1993 Area of clones as proportion of total planted area

Table V.18 Area under tea, National tea company

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1980	2418	2392	26	1
1981	2247	2196	51	2
1982	2413	2359	54	2
1983	2374	2300	74	3
1984	2399	2297	102	4
1985	2423	2249	174	7
1986	2410	2191	219	9
1987	2427	2162	265	11
1988	2377	2063	314	13
1989	2384	2025	359	15
1990	2380	1977	403	17
1991	2381	1962	419	18
1992	2416	2004	457	19
1993	2467	1982	485	20
1994	2510	1991	519	21

BTB managed estates: thirteen years data (1980-93) from 3 (Dauracherra, New Shamanbagh and Patheria tea estate) estates were collected and presented below Table V.19. Table indicates that over the period total tea area and clonal area increased by 20% and 290% respectively, while area under seedlings increased by 7% (Figure V.37). In addition clonal tea increased from 5% of total tea area in 1980 to 15% in 1993. The rate of increase being less than 1% per annum(Figure V.38).

Bilashcherra experimental farm (BTRI): eleven years (1984-94) data were collected from the farm and presented in Table V.20. The table indicates over the period total tea area under seedlings and clones increased by more than 24% and 80% respectively (Figure V.39). The proportion of clonal area increased from 37% of total tea area in 1984 to 54% in 1994, with a constant increase of about 2% per annum (Figure V.40).

