AN ECONOMIC REVIEW

OF

FORESTRY IN BURMA

by

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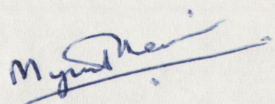
Thesis submitted for the degree of
Master of Science in the Australian
National University

February 1973.

ORIGINALITY OF THESIS

Except where acknowledged this

Thesis is my own original work.



MYINT THEIN

ACKNOWLEDGEMENTS

I would like to thank the Australian Government for the assistance given to me through the Colombo Plan.

I would also like to thank the Revolutionary Government of the Union of Burma for allowing me to undertake this study.

The assistance of the Australian National University, particularly the Department of Forestry, in providing the facilities used in this study is gratefully acknowledged.

I am especially grateful to my supervisor Mr E.D. Parkes for his continual help, advice and encouragement during the course of my study.

I would like to thank numerous staff from the Department of Forestry for their assistance in this study, especially Mr T.S. Johnson for his assistance given during the statistical analysis and model development and Mr K.L. Lyall for his assistance with the final preparation of this thesis.

The aid of U Sein Hlaing, Assistant Forest Economist, Burma and of my sister Daw Tin Tin Aye in providing invaluable data is gratefully acknowledged.

I am grateful to Mrs E.H. Robinson for typing the thesis.

My thanks go to my wife Dr Khin Mya Than for obtaining a number of Burmese publications and for coping so well with our home during my absence.

SUMMARY

Since the Second World War Burma has experienced periods of political and economic instability caused mainly by insurrections and balance of payments difficulties. Restrictions on commodity imports and nationalisation of the entire timber trade have produced substantial structural changes in the forest products market.

Forest product exports have been the second largest earner of foreign exchange and have contributed just under thirty percent of the total export income in 1968/69.

The present forestry extraction and utilisation practices will be inadequate if the increased production levels required for internal consumption and exports in the future are to be met.

The problems encountered in the timber processing industries were mainly caused by the lack of trained and skilled personnel at both the administrative and technical levels and by the lack of economic incentives for the workers.

Sound planning, based on reliable estimates of future consumption is essential for achieving future levels of forestry production and exports. For this reason a detailed analysis of the demand for forest products forms the major component of this study.

Future levels of demand for sawn timber and paper and paper products have been estimated by using the structural equations derived in chapters 8 and 9. By the year 2000 the demand for paper and paper products is expected to increase very substantially. Rapid increases in the level of literacy and industrialisation are the main causes underlying the increases.

The level of demand for teak and hardwood exports (especially in the European markets) seems likely to nearly double by 2000 A.D. As a result, substantially increased volumes of both teak and hardwoods will have to be extracted to satisfy domestic consumption and export demand at the same time.

The achievement of this increased production will necessitate a substantial increase in the level of mechanical extraction and major improvements in the processing industries. The re-introduction of economic incentives designed to achieve greater productivity from forest products industries employees should play a very important part in fulfilling the increased production while securing better quality products.

The sound development of Burma's forest resources and forest products industries will give a considerable stimulus to Burma's economic development and should help solve Burma's balance of payments problems.

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CHAPTER 1

INTRODUCTION

Forests cover approximately 57 percent of the total area of Burma, 13.33 percent being classified as reserved forests and about 44 percent as unclassed forests. Reserved forests have a history of more intensive management than the unclassed forests. Because of this and the greater demands from rural population pressures only about 10 percent of the unclassed forests in Lower Burma and 50 percent of the unclassed forests in Upper Burma can be described as being fully stocked.

The majority of the forests are inaccessable and extraction of any timbers except teak is not possible. The extraction of hardwood species is limited to the forest areas which are roaded and where extraction by trucking or carting is possible.

The political and economic instability which occurred in Burma from time to time since the Second World War resulted in periods of considerable market instability and substantial structural changes, particularly in the forest products market. Outbreaks of insurrection since independence have severely strained the country's economy and considerably reduced the production and extraction of forest products from remote areas.

Some measure of forestry's economic importance can be gauged by examining its contributions to Gross Domestic Product, export income and employment. Forestry contributed 3.68 percent of the total Gross Domestic Product in 1968/69 and employed 0.95 percent

of the total work force. These figures refer only to the forest growing and extraction industries and do not include the sawmilling and marketing sectors of the State Timber Board. Sawmilling output and employment is included in the manufacturing sector and the marketing activities are included in the trade sectors (R.G.U.B., 1965, Page 26). The expansion which has occurred in the forest products processing industries since the Second World War has substantially increased the level of employment in this sector.

Burma has been faced with recurring balance of payments difficulties since 1956/57 and the situation is worsening at the present time due to a substantial drop in export income. Both the export price of rice and the quantity of rice available for export have fallen. The export market for rice is at present very unfavourable and there seems little prospect for increasing the export income from rice in the near future. At the same time the increasing demands of a growing population and a developing economy have caused imports to rise thus adding to the balance of payments difficulties.

Although the export price of rice has fallen considerably both the volume of timber exports and the export price of timber itself have risen substantially. Consequently the share of Burma export income derived from timber has risen from $6\frac{1}{4}$ percent in 1950/51 to just under 30 percent in 1968/69.

Since timber appears to be the only commodity which Burma can export in significantly increased volumes to reduce the balance of payments deficit integrated forestry and national planning appear to be desirable. In this way it is likely that exports of forest products can be increased profitably to help solve

the balance of payments problem. It is also essential that forest management, utilisation and economic development plans be co-ordinated and be checked for compatability if the best use of Burma's valuable forest resources are to be achieved. However sound forest production goals aimed at increasing exports can only be set after detailed knowledge of the likely internal demand for those products in Burma in the future is available.

The major component of the study is a detailed analysis of the demand for Burmese forest products which attempts to establish the important determinants of that demand. A mathematical model consistent with economic theory and observed market behaviour, is developed and used to forecast the likely future levels of demand for forest products in Burma. These estimates form the basis of the discussion and calculations on export policies. Sound estimates are vital f[illegible] forest industry development planning and the setting of forest production goals.

At the same time the development of import replacement industries will depend heavily on the forecasts of future demand, the economics of local manufacture and the availability of the natural raw materials.

The abundance of bamboo, a suitable raw material for paper making, naturally prompted the development of a local paper industry which commenced operation in 1972. The effective use of raw material for paper making in the country should substantially reduce the import bill for paper and paper products, especially as the demand for paper and paper products is likely to rise substantially as a result of increases in the level of literacy and industrialisation in the

future. Longrun forecasts of the demand for paper and paper products are essential if soundly based decisions on the nature and capacity of this import replacement industry are to be made in the future.

The geographical, sociological and political backgrounds to Burma are outlined in chapter two. A brief description of the economic development which has occurred in the country prior to and after the Second World War is included.

In chapter three the historical background of forestry in Burma is described and an outline of forest conservation policy in Burma since the time of the Burmese Kings and the introduction of forest management practices during British rule is examined. The organisation of the forest service in Burma and the training of the personnel in the forest service is also discussed and traditional extraction and transportation methods are explained.

Chapter four briefly describes contemporary forest management, and utilisation techniques in Burma. Operations carried out by the Forest Department regarding timber production are looked at and an explanation of the different systems used in royalty assessment is given.

Problems of extraction are considered in chapter five together with a discussion of the possibilities for introducing more efficient mechanical equipments. The loss of teak logs during the single log flotation process, a long and unsolved problem in Burma, is also discussed and some conclusions given.

In chapter six the problems of processing forest products in Burma, particularly in the sawmilling industry, are examined and

some obvious causes for the low recovery percentage in the State owned sawmills are given. Other forest products industries (plywood and veneer) are also looked at although insufficient data is available for a thorough analysis.

Chapter seven deals with problems of market analysis and forecasting. The behaviour of the market for forest products due to fixation of the forest products prices is discussed. The identification of different variables for use in the analysis of demand for forest products in Burma is also examined. A critical review of the models used for longrun projections of the demand for forest products forms an important part of this chapter and the most suitable model for projecting the demand for forest products in Burma is selected.

Chapter eight deals with the analysis of the demand for logs and sawn timber in Burma. Both time series and cross sectional country analysis will be discussed.

Chapter nine deals with the analysis of demand for paper and paper products. Both time series analysis and cross sectional analysis are carried out for the various groups of paper and paper products and the results are presented.

Chapter ten deals with past, present, and future trends in forestry exports. Exports before the War and after the War are compared and the development of forest product export trade is discussed. A study of the European markets for tropical hardwoods is undertaken so that some idea of each market's ability to absorb increased exports of hardwoods from Burma can be obtained. The export prices for the various forest product exports are examined and implications for Burma's marketing strategies are discussed.

Chapter eleven discusses the need for and the steps involved in developing a marketing strategy for the future. Projections of the variables used in the analysis of demand for forest products are made and the demand for sawn timber and paper and paper products is forecast. A critical review of the suitability and predictability of the variables included in the models is presented.

The final chapter discusses the implications for forest and national development policy, future research requirements, policy recommendation and draws some conclusions. The possibilities for increasing forest production, the processing industries, and exports, are discussed.

CHAPTER 2

BURMA - THE BACKGROUND TO THE PROBLEM

2.1 GEOGRAPHICAL BACKGROUND

Burma is situated between 10° and $28\frac{1}{2}^{\circ}$ north latitudes and 92° and 102° east longitudes. It is surrounded by Bangladesh, India, China, Laos and Thailand on the north and east and bounded on the west and south by the Bay of Bengal and the Andaman Sea. Approximately 500 miles wide and 1300 miles long, it covers an area of some 261,694 square miles.

Elevations vary from sea level to 20,000 feet at the mountains bordering Tibet on the north. In the main, the mountain ranges run from north to south. The Arakan mountain ranges are situated on the western part of Burma and divide the Irrawaddy basin from the sea and in places rise to 10,000 feet. The Pegu mountain ranges cover the low hills in the central basin and rarely exceed 2,000 feet. The Shan Plateau which is situated in the east has an average height of 4,000 feet but in places rises to 8,000 feet. These mountain ranges extend towards the south joining the Tenasserim mountain ranges which run down towards the Malay peninsula, and which rise to about 6,000 feet.

Burma's largest river, the Irrawaddy, is navigable for about 900 miles. Its principal tributary, the Chindwin, joins the Irrawaddy just below Myingyan and is navigable for about 350 miles. These two rivers are of considerable economic importance for both

communication and transport. The Salween river which flows from Tibet through the eastern part of Burma is not safe for navigation. The Sittang river which is situated between the Irrawaddy and the Salween is also unsafe for navigation and transport because of the large tidal waves at its mouth.

Since Burma is bounded by high mountains, the communication by land to the neighbouring countries is fairly difficult. Road access between Rangoon and any neighbouring country is practically nonexistant. The nearest ports from Rangoon by sea are Chittagong, Calcutta and Singapore. Communication and transport problems are aggravated during the monsoon season when the Bay of Bengal becomes dangerous for small ships.

2.2 CLIMATE

Although about two thirds of the country is situated in the tropics and one third in the warm temperate regions, the climate can be divided into three distinct seasons, the rainy season or monsoon, from middle of May to mid October, the cold season from mid October to mid February (the coldest months being December and January) and the hot season from February to May (the hottest months being April and May). Except for small areas of northern Burma and the Shan States (which get some rain from the North East Monsoon) most of Burma is dry during Summer. The Winter or cold season is not very severe in most areas.

Rainfall varies from 25" to 40" in the central Dry Zone to 100" in the Delta region, 80" in the northern part of Burma and up

to 200" in the Arakan and Tenasserim coastal strips. The eastern high plateau or the Shan States averages about 60" of rain a year.

Temperature variations are not great in Burma. Generally the temperature ranges from 50^{o} to 70^{o} during winter, 70^{o} to 85^{o} during the rainy season and 90^{o} to 100^{o} during summer. In the Dry Zone temperatures of 55^{o} during winter and 108^{o} during summer have been recorded. Frost can occur above 3,000' altitude.

2.3 POPULATION AND ITS DISTRIBUTION

The population of Burma in 1970 was approximately 28 million of which some 80 percent can be regarded as rural. The population density in Lower Burma exceeds 200 people per square mile, while Upper Burma averages about 150 per square mile. Most of the population in Upper Burma are concentrated on the eastern bank of the Irrawaddy river in the Dry Zone. The population density of the Chin and Kachin Hills is estimated to be about 10 to 20 per square mile and that of Shan States to be about 30 to 40 per square mile. The population density of the Arakan and Tenasserim coastal strips is between 70 to 100 per square mile.

2.4 THE PEOPLE

Burmese is the common name for the 11 major indigenous races living in Burma. The majority of the population (85%) are Burmans, while the Karens, Shans, Kachins, Chins and other minor indigenous races comprise about 10% of the total population, the rest being Indians, Chinese and other exogenous races. Although there

are many indigenous dialects, almost all the population speak Burmese as their main language.

About 83 percent of the urban population and 95 percent of the rural population are Buddhist, the rest being Moslem, Hindu or Christian. Religion in Burma plays an important role in economic and social life.

On the whole the Burmans are much more highly educated than the other indigenous races. They are also more industrious and tend to live in the richer valleys and along the main lines of communication.

The health standards of Burma are generally above those experienced in most of the South East Asian countries.

2.5 LIVELIHOOD AND CUSTOMS

Burma is predominantly an agricultural country depending heavily on the cultivation of rice. In the dry zone where the rainfall is scanty, the main crops are cotton, maize, groundnuts, tobacco etc. Rice is grown in preferance to other crops where there is sufficient rainfall or irrigation.

In the hilly regions most of the population depend on shifting cultivation for their livelihood.

There are a number of mineral deposits throughout the country but only about 0.3 percent of the working population are employed in their extraction.

2.6 GEOLOGY AND SOILS

Burma is divided into four main geological regions.

2.6.1 The Shan Plateau and the Eastern Highland

This area extends north along the Chinese border to the rugged mountain peaks on the Tibetan boundary. The oldest rocks are found in the Shan States and in Tenasserim. In the north, ancient metamorphic rocks such as those in the ruby mining district of Upper Burma are common. In the Shan Plateau large areas of limestone are found. The Tenasserim consists mainly of sedimentary rock and masses of granite with igneous intrusions in which tin, wolfram, antimony and zinc occur. In the extreme north and south the soils are usually red tropical soils while red brown earths predominate in the Shan Plateau.

2.6.2 The Western Hills Region

This region comprises the ranges of hills which start from the eastern extremity of the Himalayas and continue southwards forming the Kachin, Naga, Manipur and Chin Hills. Almost all of this region is made up of pre-tertiary rocks. The soils of the lower altitude are predominantly red tropical but at higher elevations these merge into well drained sandy soils.

2.6.3 The Central Belt of Burma

This area covers the large central valley which has been sinking since the early Tertiary period. It is built up entirely of tertiary sediments, the greatest thickness being near the central

axis of the basin. Economically, the tertiary rocks are of great importance in Burma as they contain reservoirs of petroleum. The main rock types are sandstones and clays.

2.6.4 The Arakan Coastal Strip

It is a low lying narrow strip of land on the western part of the Arakan Yoma which becomes wider in the far north. Its soil consists mainly of silty loam. Outcrops of Tertiary sediments with red tropical soils and sandy stone soils also occur in some places.

2.7 ECONOMY

The recent development of the Burmese Economy can conveniently be divided into three prominent periods:-

I : - Before the Second World War

II : - After the Second World War and before the nationalisation of the Trade

III : - After the nationalisation of the Trade.

2.7.1 Before the Second World War

Before the Second World War, Agriculture and Fisheries, Forestry and Mining, played an important part in the development of the country. More than half of the national output in 1938-39 was accounted for by these four sectors with Agriculture and Fisheries contributing some 40 percent of the Gross Deomestic Product, Forestry 7 percent and Mining $5\frac{1}{2}$ percent.

For the five year period from 1936-41, exports accounted for 50 percent of the total domestic product (G.D.P.) while only twenty five percent of the G.D.P. was spent on imports. Consequently Burma enjoyed a favourable balance of trade during this period. Rice accounted for nearly half the total value of exports. A substantial flow of foreign investments into Burma occurred during the pre-war period and Andrus (1947) estimated that it amounted to nearly £155 millio sterling in 1941 with about £56 million being accounted for by the Indian chettyars (money lenders), mostly for agricultural loans.

The Japanese invasion of Burma during the Second World War lasted from April 1942 to the early part of 1945, resulted in the evacuation of British personnel from Burma, and the setting up of a Japanese Military Government. The economy became very unstable during the Japanese regime.

2.7.2 After the Second World War and Before the Nationalisation of the Trade

Foreign investment in Burma, which had ceased during the Japanese occupation, did not recommence after peace was re-established largely due to the unstable political environment and Britain's severe scarcity of investment capital. Considerable internal pressure by the Burmese for independence from the British Government resulted in very little progress being made to restore the economy and repair the severe damage caused by the war. The situation deteriorated to such an extent that foreign capital started to flow out of Burma. During

1946-47, Rs.[1] 300 million was transferred out of the country, largely to India. In the following year the total rose to Rs. 390 million. Thereafter, a rigid system of exchange control was enforced and during 1948-49, these transfers declined to about Rs. 30 million.

Burma gained independence in January 1948 and soon afterwards the Anti Fascist People's Freedom League (hereafter A.F.P.F.L.) came into power. In February 1948 the White Flag Communist Party adopted a program to overthrow the A.F.P.F.L. government. The following month the Communists went underground and then into active revolt. A few months later the People's Volunteer Organisation went underground. Karen revolts broke out in September with a separate Karen State as their objective. In December the powerful Karen National Defence Organisation was formed and it too went into active revolt.

The Two-Year Plan which was formulated soon after the A.F.P.F.L. government came into power had to be abandoned because of the insurrection problems. Transportation and communications were considerably reduced. Trains and Inland Water Transport could not run at night and railway lines and town water supplies were frequently damaged. These activities severely reduced the level of production and commerce.

As a result of the insurrection any post war recovery that had been achieved was almost completely lost within the first two years of independence. After the Two-Year Plan expired the government launched an Eight-Year Programme. Peace was restored to a certain extent during that period.

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[1] The Indian Rupee was the currency used in Burma before independence as both countries were under British control during that time.

The post war rice shortages in South East Asia enabled the State Agricultural Marketing Board (hereafter S.A.M.B.) to sell inferior quality rice to overseas customers until 1953. From 1954 onwards the rapidly increasing production of rice in South East Asia made it extremely difficult for the S.A.M.B. to find customers for the low quality rice they were trying to sell. The result was a substantial drop in Burma's export income and, consequently, balance of payments difficulties increased rapidly. From 1956, the Open General Licence (O.G.L.) for imports had to be gradually restricted. A political split in the A.F.P.F.L. government during the early part of 1958 increased the problems of the economy.

In September 1958, the Prime Minister asked General Ne Win, the Chief of Staff of the Burmese Armed Forces, to take over power from him for about six months until a fair and peaceful election could be held. In October 1958 General Ne Win was elected as Prime Minister by the Parliament. During General Ne Win's regime, peace and discipline was restored throughout the country. However he did not have time to solve the country's economic problems.

A general election was held in early 1960 and the majority of the seats were won by the A.F.P.F.L. (Clean) candidates. A new government was formed in March 1960 with the previous Prime Minister as head of the new government. In March 1962, when the Prime Minister was about to create separate states for the Arakanese and the Shans to fulfill pre-election promises, General Ne Win successfully accomplished a coup and formed the Revolutionary Government of the Union of Burma. His cabinet members, apart from the Foreign Minister who was from the Public Service, were military personnel.

Political leaders from both sides were arrested and all existing parties were abolished. To replace them the Revolutionary Government formed The Burmese Socialist Programme Party.

The nationalization of key industries (the Teak industry, Inland Water Transport Corporation and Distilleries) had proceeded rather slowly and sporadically under the A.F.P.F.L. government but in view of the severe economic difficulties facing the nation, the Revolutionary Government launched a series of swift and sweeping steps early in 1963 to nationalise all sectors of the economy. Nationalization covered both local and foreign owned enterprises. In January 1963, the government took over the remaining British holdings in the joint oil venture of the Burma Oil Company. In February 1963 all banks, insurance, shipping and air travel agencies and all export and import businesses were nationalised. The retail commodity distribution sector was nationalised in March 1964. It comprised more than 12,000 trade establishments which were reorganised and became known as "People's Shops". More than 20 Trade Corporations were also established to handle the export, import, and internal distribution of both imported and locally produced goods. The co-ordination and handling of all the exports and imports of the different Trade Corporations was given to the newly established Myanma Export Import Corporation (M.F.I.C.).

2.7.3 After the Nationalization of the Trade

After the formation of different Trade Corporations commodity distribution in the townships was done by people's shops,

but in the villages it was done by village co-operatives. Lack of experience and removal of monetary incentives soon allowed inefficiencies to develop in the Trade Corporations and people's shops and in the general commodities distribution sector. Black marketeering of all commodities became prevalent and the production of all commodities fell abruptly. Misappropriation of government money and commodities in the people's shops was common and the government lost substantial funds through the Trade Corporations and people's shops. Although people's shops were run at a loss, village co-operatives made considerable profits in commodities distributions so the government realized the need for changing the system of people's shops to township and village co-operatives throughout the country.

CHAPTER 3

HISTORICAL BACKGROUND OF FORESTRY IN BURMA

3.1 FOREST CONSERVATION POLICY

Forest conservation was introduced in Burma in 1752, during the Alaungpaya dynasty when the Burmese Kings proclaimed teak as a "Royal Tree" which could not be cut without their permission. Soon after the First Anglo Burmese War in 1826 the British occupied the whole of Arakan and Tenasserim and teak forests in Tenasserim were exploited heavily without any control whatsoever. It was not until 1851 that the British Government appointed the first fully qualified forester (Mr Brandis) to Burma. The autorities began to realise that timber resources were being depleted and laid down a forest conservation policy similar to that laid down by the Burmese Kings.

Scientific management of forestry began after Mr Brandis was reappointed in 1856. The management of all reserves and some of the unclassed forests were covered by Working Plans which aimed at sustained yield management of the forests in perpetuity. The first British forest legislation relevant to Burma was the Indian Forest Act VII of 1865. Rules under this act laid down the procedure for reservation of forests. In spite of some opposition, progress in reservation continued steadily. In 1881, the Indian Forest Act of 1865 was replaced by the Burma Forest Act XIX and, following the amalgamation of Upper and Lower Burma in 1895, the Forest Act was extended to cover all of Burma. The new Burma

Forest Act of 1902 introduced the reservation of six species other than teak over the whole of Burma and of many other species over selected localities. It also included the control of felling, logging and collecting.

3.2 FOREST MANAGEMENT

Forests in Burma are divided into two classes, namely, reserved forests and unclassed forests. From the point of view of utility and management they are again divided into three categories according to accessibility as follows:

(i) Local Supply Working Circle,

(ii) Commercial Supply Working Circle, and

(iii) Teak Selection Working Circle.

Those areas accessible for extraction of all timbers are classed as Local Supply Working Circle while areas accessible or likely to become accessible by opening up of extraction roads for non-floatable timbers are classed as Commercial Supply Working Circle. The remaining inaccessible areas in the interior are classed as Teak Selection Working Circle.

The management system adopted in the Commercial Supply Working Circle and Teak Selection Working Circle is the Burma Selection System.[1] In suitable localities of the Commercial Supply

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[1] Burma Selection System is a periodic selection system with a fixed felling cycle (30 years) rather than a true selection system. Under this system all trees conforming to the standard of marketability which have reached the prescribed girth limit, or are deteriorating or dying and will not survive for another 30 years are taken out. At the same time climber cutting and improvement fellings are carried out during marking and girdling operations.

Working Circle concentrated regeneration by means of taungya (raising plantation with the help of agricultural crops) is also practised. The management system adopted in the Local Supply Working Circle is either coppice with standards or clear felling. The method of regeneration is adapted to suit local conditions.

3.3 LIMITATIONS IN FORESTRY PRODUCTION

In general, there are four limitations in forestry Production:-

(i) Legal limitations

(ii) Technical limitations

(iii) Natural limitations

(iv) Economic limitations

3.3.1 Legal Limitations

The Burma Forest Act prohibits a range of activities in either the reserved or unclassed forests. One of the most important parts of the act (Section 26) prohibits extraction of timber, or other activities, by non forest service personnel in the reserved forests.

Some of the rules which are meant to supplement the act prohibit the cutting of teak trees, reserved trees, and unreserved trees, in the unclassed forests unless they are for domestic, public, agricultural and fishing purposes and only if they are to be used within 20 miles of felling and used within a year.

There are also rules and regulations in the Act to control felling, logging and the collection of forest products.

3.3.2 Technical Limitations

Extraction of timber for trade purposes under license or any form of agreement is controlled as follows.

Application of girth limits to various species in reserved and unclassed forests in accordance with the Working Plans is rigidly enforced. Exploitable girth limits vary from species to species and from locality to locality, but generally, in the reserved forests, girth limits for teak in good teak forests is 7'6" girth at breast height (g.b.h.) and in poor teak forests is 6'6" g.b.h. As for hardwoods the exploitable girth limit is generally 6' g.b.h. In unclassed forests the girth limit for teak is 7' g.b.h. but, as with hardwoods, the girth limit is 6' measured at 18" from the ground.

Obligatory and optional species for hardwoods vary according to local marketability of the species. There are also certain specifications for minimum size and quality of logs to be extracted from obligatory species.

3.3.3 Natural Limitations

Natural factors which limit forestry activities are climate and topography.

Burma receives monsoon rains almost continuously from mid May to mid October. The weather is very warm during summer. Timber extraction in Burma is heavily dependent on animal power which

can work only during the rains where water and fodder are plentiful. During the hot weather animals have to be given rest because of heat and lack of suitable fodder.

Topography also plays an important role in the efficient extraction of forest produce. Most of the forested areas are in hilly country thus adding to the extraction problems. Road construction and road transport is usually too expensive, consequently, extraction is usually limited to areas with suitable stream and river access to allow flotation of logs to the market.

3.3.4 Economic Limitations

The forests of Burma are very irregular with many species mixed together. The abundance of species handicaps efficient forest management since forest utilisation up till now has been confined to a few valuable species. The high cost of transport and the heavy reliance on flotation methods has meant that most low value species can not be extracted economically.

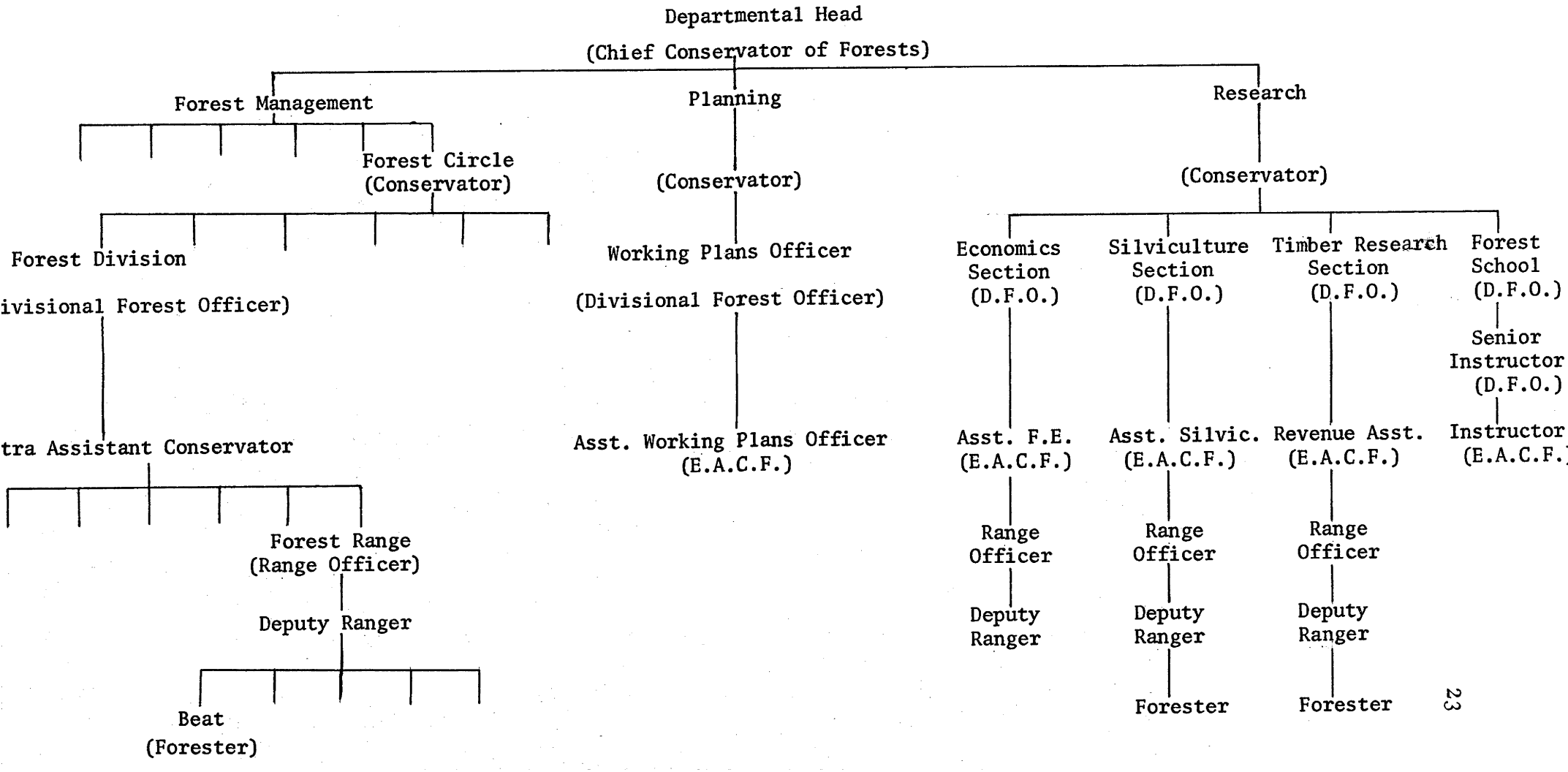
3.4 ORGANISATION OF THE FOREST SERVICE

The organisation of the Forest Service in Burma is illustrated in figure 3.1

The Chief Conservator of Forests is the administrative head of the Department of Forests. Under him are six territorial conservators, each responsible for forest management in his respective Forest Circle, one Conservator responsible for Planning,

FIGURE 3.1

ORGANISATION OF THE FOREST SERVICE IN BURMA



one Conservator responsible for research which includes supervising the Burma Forest School, The Forest Economist, The Silviculturist, and The Divisional Forest Officer in charge of the Timber Research and Agency Division.

Under each territorial Conservator there are between four and seven forest divisions (usually six), each headed by a Divisional Forest Officer. Extra Assistant Conservators of Forests are placed under Divisional Forest Officers to assist them in their administrative duties. Every Divisional Forest Officer has to supervise between four and six Forest Ranges (depending on the intensity of the forest management).

One Forest Ranger is placed in charge of each Forest Range and he is usually assigned a number of Deputy Rangers who assist him in his duties. A Forest Range is made up of several beats (a beat is the smallest unit of management in the Forest Department) and may contain several compartments (inside the reserved forests), coupes (unclassed forests) or defined areas (outside either reserved or unclassed forests). A Forester is placed in charge of each beat.

3.5 TRAINING OF PERSONNEL

There are three levels of Forest Service Employee trained and employed in Burma.

(i) Senior Branch

(ii) Range Officers

(iii) Deputy Rangers

Senior Branch personnel are recruited by the Public Service Commission from students who have at least two years of University education and are of sound health. After selection the successful candidates undertake a four year course at the Department of Forestry, University of Rangoon. On completing the course they are appointed as Extra Assistant Conservator of Forests.

Probationary Stipendiary Rangers are selected from students with at least matriculation level secondary education who pass a competitive entrance examination at the Burma Forest School. Those selected are sent to forest divisions for a minimum of one year to study intensive forestry operations. They are then sent to the Burma Forest School (Upper Course). After completing two years of studies they return to forest divisions and serve as Probationary Forest Rangers. They are given the post of Forest Ranger and placed in charge of a Forest Range if they complete a further two years of satisfactory service.

Foresters are selected from students with at least two years of secondary education. Three years field experience is necessary before the recruit can sit for the competitive examination which, if successfully passed, enables him to study at the Burma Forest School (Lower Course). After completing two years of the studies at the Burma Forest School, they also return to their respective forest divisions (if possible) with the title of Deputy Rangers.

3.6 EXTRACTION

Extraction of teak before the Second World War was done mainly by five foreign and two indigenous long term lessees. There was also one extraction agency run by the Forest Department.

The following statement shows the average breakdown of teak extraction for the five years period from 1934 to 1939.

	Cubic Tons (round)	Percent
British Lessees	370,000	79.2
Indiginous Lessees	12,000	2.6
Under Licenses	54,000	11.6
Myitmaka Extraction Agency	31,000	6.6
Total	467,000	100.0

Those who worked under Licenses were local traders who used to work in the Minor Teak Selection Working Circle and also in some of the Unclassed Forests Working Circle. Their leases were of a short term nature and did not exceed two years.

Extraction of hardwoods was done by local traders.

There are four phases in extraction:-

(i) Cutting (Felling and Logging)

(ii) Snigging

(iii) Intermediate Transportation

(a) Single log floating of teak

(b) Carting of hardwoods

(iv) Final Transportation

(a) Rafting

(b) Railing

(c) Trucking

3.6.1 Cutting (Felling and Logging)

The teak cutting season is restricted to the months June to January but hardwoods can be cut at any time throughout the year. Trees can not be felled and left on the ground for long periods because of the danger of loss from forest fires which occur almost every year. After felling, logs have to be snigged to an area free from forest fires.

The felling of teak and hardwoods is carried out with crosscut saws and axes although chain saws are being introduced where possible.