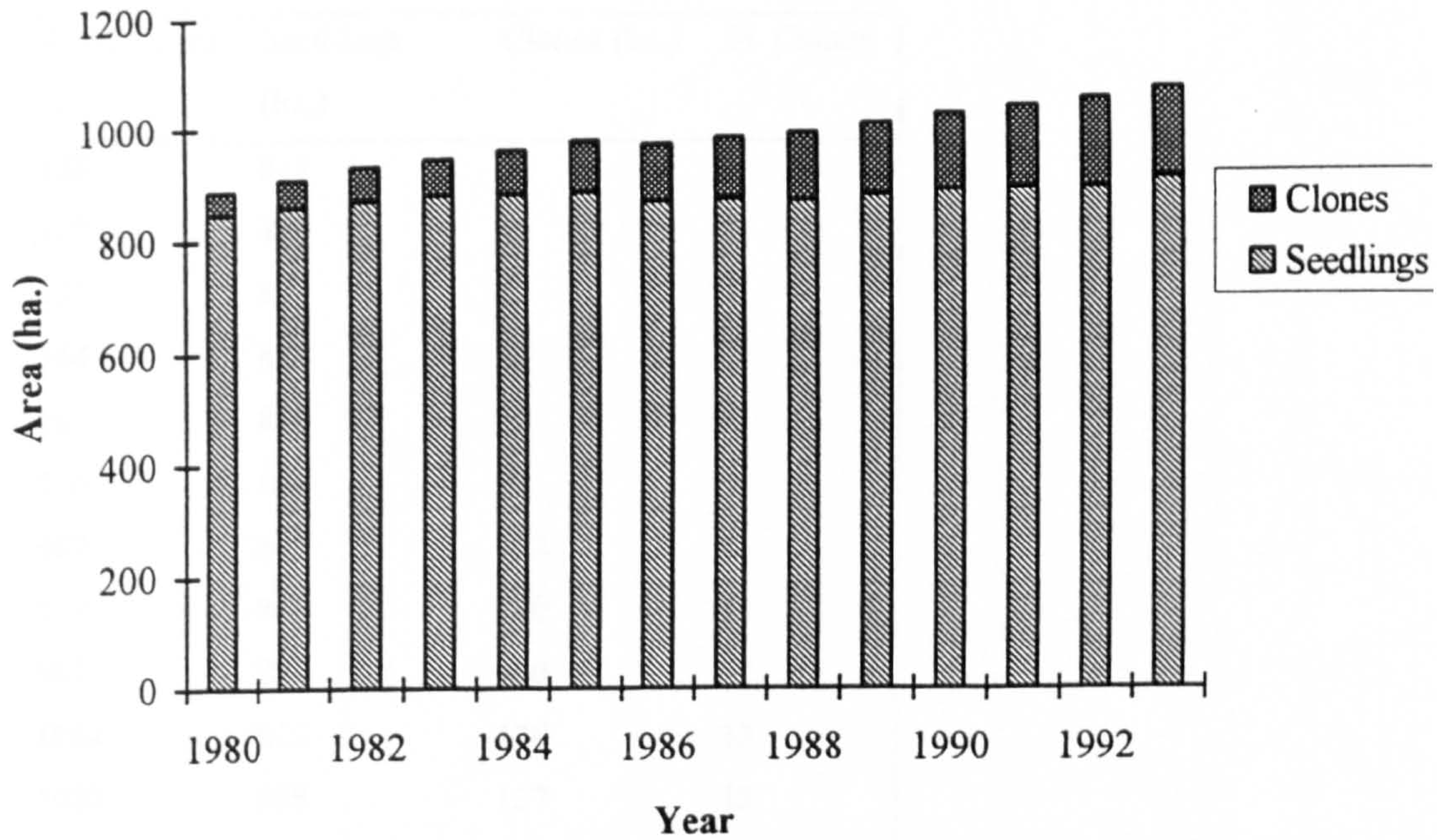

Figure V.35 National Tea Company Ltd. (Bangladesh), Doloi valley gardens, 1980-1994. Area of seedlings and clonal tea

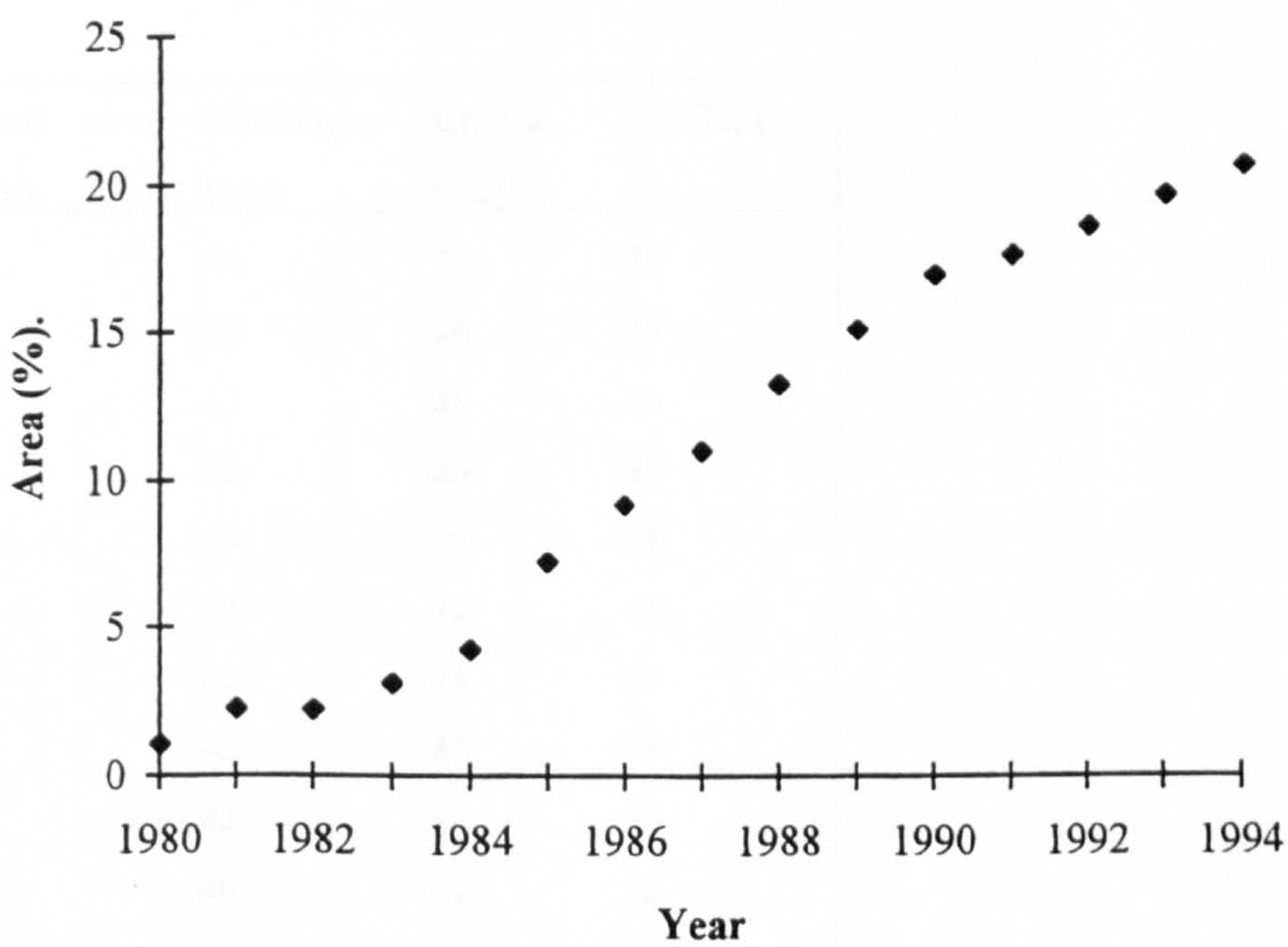

Figure V. 36 National Tea Company Ltd. (Bangladesh), Doloi valley gardens, 1980-1994. Area of clones as proportion of total planted area