3.6.2 Snigging

Snigging of logs in Burma is done by elephants and buffalos, but only elephants can be used in very difficult areas. The average snigging distance is about two miles. Teak logs are snigged to a stream where they can be floated down the stream during the rainy season. Hardwood logs, being heavier and sinkable, are snigged to a road for carriage by bullock carts to the depot.

The season for snigging by both elephants and buffalos, is from mid June to mid October and from mid November to end of February i.e. $7\frac{1}{2}$ months in a year. Elephants require rest from

mid October to mid November for annual innoculation against anthrax and from March to mid June because of heat and lack of water and fodder.

The average working capacity of an elephant is from 1-3 cubic tons and working life is about 35 years. The average capacity of a pair of buffalos is up to 1 ton and working life is about 8 years. It is very hard to estimate exactly how many elephants were used in extraction before the War. The most common estimate is about 6,000, but U Aung Baw, Director of Extraction of the State Timber Board in his broadcast about "The State Timber Board" on the 19th of August 1950 stated that there were 3,000 elephants owned by British Firms and 1,500 elephants owned by indigenous timber traders. This number has since declined to 3,046 in 1969/70.

3.6.3 Intermediate Transportation

(a) Single Log Floating of Teak

After snigging to a suitable stream teak logs are floated down the stream to the main depot during the rainy season (June to September). The average distance for single log floating of teak is from 20-80 miles but in a few places the distance may be more.

(b) Carting of Hardwoods

After snigging to a suitable location, hardwood logs are carted 5 to 8 miles to a road, river, or railhead where trucking, or any other suitable kind of transportation, is available. Usually however logs are transported to the main depot by truck.

3.6.4 Final Transportation

(a) Rafting

About 85 percent of teak and 60 percent of hardwoods are transported from the depot to the milling stations by means of rafts. Teak can be floated without any aid but hardwoods can be floated only with the aid of bamboos. Consequently, the transportation of hardwoods is more expensive than that of teak. The average rafting distance for teak is about 600 miles whereas hardwoods are only rafted about 250 miles. Teak is usually rafted to the sea ports and has to cover longer distances than hardwoods, which usually end up at inland towns.

(b) Railing

About 15 percent of all teak logs and 40 percent of hardwood logs are transported from depot to mill by rail. Railing can be done throughout the year for either teak or hardwoods but is usually more expensive per ton mile than water transport.

(c) Trucking

Because of road conditions and truck capacity, trucking is usually only undertaken for short distances of 10 to 20 miles. Trucking on highways is cheaper than on other roads but is still restricted to distances not greater than 30 miles, the cost being very high when compared to other kinds of transportation.

3.7 NATIONALISATION

The five British timber firms which returned to Burma after the Second World War, found most of their equipment destroyed.

The shortage of investment funds, the unstable nature of the government, and the war damage, forced the five timber lessees to form the Teak Consortium. Because of financing problems, and also to ensure themselves some participation in the timber industry in Burma after independence, the Teak Consortium invited the government to join it.

The government, realizing the substantial amount of heavy construction and rehabilitation work required, declined to participate in the Consortium. Instead it formed the Timber Project Board in conjunction with the Consortium and contributed the working capital for the Board's activities while the Consortium provided the staff and equipment. Under this arrangement the government was to receive 3/5ths of the profits of the Timber Project Board's operations.

After Burma received her independence on the 4th January 1948, the nationalisation of important industries, including the teak industry, was carried out. On 1st June 1948, the government nationalised one third of the areas leased to the Consortium. The remaining two thirds of the lease areas and the Consortium's saw mills were to be nationalised in the following year. However, when insurrection caused a complete disruption of all forestry operations in Burma, the Consortium requested the government to speed up the nationalisation process. Consequently, nationalisation of the teak industry was effectively completed by February 1949. Some license traders outside of the Consortium, were allowed to continue until the hardwood industry was nationalised in April 1964.

The State Timber Board was formed soon after nationalisation of the teak trade was commenced in June 1948, but only became a statutory body under an act of parliament in 1951.

CHAPTER 4

DESCRIPTION OF PRESENT FOREST MANAGEMENT AND UTILIZATION

4.1 GIRDLING OF TEAK

The cheapest method of transporting logs long distances in Burma is to float them down the streams and rivers. Trees must be girdled three years before felling if they are to float satisfactorily. Girdling is cutting through the bark and sapwood of the tree to expose a thin continuous ring of heartwood. The ability to float after girdling is an important property of teak, a property which very few other trees in Burma have, and one which permits the extraction of teak from remote areas. Girdling is usually done during fair weather i.e. from November to middle of May.

4.1.1 Teak Yield Regulation

The allowable cut for teak is calculated in the Working Plans utilising data obtained during the previous girdling. Teak trees of 4' g.b.h. and over are enumerated during girdling. Yield for the next felling cycle is then calculated from this enumeration data. The number of yield trees to be obtained in the next felling cycle depends on the number of trees left in the girth class one foot below the girth cutting limit and frequently includes some of the trees from the next lower girth class as well. A mortality factor is included in the calculations. The calculation of yield from the Working Plans Circle is fairly accurate and is given, together with the management schedules, in the Divisional Working Plans.

4.1.2 Selection of Areas to be Girdled

The scheduling of girdling operations is initially determined by the Divisional Working Plan. However, girdling schedules have to be co-ordinated with the State Timber Board's (S.T.B.)'s ability to fell and extract the girdled trees three years later. Consequently the Divisional Forest Officer is required to consult with the Manager of the State Timber Board before girdling operations are commenced.

4.1.3 Girdling Operation

Before girdling commences repairs are made to compartment boundary and boundary pillars. All girdled trees in the same compartment or coupe are numbered serially. At the same time future yield trees are numbered on a light sapwood blaze. Details of girdled trees and future yield trees are recorded by the girdling officer in the girdling note book. Finally the girdling officer has to prepare maps showing different types of forests and the position of girdled trees of the area.

All diaries, together with a statement of the trees girdled and left, and the girdling accounts, are sent to the Divisional Forest Officer.

4.2 MARKING FOR SELECTION FELLING

Prior to the nationalization of the timber trade, the marking of hardwood for selection felling was carried out seven years after or three years before teak girdling to avoid any confusion between

those who worked on teak and those who worked on hardwoods. The same method was still practised after the nationalisation of the teak trade but it became necessary to concentrate extraction into as few areas as possible once the State Timber Board became the only agency for the extraction of both teak and hardwoods. Although teak girdling and markir of hardwoods cannot be carried out simultaneously, present practice is to concentrate both operations in the same compartments or coupes of the commercial supply working circle to reduce the spread of the scarce extraction equipment by the State Timber Board.

Yield is usually calculated on an area basis but data on future yield trees obtained during marking is sometimes used for these calculations.

Marking for selection felling is usually carried out during th rainy season when most of the forest subordinates have less work than during fair weather.

4.3 ROYALTY APPRAISAL

Before nationalisation, teak was sold on a long term area lease basis at royalties fixed by the Forest Department. The royalty rates were calculated using extraction data obtained from the Myitmaka Extraction Agency run by the Forest Department. Since nationalisation, royalty rates have been fixed by the Forest Department after negotiating with the State Timber Board. Three different classes are in use for royalty assessment. Teak logs 30 cubic feet and over are classed as full size, over 20 cubic feet and under 30 cubic feet are classed

as undersize, and under 20 cubic feet are classed as refuse. Different royalty rates are applied for different classes with the highest rate being for full size logs.

When short term leases were used, teak was usually sold by tender and royalty rates were controlled by girth classes rather than the cubic content. The different girth classes used were under 3'6", 3'6" to 4'11", and 5' and over. Short term lessees were required to extract all timber within two years.

Logging for both long term and short term lessees were checked by the Forest Department to ensure that no marketable log was left behind in the forests during extraction. However the State Timber Board's teak logging operations are not checked.

Measuring of teak logs is usually done at a depot or at a place on the main river specified by the Forest Department.

The checking (sit marking) of hardwood logs is done at the stump but the measuring of hardwood logs is done at specified places. Royalty rates differ from species to species according to the rates given by the bidder in the reserved forests but, in the unclassed forests, the rates are fixed by the Forest Department.

4.4 PLANTATIONS

At the end of March 1936, Burma had 106,208 acres of plantations of teak and other mixed species. Most of the pre-war plantations were destroyed by the Japanese. Relatively few plantations have been established by the Forest Department since then because of a scarcity of funds. Up to the outbreak of War, plantations were regarded as

compensatory plantings for timber removed in the logging operations and were planted wherever possible whereas, since the War, plantations have been restricted to Local Supply Working Circle areas. The annual yield obtained from the natural forests is remaining constant because improvement fellings cannot be carried out effectively. Although the quality of teak from plantations compares favourably with the quality of teak from natural forests, no economic evaluations on teak plantations have ever been made in the country. Consequently, it is not possible to determine whether more teak plantations should be established or not.

4.5 UTILIZATION

Only teak, durable species and some semidurable species, are used at the present moment. The use of some of the semidurable and nondurable species will only be possible on a large scale when there are sufficient preservative treatment plants to treat them. The nondurable species have other inherent disadvantages. Their cost of extraction is the same as the cost of extraction for durable hardwoods and some of them decay during extraction.

Bamboo is used to a considerable extent in house construction (about 50 percent of the houses are built of bamboo, 35 percent of mixed bamboo and timber, 14 percent all timber and 1 percent all brick) (Long, 1959). However, the use of bamboo will probably be restricted in the future since Burma is at present establishing a bamboo based paper and paper products industry.

If some of the semidurable and nondurable timber can be substituted for bamboo in house construction then sawn timber consumption seems likely to increase in the future.

About 300 saw mills, three plywood and veneer mills, a small pulp and paper factory, and a furniture factory, are the only timber processing plants in the country. Most saw mills are still using circular saws few having band saws. The percentage of sawn timber recovered from logs has been declining over recent years and is now down to 31.5 percent.

Plywood produced by the plywood factories is generally of low quality when compared with that produced in other more developed countries. As a result, most of it cannot be sold for export and has to be used in Burma.

CHAPTER 5

PROBLEMS OF EXTRACTION

5.1 SECURITY

Security from attack by insurgents is very important in the extraction of timber. Most of the valuable forests of Burma are situated in very remote areas so they become favourite hiding places for insurgents. Since the yield per acre of both teak and hardwoods is very low (i.e. about one to one and a half tons per acre for teak and three tons per acre for valuable hardwoods in thirty years) the forest Department needs to girdle between 300,000 and 450,000 acres of teak and mark about 300,000 acres for selection felling of hardwoods every year if the desired output is to be maintained.

Since forestry operations are generally based on the management plans so most of the operations are scattered over the Forest Divisions. With the present strength of the army, the Defence Ministry has considerable difficulty in maintaining year-round security over such large and scattered areas.

5.2 AVAILABILITY OF EQUIPMENT

Most of the timber extraction in Burma is done by elephant. The number of elephants used in the timber industry before the War was estimated to be 4,500 (see section 3.6.2). The elephant population was severely depleted during the Japanese occupation and by

1969-70 there were only 3,046 elephants in the timber extraction agency of which 1,048 were owned by the State Timber Board. Private contractors owned the remaining 1,998 elephants and practically all of the 19,944 buffalos used in the timber industry.

Mechanical extraction units have been introduced to replace some of the elephant power lost during the War, but the steep terrain and the very low volume yield per acre limit their use.

The following table shows the percentage increase in crawler tractor snigging costs resulting from decreasing stand density. The table is based on data derived from studies carried out in New South Wales, Australia, by Grugeon (1961, p.29).

Table 5.1 The Percentage Increase* in Crawler Tractor Snigging Costs Resulting from Decreasing Volume Removed Per Acre.

Snigging Distance	Volume removed per acre		
	2,000 to 1,000 s.ft. per acre	1,000 to 500 s.ft. per acre	Below 500 s.ft. per acre
5 - 10 chains	7%	11%	18%
$12\frac{1}{2}$ - 20 chains	4%	$7\frac{1}{2}$%	12%
over 20 chains	3%	5%	$7\frac{1}{2}$%

*Cost increases based on stand densities below 7,500 s.ft. per acre.

Table 5.1 shows that the percentage cost increase in snigging does not increase very much at very low stand density for snigging distance over 20 chains. Under Burmese conditions where the average snigging distance is 160 chains the cost increases would be almost negligible.

However Grugeon's work did not include allowances for bunching logs prior to snigging. The percentage increase in snigging costs might still be significant even in Burmese conditions where the tractor has to bunch a number of logs before snigging them to a stream. High volumes removed per acre should reduce the distance between logs and, hence, the bunching time. A large tractor which is capable of hauling 3,000 super feet of logs would be capable of hauling between four and six logs in one trip. At very low stand densities the tractor may have to cover five or six acres before getting a full load. However, over long snigging distances big machines may not be acceptable because the loading factor becomes critical (Whayman, 1972). It is likely that the volume removed per acre could be very important if economic mechanical extraction is to be achieved.

Snigging capacity varies considerably with crawler tractor horse power but generally ranges from 500 super feet to 1,500 super feet a day within the horse power range of 50 to 200 for a snigging distance of 80 to 160 chains (Groves, K.W., pers. coms.).

Furthermore, the cost of snigging depends on the specific type of tractor, crawler or rubber tyred skidder in use. Rubber tyred skidders can travel faster and cost less to purchase than crawler tractors of the same horse power rating. Another consideration is that the efficiency of the machine in use not only depends on the suitability of the machine to the working conditions but is very much influenced by the skill and the quality of the training of the operators (Whayman, 1972).

The successful snigging operation using a combination of crawlers and rubber tyred skidders in Nicaragua (World Wood,

November 1972) under conditions very similar to those experienced in Burma indicates that mechanical equipment could probably be introduced economically in Burma in the future.

Although the introduction of mechanical equipment appears to be vital for Burma, a proper investigation into the types of equipment to be used and the training and servicing backup required is essential before any concrete decision is made.

The number of trucks owned by the State Timber Board in 1969/70 was 620 whereas private contractors owned 1,327. Although the number of tractors owned by the State Timber Board had increased from 30 in 1964/65 to 128 in 1968/69 the production of teak had not increased substantially over the same period.

A major cause of the drastic drop in timber extraction soon after nationalisation of the timber trade was the fact that most of the equipment used in the timber industry before nationalisation, such as elephants, trucks etc., was owned by private contractors rather than the timber traders and, therefore, was not available to the State Timber Board. It is likely that, at that time, the limited STB extraction resources had to be used to extract both teak and hardwood with the result that teak production fell substantially.

The five yearly average production figures for teak and hardwoods for the period 1919/20 to 1964/65 (excluding the War years) and the four years average for 1965/66 to 1968/69 is shown in the following table.

Table 5.2 Production of Teak and Hardwood (round tons)

Period	Teak	Hardwoods
1919/20 to 1923/24	509,935	488,995
1924/25 to 1928/29	486,439	532,503
1929/30 to 1933/34	389,290	341,518
1934/35 to 1938/39	467,836	463,959
1945/46 to 1949/50	155,034	274,131
1950/51 to 1954/55	129,394	421,509
1955/56 to 1959/60	203,515	625,606
1960/61 to 1964/65	306,479	693,675
1965/66 to 1968/69	258,120	604,124

Although it has been argued that the drop in production after the War was due to the lack of elephants and other extraction equipment, this seems doubtful if the post war production data is compared with the early pre-war production data. The number of elephants used between 1919/20 and 1923/24 would be about the same if not less than now (Aung Baw, 1951) and mechanical extraction equipment was not available at the time.

5.3 TRANSPORTATION PROBLEM

Teak trees are felled, logged and snigged, mainly by elephants to the nearest floating stream (i.e. a stream which is capable of transporting timber by floating down stream at some period of the Year).

In the dry weather the stream flows are usually small, but in the wet season the intermittent rains cause the streams to rise substantially. With each rise, the logs are carried downstream until eventually they reach the main rivers, where they are collected and made into rafts for controlled floating to the saw mills and depots. It is often necessary to help the logs through the shallow parts of the stream and around the sharp bends with elephants, an operation known as aunging.

The period taken for a teak log to reach a main river after being placed in the floating stream depends on the condition of the small floating streams and the frequency with which rises capable of floating logs occur. In general it takes two to three years but in some isolated localities it may take very much longer, so on average, the transportation system contains some three or four years timber supply. Once these logs reach the main river, rafting to Rangoon usually takes one to two months.

The following table shows the teak logs input into floating stream and teak logs outturn to main river depot.

Table 5.3 Teak Logs Input and Outturn

Year (June to May)	Input into Floating Stream (Logs)	Outturn to main river depots. (Logs)
1955-56	212,939	125,929
1956-57	245,535	182,373
1957-58	214,610	181,467
1958-59	259,778	184,520
1959-60	293,411	285,727
1960-61	329,257	245,740
1961-62	367,467	273,020
1962-63	380,064	305,918
1963-64	370,486	359,964
1964-65	374,091	327,145
1965-66	403,067	326,102
1966-67	373,314	332,411
1967-68	385,297	381,543
1968-69	439,635	345,874
1969-70	452,570	410,210
Total*	3,824,019*	3,130,316*

* 1955-56 to 1966-67

Exact losses of logs during stream floating are difficult to obtain but, by checking log input against log output one, two, three, and four years later, it is possible to obtain an idea of the average duration and the losses which occur in the process of single log floating of teak.

The following table shows the logs lost in the course of single log flotation with varied time lagging.

Table 5.4 Estimates of Apparent Log Loss.

Year of input into the stream (June to May)	Without lagging	One Year lagging	Two Years lagging	Three Years lagging	Four Years lagging
1955-56	87,010	30,566	31,472	28,419	-72,788
1956-57	63,162	64,068	61,015	-40,192	- 205
1957-58	33,143	30,090	-71,117	-31,130	-58,410
1958-59	75,258	-25,949	14,038	-13,242	-46,140
1959-60	7,684	47,671	20,391	-12,507	-66,553
1960-61	83,517	56,237	23,339	-30,707	2,112
1961-62	94,447	61,549	7,503	40,322	41,365
1962-63	74,146	20,100	52,919	53,962	47,653
1963-64	10,522	43,341	44,384	38,075	-11,057
1964-65	46,946	47,989	41,680	- 7,452	28,217
1965-66	76,965	70,656	21,524	57,193	- 7,143
1966-67	40,903	- 8,229	27,440	-36,896	
Total	693,703	438,089	274,588	45,845	-142,949
12 yr. av.	57,809	36,507	22,882	3,820	- 11,912*
Percentage of log input	18.14	11.46	7.18	1.20	- 4.14*

* 11 year average

If the outturn of teak logs to the main river depot is lagged for three years the difference between teak log input into floating stream and teak log outturn to main river depots is only 1.2 percent for the period 1955-56 to 1966-67 inclusive. This rate of loss is very reasonable and the results confirm the fact that the average stream flotation time is approximately three years.

Extraction of hardwood requires different methods to those used for teak. Where road conditions are satisfactory hardwood logs are carted or trucked to places where railing or floating is possible. Floating of hardwood is undertaken much less frequently than for teak because both the quantity of bamboo required to float the logs, and the subsequent cost of raft construction, are usually considerable.

At present the extraction of hardwoods is confined to Commercial Supply Working Circle areas which are only 13.06 percent of the Teak Selection Working Circle areas (some 7.61 percent of the Commercial Supply Working Circle is overlapping with the Teak Selection Working Circle).

5.4 PROBLEMS OF SILVICULTURAL CONDITION OF FORESTS

Most of the natural forests in Burma contain a considerable mixture of species. The per acre yield of valuable species is very low because the semidurable and nondurable species cannot be used economically at present. Improvement felling in favour of teak is usually carried out in conjunction with teak girdling operations. However, the scarcity of investment funds prohibits improvement felling in favour of other valuable species. An enrichment of the

species composition would result if the semidurable and nondurable species could be taken out thus favouring the regeneration of teak and other valuable species. Where teak seed bearers are prevalent in areas of bamboo, teak regeneration occurs naturally because teak seedlings usually germinate like weeds after the bamboo has flowered thus permitting light to reach the teak seeds.

CHAPTER 6

PROCESSING PROBLEMS

6.1 SAW MILLING PROBLEMS

Most of the Teak Saw Mills in Burma still use circular saws throughout. However, some State Saw Mills, e.g. Nos. (3), (4), (5) and (6), are equipped with band saws. Until 1952-53 the State Timber Board controlled only State Saw Mill No. (1) and (2) which were used for sawing teak. The combined capacity of these two mills was only 35,000 tons per annum and they could not cope with the arrival of 75,000 tons of teak at the milling station soon after the teak industry had been nationalised. With the introduction of State Saw Mill No. (3), in June 1954, the sawing capacity was increased from 60,000 tons per annum to 95,000 tons per annum. State Saw Mill No. (4), with a capacity of 35,000 tons per annum, started operation in 1953/54 but was not fully commissioned until 1955. Both State No. (5) Saw Mill in Moulmein, with a capacity of 30,000 tons per annum, and State Saw Mill No. (6), with a capacity of 46,000 tons per annum started operation in 1955/56.

Table 6.1 indicates a comparatively low recovery percentage of teak sawn timber from the State Saw Mills. The percentage of sawn timber recovered from the log input into the mills has been decreasing and in 1966/67 it reached the relatively low level of 31.51 percent. This may be partially attributed to the better quality logs being

exported, but is more likely to have been caused by the outdated nature of the saw mills and the lack of incentives for the workers employed at the State Saw Mills.

The sawn timber recovery percentage of the State owned saw mills for the years 1948/49 to 1966/67 is given in the following table.

Table 6.1 Sawn Timber Recovery Percentage of Teak

Fiscal Year	Input Cubic Tons (true measure)	Output Cubic Tons (true measure)	Percent
1948-49	20,019	7,808	39.00
1949-50	13,052	5,026	38.51
1950-51	35,690	13,755	38.54
1951-52	38,732	14,523	37.50
1952-53	36,997	12,559	33.95
1953-54	59,038	22,490	38.09
1954-55	96,985	38,154	39.34
1955-56	161,819	64,263	39.71
1956-57	194,929	74,118	38.02
1957-58	181,745	71,892	39.56
1958-59	181,960	69,799	38.36
1959-60	192,231	75,380	39.21
1960-61	193,122	77,346	40.05
1961-62	235,758	94,619	40.13
1962-63	281,544	114,155	40.55
1963-64	315,397	115,106	36.50
1964-65	313,176	103,906	33.18
1965-66	297,939	95,615	32.09
1966-67	330,149	104,026	31.51

The volume of teak log export as a percentage of the teak logs produced is shown in table 6.2.

Table 6.2 Percentage of Teak Log Export to Teak Log Production

Fiscal Year	Teak Log Production cubic tons (H) *	Teak Log Export cubic tons (H) *	Exports as a Percentage of Production
1958-59	237,188	6,850	2.89
1959-60	249,834	19,737	7.90
1960-61	292,724	20,639	7.05
1961-62	282,886	35,005	12.37
1962-63	313,829	47,718	15.21
1963-64	381,460	47,806	12.53
1964-65	261,497	54,330	20.78
1965-66	272,814	55,819	20.46
1966-67	287,410	28,904	10.06

* Hoppus.

The fall in the recovery percentage in 1964/65 and 1965/66 might be explicable by the higher percentage of the good quality teak log which was exported, thereby reducing the quality of teak logs available to the local mills. However, the 1966/67 recovery percentage for teak was still only 31.51 percent although teak log export during that year dropped to just over half the previous year's level, far less than the level exported in 1961/62 and 1962/63 during which time the recovery percentages were 40.13 and 40.55 percent respectively.

A comparison of average sawn timber recovery percentages of different mills (table 6.3) indicates that State Saw Mill No. (1), which is still operating with circular saws, has the highest sawn timber recovery percentage. This suggests that the saw mill had very little influence on the recovery percentage over the 1955-56 to 1966-67 period although variations in log quality, size, and mill management were probably responsible.

Table 6.3 Recovery Percentage of some of the State Owned Saw Mills

Fiscal Year	Saw Mills					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
1955-56	38.74	40.04	40.81	41.10	34.63	39.86
1956-57	38.68	39.69	37.71	38.36	34.97	38.51
1957-58	40.05	40.18	38.81	39.35	39.73	40.64
1958-59	39.46	39.22	37.58	38.35	37.92	38.36
1959-60	42.49	36.88	39.78	40.09	34.46	38.14
1960-61	43.01	38.42	40.54	39.80	38.95	38.90
1961-62	42.22	41.11	39.61	40.47	42.05	38.14
1962-63	41.58	39.49	40.20	42.52	44.87	39.70
1963-64	36.76	38.55	36.12	39.24	37.93	39.77
1964-65	31.62	34.07	33.06	36.62	34.78	34.66
1965-66	31.48	31.50	30.91	35.13	38.89	35.52
1966-67	37.86	30.68	30.77	30.08	38.44	32.76
Average	38.66	37.49	37.16	38.43	38.14	37.91

It has been found that some of the re-sawing mills in Rangoon are using the teak slabs from the State Saw Mills, sold to them by the State Saw Mills for fuel, for making furniture instead. This rather extravagant disposal of utilisable material as waste fuel probably has a considerable adverse effect on the sawn timber recovery. Under these conditions the quality of logs fed into the saw mills as well as the outdated nature of the saw mills seems to be relatively minor influences on the sawn timber recovery percentages (although these factors could be important in some saw mills). The lack of incentive for the workers of the State owned enterprises, who receive very low wages in comparison with private enterprise workers, is probably much more significant. The nationalisation of the hardwood industry in 1963/64 could have strained the managerial resources of the S.T.B. and added to the low recovery problem.

6.2 PLYWOOD AND VENEER FACTORY

At present there are only three plywood and veneer factories in Burma. Although timber for making plywood and veneers is abundant, the main raw materials (e.g. glue) have to be imported. Lack of trained personnel in the plywood and veneer factories seem likely to pose extra problems for producing better quality plywood and veneers for export market.

Production of plywood and veneers is shown in the following table.

Table 6.4 Production of Plywood and Veneers

Fiscal Year	Plywood			Teak Veneers c.tons[2]
	Teak c.tons[1]	Hardwoods c.tons[1]	Others c.tons[1]	
1961-62	-	-	2,321	N.A.
1962-63	-	-	2,758	N.A.
1963-64	-	-	6,115	N.A.
1964-65	30	1,238	1,238	N.A.
1965-66	120	1,088	769	N.A.
1966-67	1,107	426	-	124
1967-68	996	2,361	-	13
1968-69	1,575	569	-	77
1969-70	2,606	6,799	-	131

[1] 3/16" basis

[2] 1/32" thickness

Since nationalisation, the entire plywood production has been used locally. Although there was only one plywood and veneer factory before nationalisation the level of exports of both plywood and veneer during that period was very high when compared to the post nationalisation period.

The export of plywood and veneers can be seen in the following table.

Table 6.5 Export of Plywood and Veneers

Fiscal Year	Plywood			Veneers		
	cubic ton	Value $A	Av. Per Ton $A	cubic ton	Value $A	Av. Per Ton $A
1961-62	269	43,136	160.36	791	263,878	330.60
1962-63	562	91,165	162.22	292	127,556	436.84
1963-64	63	9,747	159.71	113	46,673	413.03
1964-65	-	-	-	312	175,478	562.43
1965-66	-	-	-	208	144,919	696.73
1966-67	2	1,119	559.49	110	145,655	1,324.13
1967-68	-	-	-	11	17,840	1,621.85
1968-69	46	13,101	284.81	67	80,105	1,195.59

The prospects of exporting large quantities of plywood and veneers are not very attractive but seem to be improving. The unit export price of veneers has increased rapidly since 1966/67. Even so, the trends and likely future developments in the unit prices of teak logs and veneers need to be carefully examined before it is finally decided whether to produce veneers for export or to export teak as logs.

6.3 PULP AND PAPER INDUSTRY

The pulp and paper industry on the eastern bank of the Sittang River in Thaton district started operation during 1972. It

has an annual output of 6,000 tons of printing paper, 6,000 tons of writing paper, and 900 tons of wrapping paper. Two more pulp and paper plants are expected to be established in the future.

6.4 OTHER PROCESSING INDUSTRY

Most of the furniture industry is owned by private enterprises (one furniture factory is run by the State Timber Board). The State owned furniture factory produces furniture of a standard design but the production rate is so low that the factory cannot meet even the furniture requirements of the government departments. The price of the furniture produced by the State owned factory is higher and the quality is lower than that produced in the private factories. Consequently very little of its output is purchased by the public.

CHAPTER 7

PROBLEMS OF MARKET ANALYSIS AND FORECASTING

7.1 DEFINITIONS

Demand is defined as the quantity of a commodity which consumers are willing to purchase in a given market per unit time at a given price. Usually demand is related to price in the traditional economic analysis but can be related to variables other than price (Gregory et.al., 1971 Chapter 1.3; Leftwich, 1955, Samuelson et.al., 1970).

Supply is defined as the quantity of a commodity which producers and other sellers are willing to offer for sale in a given market per unit time at a given price (Gregory et.al. op.cit.; Leftwich, 1955, Samuelson et.al., 1970).

Consumption is defined as the quantity of a specified commodity used or consumed in a particular area during a specified period of time. Consumption normally occurs after a sale has been made but may occur without any sale being made. (Gregory et.al., op.cit.)

If consumption data are not readily obtainable, availability is a close approximation but it excludes changes in stock which occur during the period to which it applies.

Future requirements are defined as a quantitative estimate of the amount of some commodity that would be taken in a specified market in the future. (Gregory et.al., op.cit.).

7.2 THE MARKET FOR FOREST PRODUCTS

Two distinct markets prevailed for forest products during the period covered by this research. Before the forest products industry was nationalised, sellers and buyers were free to exchange goods at a mutually satisfactory negotiated price. After nationalisation of the Trade by the government prices were fixed throughout the country and consequently a competitive market as such did not exist.

Until very recently all paper and paper products were imported but, prior to nationalisation, the importing and the distributional activities were carried out by paper and paper products merchants. The majority of imported newsprint was consumed by the newspaper publishers but some of it was used by manufacturers as stationery and exercise books. Most of the printing and writing paper was consumed by the business community, the remainder being distributed to the public after processing into different products. Almost all wrapping paper was consumed by manufacturers of confectionery and similar products.

Up to the time of nationalisation timber was distributed by the saw millers through their timber shops or other timber merchants. During the same period, teak of grades other than export quality was auctioned by the State Timber Board and then sold, by the purchasers, through the timber shops and timber merchants. The various retail prices of timber were determined by the interaction of the supply and demand.

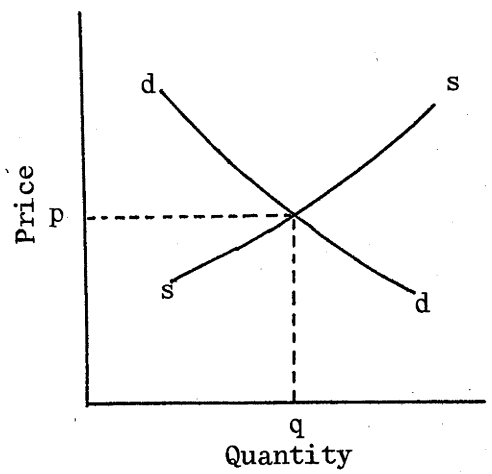
After nationalisation had been implemented the distribution of paper and paper products was carried out through the people's

shops by the Trade Corporation. These shops were also used by the Marketing Department of the State Timber Board for timber distribution; the prices of all products being fixed by the relevant government authority.

7.3 NATURE OF DEMAND FOR FOREST PRODUCTS

An economic model suitable for estimating future demand for forest products was presented by Gregory (1966) and is shown in the following figure.

Figure 7.1 Conventional Supply - Demand Model

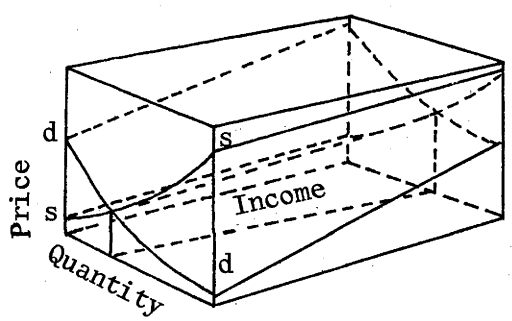


The demand curve(dd) represents the quantity of goods that a given market will take at various prices over a given time period and the supply curve (ss) represents the quantity of goods that producers will be willing to supply to that market at those prices. The intersection of the two curves determines the equilibrium market price (p) and equilibrium

market quantity (q). The latter is more properly identified with actual sales while consumption is the quantity of the product actually used or consumed.

If income is included in the above model the demand curve will shift outward as per capita income rises. The following figure illustrates this.

Figure 7.2 Effect of Income on Demand and Supply



Identification of the variables which have significant influence on demand is essential to sound forecasting. The variables most commonly found to be significant in the analysis of forest products markets are the price of the forest products, the price jof substitute materials and per capita income. These variables were tested using Burmese data.

The analysis of sawn timber demand in Burma included Gregory's wood availability index in the cross sectional country analysis since it approximates the likely supply position for timber from the existing forests (Gregory, 1966).

An index of literacy was included in the analysis of demand for cultural paper. Cross sectional data from a number of countries was also used.

Limited data availability and inaccurate data caused considerable difficulty and must cast some doubt on the exactness of the results but should not detract seriously from the overall conclusions.

7.4 PROBLEMS OF ESTIMATING AND PROJECTING THE DEMAND FOR FOREST PRODUCTS

Long run projections of demand for forest products in Burma should play an important role in formulating forest policies and programmes relating to the forest products industry and the national economy. Timber growing involves quite long production periods so the decision maker is obliged to plan, well in advance, the nature of the forest industries that would be needed in the future. The best practice would be to do this after the future requirements of forest products have been estimated.

Up till now, long run projections of demand for forest products have not been made for Burma. The relevant section of this study has been undertaken to fulfill the basic requirement for sound forestry planning for the future in Burma by deriving estimates of the aggregate demand for sawn timber, paper and paper products, up to the year 2000. To achieve this goal, a quantitative assessment of the demand elasticities, the market forces which influenced consumption,

and price levels in the recent past was undertaken, and this information was then used to forecast the demand for sawn timber, paper, and paper products in the future.

Scientific studies of the demand for forest products in Burma had not been published or undertaken when this study was commenced, so data collection and analysis had to begin from the very beginning. The difficulties encountered in the study can conveniently be discussed under three headings:-

(1) Identification of the indicator variables which significantly influence demand in Burma.

(2) Selection of the most appropriate method to forecast these indicator variables in future periods.

(3) Data requirements, deficiencies, and availability.

7.4.1 Identification of Significant Indicator Variables

The identification of variables which are significant in projecting the demands for forest products was the most difficult part of this study. Income and population are usually considered to be the most important long run determinant of forest products consumption (Hair, 1967; Leslie, 1963; F.A.O., 1960; McKillop, 1967; Zaremba, 1963). In this respect Burma is atypical. Although Burma is a developing country with a very low level of per capita income, a high percentage of its population are literate. This factor has had a considerable effect on the consumption of cultural paper especially in comparison with the consumption levels of other countries. For this reason, literacy indices were included in the cross sectional analysis.

Throughout the world price is an important determinant of the demand for sawn timber. The historical data which were available in Burma for analysis comprises consumption and price figures but only the consumption data prior to nationalisation were determined by the interaction of the demand and supply curves. As a result it is not possible to determine the demand function from the consumption and price data because the demand and supply curves cannot be separated. To overcome the problem a wood availability index is included in the cross sectional study as an approximation of the likely supply position of timber from the existing forests.

The prevalence of substitute product e.g. bamboo considerably influences the price sensitivity of the sawn timber market. For instance, a shift in demand from sawn timber to bamboo would tend to follo a decrease in bamboo prices relative to those of sawn timber.

7.4.2 Methods Used to Forecast Future Levels of the Variables

The lack of reliable projections of the major demand determinants such as income, population, prices of forest products, and substitute materials, is a serious problem for anyone wishing to project the demand for forest products in Burma.

The population data in the analysis are estimates of actual population made by the Census Department. It follows that any projections of population based on these figures will include both the weaknesses of the projection technique and the inaccuracies of both past and present population estimates. As a result it is not possible to indicate the level of conficence that can be placed on the population projection.

The problem of projecting future income is also difficult. Not only is the economy unstable but most of the per capita income data has been derived from a period during which agricultural prices were fluctuating widely.

Projections of price levels in Burma are even more intricate. The prices of most of the forest products have been fluctuating and substantial structural changes have occurred in the market place. Nationalisation of the trade has further complicated the situation because the prices of most domestic commodities, including forest products, have been fixed since that time. Real changes in relative prices are therefore extremely difficult to forecast, especially with any reasonable degree of certainty.

7.4.3 Data Requirements, Deficiencies and Availability

The severe scarcity of published data necessitated a considerable number of assumptions, much hard work, and much ingenuity, before analysis could commence. The accuracy of the result is affected if the assumptions made in deriving the sawn timber availability and other data are not correct. This validity of the assumptions is discussed in Chapters 8 and 9.

7.5 MODELS FOR LONGRUN PROJECTIONS OF DEMAND FOR FOREST PRODUCTS IN BURMA

The lack of suitable data severely limited the range of models that could be used for forecasting the demand for forest products in

Burma. However, models commonly used for analysing forest products markets and forecasting in general are discussed below. Four broad groups of models have been used for forecasting the level of demand for the different types of forest products. They are:-

(1) Graphical methods

(2) Single equation models

(3) Multi-equation models, and

(4) Input-Output models.

7.5.1 Graphical Methods

Graphical methods are the simplest and most widely used for projecting long run trends in the demand for forest products, particularly in the less developed countries. Many people believe that this technique is as useful as any of the sophisticated mathematical models provided a skilled analyst is available. It involves the fitting of a curve to the data in such a way that a satisfactory description of the relationship between the variables is provided.

Graphic model is the only practical choice if sufficient data for the use of mathematical relationships are unavailable.

7.5.2 Single Equation Model

Single equation models have been widely used to project longrun trends in demand for forest products (Hair, 1967; Simula, 1971; Leslie, 1963). The number of independent variables can vary from one upwards but the best results are achieved in the range of two to five. The model is very useful for establishing the historical relationship between detailed time series data. A good example is

consumption of forest products and demand shifters such as population, personal income, prices of forest products or prices of substitute materials.

Although this model can use any number of independent variables, it can only be used to estimate one dependent variable at a time. One of its advantages over some of the more complicated multiequation models is that the use of a computer for data processing is not always necessary. For this reason it may be easier to apply in less developed countries where computer facilties are not readily available.

7.5.3 Multi-Equation Model

Multi-equation models are simpler in application than input-output models although problems are inherent in their operational use. They can be either recursive or simultaneous. Recursive systems can be designed to provide projections of demand, supply, and price, through a system of equations in which demand is treated as a function of consumer related variables, supply as a function of producer related variables, and price as a factor which causes demand and supply to move toward equilibrium. In such a system, price is a dependent variable and variations in price will cause disequilibrium between consumption and production whereas, in the simultaneous system price is simultaneously determined with demand and supply. Because of this characteristic the simultaneous multi-equation model is very useful in specifying and solving an economic goal which balances timber supply and demand at an equilibrium price. This type of model provides the theoretically most satisfying information but its use is limited to countries with satisfactory data sources.

7.5.4 Input-Output Model

The most complicated model that has been used to project longrun trends in demand for timber products is an input-output model.[1] This model endeavours to incorporate all the sectors of an economy in a linked system of equations. The inter commodity flows between the various sectors of the economy are revealed in an input-output table. Up to the present, input-output tables have only been used for predicting relatively short run effects of specified changes in demand or supply because it is difficult to estimate the changes in input-output coefficients over long periods.

Very few people have used input-output models for forecasting. The technique is considered to be an impractical choice for making long run projections of demand for forest products. It is still in the developmental stage and it also requires substantial data and computing facilities, neither of which are yet available in Burma.

7.6 CHOICE OF AN ECONOMIC MODEL FOR FORECASTING IN BURMA

Each forecasting model has its own advantages and disadvantages, but the choice of a specific model for projections depends on:

(1) its suitability to the market structure and conditions, and

(2) the availability of suitable data.

In view of the advantages and disadvantages of different models and the limitations of data availability and reliability in Burma the single equation model was considered to be the most suitable.

1. Hair (1967).

The main reasons for selecting the single equation system are:-

(1) There is no input-output table in Burma.

(2) The satisfactory use of a multi-equation model requires a substantial number of observations for all the variables being included in the analysis. Since the available data in Burma cannot fulfill this requirement the use of multi-equation model was precluded.

(3) The intermittent structural changes which have occurred in Burma during the study period means that the number of observations under stable market conditions is reduced still further. Consequently the use of the more sophisticated forecasting models is inadvisable.

A study of the changes in forest products consumption must be related to the changes in the general economy if the model used is to describe the market behaviour adequately and in accordance with the economic history of the country. This in turn calls for a model which is suitable for testing stable periods between structural changes as easily as possible and without consuming too much time.

7.7 CHOICE OF FUNCTION

The various single equation demand functions used in market demand analysis are shown as follows:-

(1) $Y = a + b_1X_1 + b_2 X_2$

(2) $Y = a + b_1 \log X_1 + b_2 \log X_2$

$$(3)\quad Y = a.X_1^{b_1}.X_2^{b_2}$$

$$(4)\quad Y = e^{(a + b_1 X_1 + b_2 X_2)}$$

$$(5)\quad Y = a + \frac{b_1}{X_1} + \frac{b_2}{X_2}$$

$$(6)\quad Y = e^{(a + \frac{b_1}{X_1} + \frac{b_2}{X_2})}$$

$$(7)\quad Y = a.\ X_1^{-b_1}\ .\ X_2^{-b_2}$$

where Y = consumption

X_1 = income

X_2 = price.

The different functions yield elasticities of demand which vary considerably as the income, price, or consumption levels change. The choice of function therefore depends on the behaviour of the elasticities (diminishing, constant or increasing) as input levels change. The ultimate decision rests on the type of elasticity behaviour which economic theory and economic analysis leads us to expect.

The income and price elasticity functions for the different equations are shown in the following table.

Table 7.1 Income and Price Elasticities and their Characteristics Using Different Functions.

Functions	Income Elasticity	Price Elasticity	Characteristics.
$Y = a + b_1 X_1 + b_2 X_2$	$b_1 \cdot \frac{X_1}{Y}$	$b_2 \cdot \frac{X_2}{Y}$	Increasing
$Y = a + b_1 \log X_1 + b_2 \log X_2$	$\frac{b_1}{Y}$	$\frac{b_2}{Y}$	Diminishing
$Y = a . X_1^{b_1} . X_2^{b_2}$	b_1	b_2	Constant
$Y = e^{(a + b_1 X_1 + b_2 X_2)}$	$b_1 X_1$	$b_2 X_2$	Increasing
$Y = a + \frac{b_1}{X_1} + \frac{b_2}{X_2}$	$\frac{-b_1}{X_1 Y}$	$\frac{-b_2}{X_2 Y}$	Diminishing
$Y = e^{(a + \frac{b_1}{X_1} + \frac{b_2}{X_2})}$	$\frac{-b_1}{X_1}$	$\frac{-b_2}{X_2}$	Diminishing
$Y = a . X_1^{-b_1} . X_2^{-b_2}$	$-b_1$	$-b_2$	Constant

CHAPTER 8

ANALYSIS OF DEMAND FOR LOGS AND SAWN TIMBER

8.1 THE NATURE OF DEMAND FOR SAWN TIMBER IN BURMA

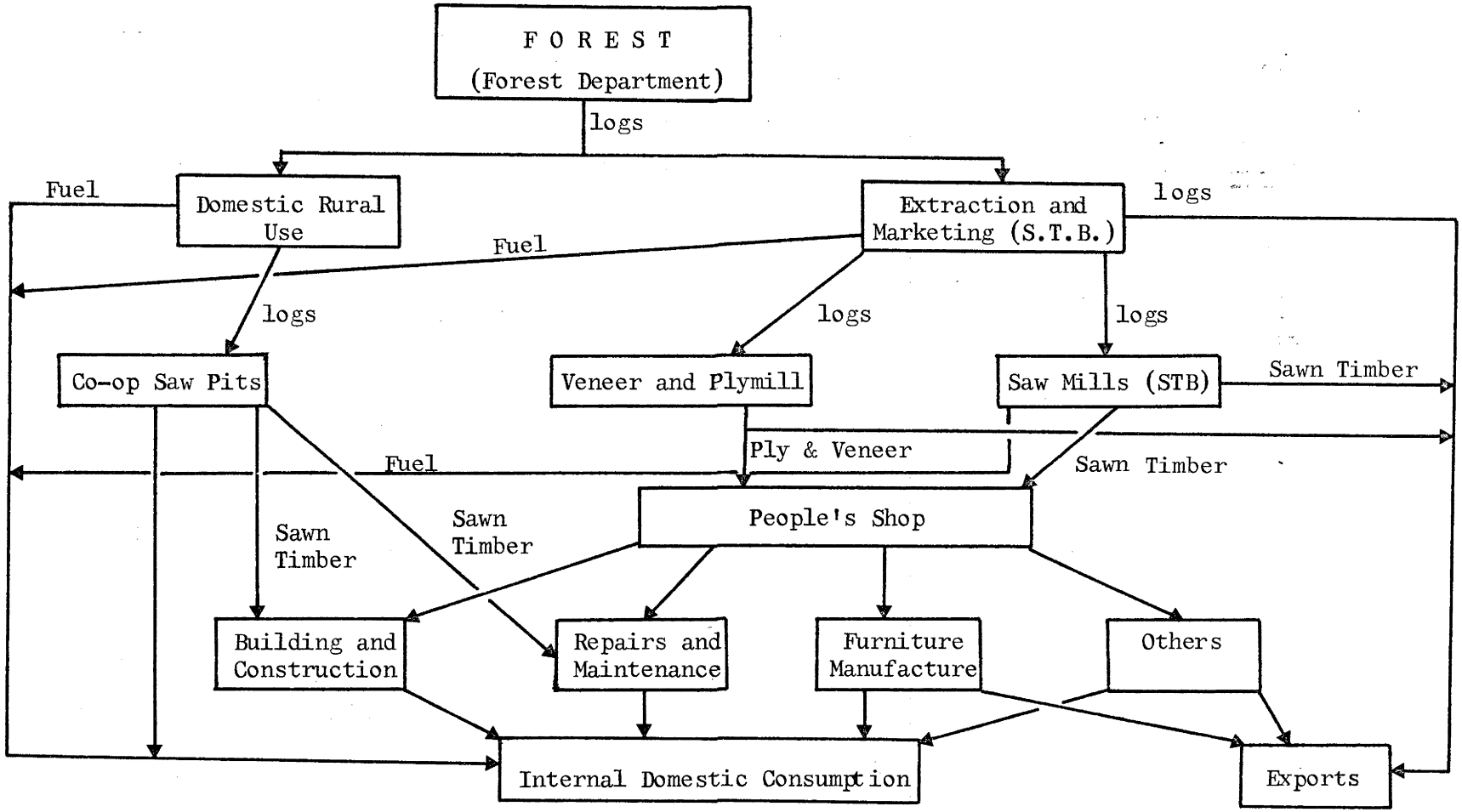
In Burma, the demand for logs is quite complex being a derived demand resulting from the demand for sawn timber which, in turn, is a derived demand resulting from the demand for building and construction, repairs and maintenance, and furniture manufacture, etc. A diagrammatic picture of the flow of Burmese forest products from the forest to the final consumer is shown in figure 8.1.

Any standing timber which is available for harvesting from forests is controlled and managed by the Forest Department. The State Timber Board is solely responsible for, and carries out, the extraction of all timber used by the timber trade. Timber used for domestic purposes is extracted and used by local people. The State Timber Board is also responsible for processing logs into sawn timber, plywood and veneers, etc., and for the distribution of logs and finished products for export (carried out by the Marketing Division of the State Timber Board) as well as the internal distribution of sawn timber through the people's shops.

The analysis of demand for sawn timber in Burma faces a number of problems not found in the more developed countries. For example, because timber is directly available and readily obtained by the large proportion of the population living in rural areas,

FIGURE 8.1

MODEL OF FOREST PRODUCTS FLOWS IN BURMA



a considerable amount of unrecorded consumption occurs. In addition, substitute materials, which are abundantly available, e.g. bamboos, have replaced timber in a number of uses, further complicating the analysis.

The lack of accurate data concerning the domestic consumption of sawn timber adds considerably to the analytical problems. Unrecorded consumption consists of:-

(1) timber felled and extracted illegally for local use by the villagers. This is more common in villages close to the forests,

(2) timber extracted and used for public uses e.g. construction of rest houses (zayat), monastaries, bridges, etc. under free grant, and

(3) timber consumed by the holders of special timber rights in which there is no realisation of royalty from the Forest Department.

Bamboo is readily available and is the most common building material. Largely a timber substitute its usage has a considerable effect on the consumption of sawn timber. It is estimated that about 50 percent of the dwellings in Burma are built of bamboos while another 35 percent are built of half bamboo and half timber (Long, 1959).

The extraction and use of unreserved species from the unclassed forests by people living close to these forests was, until recently, allowed for domestic, public, agricultural or fishing purposes. However, abuse of this privelege by some of the villagers caused it to be restricted to people who could extract and use the

material themselves. Prior to the imposition of the restrictions, most of this type of extraction was not recorded and, since some of it was also sold as sawn timber derived from so called old houses, discrepancy between recorded and actual consumption was increased.

8.2 THE FACTORS AFFECTING THE DEMAND FOR HOUSING

Differing availabilities of sawn timber together with constraints on the type of dwelling which can be constructed caused substantial variations between rural and urban consumption patterns. Most rural people use bamboo in preference to sawn timber because bamboo is readily available. The majority of the urban population prefer to use sawn timber because:-

(a) the income level of urban people is higher than that of rural people,

(b) in the long run the maintenance cost of a timber house is far less than the maintenance cost of a bamboo house in urban areas and

(c) in most of the urban areas there are restrictions on the types of building that can be constructed in certain localities.

Climate is another significant factor in the pattern of Burmese timber consumption. In contrast to temperate regions Burma's warm climate induces people to prefer bamboo houses because they are cooler than timber houses.

Traditions and customs may also affect the consumption of sawn timber quite substantially. Most newly married couples live with their parents, occupying a single bedroom built onto the main building or living in the existing house. Because the amount of sawn timber used for an extended bedroom is a great deal less than the amount of timber used for the construction of a new house, timber consumption is correspondingly smaller and, unlike other developed countries, family formation rates have not had a significant influence on the consumption of sawn timber.

8.3 PROBLEMS OF DATA AVAILABILITY, COLLECTION AND ACCURACY

8.3.1 Population

The only population data available for Burma were estimated and published by the Census Department of Burma (R.G.U.B.,[1] 1970). The only complete census enumeration carried out in Burma was in 1941 but, unfortunately most of the data was lost during the War. A partial enumeration was carried out in two stages in 1953 and 1954, the first stage being undertaken in February 1953. This was designed to record urban area population and included 248 cities and towns in Burma proper as well as 4 towns in Kachin State. The second stage, in February 1954, covered 2,143 village tracts in Burma proper and 1,016 village tracts in the Kachin State, but the area covered only about 15 percent of the total rural areas.

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[1] Revolutionary Government of the Union of Burma.

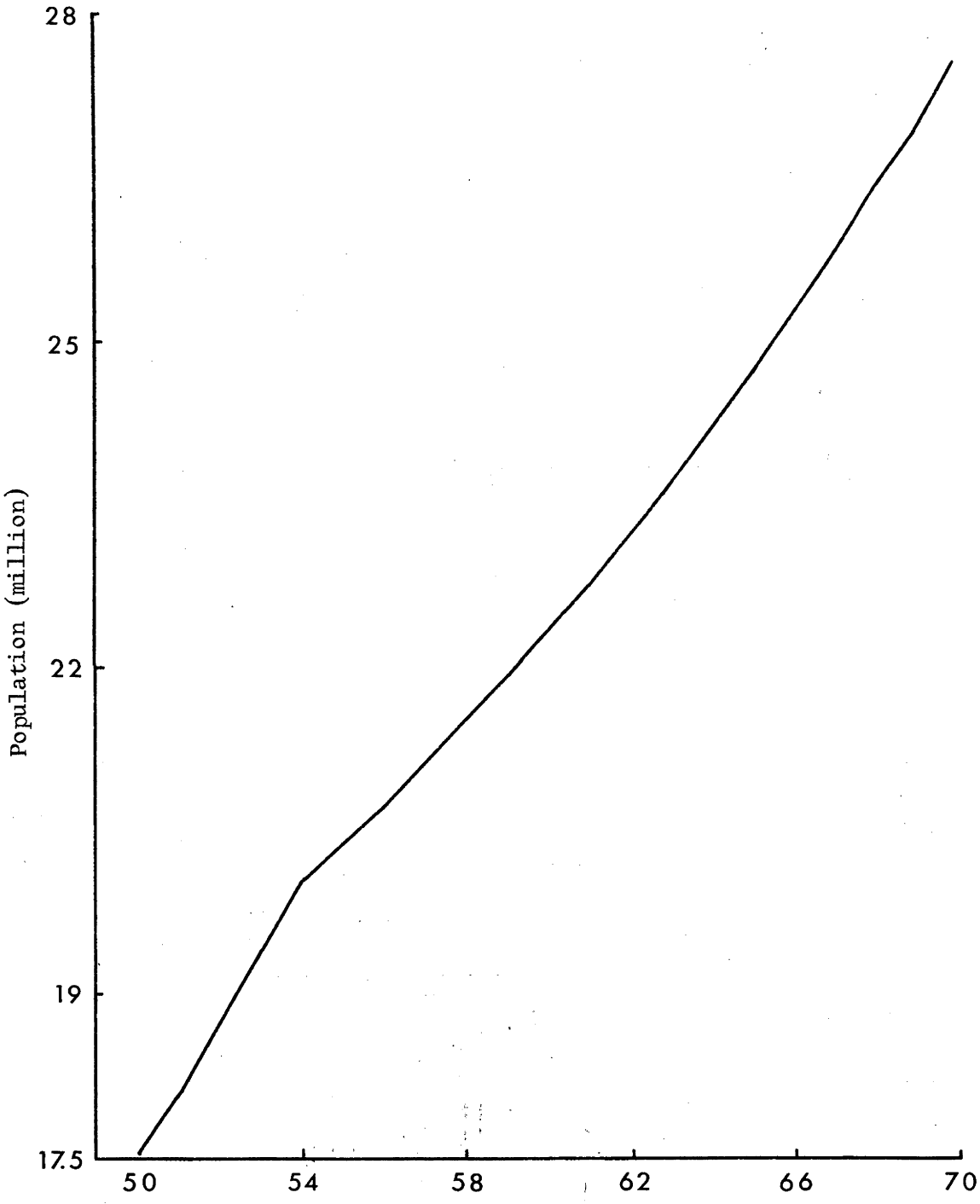
Published population estimates are available from 1950 to 1970 on a calendar year basis. The population figures for the period 1947 to 1949 were estimated using a backwards extrapolation of the published data. Because of lack of data it was assumed that immigration and emigration were equal throughout the period. The population figures between 1950 and 1953 indicate a faster growth rate than that given for 1953 onwards (see figure 8.2). To handle this problem a compound growth rate was estimated for the years 1947 to 1949 using only the data for 1950 to 1953 when extending the extrapolation back to 1947.

As the calendar year overlaps the financial year (1st October to 30th September) by some nine months, calendar year data was assumed to be synonymous with financial year data.

8.3.2 Income

Income data was derived from published estimates of Gross Domestic Product at Constant Prices (G.D.P.(C)), Gross Domestic Product at Market Prices (G.D.P.(M)) and Personal Disposable Income at Market Prices (P.D.I.(M)) (R.G.U.B., 1965). The same income data were used in the time series analysis for both sawn timber and paper and paper products. Gross National Product at Factor Cost (G.N.P.(F)) and Gross National Product at Market Prices (G.N.P.(M)) were used in the cross sectional analysis of sawn timber and paper and paper products respectively because they were the only income data available for all the countries included in the cross sectional analysis. The use of Gross National Product at Market Prices (G.N.P.(M)) is not necessary in the time series analysis as it is highly correlated with the G.D.P.(M).

FIGURE 8.2 POPULATION OF BURMA



P.D.I.(M) is available from 1946/47 to 1962/63 while G.D.P.(M) and G.D.P.(C) are available from 1946/47 to 1963/64 in published form (R.G.U.B., 1965). G.D.P.(M) and G.D.P.(C) are also available from 1961/62 to 1968/69 (R.G.U.B., 1970) and from 1962 to 1967 (U.N.[2], 1970) in published form but a change in the method of estimation of the national income after 1962-63 made it difficult to get a consistent data series from all the published sources. Fortunately, the Director of the Central Statistical and Economics Department in Burma supplied tentative figures for G.D.P.(C) from 1964/65 to 1969/70 which were consistent with the published form (R.G.U.B., 1965).

8.3.3 Sawn Timber Availability (time series)

The total availability of sawn timber covers two distinctly different sawn timber groups - teak and hardwood.

8.3.3.1 Teak Sawn Timber Availability

The quantity of teak sawn timber available for consumption in Burma was derived from teak log production data and teak log export data for the years 1948/49 to 1967/68. Figures for teak log exports for the years 1948/49 and 1949/50 were not available so estimates of teak log export were assumed to be the same as the 1950/51 figures (150 round tons each year). In 1955/56, and 1956/57, figures of 6,633 round tons and 5,426 round tons respectively of teak butt ends had to be included in the teak log export data since they were already recorded in the log production data.

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[2] United Nations

The volume of logs available for conversion at saw mills was derived by subtracting the export volumes from the production data. There was only one plywood factory in Burma during the period under study and, since the volume of teak and hardwood log used by the plywood factory was less than 2% of the total teak and hardwood log production, it was assumed that all teak logs after exports were converted into sawn timber.

The volume of teak logs converted at private saw mills was very small so the teak sawn recovery percentages from State Saw Mills for different years were taken as the conversion factors for converting teak logs into teak sawn timber. The recovery percentage for 1967/68 was not available and was assumed to be the same as the 1966/67 level.

Teak sawn timber exports were subtracted from the teak sawn timber recovered after conversion to yield an estimate of the volume of the teak sawn timber available for consumption in Burma.

8.3.3.2 Hardwood Sawn Timber Availability

In Burma, hardwood is taken to mean all broadleaved species except teak.

The total quantity of hardwood sawn timber available for consumption in Burma comes from two distinct sources:-

(1) the sawn timber derived from official trade sources, and

(2) direct domestic consumption of sawn timber in rural areas as mentioned earlier in section 8.1.

The volume of sawn timber from trade sources is defined as the volume of timber extracted by government agencies or by other traders who have special agreements with the government allowing them to extract timber from reserved or unclassed forests for distribution to the public for local consumption.

Matchwood species are included in hardwood log production data but are used only for production as matches and packing cases. In order to obtain better estimates of hardwood sawn timber availability from trade sources, matchwood species were excluded from the hardwood production figures.

The volume of sawn timber (unreserved species) for domestic consumption is defined as the volume of timber extracted by people living within 20 miles from unclassed forests if it is for local consumption.

Estimates of domestic consumption were available from 1961/62 to 1969/70 in published form (R.G.U.B., 1969b & 1970). Data for 1948/49 to 1960/61 was derived by backward extrapolation of consumption based on each year's population.

Exports of hardwood logs and sawn timber cannot be separated from the published data but some hardwood log export data were available for the period between 1958/59 and 1961/62 and for 1963/64. Hardwood log export data on a calendar year basis were also available for 1963, and for 1964 to 1968. By assuming that 20 tons of hardwood log was exported from October to December 1963, hardwood log export data for 1962/63 and for 1964/65 to 1967/68, were derived.

For the years 1958/59 to 1967/68 the hardwood log exports were subtracted from hardwood log and sawn timber exports to obtain

estimates of the volume of hardwood sawn timber exported during that period. The hardwood sawn timber export data was then converted to a log equivalent volume basis using a recovery factor of 55 percent which is the standard figure used in Burma. The log equivalent volume of the sawn timber exported together with the volume of hardwood logs exported gave the total log equivalent volumes of hardwood exported for the years 1958/59 to 1967/68. The recorded volumes of hardwood log and sawn timber exports averaged 59 percent of the log equivalent volumes of log and sawn timber exports during 1958/59 to 1967/68 (See Appendix A). This percentage was used to transform hardwood log and sawn timber export data into hardwood log (equivalent) export figures for the years 1948/49 to 1967/68.

Estimates of the hardwood log input into trade saw mills were derived by subtracting hardwood log exports from the hardwood log production figures supplied by official trade sources. As mentioned earlier (section 8.3.3.1) log inputs into the plywood factory were not available and consequently could not be separated from the log production figures. A hardwood sawn timber recovery factor of 55 percent was used to convert log input into sawn volume. This when added to the teak sawn timber availability gave an estimate of the total sawn timber availability from trade sources.

Estimates of the total consumption of sawn hardwood timber should include estimates of domestic consumption. In rural areas, half of the domestic consumption of hardwood was assumed to be used as sawn timber and the remaining 50 percent was assumed to be used as logs because the pattern of domestic timber usage tends

to be divided equally between logs and sawn wood. Fifty percent of domestic log removals were assumed to be converted into sawn timber (55 percent recovery factor). This estimate of domestic sawn timber consumption was added to the total sawn timber availability from trade sources to give the estimated total volume of sawn timber available for consumption from both trade and domestic sources.

8.3.4 Sawn Timber Prices

Timber prices vary considerably over the country. The average wholesale prices in Burma for teak (Tectona grandis), pyinkado (Xylia dolabriformis), and in kanyin (Dipteracarpus spp.) scantlings are available from 1956/57 to 1963/64 while Rangoon prices are available for 1954 to 1961. From the two sets of data a timber price series was derived for the whole of Burma covering the period 1953/54 to 1963/64.

Prices were available for only two categories of teak sawn timber, scantlings 3'-5' in length and scantlings 6' and up. Scantlings in the range 3'-5' are mostly used in furniture manufacture and door and window framing construction. Scantlings 6' and over are also used for door and window frame construction and some specialist construction work. Nearly half the total consumption of teak in Burma is used in furniture manufacturing so the average of both price series was taken as the average price for teak sawn timber.

To derive a hardwood sawn timber price series, production figures for different species were grouped and the combined volumes were used as weights. Pyinkado, padauk (Pterocarpus macrocarpus)

and thitya/ingyin (Shorea oblongifolia/Pentacme siamensis) were grouped together and the volumes were used as weights for the pyinkado and padauk sawn timber prices. In/kanyin, pyinma (Lagerstroemia speciosa) and some other species were grouped and the volumes were applied as weights for the inkanyin sawn timber prices.

The total teak and hardwood sawn timber weighted average price was derived from teak and hardwood prices using the quantity of teak and hardwood sawn timber supplied by trade sources as weights.

8.3.5 Substitute Prices

Bamboos and bricks are the most important substitutes for sawn timber in Burma, the former being a very significant substitute, so the prices of these materials were used in the analysis.

Wholesale prices for two different bamboos, kyathaung (Bambusa polymorpha) and hmyinwa (Dendrocalamus strictus), were available from 1956/57 to 1966/67. Wholesale prices for 1953/54 to 1955/56 were derived from Rangoon wholesale prices on the same basis as those for sawn timber prices. The average price of bamboo was derived by using the kyathaung and hmyinwa consumption levels as weights.

Wholesale brick prices in Rangoon are available for the period 1956 to 1963 on a calendar year basis. The calendar year data was assumed to closely approximate financial year data for 1955/56 to 1962/63. Brick consumption is largely limited to the main cities and is only really significant in Rangoon.

8.3.6 Cross-Sectional Sawn Timber Availability

Cross sectional data on hardwood sawn timber availability for the years 1966, 1967 and 1968, were collected for 29 countries. Combined hardwood and coniferous sawn timber availability was collected for 1966 only. Many countries had to be excluded from the study because data for production, exports, imports or for the index of wood availability data was not available.

Hardwood sawn timber availability for 1966 was available for 36 countries but, of these, only 11 did not consume any soft wood sawn timber.

8.3.7 Cross-Sectional Income Data

Gross National Product at factor cost for the year 1966 (I.M.F., 1969) was used as an approximation for income in the countries studied. In addition, because taxation systems differ widely between countries, Gross National Product at factor cost was considered to be more suitable than any other disposable income estimate.

8.3.8 Country Population Data

Population estimates for the countries included in the cross sectional study were collected from The Year Book of Forest Products (F.A.O., 1968).

8.3.9 Wood Availability Index

Gregory's wood availability index data (Gregory, 1966, page 110) was used for both the combined hardwood and conifers consuming

countries. Some difficulty was experienced in deriving a wood availability index for the countries which consumed hardwoods only, arising mainly in the derivation of a new constant term. Gregory (1966, page 109) used a constant of 142 in his formula, but a new constant term had to be derived for the hardwood countries by ignoring the conifers forest in use and using the hardwood area in use alone. The new constant term of 28.4 was obtained by multiplying Gregory's 142 by 0.2 (the proportion of hardwood to total consumption in the U.S.A.) while ignoring the multiplier for softwoods. The wood availability indices for countries which consume solely hardwoods were then calculated by multiplying the derived constant by the sum of the hardwood area in use and the hardwood area in use in the mixed coniferous and hardwood forests. Both Gregory's (1966, page 109) formula and the derived formula are shown below.

Gregory's Formula

$$W.A.I. = 142/P(C \times 0.8 + H \times 0.2)$$

Derived Formula

$$W.A.I. = 28.4/P(H + M)$$

where W.A.I. = Wood Availability Index

P = Population

C = Coniferous forests area in use in hectares

H = Hardwood forests area in use in hectares

M = Hardwood forests area in use in mixed coniferous and hardwood forests in hectares

8.4 ANALYSIS AND RESULT

The use of economic theory underlies the selection of the variables to be included in the model of the demand relationships of sawn timber in Burma. The variables included in the model were the price of sawn timber, the prices of substitute materials, income, and population.

Price has traditionally been considered as the most important variable in any analysis of demand (McKillop, 1967; Gregory, 1966; Ferguson, 1967; Leftwich, 1955; Samuelson et al., 1970). Any changes in the price of a commodity normally cause changes in the level of consumption[3] so the inclusion of sawn timber prices in the demand model was considered essential.

The prices of substitute materials also influence the level of demand, especially if there are effective technical substitutes. The availability of substitute materials has a considerable effect on both the consumption levels of sawn timber and the sensitivity of the market to changes in sawn timber prices. A shift in the consumption of sawn timber could easily result from a minor change in prices of substitute materials, especially where they give similar technical performances and levels of satisfaction.

Income is also a demand shift variable. Consumption of sawn timber in Burma was found to be highly correlated with income over the period 1948/49 to 1957/58 (see section 8.5).

Population is a significant demand shift variable in most countries. As population increases, more and more forest products

3. Ceteris paribus.

in the form of furniture will be required. At the same time, an increasing number of houses will be needed for shelters, which, in turn, calls for a greater consumption of sawn timber.

In the cross sectional analysis, wood availability index is included as a variable for analysis but price is excluded. Gregory (1966) states that, although price is the key variable in most analyses of demand, it is not a variable influencing consumption in the usual sense. This does not mean that price is unimportant and unrelated to consumption but that it can be disregarded because it is directly related to consumption.

Since the objective of this analysis is to forecast future levels of demand, but not supply, the inclusion of price is not necessary. The inclusion of a price variable would be required if the objective of the study was to determine both demand and supply functions in order to derive forest production goals. The intersection of the supply and demand curves would give consumption and market price under the specified conditions.