Table V.19 Area under tea, BTB managed estates (Bangladesh), 1980-93

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1980	888	847	41	5
1981	909	860	49	5
1982	931	870	61	7
1983	944	878	66	7
1984	960	880	80	8
1985	976	884	92	9
1986	969	867	102	11
1987	979	869	110	11
1988	987	867	120	12
1989	1004	876	128	13
1990	1022	885	137	13
1991	1036	888	148	14
1992	1049	989	160	15
1993	1068	906	162	15

Table V.20 Area under tea, BTRI experimental farm (Bangladesh), 1984-94

Year	Total area (ha.)	Seedlings (ha.)	Clones (ha.)	% Clones
1984	70	44	26	37
1985	70	43	26	39
1986	79	43	35	44
1987	80	43	36	45
1988	82	43	39	48
1989	85	43	42	49
1990	87	43	44	51
1991	87	43	44	51
1992	87	43	44	51
1993	87	40	47	54
1994	87	40	47	54

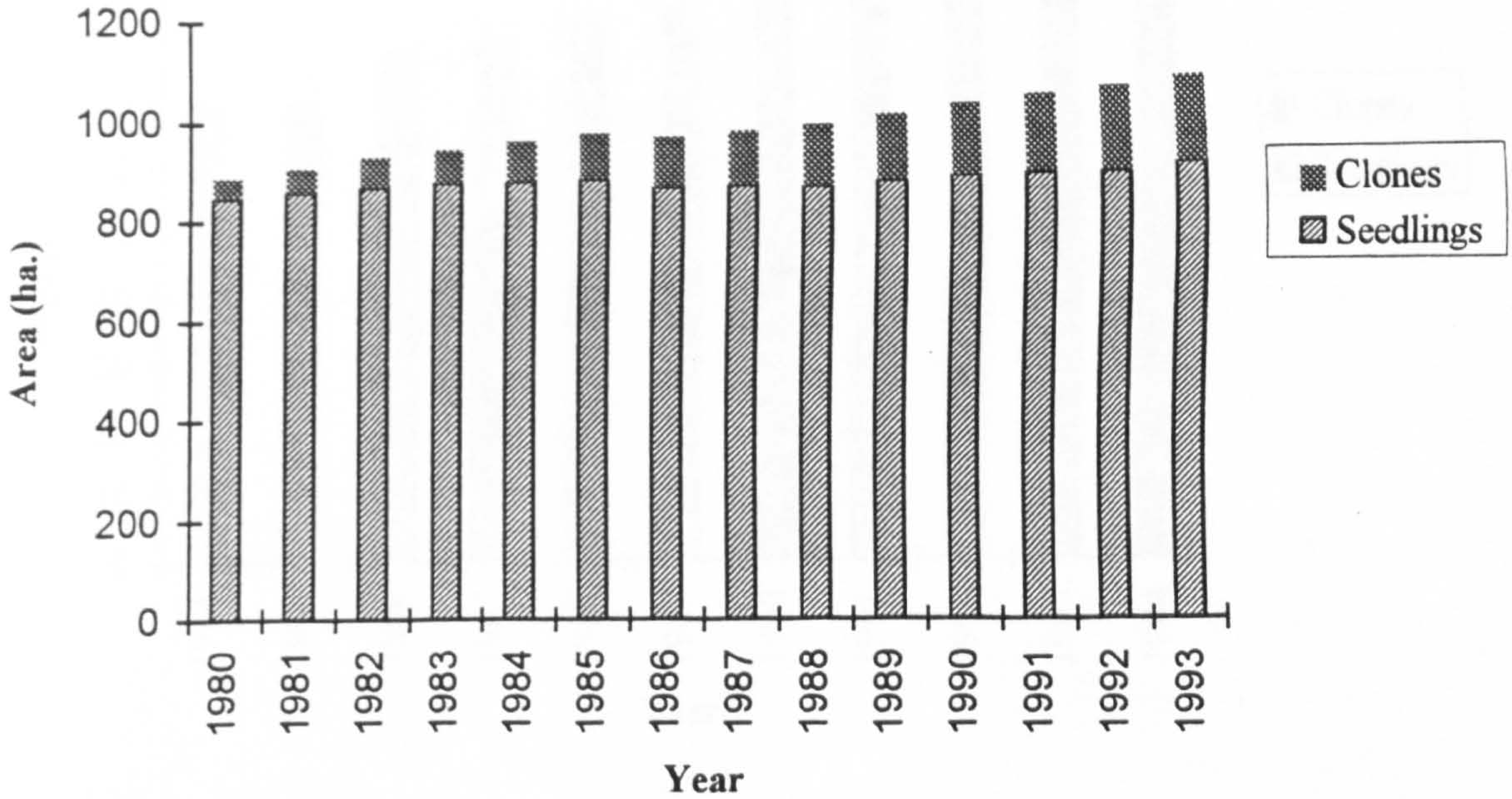

Figure V.37 Estates under BTB management (Bangladesh), 1980-1993
Area of seedlings and clonal tea