Although the time series study did not include supply, the inclusion of the wood availability index in the cross sectional study was included as a proxy timber supply variable likely to result from the existing areas of forests.

Problems of multicollinearity were experienced in models which contained both population and income because these variables are highly correlated. The problem was eliminated by using consumption and income data on per capita basis.

The following theoretical demand relationships were used to construct the economic model of demand for sawn timber in Burma.

(1) For the time series analysis the per capita quantity of sawn timber demanded was assumed to be a function of its price, the prices of substitute materials and per capita income.

(2) For the cross sectional analysis the per capita quantity of sawn timber demanded was assumed to be a function of per capita income and the countries wood availability index.

The choice of different functions for demand analysis (see section 7.7) was mainly governed by the nature of the elasticities likel to be obtained. A number of functions were rejected because the behaviour of the elasticities was not consistent with economic theory.

Several equations were tested using per capita sawn timber availability as the dependent variable with different combinations of per capita income, sawn timber prices, and substitute prices as the independent variables and using different functions. Regressions were also used to test for the occurrence of structural changes in the market by examining the behaviour of the regression coefficients as the number of observations were successively reduced. The signs of the respective coefficients had to correspond with the signs one would expect on a priori grounds e.g. for a simple linear function the coefficients had to be positive for income, negative for price, positive for substitute price, and positive for wood availability index.

8.5 RESULTS

The analysis was confined to the 1953/54 to 1957/58 period because:-

(a) price data were not available prior to 1953/54, and

(b) significant political, balance of payments, and economic structural changes occurred after 1958/59 (see page 15).

The very restricted series of observations available for analysis was the main reason for the statistically unsatisfactory regression results obtained. Testing the data with each of the commonly used functions produced unacceptable results. Typically the price and income coefficients were not significantly different from zero at the 5 percent level and the regression analyses of variance were insignificant at the 5 percent level.

In several cases the signs of the coefficients were intuitively incorrect as well. Regardless of the nature of the results, the need to restrict the analysis to five observations imposed severe limitations on the reliability of the results.

None of the regressions tested explained sufficient variation in the dependent variable to prove significant in an analysis of variance test at the 5 percent confidence interval.

The regressions of sawn timber availability from trade and from trade plus domestic sources on per capita G.D.P. at market prices and sawn timber weighted average prices for the period 1953/54 to 1957/58 are shown in equations (1) to (8). Standard errors are given in parenthesis below the corresponding regression coefficients, R^2 is the coefficient of determination, and the log base is the natural log base, in each case.

Availability From Trade

(1) $Y_1 = -0.5068 + 0.0358X_2 - 0.5239X_4$ $(R^2 = 0.78)$

(0.0141) (0.4275)

(2) $Y_1 = 2.2249 - \frac{103.9952}{X_2} + \frac{0.6077}{X_4}$ $(R^2 = 0.79)$

(39.8681) (0.4656)

(3) $\text{Log } Y_1 = 1.4386 - \frac{122.1504}{X_2} + \frac{0.7628}{X_4}$ $(R^2 = 0.78)$

(47.6625) (0.5566)

(4) $\text{Log } Y_1 = -9.1511 + 2.2694 \text{log} X_2 - 0.6771 \text{log} X_4$ $(R^2 = 0.78)$

(0.8977) (0.5342)

where Y_1 = Per capita sawn timber availability from trade (c.ft.)

X_2 = Per capita Gross Domestic Product at market prices ($A)

X_4 = Sawn timber weighted average prices ($A/c.ft.)

The results showed that the coefficient of determination, R^2, was significant at the 5 percent level in each function. However, none of the income or price coefficients was significantly different from zero at the 5 percent level.

Both the reciprocal function and the logarithmic reciprocal function gave correct signs for the income and price coefficients but the signs were incorrect in the case of the logarithmic transformation.

Availability From Trade and Domestic

(5) $Y_2 = -0.5036 + 0.0375X_2 - 0.5040X_4$ $(R^2 = 0.80)$

$(0.0144) \quad (0.4362)$

(6) $Y_2 = 2.4484 - \frac{109.0189}{X_2} + \frac{0.5895}{X_4}$ $(R^2 = 0.80)$

$(40.5657) \quad (0.4737)$

(7) $\text{Log } Y_2 = 1.4922 - \frac{113.1782}{X_2} - \frac{0.6235}{X_4}$ $(R^2 = 0.80)$

$(42.5947) \quad (0.4974)$

(8) $\text{Log } Y_2 = -8.3600 + 2.1003 \text{log} X_2 - 0.5787 \text{log} X_4$ $(R^2 = 0.79)$

$(0.8035) \quad (0.4782)$

The results were very similar to those for availability from trade. The R^2 values were marginally higher and were significant at the 5 percent level. None of the income or price coefficients was significantly different from zero at the 5 percent level and, as before, the reciprocal and logarithmic reciprocal functions gave correct signs while the logarithmic function had incorrect signs for the coefficients.

The inclusion of substitute prices (bamboos and bricks) in the analyses did not significantly improve the results. This may be partially due to average prices for bamboos being derived from information applicable to most towns and cities whereas most of the bamboos were extracted and consumed by rural people who paid a royalty for the bamboos. The average royalty paid was found to be considerably lower than the prevailing bamboo prices (about A12¢ per 100 bamboos compared to a market price of about $A8 per 100 bamboos). Bricks

were not a significant economic substitute for sawn timber, their use being restricted to the high income groups.

Of the many regressions tested, in an effort to find one which was statistically acceptable, only those involving consumption and income were satisfactory. Of the three income variables tested, P.D.I. at market prices had the highest correlation coefficient with consumption, when tested over the period 1948/49 to 1962/63. However, when the base period was changed, the correlation coefficient between income and consumption changed because of structural changes in the market. The changes in the correlation coefficients between consumption and the three income variables, per capita G.D.P. at constant prices, G.D.P.(C), per capita G.D.P. at market prices, G.D.P.(M), and P.D.I. at market prices, P.D.I.(M), are given below.

	G.D.P.(C)	G.D.P.(M)	P.D.I.(M)
1948/49 to 1962/63	0.82	0.90	0.92
1953/54 to 1957/58	0.88	0.81	0.70

The correlation coefficients of per capita sawn timber consumption and per capita real income over four periods from 1948/49 to 1967/68 were as follows.

	Correlation Coefficient
1948/49 to 1952/53	0.98
1953/54 to 1957/58	0.88
1958/59 to 1963/64	0.42
1964/65 to 1967/68	0.39

The results for the first two periods were statistically acceptable. The R^2 values and the income coefficients were highly

significant in each case, the best results being obtained with the inverse and the logarithmic inverse functions. Regressions of sawn timber consumption on per capita real income over the period 1948/49 to 1957/58 were also highly significant and had R^2 values approaching 0.90.

The substantial variation in the correlation coefficients between the first two periods and the last two periods is probably due to the substantial changes which occurred in the economy. The economy was considerably more stable during the first two periods and, despite the insurrection problems, an effective market oriented economy operated without any major controls being imposed. In the third period, restrictions and controls were imposed on the economy because of balance of payments difficulties. These problems, which continued during the fourth period, and the nationalisation of all the important economic sectors added more constraints to the market system thus distorting the market structure and affecting the consumption of sawn timber.

The drop in the correlation coefficient between the first and the second periods appears to be largely explained by the dramatic decrease in the production of bamboo at that time. In 1952/53 output was 4,604,955 thousand bamboos, in 1953/54 it had fallen to 875,138 thousand bamboos, and by 1954/55 it had fallen to 86,766 thousand bamboos. This tremendous decrease in bamboo production is difficult to explain but could be due to the tapering off of the unusually high

rate of house reconstruction which typified the post war period. These houses were made predominantly from bamboo, the only readily available material. By 1953/54 most of the reconstruction had been completed and a trend towards the use of more permanent materials had begun.

The selection of a suitable equation for longrun projections is complicated by the intermittent structural changes which occurred in Burma. The correlation coefficients of sawn timber consumption and income (p.91) effectively showed that 1953/54 to 1957/58 was the most stable period for the sawn timber market and the economy as a whole. This time series was, however, not long enough to give the accuracy of results required for projection purposes. The regressions of consumption on real income for the period 1948/49 to 1957/58 did provide suitable equations for forecasting purposes but were rejected because price was regarded as an essential variable in forecasting sawnwood consumption (see section 8.4).

Since a suitable equation could not be obtained from the time series analysis, a cross-sectional analysis was carried out to assist in forecasting the demand for sawn timber in Burma. Gregory (1966) states that, since cross-sectional analysis has been sparingly used in studies of this nature, he considers cross sectional study offers a greater possibility for discovering new relationships.

Income, population, and the degree of industrialisation, are considered to have a substantial effect on the demand curve. Although countries with large quantities of competing materials should have a different consumption pattern to those with a more limited choice, the effect of competing materials could not be evaluated because of the difficulty in getting consistent data for sufficient countries. Consequently only income and wood availability index were included in the cross-sectional analysis.

A number of regressions were run over both the whole sample and stratifications of the sample so that the income elasticities of demand for different income groups could be obtained.

From the sample of eleven countries which consume only hardwood, one equation alone gave significant coefficients and had the correct sign for income and wood availability index.

The results are given in equations (9) to (12).

$$(9)\quad Y_{16} = -0.7869 + \underset{(0.0027)}{0.0110^{***}}\ X_8 + \underset{(0.0186)}{0.0194}\ X_9 \qquad (R^2 = 0.67)$$

$$(10)\quad \text{Log } Y_{16} = -8.3855 + \underset{(0.3763)}{1.5506^{***}}\ \log X_8 + \underset{(0.0169)}{0.0416^{*}}\ X_9 \qquad (R^2 = 0.70)$$

$$(11)\quad \text{Log } Y_{16} = -8.3886 + \underset{(0.4049)}{1.5710^{***}}\ \log X_8 + \underset{(0.1224)}{0.2613}\ \log X_9 \qquad (R^2 = 0.66)$$

$$(12)\quad Y_{16} = -6.1841 + \underset{(0.4949)}{1.4535^{**}}\ \log X_8 + \underset{(0.0222)}{0.0154}\ X_9 \qquad (R^2 = 0.52)$$

*** Significant to 1 percent level.

where Y_{16} = Per capita hardwood sawn timber availability (c.ft.)

X_8 = Per capita Gross National Product at factor cost from cross sectional country data ($U.S.)

X_9 = Wood Availability Index for only hardwood consuming countries.

The other functions usually yielded significant income coefficients but the coefficient for the wood availability index for hardwoods was usually insignificant. This may have been caused by the inaccuracies inherent in calculating the hardwood wood availability index.

For the sample of the 29 countries included in the coniferous and hardwood analysis the different types of functions revealed substantially different coefficients of determination, the logarithmic transformation having the highest R^2 value (0.92). A straight linear function and logarithmic transformation for income only also had a high coefficient of determination with both income and wood availability coefficient significantly different from zero at 0.1 percent level. With the use of the logarithmic function the significance level of the wood availability index coefficient dropped slightly although the coefficient of determination improved. The use of the logarithmic reciprocal function reduced the significance level for the wood availability coefficient to the 5 percent level and at the same time reduced the R^2 value. The results are given in equations (13) to (16).

$$(13)\quad Y_3 = -0.7128 + \underset{(0.0006)}{0.0093^{****}}\, X_8 + \underset{(0.0170)}{0.0994^{****}}\, X_{10} \qquad (R^2 = 0.89)$$

$$(14)\quad \text{Log } Y_3 = -6.2582 + \underset{(0.0781)}{1.0490^{****}}\, \log X_8 + \underset{(0.0703)}{0.2607^{***}} \log X_{10} \qquad (R^2 = 0.92)$$

$$(15)\quad Y_3 = -14.9764 + \underset{(0.3875)}{2.8569^{****}}\, \log X_8 + \underset{(0.0162)}{0.1180^{****}}\, X_{10} \qquad (R^2 = 0.89)$$

$$(16)\quad \text{Log } Y_3 = 2.2142 - \underset{(34.7061)}{\overset{****}{\frac{256.5342}{X_8}}} - \underset{(0.5877)}{\overset{*}{\frac{1.3679}{X_{10}}}} \qquad (R^2 = 0.78)$$

**** Significant to 0.1 percent level

where Y_3 = Per capita sawn timber availability from cross-sectional country data

X_{10} = Combined wood availability index.

To determine whether significant differences in market behaviour exist between countries with different income levels the sample was stratified into three income groups - (1) under $US 250 per annum, (2) between $US 250 per annum and $US 1500 per annum, and (3) $US 1500 and over. The higher income group had 9 observations. The middle and lower income groups had 10 observations each. The income and wood availability coefficient from the lower income groups are more significant than the other two groups and usually have higher coefficients of determination.

The correlation coefficients of sawn timber consumption against income and wood availability index for the above three income groups, using a straight linear function, are as shown below.

	$US 1500 & over	Between $US250 & $US1500	Under $US250
Income	0.32	0.77	0.74
WAI	0.84	0.47	0.52

The equations which gave the best results for the above three income groups are shown below:-

$US 1500 and over

(17) $Y_3 = 5.2858 + 0.0012\ X_8 + \underset{(0.0301)}{\overset{****}{0.1120}}\ X_{10}$ $(R^2 = 0.73)$
(0.0020)

(18) $\text{Log } Y_3 = -0.4418 + 0.2921 \log X_8 + 0.2189 \log X_{10}$ $(R^2 = 0.48)$
(0.5326) (0.1039)

(19) $Y_3 = -19.9497 + 3.6581 \log X_8 + \underset{(0.0295)}{\overset{***}{0.1117}}\ X_{10}$ $(R^2 = 0.74)$
(4.8019)

(20) $\text{Log } Y_3 = 3.1630 - \frac{1105.3676}{X_8} - \frac{0.9533}{X_{10}}$ $(R^2 = 0.15)$
(1550.5191) (1.5984)

Between $US 250 and $US 1500

(21) $Y_3 = 1.6395 + \underset{(0.0014)}{\overset{***}{0.0061}}\ X_8 + \underset{(0.0355)}{\overset{*}{0.0921}}\ X_{10}$ $(R^2 = 0.79)$

(22) $\text{Log } Y_3 = -7.7619 + \underset{(0.2882)}{\overset{***}{1.2799}} \log X_8 + 0.2913 \log X_{10}$ $(R^2 = 0.76)$
(0.1412)

(23) $Y_3 = -22.3087 + \underset{(1.2121)}{\overset{**}{3.8936}} \log X_8 + 0.0837\ X_{10}$ $(R^2 = 0.69)$
(0.0435)

(24) $\text{Log } Y_3 = 2.6103 - \frac{\overset{***}{729.6630}}{X_8} - \frac{0.9784}{X_{10}}$ $(R^2 = 0.69)$
(185.2544) (1.1298)

Under $US 250

$$(25)\quad Y_3 = -0.5562 + \underset{(0.0016)}{0.0070^{***}}\ X_8 + \underset{(0.0079)}{0.0244^{**}}\ X_{10} \qquad (R^2 = 0.81)$$

$$(26)\quad \text{Log } Y_3 = -7.7184 + \underset{(0.4302)}{1.3240^{**}}\ \text{log } X_8 + \underset{(0.1432)}{0.3355}\ \text{log } X_{10} \qquad (R^2 = 0.71)$$

$$(27)\quad Y_3 = -4.2545 + \underset{(0.2055)}{0.9591^{***}}\ \text{log } X_8 + \underset{(0.0076)}{0.0274^{***}}\ X_{10} \qquad (R^2 = 0.82)$$

$$(28)\quad \text{Log } Y_3 = 0.8455 - \underset{(57.1782)}{\frac{125.8139}{X_8}} - \underset{(0.5982)}{\frac{1.2733}{X_{10}}} \qquad (R^2 = 0.63)$$

** Significant at 2 percent level

Figure 8.3 and 8.4 show the actual and estimated consumption levels for sawn timber using equations (25) and (26) for the countries with an income level of less than $US250 per annum. From these figures it was evident that Tanzania and Nigeria have a substantially lower level of actual consumption than that estimated by either equation. This could be due to their income levels being over estimated or because the forest areas are a considerable distance from the population centres so that forest products cannot be sent to the main markets cheaply enough.

Alternatively, balance of payments difficulties may have caused these countries to concentrate on export markets in order to earn foreign exchange, rather than supply internal markets.

FIGURE 8.3 PLOT OF ACTUAL, ESTIMATED AND THE UNEXPLAINED RESIDUAL

Per capita consumption as a function of per capita income and wood availability index

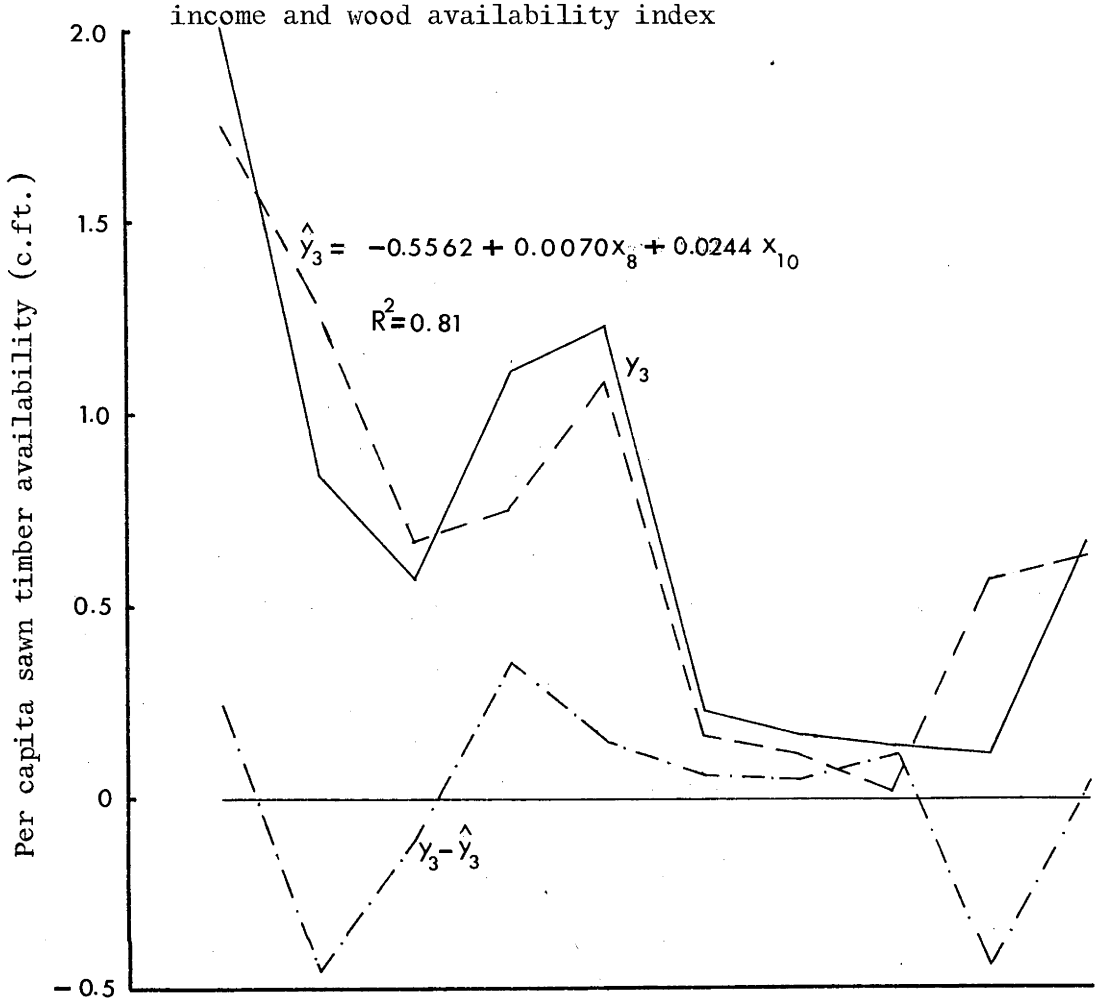
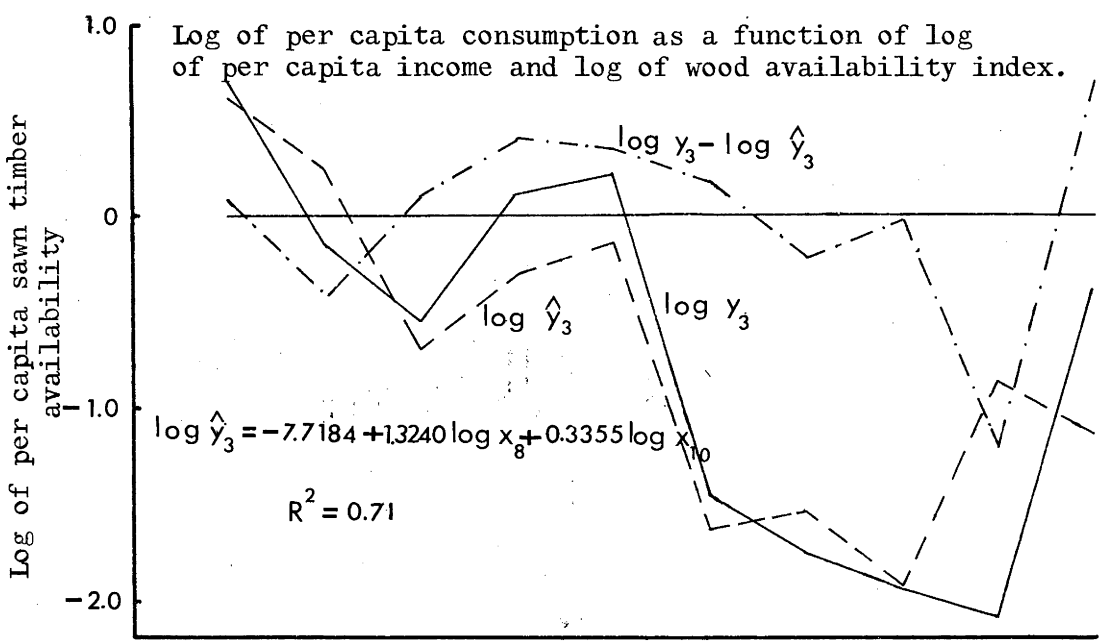


FIGURE 8.4 PLOT OF ACTUAL, ESTIMATED AND THE UNEXPLAINED RESIDUAL

Log of per capita consumption as a function of log of per capita income and log of wood availability index.



The income elasticities of demand and the elasticity of the wood availability index for different income groups derived from the logarithmic function are as follows -

Income	Income Elasticity	Wood Availability Index Sensitivity
Under $US 250 / annum	1.32	0.34
Between $US 250 and $US 1500 / annumm	1.28	0.29
$US 1500 and over	0.29	0.22

The above income elasticities conform with the assumption of diminishing income elasticity of demand although the income elasticity for the high income group was not significant. Since both simple linear and logarithmic transformations cannot yield diminishing income elasticity these functions will not be suitable for projection purposes over wide ranges in income or at either extreme of the income ranges. Unfortunately this is true even though the logarithmic transformation for income alone for all countries gave an R^2 value of 0.89 and the plot of the residual indicated that they were random and did not contain either positive or negative serial correlation.

The logarithmic reciprocal transormation for the lower income group did not yield statistically significant results.

However the regression of consumption on the log of income and wood availability index for the low income group had a high R^2 value (0.82) and both the income and wood availability index coefficients were significantly different from zero at the 1 percent

level. The plot of the residual also showed that they were random and did not contain either positive or negative serial correlation (Figure 8.5).

8.5.1 Estimates of Elasticities

The elasticities for income and price are discussed separately for time series analysis and cross-sectional analysis. The elasticity estimates for both income and price are important for prediction purposes. Few attempts have been made to determine the actual income elasticity of demand for sawn timber although it is commonly assumed that the income elasticity of wood consumption is unity.[4] Similarly, few attempts have been made to determine the price elasticity of demand for sawn timber.

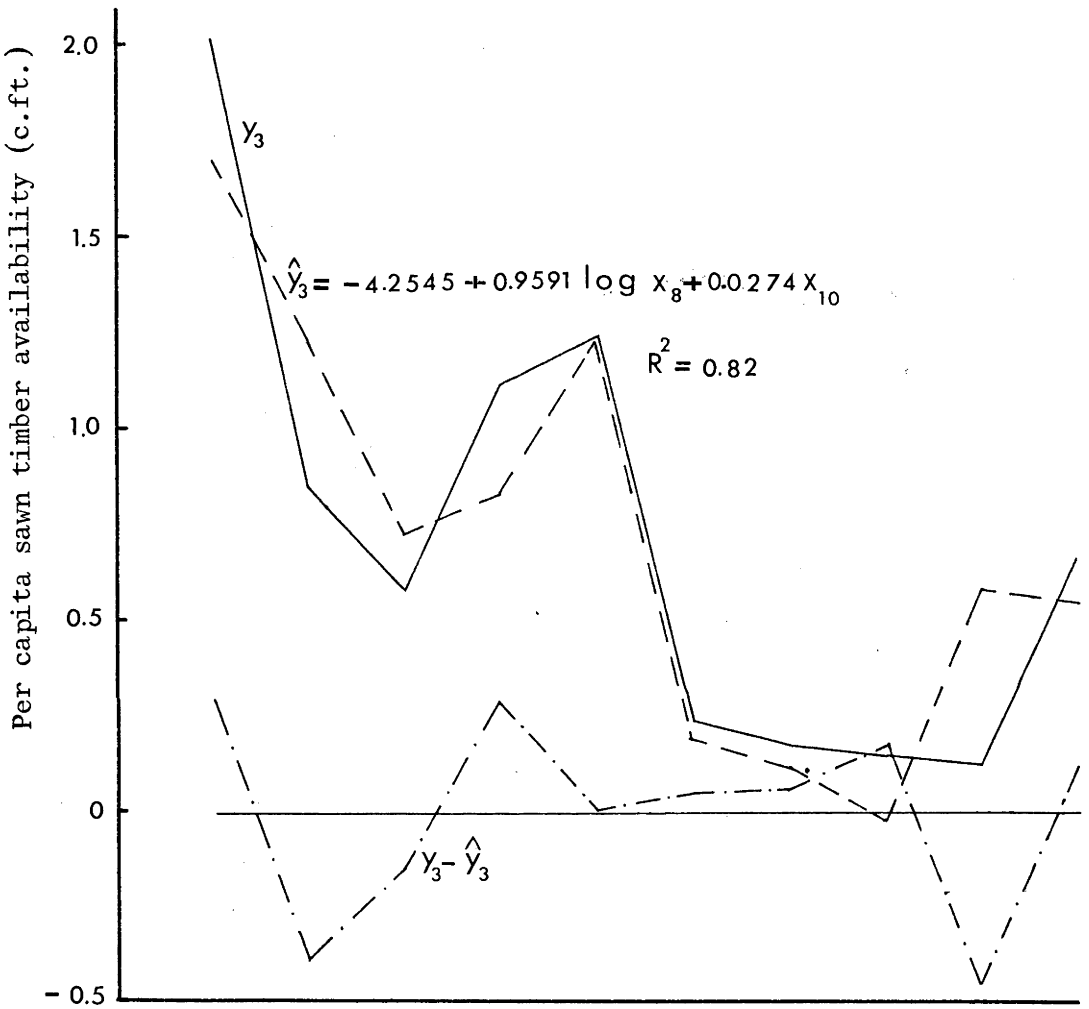
The income and price elasticities of demand for sawn timber can readily be derived from the different functions in the time series analysis. The logarithmic function gives the average elasticity for the whole sample. The income elasticity of demand for sawn timber was found to be around 2.2 but it was sensitive to changes in the time period. The price elasticity of demand for sawn timber was found to be rather low, being approximately -0.7. The following are the income and price elasticities of demand derived from the logarithmic transformations of the time series data.

	Elasticity
Income	2.21
Price	-0.58

4. See Gregory, 1966.

FIGURE 8.5 PLOT OF ACTUAL, ESTIMATED AND THE UNEXPLAINED RESIDUAL

Per capita consumption as a function of log of per capita income and wood availability index.



The elasticities derived from the logarithmic reciprocal functions vary with changes in income and price. As income and price increase the elasticities decrease (the point of inflexion is at $US38). The income and price elasticity derived from the logarithmic reciprocal function, at Burma's given existing levels of income and price, are 1.28 for income and -0.54 for price.

The income elasticities of demand for sawn timber derived from the cross-sectional analysis of all countries (with income transformed logarithmically), for different levels of wood availability index, are shown in the following table.

Table 8.1 Elasticities of Income at Different Wood Availability Index

Income ($US)	W.A.I. 10	30	50
100	*	1.64	0.69
250	1.43	0.65	0.42
500	0.72	0.45	0.32
1000	0.48	0.34	0.26
1500	0.40	0.30	0.24

* The calculated elasticities are meaningless at this income and W.A.I. level.

Countries with low per capita income levels and shortages of timber have high income elasticities of demand for timber.

As either income or wood availability index increase the income elasticities drop substantially, especially in the low income groups. If the wood availability index is high changes in income have little effect on consumption, especially at high income levels. If wood is scarce, a given increase in income apparently has a much larger effect on wood consumption. These trends are intuitively correct.

The income elasticities of demand for sawn timber derived from the low income group, when income is transformed logarithmically, were slightly lower than those obtained for the whole sample. The following table illustrates this.

Table 8.2 Income Elasticities of Demand for Low Income Countries (under $US 250)

Income ($US)	W.A.I. 10	30	50
100	2.18	0.97	0.57
250	0.72	0.51	0.39

8.5.2 Application of Results

To be effective any cross-sectional analysis should be able to explain the differences in cultural conditions, tastes, and physical requirements, for timber. For this to happen it is necessary to assume that countries moving from one income level to a higher income level will take on the characteristics of nations presently at the higher level which, in itself, will include a change in the pattern of wood use and wood consumption.

Factors other than income and wood availability will influence timber consumption but it is usually too difficult to measure them and include them in the analysis.

Countries like Sweden, Denmark, and the Netherlands, consumed more wood than one would expect from the analysis while countries like Spain, Brazil and Thailand consumed less than expected. Although Sweden is rich in forest resources it is exporting a large amount of finished timber products. Denmark and the Netherlands are poor in forest resources but consumption levels are met by importing forest products. Denmark, being a large exporter of finished timber products (especially furniture), will naturally appear to consume more than expected or than it requires for its own consumption. The Netherlands, a major producer of cabinets for various electrical appliances, would also import more than it consumes itself. These factors, which considerably influence apparent consumption data, are not taken into consideration in the cross-sectional data.

At the moment local supplies are insufficient for Spain's own requirements with the result that a substantial amount of its timber consumption has to be imported. The higher cost of imported timber combines with the climatic and cultural influences on home construction so that stones form the major building material. This may explain why the actual level of consumption is less than that predicted from the study. Brazil and Thailand each have substantial forest resources but, in both countries, actual consumption is very much lower than the predicted value. This may be due to either per capita income or the wood availability index being over estimated.

The inclusion of such relatively heterogeneous countries in the analysis might significantly effect any projections made because of the distinctly different timber consumption patterns of some of them.

When the analysis was restricted to those countries which have an income of less than $US 250 per annum the results were much better although Tanzania and Nigeria consumed less than expected. Sawn timber consumption in Tanzania was very low when based on the income level of $US 80. Although Tanzania's income was higher than that of Burma, consumption was only about a fifth of Burma's. This may be due to income or the wood availability index being over-estimated or due to both being over estimated. Nigeria consumed less than predicted by the equation.This may bedue to the concentration on exports brought about by a balance of payments problem and also because of the large variation in income distribution. Moreover, as the forested area is usually some distance away from population centres the cost of production is relatively high and tends to restrict local consumption.

The use of a simple linear function and a logarithmic function for income alone gave similar R^2 values and estimates of country consumption levels. The linear function however does not give diminishing income elasticity of demand for sawn timber with rising levels of income , which is a necessary condition.

In the cross-sectional analysis both income and wood availability index are significantly different from zero at 1 percent level when income is logarithmic transformed in the low income group

and, also, the coefficient of determination is significant at 10 percent level. Hence, it seems more reasonable to use equation (27) for long term projections of demand for sawn timber in Burma.

CHAPTER 9

ANALYSIS OF DEMAND FOR PAPER AND PAPER PRODUCTS

9.1 BACKGROUND

In most countries the consumption of paper and paper products is directly related to the economic, social, and cultural conditions existing in that country. World demand for paper and paper products has been growing rapidly over the last two decades mainly due to rising standards of living and industrial development. F.A.O. (1960) studies indicate that the demand for paper and paper products is growing more rapidly in the developing countries than in the developed countries.

Burma's per capita consumption of all types of paper and paper products is fairly low when compared to that of other developing countries because of the economic and cultural factors which restrict the availability of paper and paper products in the country. However, when only cultural paper alone is considered, Burma's per capita consumption is significantly higher than that of any country within the same income range and is higher than some of the countries with income levels of $A 270.

Burma did not have a paper and paper products industry until very recently. The first pulp and paper factory was established in 1972 in the Sittang Valley. The mill is small, having a rated production capacity of only 40 tons of paper and paper products a day. A new paper mill is designed to produce printing and writing

paper and wrapping paper but the annual output, on a 300 day per annum basis, is unlikely to exceed 12,000 tons, or about 45 percent of the consumption in 1968/69.

Raw material for paper making is abundant in Burma, bamboo being the most readily available and suitable raw material. The ample supply of raw material is the main reason for establishing and expanding a paper and paper products industry in the country. This development is likely to change the pattern and behaviour of paper and paper products consumption in the future, a factor which complicates the estimation of future demand even more.

The experience of other countries indicates that the consumption pattern of paper and paper products is likely to change abruptly if a paper and paper products industry is established. A very good example is New Zealand where the consumption of paper and paper products changed substantially after the establishment of the paper and paper products industry.

Although raw material for paper making is plentiful in Burma quite a few problems were encountered during the establishment of the paper and paper products industry. The worst problem was the large amount of capital required. In most developing countries the funds available for large scale projects are very limited so that a smaller than optimal capacity paper industry often has to be built and the country invariably ends up supporting an unprofitable small capacity industry with a high cost of production.

Other problems were the unavailability of suitable supplies of water, chemicals, power, and the levels of technology in both

machinery and man power. In most of the developing countries all the chemicals required for paper making have to be imported and the power supply is usually inadequate for the establishment of a large capacity paper industry. Furthermore, the current high level of technological research into paper and paper products and pulp and paper making machinery means that technological changes are continually occurring in the industry. As a result, additional expenditures on plant and machinery are necessary if the improved technical knowledge is to benefit the country concerned.

The establishment of a paper and paper products industry in Burma was first proposed in the early fifties, but, because of changes in government policy and general political instability, the plan was shelved.

9.2 PURPOSE OF THE STUDY

The purpose of this section of the study is to analyse the Burmese market for paper and paper products in order to forecast the country's future levels of demand for those products. The information should help policy makers to decide on the optimal type and size of paper and paper products industry in Burma. An additional objective of the study is the development of techniques appropriate to the forecasting of demand for paper and paper products in less developed countries with similar characteristics to Burma's.

9.3 DATA FOR DEMAND ANALYSIS

Although reliable data is a desirable prerequisite for any analysis of market behaviour and demand it is unlikely to be available in a suitable form in most developing countries. In Burma data problem arises in two areas:-

(1) Insufficient statistics on paper consumption.

(2) Inaccurate and insufficient information on important economic indicator variables.

Most studies of paper and paper products consumption have shown that population and income are the main determinants of demand (Hair, 1967). The prices of paper products have occasionally been significant but in most studies price has been excluded from the analysis.

In this study, price was included in a preliminary analysis because of the competition from substitute materials which is occurring in some paper and paper products categories, e.g. wrapping paper. Unfortunately, it was not possible to obtain the real market price for paper and paper products and it had to be dropped from the final analysis.

The population and income data used were the same as those outlined in the previous chapter.

Consumption data could be calculated for the following six major groupings of paper and paper products:- newsprint, printing and writing paper, wrapping paper, paperboard, other types of paper, and total paper and paper board. A detailed listing of the individual commodities in each of the above groups is given in Appendix B.

9.3.1 Availability

Burma did not produce paper and paper products during the period of the study, and it became necessary to rely on import statistics for the analysis. The quantity of paper and paper products imported each year was assumed to be equivalent to the actual quantity of paper consumption because data concerning re-exports and changes in stock were not available for the whole study period. Re-export data for paper and paper products was available for only a short period and, in any case, the quantities were usually negligible so their exclusion from the availability calculations was not considered unduly detrimental.

Consistent data on paper and paper products import were unavailable for the whole study period. Data up to and including 1951/52 were published on a financial year basis (i.e. October to end of September) while data for 1953 and after were published on a calendar year basis. However, since income data was published on a financial year basis, it was necessary to convert the calendar year import data to financial year basis.

Apart from wrapping paper, where the quantity of paper bags imported is not given separately in the Bulletin of Import Trade from 1964 onwards, the import data for the different categories of paper and paper products are complete. Imports of paper bags from 1964 (1963/64) onwards were estimated by the writer.

9.3.2 Price Data

Paper and paper products do not have to compete with readily available substitutes in the market place in Burma so

consequently the quantity consumed is less sensitive to price changes than would be the case if substitutes were readily available. However, in the preliminary study, price was included as an independent variable for some paper categories because of the prevelance of substitute materials.

Neither real nor domestic prices were available for paper and paper products so the landed cost was used instead. This cost does not include customs duty, transport charges, or profit margins.

In most countries price is not an important determinant of paper and paper products consumption but in Burma, it may be an important influence on the consumption of certain types of paper and paper products. Such seems to be the case for wrapping paper and other paper because the analysis showed price to be more significant than income. The effect appears to be largely due to the availability of a number of substitute materials for wrapping paper, e.g. leaves which are used for wrapping and split bamboo baskets.

It should be borne in mind that the various paper and paper products prices used in this study are not real prices but only the landed costs. Consequently, the discussion of the significance of price coefficients and their interpretation should be qualified to some extent.

9.3.3 Other Variable

It is often argued that better results can be obtained by using more variables in the estimating equations and by developing and using more sophisticated models (Hair, 1967). With this point

in view the writer included newspaper circulation as an additional independent variable for newsprint consumption. Burmese and English newspaper circulation data were available for the period 1950 to 1967 and Chinese and Indian newspaper circulation data were available from 1950 to 1963 and from 1954 to 1963. Total newspaper circulations could be calculated only for the ten year period 1954 to 1963, on a calendar year basis.

Newspaper circulation was found to have an insignificant influence on newsprint consumption probably because newsprint was used for two other purposes as well, i.e. printing and writing paper.

9.4 PRELIMINARY STUDY

A series of regression equations were run over different time periods, for data up to 1956, using a range of functions for each paper and paper products group. However, it was not possible to determine a common and stable period for the all paper products category nor was it possible to obtain equations which gave significant income and price coefficients. Hence, it was decided to approach the study by eliminating price from the analysis.

9.5 MODIFIED STUDY

It was evident from the preliminary study that, wrapping paper excepted, income was a significant demand determinant for the paper and paper product groups. As most demand analyses include income as the key demand variable for paper and paper products consumption, it was decided to attempt a similar analysis using income as the sole demand determinant.

As mentioned in section 2.7.2, the Open General Licence (O.G.L.) for imports of all commodities had been reduced enormously in 1956 because of balance of payments difficulties. All imports were restricted and people wishing to import any commodity had to apply for an import permit from the Trade Ministry.

Imports of paper and paper products, like all other imported commodities, have been restricted since 1956. The phasing out of the Open General Licence during 1956 is evident in the fall of the percentage value of imports through O.G.L. from 44.3 percent in 1955 to 24.3 percent in 1956. Since then, imports of some paper and

paper product commodities have been subject to government restrictions which, in turn, restricted the volume and composition of the paper and paper products groups which have been available for consumption.

The base period chosen for this section of the analysis was 1946/47 to 1955/56, a period during which relatively free market conditions existed.

Only the logarithmic reciprocal function was applied but saturation consumption levels for the different paper and paper products (F.A.O, 1960) were used in fitting the curves.

9.5.1 Reclassification of Paper and Paper Product Groups.

Paper and paper products were regrouped according to their related usuage. Newsprint and printing and writing paper were grouped together to form a new group called cultural paper. Wrapping paper, paper board, and other paper, were also grouped together and classified as industrial paper.

Newsprint is often substituted for printing and writing paper in Burma, a phenomenom evidenced by the number of government publications printed on newsprint. Students use newsprint for writing because it is less expensive and readily available and some exercise books are made of newsprint. Consequently, combining printing and writing paper with newsprint to form cultural papers should give better theoretical results.

The grouping of wrapping paper, paper board, and other paper, together and the formation of the new type called industrial paper was done chiefly because wrapping paper and other paper were

responsive to price while paper board had an erratic consumption pattern which should have been smoothed out by the grouping.

9.5.2 Saturation Values for Paper and Paper Products

World saturation consumption levels obtained by F.A.O. researchers in the cross-sectional analysis of a large number of countries F.A.O. (1960) were used in this study and are given below.

	Pounds per capita
Newsprint	132
Printing and Writing	132
Other Paper	176
Paper Board	924
Total Paper and Paper Board	1364

9.5.3 Analysis and Result

Cultural paper was tested by regressing the logarithm of per capita cultural paper availability as a function of the inverse of per capita G.D.P. at constant prices. The per capita saturation value of 264 pounds for cultural paper was applied as a ceiling limit at per capita income levels of $A 100,000, $A 110,000 and $A 120,000 for fitting the curve. The systematic exclusion of some observations was undertaken as a test of the stability of the coefficients. It was found that the coefficients were remarkably stable, the largest variation being 0.83 percent and the coefficient of determination was very high. The results of the basic equations are given below.

$$(7)\quad \text{Log } Y_{10} = 5.7347 - \frac{282.9417}{X_1} \qquad (R^2 = 0.98)$$

$$(8)\quad \text{Log } Y_{10} = 5.7412 - \frac{280.1024}{X_1} \qquad (R^2 = 0.99)$$

where Y_{10} = Per capita cultural paper availability in pounds.

X_1 = Per capita G.D.P. at constant 1961/62 prices in $A.

Industrial paper was tested in the same way but using a per capita saturation level of 1,100 pounds at the same levels of income. A high coefficient of determination was obtained and the coefficients were more stable than those obtained for cultural paper. The basic equation is given below.

$$(9)\quad \text{Log } Y_{11} = 6.9848 - \frac{341.5440}{X_1} \qquad (R^2 = 0.99)$$

where Y_{11} = Per capita industrial paper availability in pounds.

Finally, the same test was applied to total paper and paper board using a per capita saturation value of 1364 pounds and the same ceiling incomes. The coefficients were again very stable and a very high coefficient of determination was obtained. The basic equation is given below.

$$(10)\quad \text{Log } Y_9 = 7.2105 - \frac{318.5707}{X_1} \qquad (R^2 = 0.99)$$

One satisfying feature of the results was that the sum of the individual forecasts, using the cultural and industrial paper

equations, was remarkably close to the forecast consumption levels that were derived from the total paper and paper board equation.

9.5.4 Income Elasticities

The income elasticities of demand for paper and paper products derived from the logarithmic reciprocal function at various income levels are given in Table 9.1. They have been converted to $U.S. equivalent so that they can be compared to the values of income elasticity of demand given in the F.A.O. publication (1960).

Table 9.1 Income Elasticities of Demand for Different Paper and Paper Products.

Per capita Gross Domestic Product (1961/62 prices) $U.S.	Cultural Paper	Industrial Paper	Total Paper and Paper Board
50	6.3365	7.6195	7.1359
100	3.1682	3.8097	3.5679
200	1.5841	1.9048	1.7839
400	0.7920	0.9524	0.8919
800	0.3960	0.4762	0.4459
1,200	0.2640	0.3174	0.2973
1,600	0.1980	0.2381	0.2229
2,000	0.1584	0.1904	0.1783
2,500	0.1267	0.1523	0.1427

The elasticities derived for given income levels in this study differ from those derived in the F.A.O. (1960) study. The

elasticities for the category of all paper and paper products diminish at a faster rates than the F.A.O. study values. For this reason it was decided to test the forecast per capita consumption levels which had been derived from the total paper and paper products equation. It was found, that at an income level of $A 200, the forecast per capita total paper and paper products consumption was 276 pounds. This level seemed excessively high, as the per capita total paper and paper board in Australia which has $A 2000 per annum per capita income, was only 260 pounds. As a result, the approach was rejected and a third study was made using recent international cross-sectional consumption and income data.

9.6 CROSS-SECTIONAL ANALYSIS

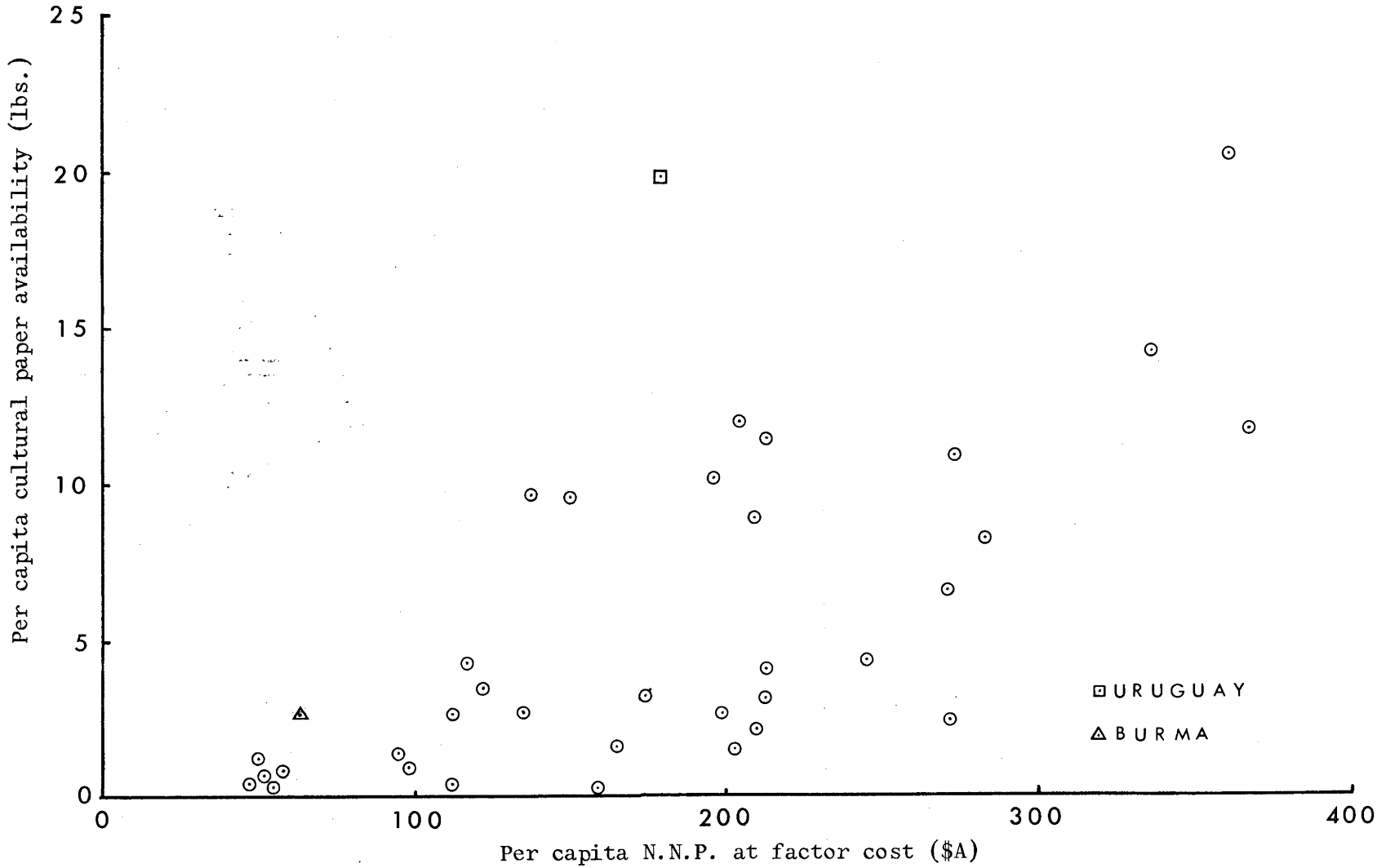
Cultural paper and industrial paper availabilities data for 62 countries, during 1968 were extracted from "Year Book of Forest Products (1969-70)". Per capita Net National Product at factor cost was used as the income variable for all countries except Burma, Sweden, Ethiopia, Malawi, Ceylon and Ghana, because Gross National Product at market prices was the only data available for those countries. In Tanzania where only Gross Domestic Product at market prices alone was available for 1968 and G.D.P. at factor cost was the only measure available for the year 1968 in Uganda. The income data was collected from "Year Book of National Accounts Statistics" (1969) and "International Financial Statistics" (1972).

Per capita cultural paper availability was then plotted against per capita income for each country. A graph of per capita

income against consumption, for the 36 countries with income levels below $A 400, is given in figure 9.1. The graph plainly shows that the per capita consumption of cultural paper in Burma during 1968 was well above the level of other countries with the same income level. Furthermore, Burma's consumption levels exceeded those of Pakistan, Uganda, Sierra Leone, Kenya, Morocco, Tunisia, Zambia, Jordan, and Iraq, all of which have higher income levels than Burma. This is probably because Burma has a higher percentage of her population who are literate than most of the above countries, a fact which suggests strongly that a literacy index should be included as an independent variable in the cross-sectional analysis. It was also observed that countries like Finland, the Netherlands, the United Kingdom and Uruguay, have unusually high consumption levels, probably because they are major exporters of paper manufactures, books, and printed matter, thereby increasing the level of their apparent paper consumption. The total value of export for printed matter in 1968 from the Netherlands and from the United Kingdom were $U.S. 71,642,000 and $U.S. 164,754,000 respectively as against imports of $U.S. 40,244,000 and $U.S. 87,995,000 respectively. Finnish and Uruguayan exports consist mainly of paper manufactures rather than printed matter.

In the final cross-sectional study of demand for paper and paper products, the data for paper availability, population and income in the different countries, were collected for 1966, 1967 and 1968. The aim was to eliminate the influence of any short term changes in stocks. Complete data could not be obtained for all of the sixty-two countries, and only the twenty-four countries with complete data were included in the final analysis.

FIGURE 9.1 CONSUMPTION AGAINST INCOME



Literacy indices were collected from the Demographic Year Book (U.N. 1971). The method of enumerating literacy percentages and the years for which they are available vary from country to country and in some countries simply cover a sample area. It was found necessary to select 1961 as the base period for estimating the literacy index which implies that the literacy index of 1961 was relevant to the paper and paper products consumption between 1966 and 1968.

Industrial paper consumption was analysed using income as the sole instrument variable. The availability data for Burma were taken from the previous analysis and income data such as G.N.P. at market price were estimated by the writer.

A number of plots were made to examine the different relations. They were:-

(1) Per capita cultural paper availability against per capita G.N.P. at market prices (fig. 9.2).

(2) Log of per capita cultural paper availability against per capita G.N.P. at market prices (fig. 9.3).

(3) Log of per capita cultural paper availability against log of per capita G.N.P. at market prices (fig. 9.4).

(4) Per capita cultural paper availability against litaracy index (fig. 9.5).

(5) Log of per capita cultural paper availability against literacy index (fig. 9.6).

(6) Log of per capita cultural paper availability against the log of literacy index (fig. 9.7).

(7) Per capita industrial paper availability against per capita G.N.P. at market prices (fig. 9.8).

(8) Log of per capita industrial paper availability against per capita G.N.P. at market prices (fig. 9.9).

(9) Log of per capita industrial paper availability against the log of per capita G.N.P. at market prices (fig. 9.10).

(10) Literacy index against per capita G.N.P. at market prices (fig. 9.11).

The main points to emerge from the above plots were:-

(1) The relationship between per capita cultural paper consumption and per capita G.N.P. at market prices was linear.

(2) The relationship between per capita cultural paper consumption and literacy index was curvilinear.

(3) The relationship between per capita industrial paper consumption and per capita G.N.P. at market prices was also linear.

9.6.1 Analysis and Result

There does not appear to be any significant difference between the effect of G.D.P. at market prices or G.N.P. at market prices on the consumption of either cultural or industrial paper although one more observation was included with G.D.P. at market prices.

$$(11)\quad \text{Log } Y_{14} = -7.0901 + \underset{(0.1222)}{0.9171^{****}} \text{ log } X_{20} + \underset{(0.2667)}{0.9655^{***}} \text{ log } X_{21} \quad (R^2 = 0.90$$