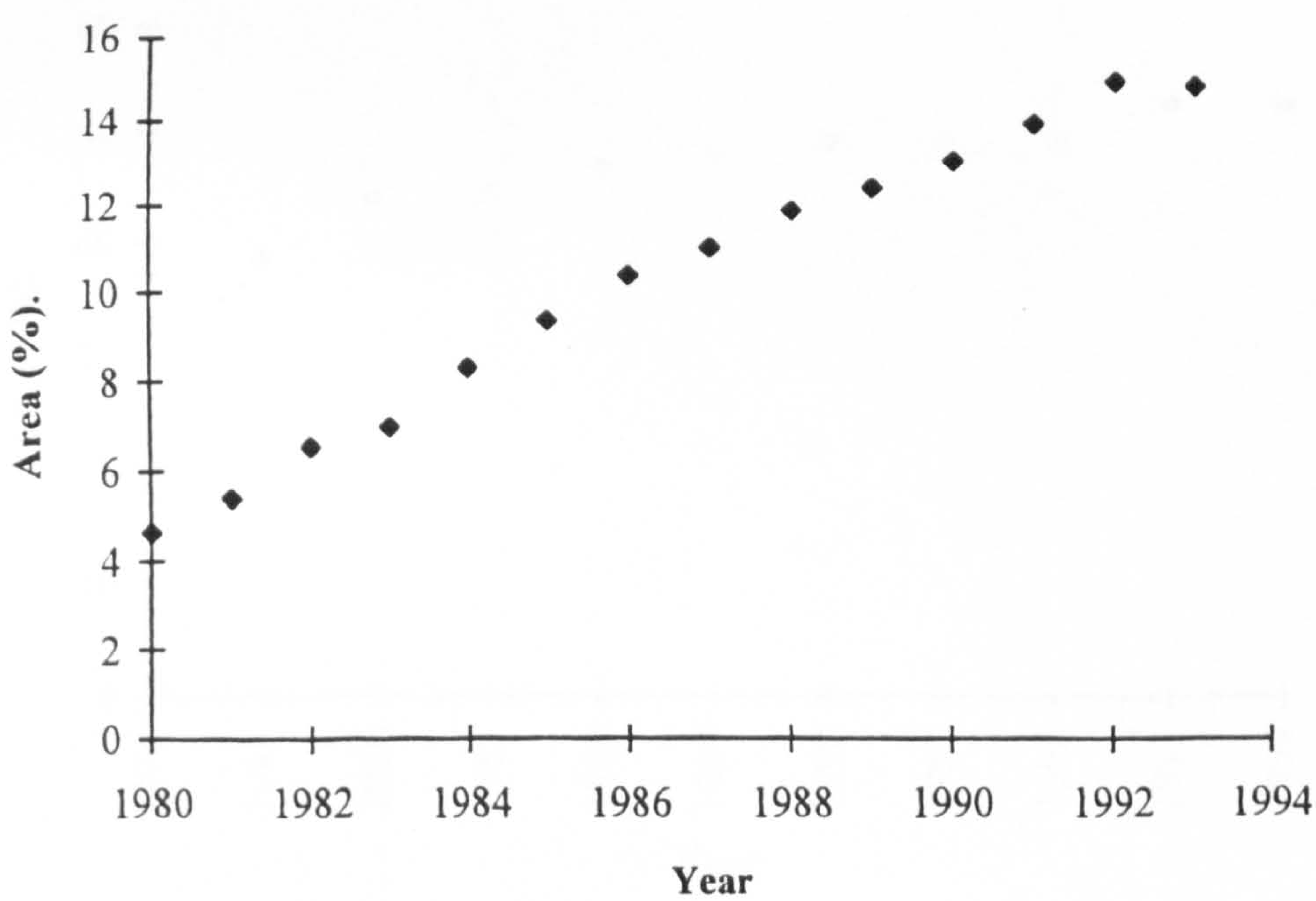

Figure V.38 Estates under BTB management (Bangladesh), 1980-1993
Area of clones as proportion of total planted area

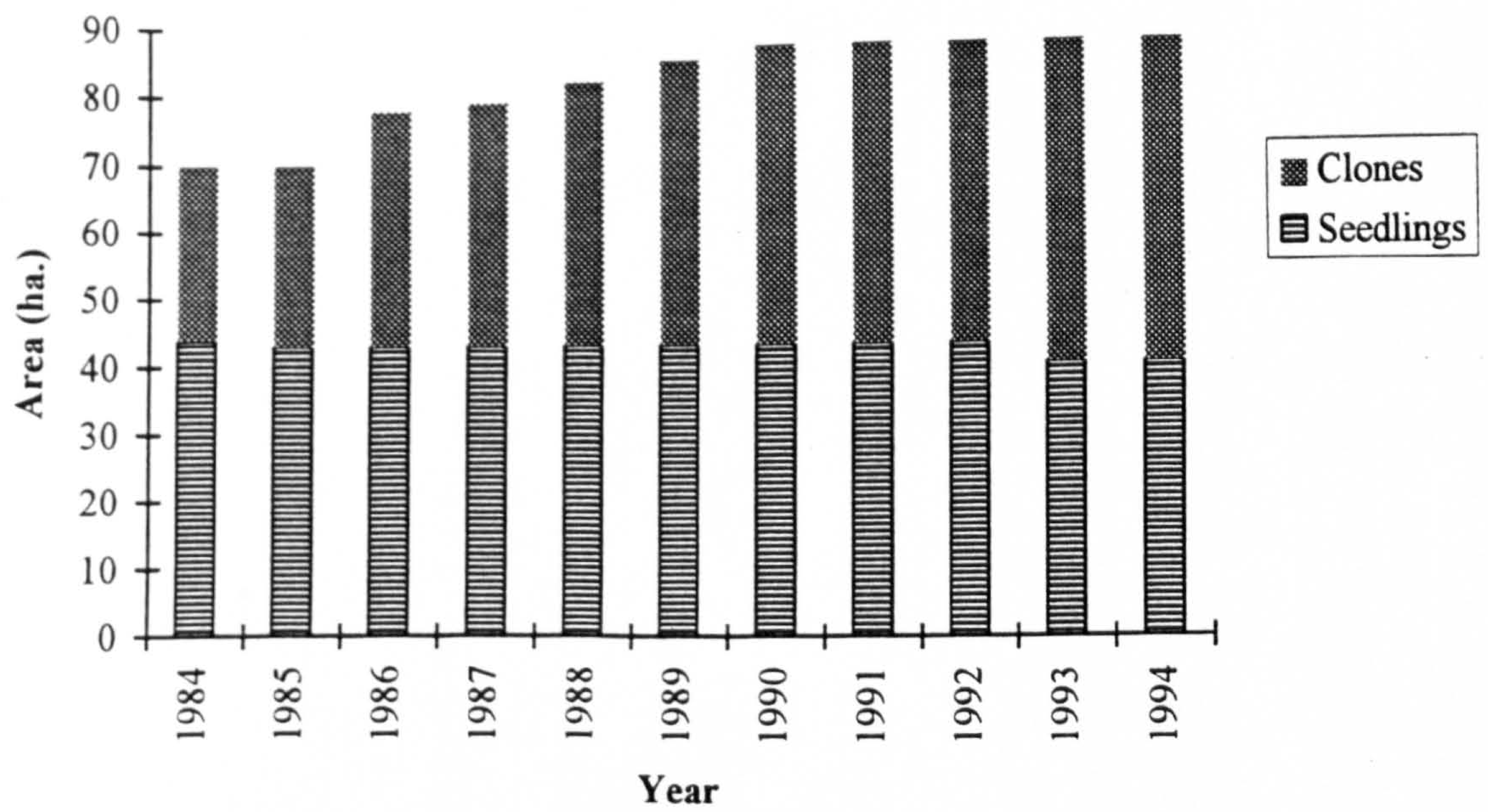

Figure V.39 Bilash Cherra Experimental Farm (Bangladesh), 1984-1994
Area of seedlings and clonal tea