FIGURE 9.2 CULTURAL PAPER CONSUMPTION AGAINST INCOME

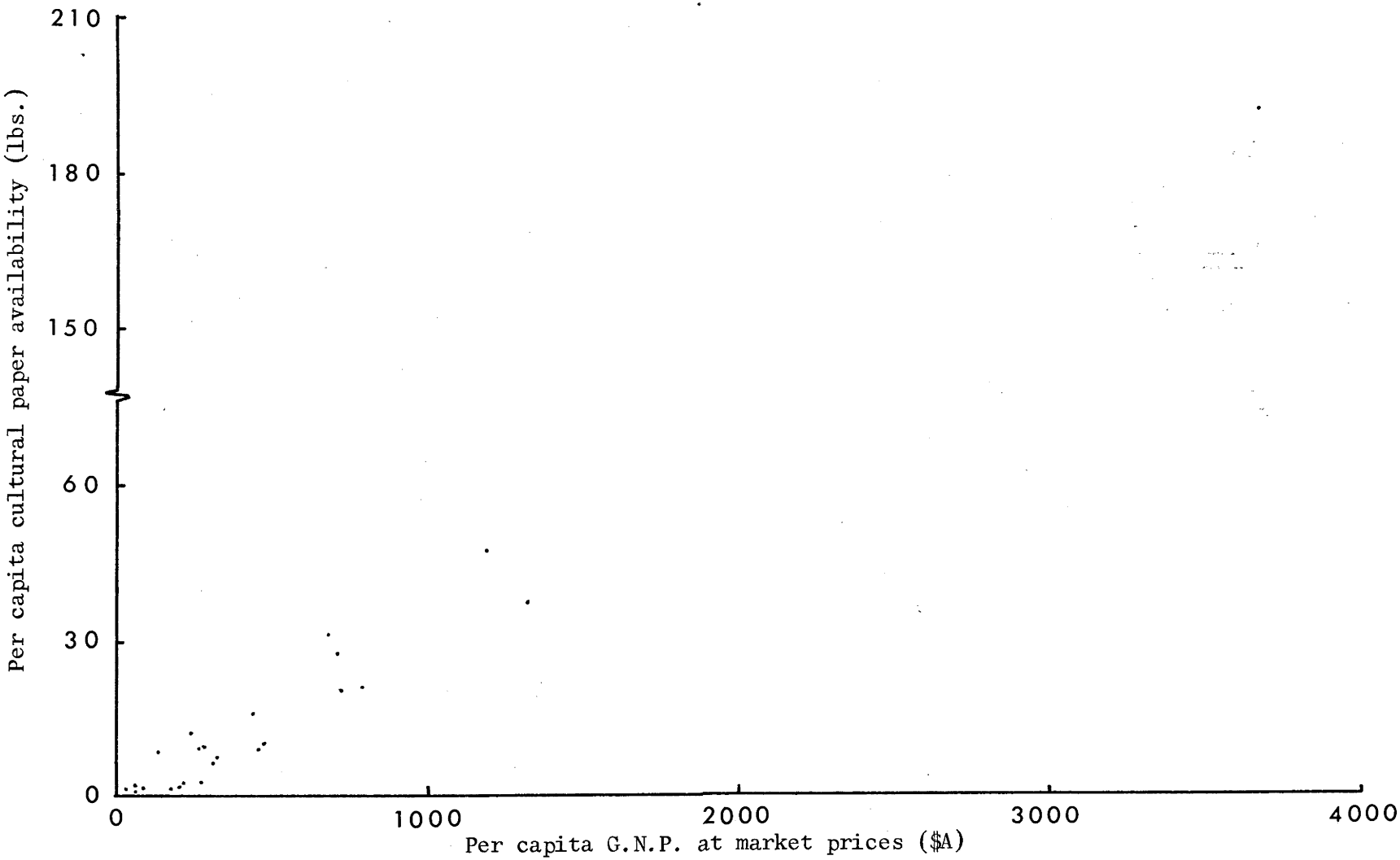


FIGURE 9.3 LOG OF CULTURAL PAPER CONSUMPTION AGAINST INCOME

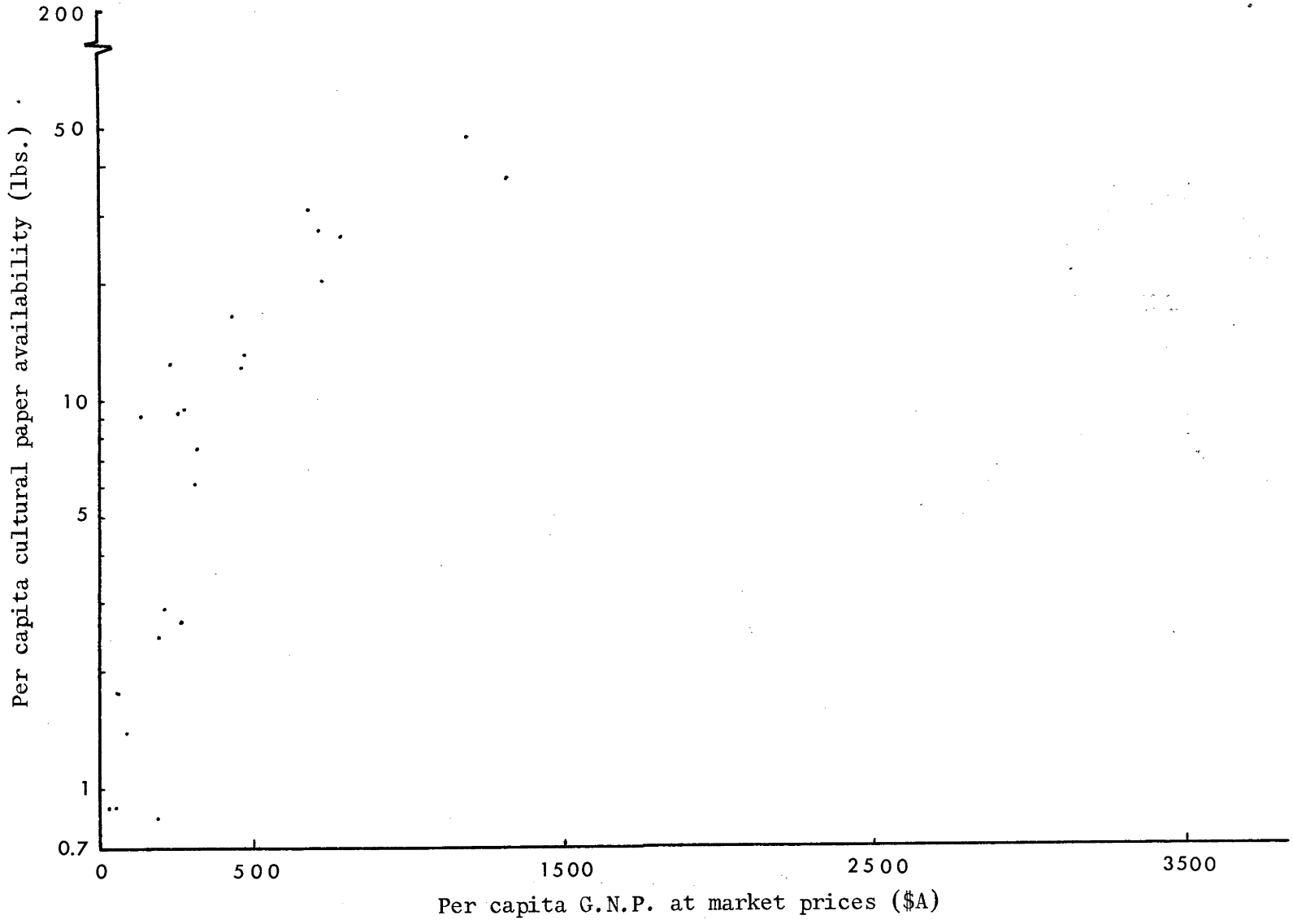


FIGURE 9.4 LOG OF CULTURAL PAPER CONSUMPTION AGAINST THE LOG OF INCOME

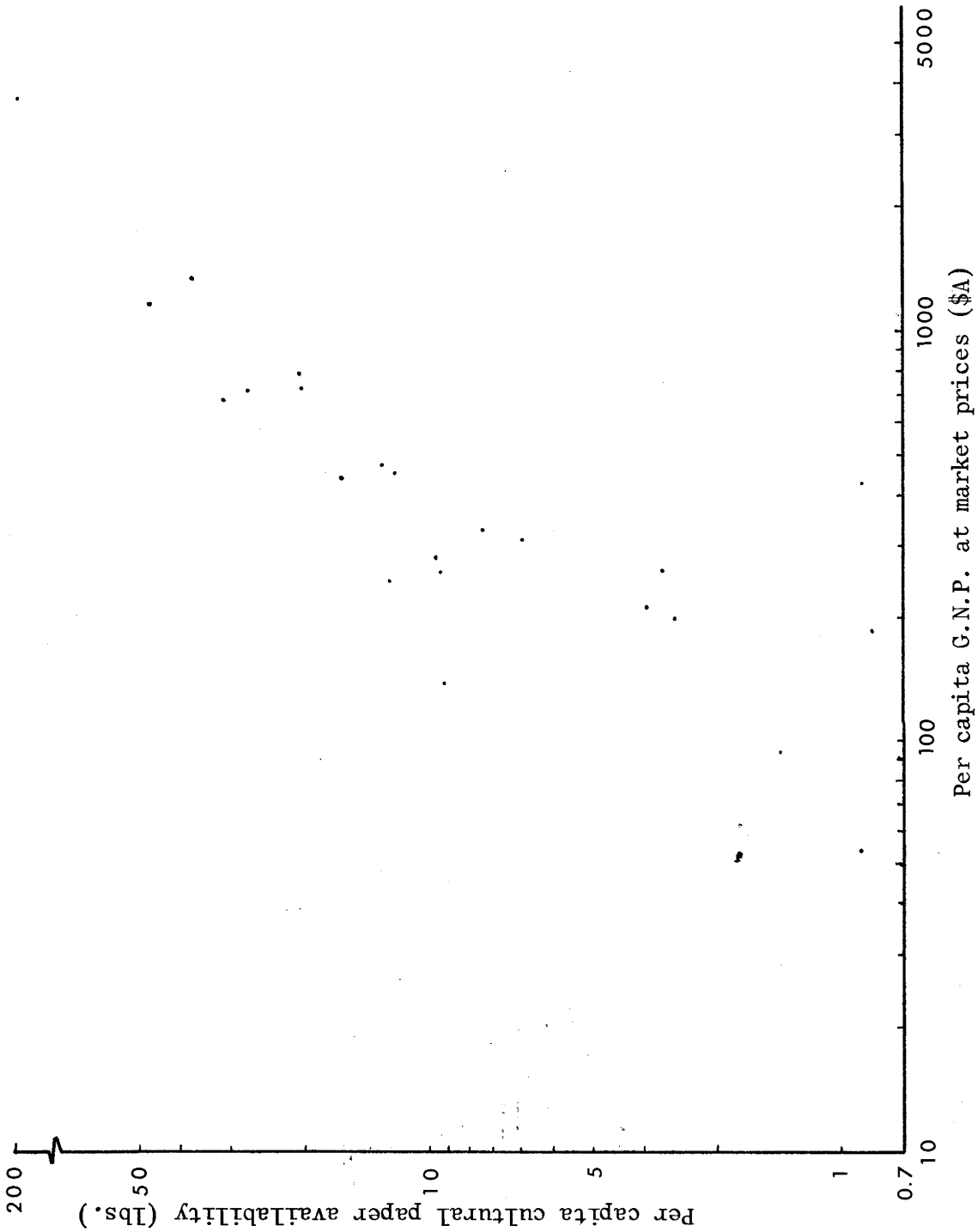


FIGURE 9.5 CULTURAL PAPER CONSUMPTION AGAINST LITERACY INDEX

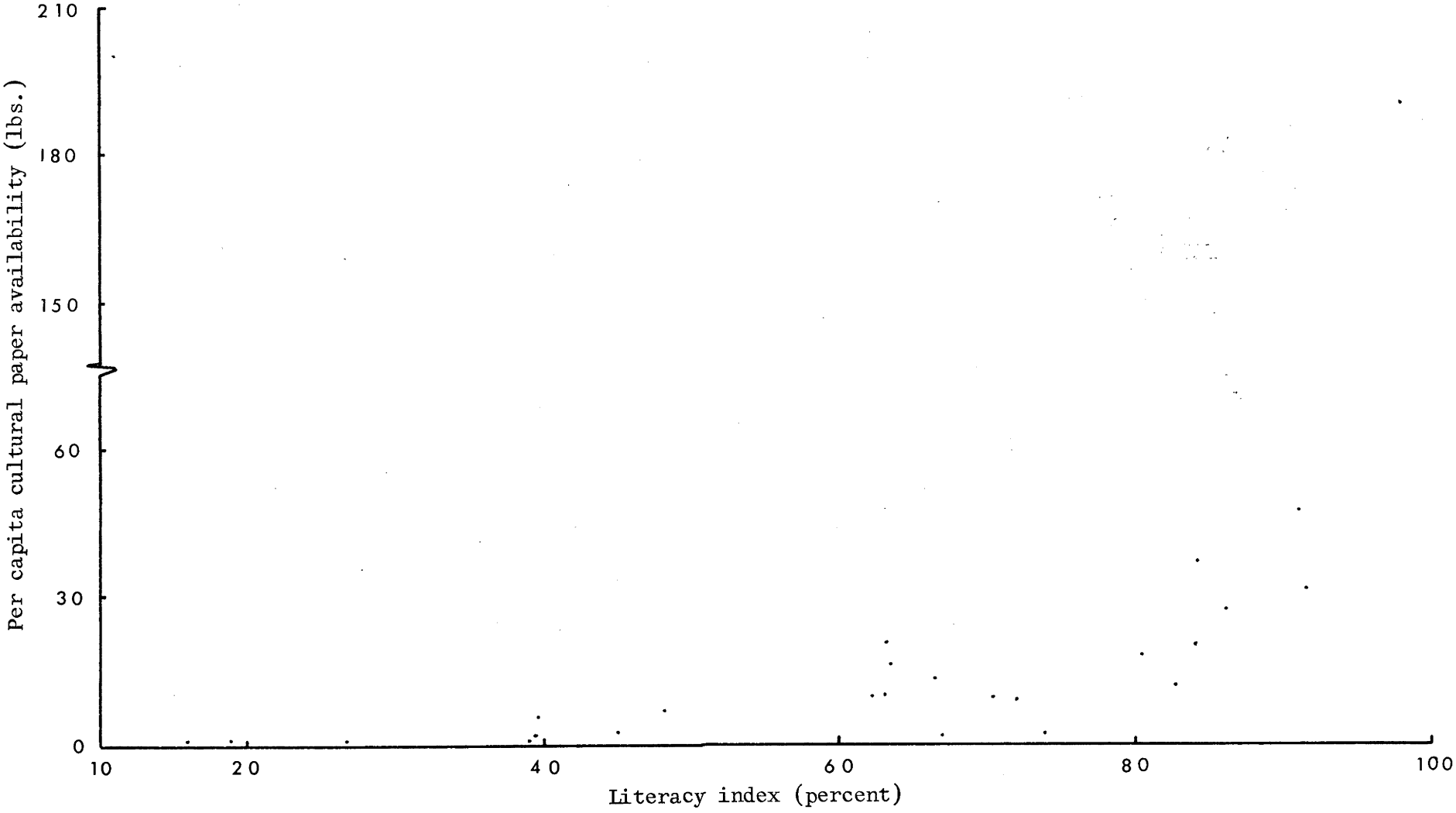


FIGURE 9.6 LOG OF CULTURAL PAPER CONSUMPTION AGAINST LITERACY INDEX

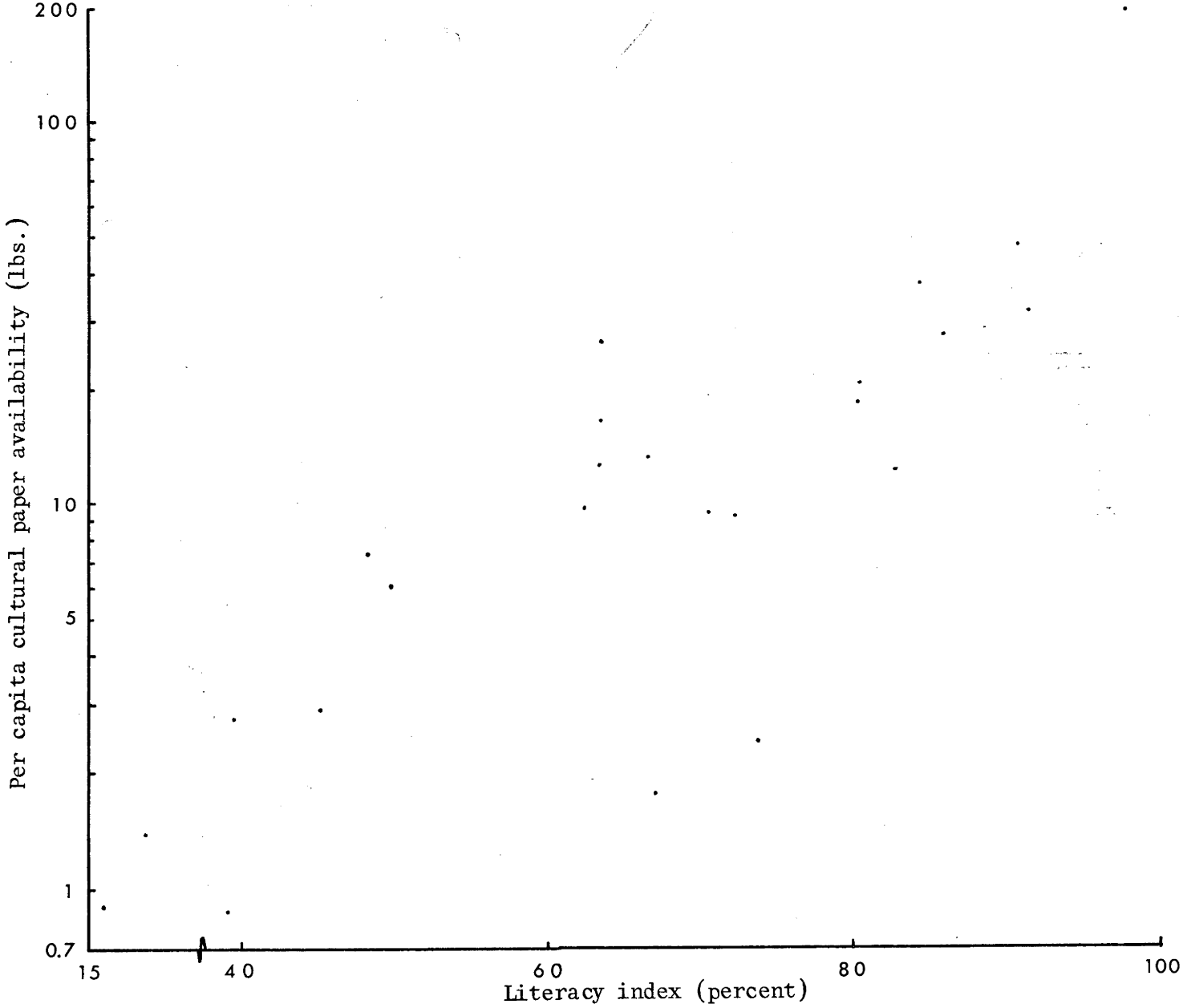


FIGURE 9.7 LOG OF CULTURAL PAPER CONSUMPTION AGAINST LOG OF LITERACY INDEX

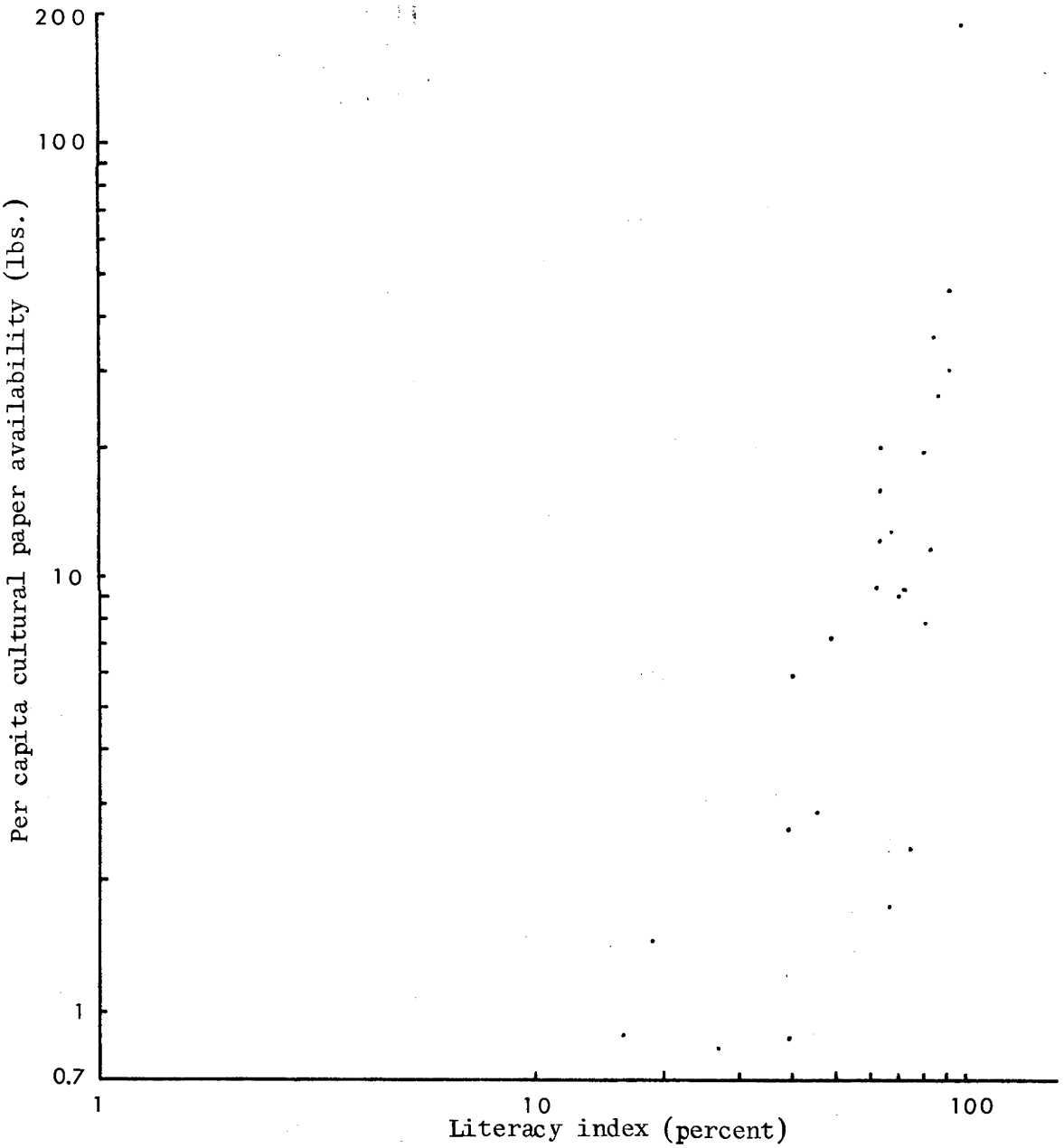


FIGURE 9.8 INDUSTRIAL PAPER CONSUMPTION AGAINST INCOME

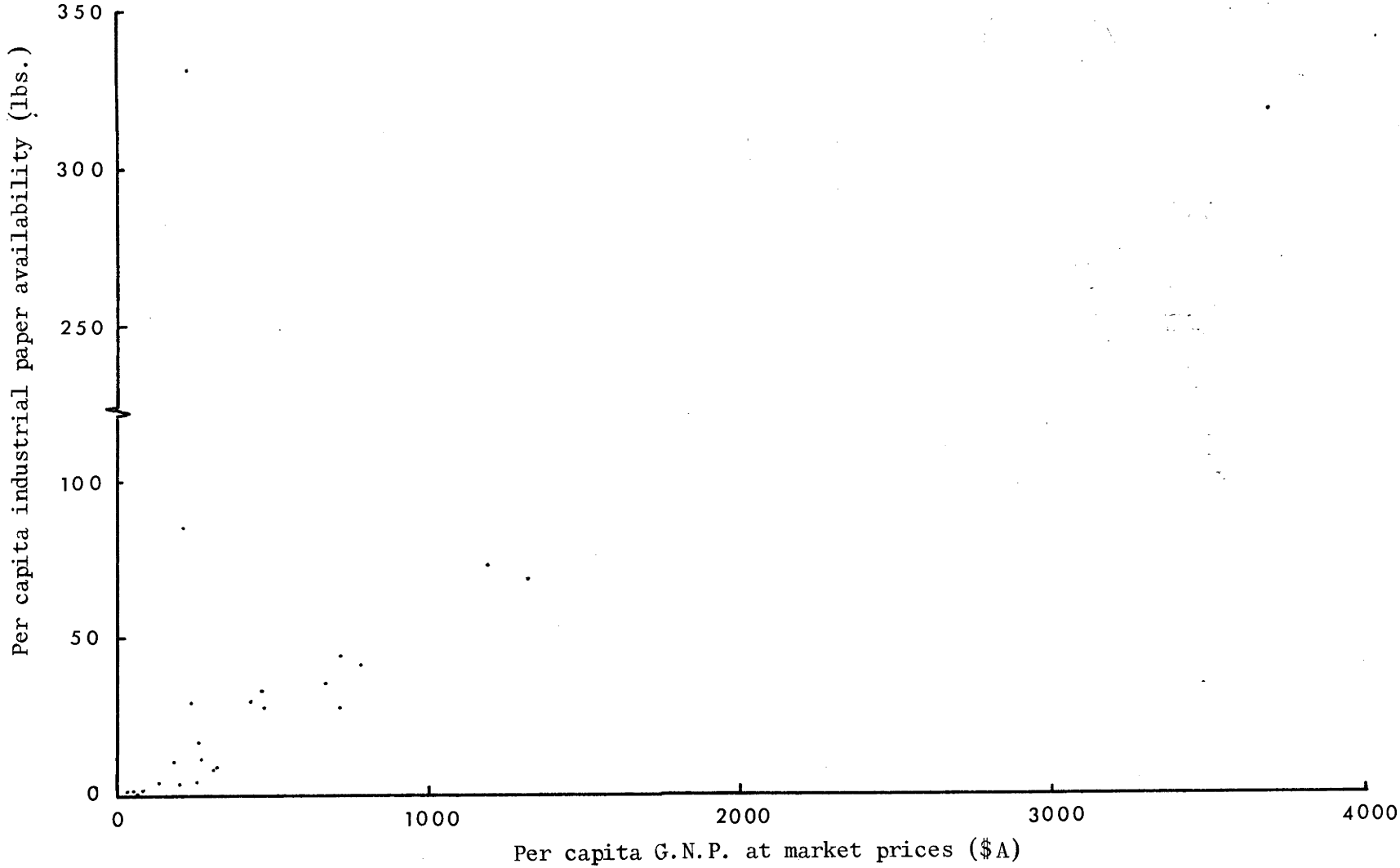


FIGURE 9.9 LOG OF INDUSTRIAL PAPER CONSUMPTION AGAINST INCOME

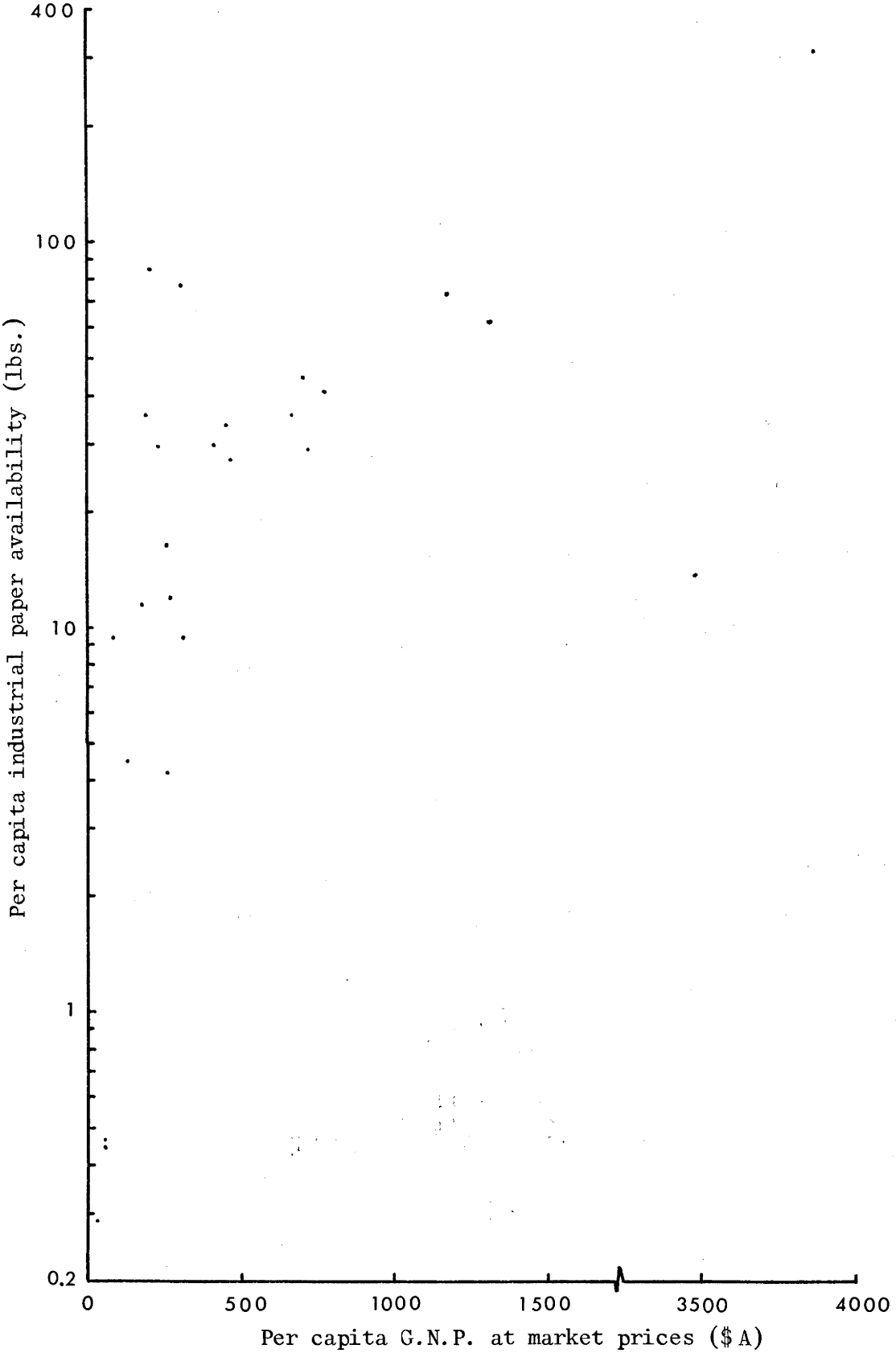


FIGURE 9.10 LOG OF INDUSTRIAL PAPER CONSUMPTION AGAINST THE LOG OF INCOME

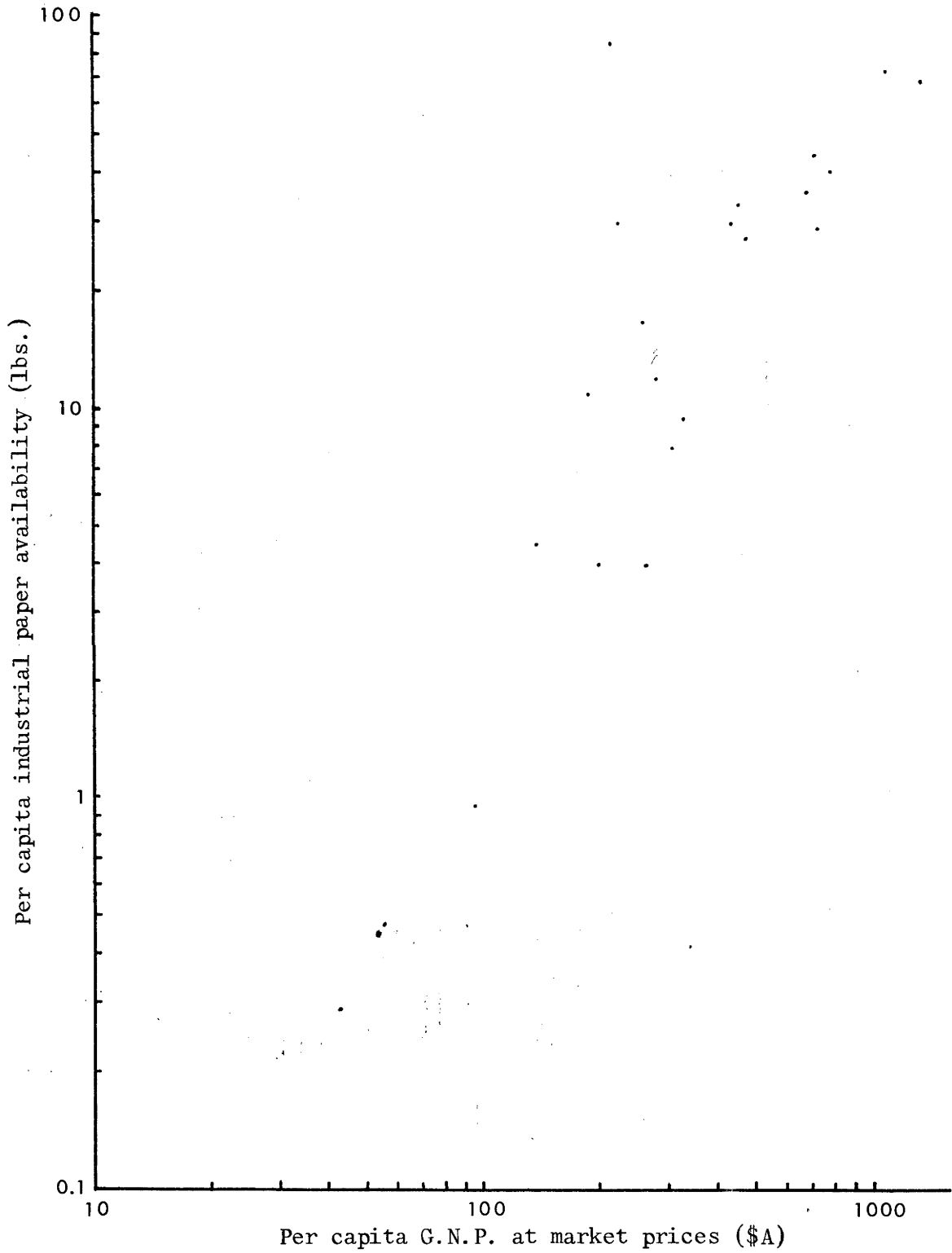
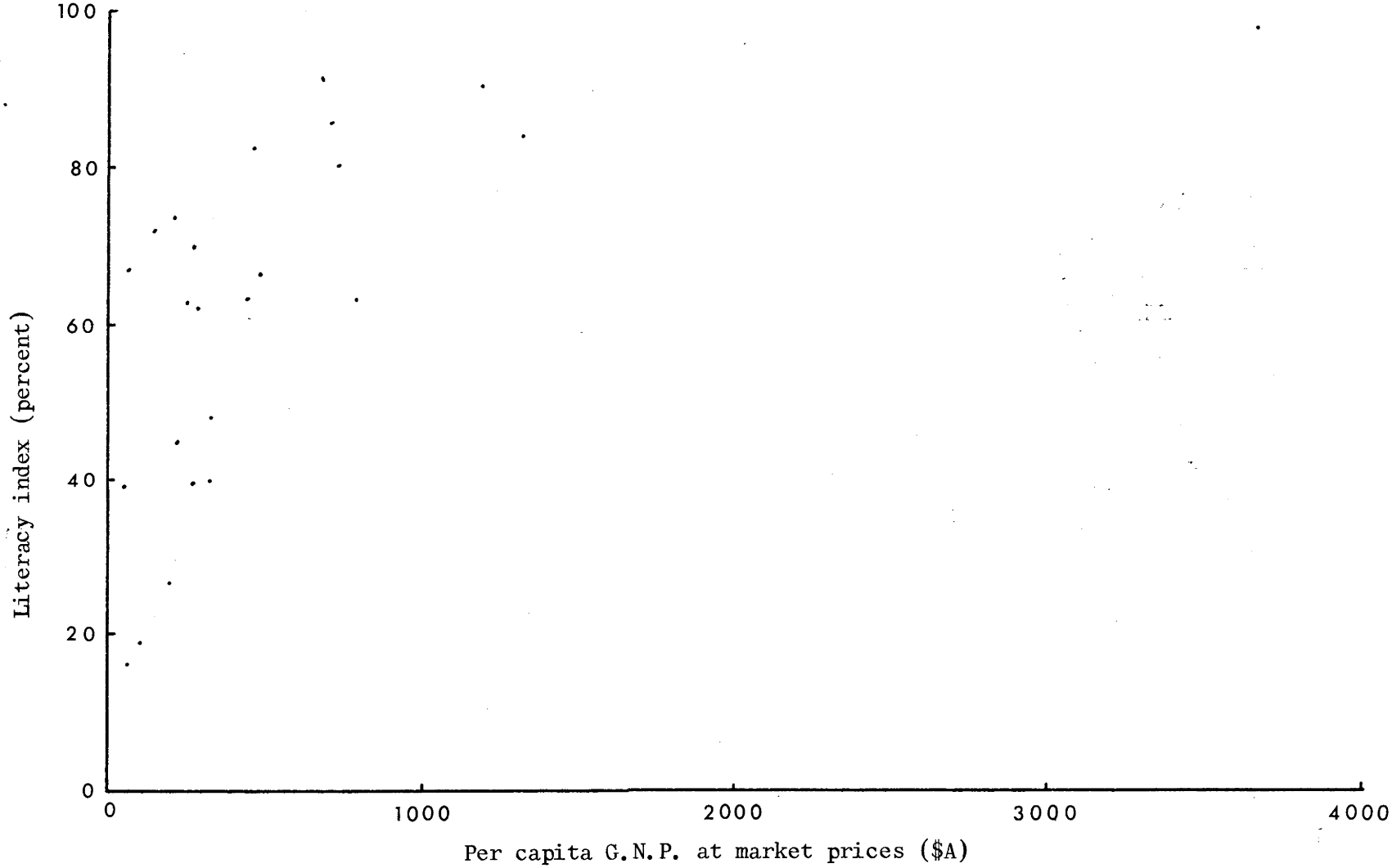


FIGURE 9.11 LITERACY INDEX AGAINST INCOME



$$(12)\quad \text{Log } Y_{14} = -7.1706 + \underset{(0.1238)}{0.9052^{****}} \log X_{19} + \underset{(0.2695)}{0.9988^{***}} \text{Log } X_{21} \qquad (R^2 = 0.90)$$

$$(13)\quad \text{Log } Y_{15} = -6.3377 + \underset{(0.1502)}{1.5396^{****}} \log X_{20} \qquad (R^2 = 0.83)$$

$$(14)\quad \text{Log } Y_{15} = -6.3813 + \underset{(0.1504)}{1.5429^{****}} \log X_{19} \qquad (R^2 = 0.83)$$

where Y_{14} = Per capita cultural paper availability from cross-sectional country data (lbs).

Y_{15} = Per capita industrial paper availability from cross-sectional country data (lbs).

X_{19} = Per capita G.D.P. at market prices from cross-sectional country data ($A).

X_{20} = Per capita G.N.P. at market prices from cross-sectional country data ($A).

X_{21} = Literacy index.

G.N.P. at market prices is used throughout the following analysis.

The use of total data, rather than per capita data, was also tested for both cultural and industrial papers. The use of total data normally improves the coefficient of determination but the population coefficient was not significant at the 5 percent level, as can be seen in equation (15).

$$\text{(15)}\quad \text{Log } Y_{12} = -7.3637 + \underset{(0.1072)}{0.9217^{****}} \log X_{18} + \underset{(0.1217)}{0.2388} \log X_{22} + \underset{(0.2345)}{0.9202^{****}} \log X_{2}$$

$$(R^2 = 0.97)$$

where Y_{12} = Total cultural paper availability from cross-sectional country data in million pounds.

X_{18} = Total G.N.P. at market prices from cross-sectional country data in million dollars Australian.

X_{22} = Total population from cross-sectional country data in million.

Using a literacy index rather than the logarithmic value for the literacy index caused the coefficient for population to become significant at the 5 percent level without changing the coefficient of determination. In addition, the income and literacy coefficients were both found to be significant at the 0.1 percent level. Equation (16) illustrates this.

$$\text{(16)}\quad \text{Log } Y_{12} = -4.6274 + \underset{(0.1111)}{0.8664^{****}} \log X_{18} + \underset{(0.1216)}{0.2766^{*}} \log X_{22} + \underset{(0.0051)}{0.0216^{****}} X_{21}$$

$$(R^2 = 0.97$$

The results of applying different functions to the regression of per capita consumption on per capita income for both cultural and industrial papers are shown below. The literacy index was varied solely for cultural paper.

$$(17)\quad Y_{14} = -121.5041 + \underset{(8.1345)}{\overset{***}{23.2504}} \log X_{20} + \underset{(0.3730)}{0.1297} X_{21} \qquad (R^2 = 0.49)$$

$$(18)\quad \text{Log } Y_{14} = -4.2424 + \underset{(0.1235)}{\overset{****}{0.8469}} \log X_{20} + \underset{(0.0057)}{\overset{****}{0.0234}} X_{21} \qquad (R^2 = 0.91)$$

$$(19)\quad \text{Log } Y_{15} = -6.3377 + \underset{(0.1502)}{\overset{****}{1.5396}} \log X_{20} \qquad (R^2 = 0.83)$$

$$(20)\quad Y_{15} = -7.7347 + \underset{(0.0058)}{\overset{****}{0.0825}} X_{20} \qquad (R^2 = 0.90)$$

$$(21)\quad Y_{15} = -200.2135 + \underset{(9.4911)}{\overset{****}{41.2863}} \log X_{20} \qquad (R^2 = 0.46)$$

Equation (17) for cultural paper and equation (21) for industrial paper each gave diminishing income elasticities in conformity with the assumption of diminishing income elasticities of demand, but the coefficients of determination were very low (0.49 and 0.46 respectively). At the same time, as for cultural paper only the income coefficient for cultural paper was significantly different from zero at the 1 percent level while the literacy index coefficient was not significant, even at the 5 percent level. For industrial paper, the income coefficient was significant at 0.1 percent level.

Equation (20) gave an increasing income elasticity of demand for industrial paper although the income coefficient was

significantly different from zero at 0.1 percent level and a high coefficient of determination (0.90) was obtained.

Equation (18) for cultural paper and equation (19) for industrial paper both gave a constant income elasticity of demand, the income elasticity of demand for cultural paper being 0.8469 and that of industrial paper 1.5396. These two values do not agree with values derived by the F.A.O. (1960) study.

It is debatable whether a constant income elasticity of demand for paper and paper products is appropriate for projection purposes or not. However, the calculated values are reasonable and if it is possible to stratify income into different income groups, it is likely that the values of the elasticity will be improved.

These values have to be accepted until such time as more data becomes available. In the interim, equations (18) and (19) have been used to provide forecasts of the consumption of cultural and industrial paper in Burma up to the year 2000.

CHAPTER 10

FORESTRY EXPORTS - PAST, PRESENT AND LIKELY TRENDS

10.1 EXPORTS BEFORE THE WAR

Before the second world war timber was Burma's main forest products export although some minor forest products such as cutch and lac were also exported in large quantities. The average annual volume and corresponding value of teak and hardwood exports for the period 1936 to 1941 are given in Table 10.1.

Table 10.1 Average Annual Exports of Teak and Hardwood for the Period 1936 to 1941

	Log		Sawn		Total	
	Cubic Ton (Hoppus)	$A (000)	Cubic Ton (True)	$A (000)	Cubic Ton	$A (000)
Teak	2,397	55	217,695	6,012	220,092	6,067
Hardwood	N.A.	N.A.	N.A.	N.A.	33,113	519

Source:- (1) Pers. comms. Forest Economist, Burma

(2) Myint Aung (1967)

During this period teak log exports formed less than one percent of the log equivalent volume of teak sawn timber exports. Assuming that a 50 percent (hoppus to true) recovery percentage was

relevant for the conversion of teak during that period, the total export of teak should be equivalent to 437,787 tons of log volume.

Pre-war hardwood exports were quite high but it was not possible to separate the log and sawn timber export components. An average of some 33,113 cubic tons of hardwood was exported from Burma during the 1936-41 period and the average annual production of hardwoods was about 400,000 cubic tons. Table 10.2 shows the annual averages of both outturn and exports of teak and hardwoods during the decades ending 1920, 1930 and 1940.

Table 10.2 Average Annual Production and Exports of Teak and Hardwood

Decade Ending	Teak		Hardwoods	
	Production	Exports	Production	Exports
1920	325,807	160,078*	380,086	24,103*
1930	497,437	219,803*	514,409	31,741*
1940	432,384	194,127*	403,022	32,473*

Source:- Anon (1962)

* Mainly sawn timber though not distinguishable.

The ten year average annual production of teak and hardwoods reached a peak during the decade ending 1930 but fell during the following decade due to the world wide trade depression of the early thirties. Exports of teak also reached a peak during the decade ending 1930.

On an average over the period 1936 to 1941, 96% of the exports of teak sawn timber and 80% of the teak log exports went to countries within the British Empire. The remainder went to non-British countries, consisting mainly of Germany, Holland and Italy. Hardwood exports were consigned almost exclusively to the British Empire. Within the British Empire, India and the United Kingdom were the two main importing countries with an average of 75% of the total teak sawn timber exports and 47% of the teak log exports going to India. The corresponding figures for the United Kingdom were 16% and 28% respectively. In addition some 87% of the exports of hardwoods went to India and about 12% went to the United Kingdom.

The average (F.O.B.) export price of teak and hardwoods for the period 1936 to 1941 are given in Table 10.3.

Table 10.3 Average Export Price of Teak and Hardwood, 1936-41 ($A per cubic ton)

	Logs	Sawn	Total
Teak	23	28	27
Hardwood	N.A.	N.A.	16

Source:- (1) Pers. Comms. Forest Economist Burma

(2) Myint Aung 1967

Because the majority of the timber exported during that period went to the United Kingdom and India the price was extensively controlled by these two countries.

10.2 EXPORTS AFTER THE WAR

Exports of teak and hardwoods were resumed soon after the war although at a reduced level. Exports of teak during the period 1948/49 to 1967/68 are indicated in Table 10.4.

Table 10.4 Post War Teak Exports (cubic tons)

Year	Logs (Hoppus)	Sawn Timber (True)	Total
1948-49	N.A.	N.A.	66,817
1949-50	N.A.	N.A.	15,954
1950-51	159	49,927	50,086
1951-52	170	44,394	44,564
1952-53	91	28,336	28,427
1953-54	160	28,887	29,047
1954-55	765	30,768	31,533
1955-56	6,930*	49,953	56,883
1956-57	6,602**	59,530	66,132
1957-58	2,639	63,791	66,430
1958-59	6,850	66,796	73,646
1959-60	19,737	70,854	90,591
1960-61	20,639	71,396	92,035
1961-62	35,005	84,014	119,019
1962-63	47,718	98,171	145,889
1963-64	47,806	106,053	153,859
1964-65	54,330	85,738	140,068
1965-66	55,819	79,636	135,455
1966-67	28,904	71,267	100,171
1967-68	39,724	70,267	109,991

Source:- (1) Myint Aung (1967)

(2) Kyaw Thein (1969)

* Includes 6633 tons of buttends exported to India.

** Includes 5426 tons of buttends exported to India, Hong Kong

Until 1956/57 exports of teak logs were below pre-war levels. The export of teak logs for 1955/56 and 1956/57 seemed to exceed the previous levels but buttends had been included in the log export figures for both years. Teak log exports rose abruptly from 9.30% of total teak exports in 1958/59 to 41.21% in 1965/66 but have since dropped below the latter level.

Export of hardwoods for the years 1948/49 to 1967/68 are given in Table 10.5.

Table 10.5 Post War Hardwood Exports (cubic tons)

Year	Volume
1948-49	20,185
1949-50	3,004
1950-51	18,394
1951-52	25,407
1952-53	14,244
1953-54	8,850
1954-55	10,276
1955-56	24,948
1956-57	19,774
1957-58	15,858
1958-59	25,844
1959-60	10,264
1960-61	9,700
1961-62	18,657
1962-63	22,313
1963-64	4,722
1964-65	3,318
1965-66	708
1966-67	5,310
1967-68	699

Source:- Pers. Comms. Forest Economist, Burma.

Although output has increased very sharply since 1953/54, post-war hardwood exports have never reached the pre-war levels due to production problems and increased internal competition. Hardwood exports also declined substantially after nationalisation of the entire timber trade.

The average export price per ton for teak and hardwoods over the period 1948/49 to 1967/68 are given in Table 10.6.

Table 10.6 Post War Export Price for Log and Sawn Timber ($A/c.ton)

Year	Teak			Hardwoods
	Log	Sawn	Av. Price	
1948-49	N.A.	N.A.	115	50
1949-50	N.A.	N.A.	142	63
1950-51	253	171	172	66
1951-52	313	175	175	80
1952-53	353	174	175	77
1953-54	273	162	163	71
1954-55	233	163	165	64
1955-56	84*	172	162	54
1956-57	106*	178	171	52
1957-58	203	156	158	63
1958-59	215	153	159	72
1959-60	239	161	178	49
1960-61	242	170	186	57
1961-62	251	175	197	72
1962-63	255	177	202	65
1963-64	225	163	182	70
1964-65	258	157	196	69
1965-66	298	175	226	73
1966-67	429	161	238	92
1967-68	443	163	264	84

* Includes the price of buttends.

The average export price of teak logs has risen substantially since 1965/66, partly because of the high export price for green teak logs during that time. The average export prices for green teak logs and dry teak logs, in 1967, were $A.647 and $A.394 respectively. Since green timber is preferable for veneering it seems highly probable that an increased proportion of the teak logs exported for veneering were sold green. This is a trend that will have major policy implications for the future and one which may require a detailed examination of the possibility of increasing the future supply of green teak logs.

The average export price of teak sawn timber did not fluctuate greatly but was highest during 1956/57 and lowest during 1958/59, being $A.178 and $A.153 per cubic ton respectively. An apparent contradiction can be seen in Table 10.6. The average price of teak sawn timber exports is significantly less than the average price of teak log exports even though sawn timber is the more highly processed product. This anomaly occurs because exported teak logs were of very high quality and were used for veneering whereas the logs which were not suitable for veneering were converted locally into sawn timber. Another factor in the low price of teak sawn timber was the low quality sawn timber produced internally, especially in regard to sizes and defects.

The average export price of hardwoods seemed to rise steadily but it was not possible to establish reasons for the increases. For none of the data was there a breakdown into species or into logs and sawn timber.

The post-war pattern of teak exports has changed considerably. The dominance of India and the United Kingdom has diminished a great deal particularly after 1958/59 since when a number of European countries have tended to dominate the market. Of the teak importing countries in Europe, Denmark has been the most significant since 1958/59, in terms of logs as well as sawn timber.

Since 1957/58, Denmark, West Germany and Italy have become the major markets for teak logs. These countries together took more than 60% of Burma's total teak log exports during the period 1957/58 to 1965/66. The annual percentage of total teak log exports to each of the three countries is given in Table 10.7.

Table 10.7 Percentage of Total Teak Log Exports

Year	Percentage		
	Denmark	West Germany	Italy
1957-58	48.39	5.91	12.32
1958-59	21.04	27.53	20.35
1959-60	16.63	42.16	23.36
1960-61	18.77	40.81	19.26
1961-62	38.20	18.60	23.23
1962-63	29.83	33.00	15.37
1963-64	30.30	24.25	14.95
1964-65	25.60	25.13	14.80
1965-66	25.82	21.99	12.45

The major export markets for teak sawn timber since 1957/58 have been Denmark, Hong Kong, the United Kingdom, Singapore,

Sweden and Pakistan. The exports of teak sawn timber to India from 1950/51 to 1956/57 varied between 40% and 80% of the total but have dropped drastically since. The various percentages of teak sawn timber exports to Denmark, Hong Kong, U.K., Sweden, Pakistan and Singapore since 1957/58 are given in Table 10.8.

Table 10.8 Percentage of Total Teak Sawn Timber Exports

Year	Percentage					
	Denmark	Hong Kong	U.K.	Singapore	Sweden	Pakistan
1957-58	6.03	10.75	14.17	-	3.04	9.82
1958-59	8.83	15.66	12.76	6.34	3.05	7.05
1959-60	17.33	12.77	16.25	4.67	3.34	7.68
1960-61	11.46	14.42	15.96	6.33	4.01	9.51
1961-62	11.88	13.43	13.85	6.84	4.61	9.74
1962-63	19.63	21.29	9.27	9.47	7.62	8.91
1963-64	13.94	17.78	11.75	9.59	9.23	16.07
1964-65	12.03	19.81	14.00	13.08	9.21	16.52
1965-66	15.78	19.92	12.88	9.64	6.93	6.84

Denmark has now become the leading importer of teak from Burma if both log and sawn timber are considered.

Hardwood exports to India and the United Kingdom between 1948/49 and 1954/55 accounted for between seventy and one hundred percent of the total volume of hardwood exports.

Since then, the export markets have fluctuated widely. West Germany alone accounted for 56% of all hardwood exports during

1955/56 and 1956/57. In 1957/58, export of hardwoods to West Germany, the U.K, and to Pakistan dropped to 48.14% of the total amount exported. In 1958/59 India again dominated the market by taking more than 75% of the total volume of hardwoods exported, a substantial increase which was largely due to a big export order for hardwood railway sleepers. Exports to Pakistan in the same year accounted for 13.46% of the total hardwood exports.

In both 1959/60 and 1960/61 the United Kingdom and Pakistan took 63.42% and 82.87% respectively of the total exports of hardwood. In 1961/62, India took 42.42% of the total hardwood exports (mainly hardwood railway sleepers). In 1962/63, exports to Jordan jumped to 56.23% of the total Burmese hardwood exports. Since 1963/64, exports of hardwoods have decreased drastically due to the large drop in production following nationalisation of the hardwood industry.

10.3 EUROPEAN MARKET PROSPECTS FOR TROPICAL HARDWOOD EXPORTS

The survey undertaken by GATT (1967) into the Western European market for tropical sawn wood found that the six countries surveyed, namely the United Kingdom, the Federal Republic of Germany, France, the Netherlands, the Belgium Luxembourg Economic Union, and Italy, accounted for 85% of the European imports of tropical sawn wood in 1965. Of this amount the United Kingdom alone accounted for 47% of the total European imports while the other EEC countries consumed the remaining 38%.

Table 10.9 shows the volume of tropical sawn wood imported by various countries, and their respective market shares, in 1965.

Table 10.9 Imports into Europe of Tropical Sawn Wood

Countries	Imports (000) m3	Percent
France	153	13.0
FRG	113	9.6
Netherlands	87	7.4
BLEU	65	5.5
Italy	33	2.8
Total EEC	451	38.3
U.K.	556	47.3
Total area surveyed	1,007	85.6
Denmark	48	4.1
Sweden	32	2.7
Spain	29	2.5
Others	61	5.1
Area not covered	170	14.4
Total	1,177	100.0

Source: GATT(1967), Pages 17 and 18.

The United Kingdom and EEC countries together imported 1 million m^3 of tropical sawn wood in 1965, a 26% increase over 1961 levels. Most of the increase was in the EEC countries, the total value of tropical sawn wood imported by them being $U.S. 87.2 million in 1965.

The survey also found that imports of tropical sawn wood expanded more rapidly between 1961 and 1966 than did imports of either tropical roundwood or non tropical sawn wood over the same period. Despite the drop in round wood imports, sawn wood imports are still running at a high level. Both tropical and non tropical sawn wood are imported, the type varying considerably between importing countries.

The survey also found that over 50% of the tropical sawn wood imported was supplied by Malaysia and the Ivory Coast. Other suppliers were Ghana, Nigeria, Mozambique, Burma, Thailand, Indonesia, Honduras, Guyana and Brazil. The market for tropical round wood was dominated by exports from four countries, namely the Ivory Coast, Nigeria, Ghana and Gabon.

Seven species, specifically keruing (Dipterocarpus spp.), ramin (Gonystylus bancanus), yang (Dipterocarpus spp.), teak (Tectona grandis), merantis (Shorea, Pareshorea, Pantacme, Hopea spp.), Sipo (Entandophragma utile), and afromosia (Pericopsis elata), represent about 60% of the total sawn wood imported into the countries in the survey.

Most of the EEC countries preferred to import logs rather than sawn wood, the majority of the importers being saw millers or veneer manufacturers who preferred to process the logs in their own mills. In this way they had better control of sawn wood quality and were able to cut the exact sizes demanded by the market at that time. Although 90% of Germany's log imports were tropical species in 1961 and the figure for 1966 was 89%, log imports from Burma

during the corresponding periods were only 0.8% and 2.1% respectively. Despite the increase in Burma's share of Germany's total log imports her share of German sawn wood imports was quite stable at 2.1% in both years. Ramin, keruing and merantis were the principle species imported and they formed 23% of Germany's tropical timber imports over the years 1964 to 1966.

Estimates by GATT (1967, Page xxviii) indicate that tropical sawn wood consumption in 1975 will increase to 2,232 thousand cubic metres of logs and sawn wood, a 27% increase over 1965 levels. Of this total, it is estimated that sawn wood consumption will be 1,429 thousand m^3 in 1975, a 50% increase over 1965 levels.

If the survey findings hold, Burma should be able to sell increased quantities of both teak and hardwoods in Europe. However, the present extraction system will need to be improved to permit the extraction of a greater volume of hardwoods and green teak logs from presently inaccessible areas.

Table 10.10 shows the average export price of green and dry teak logs for the year 1967 and 1969.

Table 10.10 Average Export Price of Teak Logs($A/c.ton)

Year	Green	Dry	Average
1967	647	394	441
1968	572	402	435
1969	411	315	341
Average	543	370	406

Source: Bulletin of Export Trade 1967, 1968 and 1969.

In 1967, the average export price per cubic ton of green teak logs was more than $1\frac{1}{2}$ times that of dry teak logs but dropped in the next two years. The highest export price per cubic ton of green teak logs ($A 903) was attained when 261 cubic tons were exported to the Belgium and Luxembourg Economic Union countries in 1967.

The reason for the drop in the prices of green and dry teak logs during 1969 is not clear but the percentage of green teak logs exports had risen from 18.61% to 19.34% and then to 27.87% of the total teak log exports in 1967, 1968 and 1969 respectively.

Burma largely controls the export market for teak but the hardwood market is much more competitive. Most of the African countries are potentially rich in forest resources and their closeness to the European markets gives them a substantial freight advantage over most of the Asian countries.

Although freight costs are a factor restricting the exports of hardwoods, the Malaysian saw mills have succeeded in boosting their sales of sawn wood in Europe and have captured between 30-50% of the tropical sawn wood market. This may be due to the superior qualities and better market service given by the Malaysian saw-millers who supply the correct sizes and moisture contents demanded by European buyers.

It seems evident that markets for teak and hardwoods will continue to be available in the future provided Burma can satisfactorily service the market requirements. Strict attention to details such as the quality of the sawn timber presented for sale is essential if Burmese exporters are to be successful.

CHAPTER 11

MARKETING STRATEGIES FOR THE FUTURE

11.1 INTRODUCTION

Before forecasts of consumption of sawn timber and paper and paper products can be made, the indicator variables selected in the analysis of demand for those products have to be projected into the future. Projections of these variables are discussed separately.

11.2 PROJECTIONS OF DEMAND FOR SAWN TIMBER

Forecasts of the following indicator variables have to be made before projections of the levels of demand for sawn timber can be completed

(i) Population

(ii) Income

(iii) Prices of sawn timber.

(iv) Wood availability index

11.2.1 Population Projections

Population is the most important determinant of demand for forest products in Burma. Since population projections are not available from other sources, estimates of Burma's population for the years 1980, 1990 and 2000 had to be made.

As mentioned in section 8.3.1, the growth in population between 1950 and 1953 was higher than for the period after 1953. In all, three time periods were selected for calculating the rates of population growth, i.e. (1) 1953/54 to 1963/64 which had a compound growth rate of 1.92 percent, (2) 1953/54 to 1969/70 which had a 2.02 percent growth rate and (3) 1949/50 to 1966/67 which had a higher growth rate of 2.16 percent. However, the 2.16 percent growth rate seems inappropriate because the earlier years (1949/50 to 1952/53) had a higher rate of growth than that prevailing in recent years.

Since it is unlikely that Burma will be officially restricting her population in the near future because of small population compared with neighbouring countries, the present growth rate should be applicable until the end of the century. Even so, the growth rate of 1.92 appears to be the most reasonable of the three estimates because individual families are likely to restrict their own reproductive rates in the future, particularly if the cost of living rises without any compensating increase in wage rates.

The following table gives the population projections for the years ending 1980, 1990 and 2000 using the three compound rates of growth mentioned above.

Table 11.1 Population Projections

Year	Low (Thousands) (1.92%)	Medium (Thousands) (2.02%)	High (Thousands) (2.16%)
1980	32,734	33,447	34,236
1990	39,579	40,841	42,390
2000	47,854	49,870	52,486

11.2.2 Income Projections

Income was shown to be an important determinant of demand for forest products in Burma. Consequently, income projections were necessary for projecting the demand for sawn timber in Burma. Projections of Gross National Product at factor cost were used in the cross-sectional analysis.

The only data on total and per capita Gross National Product at factor cost which were suitable for projection purposes were for the years 1949/50 to 1962/63. Prior to 1949/50 the economy was very unstable, mainly because of the insurrection problems. After 1962/63 the economy underwent substantial structural change as a result of nationalisation.

Compound growth rates were used for projecting both total and per capita Gross National Product at factor cost. The actual rates were calculated using the three time periods 1950/51 to 1961/62, 1950/51 to 1962/63 and 1949/50 to 1962/63. The compound rates of growth obtained for total Gross National Product at factor cost were 4.15, 4.25, and 4.72 percent respectively. The projections observed from the lowest growth rates seem to be the most likely to be achieved in view of the balance of payments problem and other economic difficulties.

The following table shows the projected total Gross National Product at factor cost and per capita Gross National Product at factor cost derived for the three years 1980, 1990, and 2000.

Table 11.2 Projected Total and Per Capita Gross Product at Factor Cost.

Year	Low		Medium		High	
	Per Capita $A	Total Million $A	Per Capita $A	Total Million $A	Per Capita $A	Total Million $A
1980	78.47	2,701	80.82	2,764	87.18	3,042
1990	95.12	4,057	99.12	4,189	110.84	4,826
2000	115,30	6,092	121.56	6,348	140.92	7,654

11.2.3 Wood Availability Index Projection

This variable is one of the more difficult to project because it will depend heavily on population growth and on government decisions on plantation establishment. Before attempting to project the Burmese wood availability index, a discussion of the composition of the existing forests and plantations is required.

In Burma, forests cover some 150,049 square miles of the total land area, 34,877 square miles being reserved forests and 115,172 square miles being unclassed forests. Approximately 10% of the unclassed forests in Lower Burma and 50% of the unclassed forests in Upper Burma are fully stocked.

The Teak Selection Working Circle (T.S.W.C.) covers all teak bearing areas whether in the reserved or the unclassed forests. The area of forests included in the T.S.W.C. is 23,138 square miles. The area of the Commercial Supply Working Circle (C.S.W.C.) is 9,492 square miles of which some 6,067 square miles overlap with the T.S.W.C. The area of forests in the Local Supply Working Circle (L.S.W.C.) is 2,276 square miles, of which some 1,045 square miles overlap the T.S.W.C.

About 56,242 square miles of the unclassed forests are in the T.S.W.C. while 810 square miles are in the C.S.W.C. The L.S.W.C. contains 4,557 square miles of unclassed forests of which roughly 2,801 square miles overlap the T.S.W.C.

The Forest Department has estimated that 450,000 round tons of teak and 2,400,000 round tons of valuable hardwoods could be extracted every year on a sustained yield basis from the existing forests. The present extraction of teak covers almost all teak bearing areas and is already close to the sustained yield level so the yield cannot be increased unless a programme to establish teak plantations is undertaken. On average, only 700,000 round tons of hardwood are extracted each year while the potential yield is 2,400,000 round tons.

The figure which Gregory (1966) took for the forest area in use in Burma did not include the area of the T.S.W.C. and plantations

which seem reasonable as only teak was extracted from that area at the time (Areas overlapping with this working circle were included). Consequently some 42,000,000 acres (19,000,000 hectares) of the T.S.W.C. which does not overlap with any other working circle has not been logged for its valuable hardwoods.

By 1936, an area of 106,208 acres of teak and other hardwood plantations had been established. Nearly 25% of the plantations were destroyed during the Second World War and only about 53,000 acres (50%) will be ready for utilisation by the year 2000. Since the yield from the plantation is six times that of a natural forest the plantation area that will be in full production by the year 2000 will have an output equivalent to 318,000 acres (144,545 hectares) of mixed forests at the existing rates of production.

If one third of the present virgin natural forest area still not in use and one third of plantations are made available for each decade ending 1980, 1990 and 2000, the area of natural forests and plantation available for each decade should be about 6,400,000 hectares.

When Gregory (1966) constructed the wood availability index he used an area of forest in use of 24,087 thousand hectares (19,684 thousand hectares of non coniferous forests and 4,403 thousand hectares of mixed coniferous and non confirous forests). It is almost impossible to find out which population date was used to derive the index or which proportion of the area of coniferous and hardwood forests in use out of the mixed coniferous and hardwood forests is not relevant to Burma. Consequently it was necessary to calculate

new coefficients for the hardwood and softwood sawn timber cut from all the hardwood and mixed softwood areas. (Gregory used 0.8 for the area of softwood forests in use and 0.2 for the area of hardwood forests in use). The following formula is used to calculate the new coefficients using 1963 population data (23,735 million) and a wood availability index of 32.

$$A = \frac{32 \times 23735}{142 \times 24087}$$

$$= 0.2221$$

Where A = new proportion for hardwood and mixed coniferous and hardwood areas.

This value is used for estimating the wood availability index for the years 1980, 1990 and 2000 using the following formula.

$$W.A.I. = 142. \frac{HM}{P} . A$$

Where W.A.I. = Wood availability index

HM = Area of both hardwood and mixed coniferous and hardwood forests in use (hectares)

P = Population

A = 0.2221

The following table shows the projected wood availability index for the respective periods.

Table 11.3 Projected Wood Availability Index

Year	W.A.I.
1980	29
1990	29
2000	29

The wood availability index is a proxy variable for the supply of sawn timber. The inclusion of this variable has the effect of including an approximation of potential wood supply although supply in its own right was not included in this analysis. The increased production from plantations offsets the increases in population with the result the W.A.I. is not expected to vary over the next thirty years.

11.2.4 Projections

The following equation was used for projecting the demand for sawn timber in Burma.

$$(27) \quad Y_3 = -4.2545 + 0.9591 \log X_8 + 0.0274 X_{10}$$

Where

Y_3 = Per capita sawn timber availability from cross sectional country data (c.ft.)

X_8 = Per capita G.N.P. at factor cost from cross-sectional country data ($U.S.)

X_{10} = Combined wood availability index.

The following table shows the projected demand for sawn timber in Burma up to the period ending 2000 using the equation given above.

Table 11.4 Projected Demand for Sawn Timber.

Period	Cross-Sectional*	
	Per capita c.ft.	Total th.c.tons
1980	0.89	583
1990	1.07	847
2000	1.26	1,206

*Does not include domestic consumption.

If the domestic demand for logs and sawn timber from the domestic sources is included in the figure for the demand for sawn timber derived from the cross-sectional analysis, the total demand for logs in the year 2000 will be more than the potential yield of valuable hardwoods in Burma, and approximately the same as the yield of total teak and valuable hardwoods. A compound growth rate of 2% is derived from R.G.U.B. (1969b, 1970) when the projected demand

for logs and sawn timber for domestic consumption for the years 1980, 1990 and 2000 was calculated.

A recovery percentage of 55% is used in converting the sawn timber to log equivalent volume.

Table 11.5 Projected Demand for Logs

	1980	1990	2000
Trade			
Sawn volume (000 c.ton)	583	847	1,206
Log equivalent volume (000 c.ton true)	1,349	1,960	2,792
Domestic			
Sawn volume (000 c.ton)	101	123	149
Log equivalent volume (000 c.ton true)	233	284	346
Log and Pole usage (000 c.ton true)	233	284	346
Total Domestic (000 c.ton true)	466	568	692
Total log and log equivalent	1,815	2,528	3,484

The use of the lowest projected value of per capita Gross National Product seems reasonable because the economy in Burma has been quite unstable recently and the latest devaluation of the Burmese currency will probably reduce the real growth of per capita income.

Any increase in population without a corresponding increase in the area of forest will tend to decrease the wood availability index. Burma's heavy usage of natural forests will also tend to lower the wood availability index.

Theoretically, projections derived from the cross sectional analysis should be more consistent than those derived from the time series analysis because the wood availability index approximates the potential supply of sawn timber from the existing forests. Such projections indicate potential demand rather than the actual demand because the actual demand is indicated by the intersection of supply and demand during that period and supply is influenced by the demand for exports. Burma is likely to be increasingly dependent on exports of timber products to balance the import bill. Hence in the future it is unlikely that the internal demand for sawn timber will be able to be fully met unless the rate of plantation establishment is increased or unless more efficient utilisation practices are implemented to allow greater utilisation of semi and nondurable hardwoods.

11.3 PROJECTIONS OF DEMAND FOR PAPER AND PAPER PRODUCTS

Projections of the following additional variables are required before projections of demand for paper and paper products can be completed

(i) Gross National Product at market prices

(ii) Literacy index.

11.3.1 Gross National Product at Factor cost

Gross National Product at Market prices has grown at a similar rate as the growth rate of Gross National Product at factor cost.

The compound growth rates of Gross National Product at market prices were 4.53, 4.57 and 5.09 percent respectively for the same three periods as those for which Gross National Product at factor-cost were calculated. The corresponding growth rates of per capita G.N.P. at market prices were 2.26, 2.34 and 2.79 percent respectively.

The following table shows the projected level of total G.N.P. at market prices and per capita G.N.P. at market prices up to the year 2000 using the compound rates of growth given above.

Table 11.6 Projected Total and Per Capita Gross National Product at Market Prices

Year	Low		Medium		High	
	Per Capita $A	Total Million $A	Per Capita $A	Total Million $A	Per Capita $A	Total Million $A
1980	91.40	3,185	93.19	3,222	102.14	3,576
1990	114.27	4,957	117.41	5,039	134.43	5,878
2000	142.86	7,717	147.92	7,879	176.92	9,660

11.3.2 Literacy Index

The literacy index of Burma in the cross-sectional analysis was, in fact, an estimate for the year 1961. A pilot literacy scale campaign was started in Burma in 1964 and a country-wide literacy campaign was launched later. The result was a substantial

increase in the percentage of the population who were literate (Win Tin, 1972). For example it has been estimated that the literacy index of the Monywa District in Burma is now 91.98% (Kyaw Min Kyaw, 1972). The latest literacy campaign (1972) covered almost the whole of Burma and was found to be very efficient. The authorities are trying to eliminate illiteracy by 1980 (Win Tin, 1972).

If this goal is achieved the rapid increase in literacy will be reflected very significantly in the increased consumption of cultural paper in the future.

It is hard to estimate the literacy index for the projection years but, with the recent increases in the literacy index, it is anticipated that the literacy index of Burma will increase to 85, 90 and 95 percent respectively for the years 1980, 1990 and 2000. These estimates are conservative when compared to the published statements referred to above, but seem to be more realistic and hence, more likely to be achieved.

11.3.3 Projections

The equations used for projecting the demand for cultural and industrial paper in Burma are given below.

(18) $\text{Log } Y_{14} = -4.2424 + 0.8469 \log X_{20} + 0.0234 X_{21}$

(19) $\text{Log } Y_{15} = -6.3377 + 1.5396 \log X_{20}$

Where Y_{14} = Per capita cultural paper availability from cross-sectional country data in pounds.

Y_{15} = Per capita industrial paper availability from cross-sectional country data in pounds.

X_{20} = Per capita G.N.P. at market prices from cross-sectional country data ($A)

X_{21} = Literacy index.

Table 11.7 shows the projected demand for cultural and industrial paper in Burma up to the period ending 2000 using the above equations which were derived from the cross-sectional analysis.

Table 11.7 Projected Demand for Cultural and Industrial Paper

Period	Cultural		Industrial		Total	
	Per Capita (lbs)	Total (000 tons)	Per Capita (lbs)	Total (000 tons)	Per Capita (lbs)	Total (000 tons)
1980	4.79	70.00	1.84	26.89	6.63	96.89
1990	6.52	115.20	2.60	45.94	9.12	161.14
2000	8.88	189.71	3.68	78.62	12.56	268.33

The lowest per capita G.N.P. at market prices was used to project the level of demand for both cultural and industrial paper.

The following table shows the projected demand for round logs for making paper and paper products.

Table 11.8 Projected Demand for Round Wood Equivalent Log Volumes for Paper Production.

Period	Cultural (000 c.ft.)	Industrial (000 c.ft.)	Total (000 c.ft.)
1980	8,050	2,689	10,739
1990	13,248	4,594	17,842
2000	21,817	7,862	29,679

CHAPTER 12

IMPLICATIONS, RESEARCH REQUIREMENTS, POLICY RECOMMENDATIONS AND CONCLUSION

12.1 IMPLICATIONS

12.1.1 General Economy

Rice has been the main export of Burma since before the Second World War. An average 3,198,000 tons of rice were exported annually between 1936 and 1941 but this figure fell to 883,464 tons between 1963/64 and 1968/69. As mentioned in section 2.7, Burma has been faced with balance of payments problems since 1955/56, largely as a result of the rapid drop in the export price of rice since 1953. Most of the major rice importing countries, e.g. India, Ceylon, Indonesia and Japan, decreased their import of Burmese rice from 1955/56 onwards because wheat was made available to them by America, usually in the form of gifts. About the same time the production of rice became so high in America, Japan, and some of the Western European countries, (R.G.U.B., 1970) that they built up surplus stocks of rice which were either given away or sold on easy credit terms to the rice importing countries. The average export price of rice and rice products from 1950 to 1967 is given in Appendix G.1.

By 1960 the average export price per ton of rice and rice products had dropped to less than half of the level received in 1953. Although the export price of rice had fallen, the import

prices of other commodities were rising steadily and adversely affecting the terms of trade, a situation common to most developing countries which are heavily dependent upon the export of agricultural products. Export and import price indices for Burma are given in Appendix G.2. The indices indicate that the trend of export prices has been slightly downwards whereas the import price index has risen steadily since 1962/63. The export price index during the first half of 1969/70 dropped alarmingly to 84.2 (1963/64 = 100) while the import price index rose slightly to 117.0.[1] In all the post-war years except 1967/68, 1968/69, and the first half of 1969/70, the export price index for rice and rice products was lower than the general export price index.

The trends in the value of commodity imports for the years 1940/41, 1950/51, 1960/61, and 1968/69, are shown in Appendix G.3. Imports of all commodities except machinery and transport equipment, fell between 1960/61 and 1968/69.

The trends in the values of commodities exported from Burma for the corresponding periods are shown in Appendix G.4. From these tables it is clear that the value of commodities imported has exceeded the values of commodities exported during the post-war years. The pattern of the export trade has changed dramatically. The total value of exports in 1968/69 was slightly lower than the total value of exports in 1940/41 in which year exports of rice and rice products accounted for 50 percent of the value of all exports whereas timber exports made up only 5.9 percent of the total. The value of rice and rice product exports fell from a 1956/57

1 - Revolutionary Government of the Union of Burma, 1969b, Report to the People for the year 1969/70.

peak of $A 167.829 million, which was 75 percent of all exports, to $A 44.039 million in 1968/69. The value of timber exports increased nearly three hundred percent between 1950/51 and 1968/69 so that, by 1968/69, rice and rice crop exports made up only 42% of the total value of exports while timber exports constituted about 29 percent of the total.

Since most of the rice deficit countries will be self sufficient in the near future, the future prospects for maintaining rice export markets appear to be poor. Consequently any increase in export trade will most likely have to come from other sources. Serious consideration will have to be given to the development of import replacement industries in order to reduce the import bills for any finished materials and products which could be produced economically in the country.

12.1.2 Demand for Forest Products

Both the internal demand for sawn timber and paper and paper products and the level of timber exports are expected to increase in the near future. It appears from chapter 11 that, in Burma by the year 2000, both the demand for paper and paper products and the demand for sawn timber could become so large that the authorities will have to find ways to increase forest production if supplies are to be adequate. The analysis of chapter 10 also indicates that the future export possibilities for timber by itself could make it a major earner of foreign exchange since the export markets for both logs and sawn timber seem likely to increase considerably

in most European countries. On the other hand, the paper and paper products industry is still in a very early stage of development and it will take some time before it can meet the present internal demand for paper and paper products.

The current value of imports of paper and paper products into Burma in 1950/51 was $A 4.744 million compared with $A 6.248 million in 1968/69. This increase occurred after import restrictions had been imposed because of balance of payments difficulties. The development of import replacement industries such as the establishment of a paper and paper products industry was largely due to the ready availability of suitable raw materials. If a paper and paper products industry had not been established, the analysis indicates that by the year 2000 the import bill for those products, using 1968/69 prices, could be approximately $A 55 million.

Exports of timber will need to be increased if foreign exchange earnings are to be maintained or increased. Teak exports could be expanded either by increasing production to the pre-war level or by decreasing the volume consumed in Burma. Exports of both semi-durable and durable hardwoods could be increased by extracting more hardwoods from the accessible areas and by the construction of more roads into the presently inaccessible areas. The increased use of non-durable species could also result from increased road access to the presently inaccessible areas, from faster extraction as a result of the introduction of mechanical equipment, and from the building of preservation plants. An integrated extraction operation removing much larger volumes per acre could significantly

reduce extraction costs. Internal sawn timber consumption could be directed away from teak and some of the more valuable hardwoods towards the non-durable species, provided the non-durable species were adequately treated with preservatives. This would also allow increased exports of teak and other valuable hardwoods to be achieved.

As Burma does not have the equipment and skill to produce high quality products, she could earn more profit at this stage by exporting raw materials rather than finished products. Such a policy would reduce the high level of wastage in transforming the raw material into finished products. Furthermore, the price realised by exporting finished products has been much lower than the price received for raw material exports.

The use of bamboo for paper manufacture seems likely to increase substantially as pulp and paper production is increased. A substitute may have to be found for any bamboos used in the construction of dwellings if the paper industry expands sufficiently to meet the consumption levels estimated for the year 2000.

12.1.3 Timber Extraction

As mentioned in section 5.2 about two thirds of the elephants power used for the extraction of timber is owned by timber contractors. This means that most of the extraction work still has to be done by the contractors.

Although it has been estimated that there are about 6,500 wild elephants in Burma (Kyaw Thein, 1969) there is some doubt about the accuracy of this number and the ability of the extraction

agency to catch them. Consequently it is unlikely that the number of elephants required for extraction will be obtained in the near future. Therefore, if Burma is to increase the extraction of teak and hardwoods, some form of mechanisation will be required.

Although some mechanical equipment has been obtained, its use is restricted to certain parts of the country. At the same time, spare parts are not readily available, mainly because they have to be imported. The low yield per acre is another problem for mechanical extraction but it would most likely be solved by introducing appropriate equipment.

Loss of teak logs during single log floating has been a great problem in Burma. It appeared to be serious when logs placed in the floating stream were compared with log output in the same year but, as already indicated, teak logs take an average three years to float down the streams to the depot. With a three year time lag between log input into the floating stream and log output at the depot, the loss during single log floating of teak is quite small, although some deterioration is almost certain to occur. The most serious cost of the log floating process most likely lies in the $A 12,000,000 worth of logs which are in the streams at any one time.

Wages are another aspect of Burmese timber extraction which seem to need attention. Before the nationalisation of the timber trade the extraction of teak was mainly carried out by contractors whose employees were better paid than government employees. With nationalisation these people suffered a reduction in wages so there was less incentive for them to work hard and be efficient.

12.1.4 Timber Processing

The export prices received for finished timber products depend mainly on the quality of the products produced by the processing plants. Most of the processing plants in the country have been unable to produce high quality products with the result that Burma has received low prices for the finished products. The average price of teak sawn timber has been declining, both in monetary and real terms, for some time. The export market for Burmese plywood is very small while the price received for Burmese veneer is quite low. Even though the number of plywood and veneer factories in Burma has risen from one to three in recent years the production of plywood has dropped since nationalisation.

While teak log prices remain substantially higher than sawn timber log volume prices (about six and a half times higher in 1966/67), it seems logical to sell teak in the form of logs rather than sawn timber, unless more efficient conversion and better quality control can be achieved in Burma itself. Most of the exported logs are used for veneer production and foreign processors are willing to pay high log prices while the international price of veneers are high. Most of the teak log importers have their own capital intensive processing plants, and prefer to import raw material rather than finished products.

The discussion in chapter 10 indicated that the demand for hardwood sawn timber imports in Western European countries would increase substantially by the year 2000. If Burma wishes to increase her share of that increased market than she will have to

provide better quality control and market service and will also have to change from the British system to the Metric system of measurement and market sizes.

To achieve the production of good quality products requires modern equipment and machinery, a better trained and highly skilled work force, and good management. It will also be necessary for Burma to introduce relevant changes in technology as they occur but the cost of new machinery could be a severe drain on Burma's limited overseas funds unless very substantial real gains in productivity and output result.

Being an import replacement industry, the paper and paper products industry could play a vital role in saving overseas exchange in the future especially in view of the expected increase in paper consumption accompanying increases in population size and literacy levels. However, the economic efficiency of the industry will have to be watched carefully if it is to achieve its objectives at reasonable cost levels.

The building of more saw mills or the expansion of existing ones should be carefully considered with a view to increasing hardwood sawn timber exports. Mismanagement, bad planning, or misallocation of capital resources, such as occurred with State Saw Mill No. (5) at Moulmein (operating at only one third of its 30,000 cubic tons capacity), should be avoided.