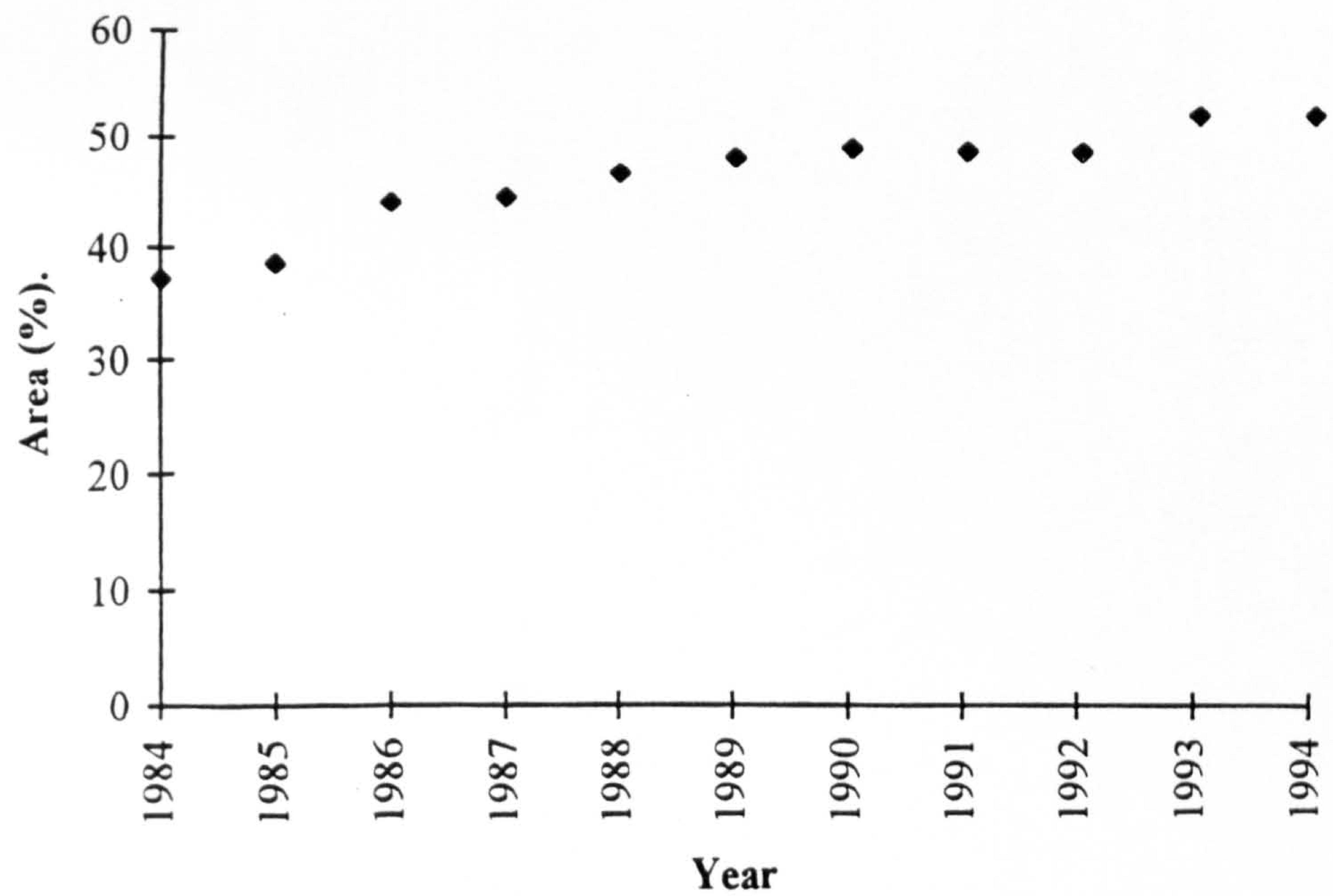

Figure V.40 Bilash Cherra Experimental Farm (Bangladesh), 1984-1994
Area of clone as proportion of total planted area