The prospects for exporting wood chips look reasonable in the future. Most of the hardwood trimmings and tops are left in the forests during extraction. If mobile or small scale chippers

could be attached to saw mills or used in the forests the possibility of utilising the trimming, the tops, and the saw mill waste, appears promising. However such practices will need careful economic investigation before being implemented.

12.1.5 Export Possibilities

Green teak logs have been fetching much higher prices in export markets than dry teak logs. If more green teak could be extracted, a lot of the expenditure on girdling would be eliminated and there would be a reduction in the opportunity costs of girdling and then waiting six years before processing. Alternatively the increased growth on the trees, if allowed to grow the extra six years, would equal an average 2 cubic feet per tree. The demand for teak logs, whether dry or green, has been so great that Burma could not fully meet the demand until recently. On the other hand, the demand for sawn teak has not been nearly as great as the demand for logs.

The demand for hardwood sawn timber in Western European countries is high at present and is expected to grow. However, Burma has lost a number of hardwood export markets through poor market servicing, inferior quality control, and unstable supply. Every effort should be made to regain these markets provided the problems of extraction and processing can be overcome.

12.1.6 Wage Rates

The existing labour wage rates and the pay scales for all the government services have been fixed and no new revisions have been made since Independence although the cost of living has risen substantially.

A composite index derived from R.G.U.B. (1965) and the Consumer Price Index (R.G.U.B.,1971) rose from 100 in 1950 to 114.51 in 1964. However, the index was calculated using prices from the people's shops. Since there was a very limited supply of commodities available from the people's shops the actual increase when unofficial market prices are considered would be nearer 100 to 200 percent.

A major review of wage rates is essential if economic incentives are to be restored and efficiency is to be improved, or even maintained, in the future. Prior to nationalisation, a bonus system was commonly used in private enterprise. The removal of the bonus system after nationalisation substantially reduced the level of incentive for employees to fulfill their duties satisfactorily. The problems of the present economy are largely attributable to this lack of incentive coupled with the need for the work force to have multiple jobs in order to maintain their standard of living.

12.1.7 Training

Inadequate training is evident in most areas of the economy and is significantly reducing the efficiency of production processes throughout the country. Training is needed at all levels but is especially important at managerial and administrative levels in jobs which require high levels of planning and executive skill. In service training is needed for all specialist equipment operators because the output of any equipment is heavily dependent upon the operators skill in using and maintaining that equipment.

12.2 RESEARCH REQUIREMENTS

As Burma does not have a Forest Research Institute all forestry research has been carried out by the Forest Research and Training Circle in Rangoon. Research on the properties and manufacture of paper and paper products has been carried out by the Union of Burma Applied Research Institute in Rangoon which was formed in the early fifties. Unfortunately, the Forest Research and Training Circle is understaffed, the research facilities are inadequate, and most of the researchers have to fulfill other duties apart from research. As a result, only elementary research is carried out.

There are just four research branches under the Forest Research and Training Circle. They are:-

(1) Forest Economics Research Branch

(2) Forest Silvicultural Research Branch

(3) Wood Anatomy and Biology Research Branch, and

(4) Timber Physics and Mechanics Research Branch

The compilation of data on the production of the forest products in all divisions and on forest products exports, as well as research on the different kinds of minor forest products, is carried out by Forest Economics Research Branch. The Silvicultural Research Branch maintains three permanent nurseries in the country, most of the silvicultural research being undertaken in these nurseries. The nurseries also supply teak stumps and other tree seeds required by the Forest Divisions for intensive plantation schemes and so on. Timber identification work is carried out by the Wood Anatomy and

Biology Research Branch. Testing of timber is carried out by the Timber Physics and Mechanics Research Branch. The last two sections are under the Divisional Forest Officer of the Timber Research and Agency Division.

Since Burma will be heavily dependent on the present forest resources to meet the increased future levels of exports and internal consumption, it is essential that a Forest Research Institute be established to carry out both basic and applied research work which is aimed at achieving a higher level of production of top quality products.

A sound national forest policy based on the best available estimates of Burma's future requirements is required so that the growing, harvesting, and processing, of the different products can be planned and implemented. Long term forecasting of demand for forest products has a vital role in formulating a sound forest policy for the future, a role which is particularly important in forestry where the production period is long relative to that of other agricultural products. Scientific estimation of future requirements requires a substantial research effort if reasonably accurate results are to be obtained.

Sound forest planning and reliable estimates of both the existing growing stock of the forests and the growth functions of the important species are dependent upon good inventory data. Future forest inventory projects should include the measurement of as many species as practicable. Since almost all of the forests in Burma are mixed forests, sample sizes will need to be fairly large and will

be costly in both money and time. Research work to determine the optimum size and optimum number of sample plots is urgently needed so that reliable results can be obtained at minimum cost.

Estimates made in chapter 11 indicate that the internal demand for sawn timber and paper and paper products will increase substantially over the next thirty years. If Burma is to meet the anticipated increase in future demand for forest products it is essential that high priority be given to research into economic methods of extracting and preserving any nondurable species which are not usable at the present time. Research work should be directed into the possibilities of using nondurable hardwoods as sawn timber after treatment with preservatives. Alternatively, these species might be used as wood chips, either by the Burmese paper and paper products factory or by exporters.

Large scale timber seasoning and preservation will be necessary if the sawn timber derived from semidurable species is to be earmarked for export while the nondurable timbers are used for internal consumption. Research is required to determine the most profitable method and the optimal scale of plant for seasoning and preserving each species. Proper seasoning of hardwoods will be very important in the future if any major expansion of export markets is to be achieved. Most of the hardwood sawn timber importers have very exact moisture content requirements for sawn timber.

Research into the applicability of mechanical extraction equipment to the terrain and weather conditions in Burma is necessary to determine whether the equipment is more economic and better suited

to Burmese conditions than the animal power and antiquated equipment now being used. The research should be undertaken urgently because Burma will not be able to extract very much larger volumes of timber if the existing methods and equipment are retained.

The suitability of hardwood species for pulping should also be investigated. Burma is rich in hardwood species whose pulping qualities are unknown. If proved satisfactory, they might supplement bamboo as a paper raw material and possibly have an important influence on the prospects of Burma gaining a woodchip export market.

Investigations into the economics and feasibility of establishing large scale plantations of valuable species for producing sawn timber to meet future internal consumption and anticipated export markets is vital. Research into the suitability of fast growing species for pulping to supplement the bamboo resources should be undertaken. This is essential if the capacity of the paper and paper products industry is to be expanded to meet the anticipated substantial increase in internal demand while reducing the unit cost of production of paper and paper products through greater economies of scale. A careful economic analysis of the different sizes, location, and types of plantations and species, is necessary if the best use is to be made of Burma's scarce capital resources.

12.3 POLICY RECOMMENDATIONS

Estimates of the future demand for paper and paper products and sawn timber to the year 2000 indicate that, unless forest production can be increased substantially, supply will be significantly

less than demand. The area of plantations or the growth rates of the existing forests, or both, need to be increased. The largely unutilised semi and nondurable species should be harvested much more intensively. The domestic demand for sawn timber by 2000 is estimated to be equal to the present yield of all hardwoods, durable as well as semidurable, from all of the forests in Burma, thus leaving none for export markets or for pulp and paper production. It seems evident that production must be increased to meet the future local demand for sawn timber while leaving a substantial volume for export markets. If nondurable species could be successfully treated they might be directly substituted for more durable species in the internal sawn timber demand thereby allowing the other valuable species to be exported to earn foreign exchange.

The extension of the Hardwood Supply Working Circle should be achieved as quickly as possible by building more extraction roads and by achieving greater level of economic utilisation of the non-durable species. Since the establishment of processing plants takes time it may be necessary to find temporary chip export markets for the nondurable species. The introduction of wood chipping machines should increase the level of timber utilisation, leave less of the tree behind in the forest, and, if also attached to saw mills, should allow the recovery of a substantial volume of material which is wasted at present.

The export of green teak logs should be encouraged to exploit fully the appreciable price differential between dry and green logs. The construction of more extraction roads into the areas at present unroaded should facilitate the extraction of greater volumes of green teak logs.

The present system of extraction is rather inefficient, mainly because :-

(1) There is a lack of economic incentives for S.T.B. workers compared to the workers employed by private contractors.

(2) Opportunities exist for the contractors to overcharge on snigging costs and are likely to lead to corruption between S.T.B. subordinate staff and the contractors thus decreasing the economic return to the nation.

(3) Nationalisation of the entire timber trade placed a very heavy burden on the limited S.T.B. resources which are responsible for carrying out the extraction of both teak and hardwoods.

If extraction continues to be left to contractors because of a shortage of S.T.B. staff, the possibility of forming co-operative societies for the extraction of hardwoods should be seriously considered. The S.T.B. would then be able to concentrate on the efficient extraction of teak.

Mechanical equipment should be introduced to supplement animal power as quickly as possible. The type of equipment to be procured will have to be carefully considered before it is introduced and its maintenance must be capable of being carried out in the country without prolonged delays.

Establishment of timber preservation plants are essential for increasing the use of nondurable species. Investigations into the present techniques of producing plywood and veneers is vital

because the production of both plywood and veneers has declined despite the recent establishment of two more plywood factories. The decision whether to establish more plywood and veneer factories will depend on the prospects of the existing ones being able to produce more and better quality products for export. New Saw Mills will be required if any major expansion of the new hardwood export market occurs. The seasoning of hardwoods for export markets will be necessary in the future to meet the rigorous European market requirements.

A rapid expansion of the paper and paper products industry will be necessary if local production is to meet the anticipated future demand for paper and paper products. An inventory of the raw materials for making paper and paper products and a thorough economic evaluation of the development plans will be a prerequisite for deciding on the future capacity of the paper and paper products mills.

Provided satisfactory economic returns are achievable, fast growing species should be given preference in plantation establishment. However, the establishment of valuable hardwood species should also be carried out in economically favourable areas.

It is essential that the present pay scales and wage rates be revised as soon as possible so that incentives can be restored and employees can be compensated for increases in Burma's cost of living.

On the job and pre job training of personnel in their respective fields of production is essential to increase productivity and reduce costs.

12.4 CONCLUSION

Estimates of future forest products consumption, so vital for sound forest and industry development planning, should be regularly updated. These estimates should be incorporated in sound development planning to ensure that the scarce capital and other national resources of Burma are used in the most efficient manner. In this way, the standard of living and social conditions of the people of Burma are likely to be improved.

The analysis projects forest products consumption thirty years into the future but this time span is really too short for satisfactory forest development planning because of the long production periods involved in growing trees.

Single equation models were found to be effective for long term projections of the demand for Burmese forest products. A time series analysis of Burmese forest products consumption data did not give satisfactory results probably because of the frequent market structural changes which have occurred. The cross-sectional analysis of countries gave more satisfactory results for projection purposes but a detailed study of time series data should be undertaken if more accurate data becomes available. This will provide a check on the accuracy of the cross-sectional analysis results obtained in this study.

Forestry can play an increasingly important role in earning foreign exchange in the future provided the production and processing problems outlined above can be overcome and provided sound forest and

industrial development plans are developed and implemented. More attention needs to be paid to mechanisation of the extraction industry, and to the training, skills and incentives of the people working in the production processes in the country.

Since the stream floatation of teak logs takes about three years it is not possible to increase the production of teak in the immediate future under the present method of extraction. One way to increase the production of teak fairly quickly would be to put more logs in the floating stream from now on so that an increased log input will reach the depots from three years onwards. There are still more than one million standing girdled trees (about five years supplies at the present rate of extraction) waiting for extraction so substantial increases in teak log production should be possible provided adequate snigging capacity is available. The latter, however, depends on substantially increased mechanisation because a rapid increase in elephant power is unlikely to occur. The solution seems to be more snigging from stump to floating stream which, in turn, calls for more equipment for extraction.

Fully trained and competent managerial staff are necessary in all the processing industries if increased production and better quality control are to be achieved.

Increased export earnings from forestry are likely to be attained provided the existing problems in the forestry and forest products industries can be solved. Furthermore, the development and implementation of sound forestry and a healthy forest products industry will make a substantial contribution to the future development of the nations economy.

(Footnote - The wage rates of all the employees throughout Burma were very recently revised. In the writer's opinion the resultant increases have not been sufficient to create the level of incentive necessary in raising efficiency in the forest products industries to the desired levels).

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APPENDIX A

RATIO OF TOTAL HARDWOOD EXPORT TO TOTAL HARDWOOD LOG EXPORT

Year	Total Exported (Log & Sawn)	Log Exported c.tons (Hoppus)	Sawn Exported c.tons (True) (2) - (3)	Log Equivalent for sawn exported (0.55) c.tons (Hoppus)	Total log Equiv. Exported c.tons (Hoppus) (3) - (5)	Ratio of Total Hardwood Log Export to Total Hardwood Export (2)/(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1958-59	25,844	978	24,866	45,211	46,189	0.56)
1959-60	10,264	4,254	6,010	10,927	15,181	0.68)
1960-61	9,700	3,257	6,443	11,715	14,972	0.65)
1961-62	18,657	859	17,798	32,360	33,219	0.56)
1962-63	22,313	4,394	17,919	32,580	36,974	0.60)
1963-64	4,722	161	4,561	8,293	8,454	0.56)
1964-65	3,318	186	3,132	5,695	5,881	0.56) 0.59
1965-66	708	20	688	1,251	1,271	0.56)
1966-67	5,310	31	5,279	9,598	9,629	0.55)
1967-68	699	77	622	1,131	1,208	0.58)
	101,535				172,978	

Source: Export Bulletin 1958/59 to 1961/62, 1963/64, 1963 to 1968.

APPENDIX B

CLASSIFICATION OF PAPER AND PAPER PRODUCTS

1. Newsprint

2. Printing and writing paper - uncoated printing paper, uncoated writing paper, duplicating paper, coated printing paper, coated writing paper, exercise books, envelopes, writing pads, note books, scribbling pads, albums, diaries and memorandum, registers, other paper in boxes or packets, ledger paper, ruled or squared paper, fancy including embossed paper, duplicating paper cut to size.

3. Wrapping paper - old newspaper, paper waste and old paper n.e.s., kraft paper, brown wrapping paper, wrapping paper, paper coated or impregnated, paper bags.

4. Paper board - file covers and index card, paper board and cardboard, corrugated and similar paper, corrugated and similar board, paper board n.e.s., packing containers of paper or paper boards, other paper board cut to size, building boards, paper bituminised, paper board coated or impregnated, filing containers of paper or paper board.

5. Other paper - filter blocks of paper pulp, filter paper, paper n.e.s, carbon paper cut to size, other paper cut to size, articles of paper, paper board or cellulose wadding, blotting paper, cigarette paper, cigarette paper cut to sizes, sanitary paper, tissue paper, grease proof paper, wall paper, other copying paper cut to size.

APPENDIX C

DATA USED IN THE TIME SERIES ANALYSIS OF DEMAND FOR SAWN TIMBER

Year	Per capita sawn timber availability from trade (c.ft.) Y_1	Per capita sawn timber availability from trade and domestic (c.ft.) Y_2	Per capita Gross Domestic Product at constant 1961/62 prices X_1
1946/47	-	-	45.514
1947/48	-	-	48.929
1948/49	0.266	0.346	42.912
1949/50	0.282	0.367	42.690
1950/51	0.365	0.455	45.625
1951/52	0.509	0.605	48.437
1952/53	0.564	0.666	48.806
1953/54	0.802	0.909	48.629
1954/55	0.857	0.967	51.324
1955/56	0.793	0.906	51.163
1956/57	0.914	1.029	56.388
1957/58	0.898	1.016	53.294
1958/59	0.786	0.908	59.083
1959/60	0.796	0.920	61.600
1960/61	0.919	1.046	60.823
1961/62	0.861	0.992	62.176
1962/63	0.922	1.054	65.798
1963/64	0.843	0.977	62.246
1964/65	0.783	0.918	63.974
1965/66	0.678	0.818	60.589
1966/67	0.735	0.878	57.345
1967/68	0.722	0.869	62.053
1968/69	-	-	62.565
1969/70	-	-	62.665

APPENDIX C (Cont'd.)

Year	Per capita Gross Domestic Product at Market Prices ($A) X_2	Per capita Personal Disposable Income at Market Prices ($A) X_3	Sawn Timber Weighted Price $A/c.ft. X_4
1946/47	42.191	35.818	-
1947/48	47.996	38.775	-
1948/49	41.057	33.605	-
1949/50	40.481	32.600	-
1950/51	46.279	37.057	-
1951/52	49.629	39.146	-
1952/53	51.084	38.610	-
1953/54	51.535	40.507	1.042
1954/55	52.143	41.937	0.979
1955/56	53.345	43.105	1.093
1956/57	55.802	44.107	1.084
1957/58	55.061	43.628	1.140
1958/59	56.144	44.481	1.166
1959/60	59.328	45.496	1.199
1960/61	59.563	46.031	1.366
1961/62	62.176	47.628	1.235
1962/63	64.138	49.883	1.294
1963/64	59.730	-	1.216

Year	Bamboo Weighted Price $A/100 X_5	Brick Price $A/1000 X_6	Deflated Sawn Timber Weighted Price $A/c.ft. X_7
1953/54	7.868	-	1.180
1954/55	8.630	-	1.066
1955/56	9.762	16.144	1.116
1956/57	10.131	18.011	1.043
1957/58	9.186	16.310	1.140
1958/59	8.997	15.183	1.312

APPENDIX C (Cont'd.)

	X_5 (Cont'd.)	X_6 (Cont'd.)	X_7 (Cont'd.)
1959/60	8.058	18.928	1.199
1960/61	8.443	19.137	1.324
1961/62	9.568	15.947	1.218
1962/63	7.127	15.941	1.311
1963/64	8.066	-	1.211
1964/65	7.498	-	-
1965/66	8.061	-	-
1966/67	8.249	-	-

Year	Deflated Bamboo Weighted Price $A/100 X_{23}	Deflated Brick Weighted Price $A/1000 X_{24}	Consumer Price Index 1957/58 = 1 X_{25}
1953/54	8.911	-	0.883
1954/55	9.401	-	0.918
1955/56	9.971	16.490	0.979
1956/57	9.751	17.335	1.039
1957/58	9.186	16.310	1.000
1958/59	10.120	17.079	0.889
1959/60	8.058	18.928	1.000
1960/61	8.181	18.544	1.032
1961/62	9.436	15.727	1.014
1962/63	7.221	16.151	0.987
1963/64	8.034	-	1.004

APPENDIX D

DATA USED IN THE CROSS-SECTIONAL COUNTRY ANALYSIS OF DEMAND FOR SAWN TIMBER

Country	Per Capita Total Sawn Timber Availability (c.ft.) Y_3	Per Capita G.N.P. at Factor Cost ($U.S.) X_8	Combined Wood Availability Index X_{10}
U.S.A.	17.149	3,520	80
Sweden	23.241	2,270	91
Switzerland	8.524	2,250	15
Australia	12.413	1,840	61
Denmark	12.730	1,830	3
France	6.600	1,730	13
Norway	17.535	1,710	87
F.R.G.	7.372	1,700	11
Finland	16.460	1,600	100
Netherlands	8.035	1,420	2
Austria	10.605	1,150	43
Italy	3.397	1,030	5
Ireland	3.713	850	5
Greece	3.039	660	14
Spain	2.885	640	35
South Africa	2.311	550	4
Yugoslavia	3.853	510	18
Portugal	4.266	380	20
Iraq	0.538	270	4
Brazil	2.021	240	26
Ghana	0.852	230	10
Morocco	0.577	170	2
Philippines	1.119	160	8
Thailand	1.240	130	30
Uganda	0.234	100	1
Pakistan	0.174	90	2
Nigeria	0.144	80	1
Tanzania	0.125	80	23
Burma	0.672	60	32

APPENDIX D (Cont'd.)

Country	Per Capita Hardwood Sawn Timber Availability (c.ft.) Y_{16}	Per Capita Gross National Product at Factor Cost ($U.S.) X_{26}	Hardwood Wood Availability Index X_9
W. Malaysia	3.850	320	0.67
Thailand	1.236	130	21.71
Congo Brazzaville	1.100	120	33.81
Cen. Afr. Rep.	1.039	110	2.62
Ghana	0.850	230	9.60
Burma	0.672	60	28.35
Mauritius	0.651	210	0.24
Congo D.R.	0.248	60	11.54
Togo	0.222	100	6.18
Pakistan	0.173	90	0.67
Nigeria	0.144	80	0.47

DATA USED IN THE TIME SERIES ANALYSIS OF DEMAND

FOR PAPER AND PAPER PRODUCTS

Year	Per Capita Newsprint Availability (lbs) Y_4	Per Capita Printing & Writing Paper Availability (lbs) Y_5	Per Capita Wrapping Paper Availability (lbs) Y_6	Per Capita Paper Board Availability (lbs) Y_7
1946/47	0.131	0.134	0.677	0.087
1947/48	0.541	0.536	0.232	0.026
1948/49	0.143	0.282	0.288	0.020
1949/50	0.512	0.060	0.052	0.310
1950/51	0.731	0.303	0.393	0.242
1951/52	0.161	0.296	1.086	0.269
1952/53	0.487	0.414	0.736	0.228
1953/54	0.453	0.585	0.818	0.358
1954/55	1.113	0.377	0.515	0.251
1955/56	1.036	0.641	0.323	0.488
1956/57	1.009	0.736	0.600	0.582
1957/58	0.753	0.438	0.413	0.381
1958/59	1.055	0.683	0.496	0.420
1959/60	1.086	0.615	0.223	0.407
1960/61	1.219	0.702	0.563	0.473
1961/62	1.579	0.800	0.487	0.543
1962/63	1.213	0.903	0.148	0.536
1963/64	1.193	2.018	0.520	0.622
1964/65	1.068	1.450	0.402	0.108
1965/66	0.599	0.707	0.094	0.172
1966/67	0.837	0.467	0.075	0.130
1967/68	1.488	1.162	0.210	0.268
1968/69	0.799	0.994	0.238	0.280

APPENDIX E (Cont'd.)

Year	Per Capita Other Paper Availability (lbs) Y_8	Per Capita* Total Paper and Paper Board Availability (lbs) Y_9	Per Capita Cultural Paper Availability (lbs) Y_{10}	Per Capita* Industrial Paper Availability (lbs) Y_{11}
1946/47	0.117	1.147	0.265	0.882
1947/48	0.179	1.516	1.077	0.439
1948/49	0.084	0.816	0.425	0.391
1949/50	0.011	0.945	0.572	0.373
1950/51	0.008	1.677	1.034	0.643
1951/52	0.029	1.841	0.457	1.384
1952/53	0.016	1.881	0.901	0.980
1953/54	0.033	2.247	1.038	1.209
1954/55	0.041	2.297	1.490	0.807
1955/56	0.043	2.531	1.677	0.854
1956/57	0.049	2.976	1.745	1.231
1957/58	0.025	2.011	1.191	0.820
1958/59	0.020	2.675	1.738	0.937
1959/60	0.023	2.354	1.701	0.653
1960/61	0.076	3.033	1.921	1.112
1961/62	0.069	3.479	2.379	1.100
1962/63	0.081	2.881	2.116	0.765
1963/64	0.216	4.569	3.211	1.358
1964/65	0.133	3.160	2.518	0.642
1965/66	0.114	1.685	1.306	0.379
1966/67	0.099	1.608	1.304	0.304
1967/68	0.188	3.315	2.650	0.665
1968/69	0.101	2.412	1.793	0.619

* Difference is due to rounding off error.

APPENDIX E (Cont'd.)

Year	Newsprint Prices ($A/lb.) X_{11}	Printing and Writing Paper Prices ($A/lb.) X_{12}	Wrapping Paper Prices ($A/lb.) X_{13}	Paper Board Prices ($A/lb.) X_{14}
1946/47	0.074	0.122	0.048	0.044
1947/48	0.086	0.113	0.057	0.081
1948/49	0.075	0.100	0.059	0.053
1949/50	0.076	0.132	0.081	0.074
1950/51	0.124	0.189	0.070	0.141
1951/52	0.110	0.237	0.029	0.171
1952/53	0.067	0.135	0.044	0.089
1953/54	0.073	0.139	0.044	0.097
1954/55	0.079	0.133	0.051	0.074
1955/56	0.082	0.144	0.059	0.087
1956/57	0.079	0.146	0.061	0.132
1957/58	0.072	0.142	0.042	0.098
1958/59	0.069	0.118	0.048	0.099
1959/60	0.069	0.134	0.086	0.107
1960/61	0.070	0.126	0.042	0.094
1961/62	0.066	0.120	0.049	0.097
1962/63	0.050	0.107	0.101	0.094
1963/64	0.071	0.093	0.074	0.075
1964/65	0.066	0.120	0.054	0.089
1965/66	0.064	0.132	0.166	0.074
1966/67	0.064	0.087	0.141	0.069
1967/68	0.062	0.106	0.105	0.089
1968/69	0.066	0.102	0.091	0.082

APPENDIX E (Cont'd.)

Year	Other Paper Prices ($A/lb.) X_{15}	Total Paper and Paper Board Prices ($A/lb.) X_{16}	Newspaper Circulation in thousand X_{27}
1946/47	0.184	0.073	-
1947/48	0.192	0.104	-
1948/49	0.193	0.090	-
1949/50	0.166	0.080	-
1950/51	0.226	0.126	-
1951/52	0.303	0.095	-
1952/53	0.246	0.077	-
1953/54	0.292	0.087	25,777
1954/55	0.290	0.085	30,154
1955/56	0.273	0.099	34,455
1956/57	0.347	0.107	36.010
1957/58	0.418	0.091	40,695
1958/59	0.276	0.084	45,149
1959/60	0.311	0.096	61,735
1960/61	0.212	0.085	55,094
1961/62	0.201	0.083	68,856
1962/63	0.190	0.083	67,589
1963/64	0.142	0.085	-
1964/65	0.176	0.094	-
1965/66	0.188	0.108	-
1966/67	0.183	0.082	-
1967/68	0.174	0.089	-
1968/69	0.203	0.091	-

DATA USED IN THE CROSS-SECTIONAL COUNTRY ANALYSIS OF DEMAND FOR PAPER AND PAPER PRODUCTS

Country	Total Cultural Paper Availability (Million Pounds) Y_{12}	Total Industrial Paper Availability (Million Pounds) Y_{13}	Population (Million) X_{22}
Italy	2,487.450	3,900.819	52.390
Greece	176.809	256.836	8.704
Portugal	152.338	281.968	9.384
Spain	877.651	1,440.265	32.210
Honduras	7.055	207.453	2.407
Jamaica	22.707	63.272	1.877
Mexico	598.108	1,261.913	45.694
Nicaragua	13.448	17.416	1.801
Brazil	828.489	1,032.855	85.960
Colombia	180.777	321.872	19.229
Paraguay	5.291	7.716	2.162
Venezuela	201.280	404.765	9.743
U.S.A.	38,242.755	63,404.958	199.036
Zambia	10.582	16.535	3.949
Tunisia	3.968	54.674	4.733
Israel	100.089	183.202	2.681
Turkey	200.398	258.379	33.050
Burma	45.635	11.684	25.816
China (Taiwan)	165.786	399.253	13.293
Indonesia	96.782	32.849	110.484
Korea (Rep.)	272.929	134.701	29.919
Pakistan	166.668	114.639	120.014
Argentina	725.975	840.173	23.188
Malawi	3.748	1.984	4.174
Yugoslavia	362.436	529.545	19.953

Country	Per Capita Cultural Paper Availability (lbs) Y_{14}	Per Capita Industrial Paper Availability (lbs) Y_{15}	Total GDP at Market Prices (Mn $A) X_{17}
Italy	47.479	74.457	61,572
Greece	20.314	29.508	6,159
Portugal	16.234	30.048	4,062
Spain	27.248	44.715	22,812
Honduras	2.931	86.187	533
Jamaica	12.098	33.709	896
Mexico	13.089	27.617	21,983
Nicaragua	7.467	9.670	600
Brazil	9.638	12.016	24,147
Colombia	9.401	16.739	5,072
Paraguay	2.447	3.569	439
Venezuela	20.659	41.544	8,293
U.S.A.	192.140	318.560	725,565
Zambia	2.680	4.187	1,105
Tunisia	0.838	11.552	922
Israel	37.333	68.334	3,582
Turkey	6.063	7.818	10,288
Burma	1.768	0.453	1,359
China (Taiwan)	12.472	30.035	3,248
Indonesia	0.876	0.297	4,791
Korea (Rep.)	9.122	4.502	4,093
Pakistan	1.389	0.955	11,438
Argentina	31.308	36.233	15,725
Malawi	0.898	0.475	238
Yugoslavia	18.164	26.540	7,498

APPENDIX F (Cont'd.)

Country	Total GNP at Market Prices (Mn $A) X_{18}	Per Capita GDP at Market Prices ($A) X_{19}	Per Capita GNP at Market Prices ($A) X_{20}	Literary Index (percent) X_{21}
Italy	61,963	1,175.262	1,182.726	90.7
Greece	6,290	707.606	722.656	80.4
Portugal	4,078	432.864	434.569	63.5
Spain	22,734	708.227	705.806	85.9
Honduras	517	221.437	214.790	45.0
Jamaica	861	477.357	458.711	82.7
Mexico	21,614	481.092	473.016	66.5
Nicaragua	582	333.148	323.154	48.1
Brazil	23,926	280.910	278.339	62.3
Colombia	4,978	263.768	258.880	70.5
Paraguay	433	203.053	200.278	73.8
Venezuela	7,598	851.175	779.842	63.3
U.S.A.	729,554	3,645.396	3,665.437	97.8
Zambia	1,035	279.818	262.092	39.4
Tunisia	890	194.802	188.041	26.6
Israel	3,524	1,336.069	1,314.435	84.2
Turkey	10,331	311.286	312.587	39.7
Burma	1,358	52.642	52.603	67.0
China (Taiwan)	3,240	244.339	243.737	63.1
Indonesia	4,725	43.364	42.766	39.0
Korea (Rep.)	4,156	136.803	138.908	72.1
Pakistan	11,350	95.306	94.572	18.8
Argentina	15,599	678.152	672.719	91.4
Malawi	228	57.020	54.624	16.0
Yugoslavia	-	375.783	-	80.3

APPENDIX G.1

AVERAGE EXPORT PRICE OF RICE AND RICE PRODUCTS

Year	$A per ton
1950	97.52
1951	104.20
1952	143.77
1953	154.68
1954	116.79
1955	91.78
1956	84.99
1957	82.52
1958	87.21
1959	79.56
1960	75.34
1961	82.46
1962	90.46
1963	91.53
1964	94.14
1965	96.50
1966	97.41
1967	104.66

APPENDIX G.2

EXPORT AND IMPORT PRICE INDICES

(1963/64 = 100)

Year	Rice & Rice Products Export Index	General Export Index	General Import Index	Export/ Import Ratio
1940-41	N.A.	18.8	42.4	44.3
1951-52	N.A.	148.0	105.0	140.9
1952-53	N.A.	157.3	90.9	173.0
1953-54	121.5	130.2	89.3	145.8
1954-55	89.5	100.8	88.7	113.6
1955-56	88.0	92.0	96.6	95.3
1956-57	86.0	92.3	92.7	99.5
1957-58	90.0	94.0	100.2	93.9
1958-59	84.2	89.1	92.0	96.8
1959-60	74.6	85.0	88.5	96.0
1960-61	83.8	88.9	94.1	94.5
1961-62	92.3	94.4	88.5	106.6
1962-63	96.5	98.0	101.8	96.3
1963-64	100.0	100.0	100.0	100.0
1964-65	98.2	103.9	114.6	90.5
1965-66	100.6	107.9	113.2	95.0
1966-67	114.6	115.7	121.0	95.5
1967-68	136.7	127.6	119.3	106.9
1968-69	128.7	123.4	115.9	106.4
1969-70	93.1	84.2	117.0	71.9

APPENDIX G.3

TRENDS IN COMMODITY IMPORTS

(Million $A)

Commodity	1940/41	1950/51	1960/61	1968/69
Food	6.760	10.712	22.712	5.765
Beverages and Tobacco	2.922	1.691	0.731	0.019
Crude materials, inedible except fuels	1.375	1.316	7.221	1.834
Mineral fuels, lubricants and related materials	2.960	7.329	9.771	5.708
Animal and vegetable oils and fats	2.158	8.645	5.308	1.797
Chemicals	2.941	7.517	16.936	15.310
Manufactured goods classified by materials	28.184	70.100	95.818	46.715
(Paper and Paper Products)	(N.A.)	(4.744)	(5.813)	(6.248)
Machinery and Transport Equipment	6.225	9.021	32.389	56.261
Miscellaneous manufactured Articles	4.201	6.578	11.365	7.486
Miscellaneous Transactions and Commodities, n.e.s.	1.127	0.188	0.394	0.094
Total	58.853	123.097	202.645	140.989

APPENDIX G.4

TRENDS IN COMMODITY EXPORTS

(Million $A)

Commodity	1940/41	1950/51	1960/61	1968/69
Rice and Rice Products	51.976	135.877	124.653	44.039
Pulses	1.528	5.074	8.462	6.101
Oil Cakes	0.248	1.691	12.946	4.754
Raw Rubber	1.833	5.074	5.872	5.091
Raw Cotton	1.509	8.645	4.991	0.037
Raw Jute	-	-	0.150	0.374
Hides, Skin & Leather	0.516	1.504	0.300	0.206
Teak	5.518	9.773	17.130	29.871
Hardwood	0.649	1.691	0.544	0.075
Paraffin Wax	5.843	-	0.976	0.824
Base Metal, Ores etc.	11.839	13.155	7.617	8.722
Precious Stones & Pearls	-	-	0.488	2.078
Others	22.990	0.940	3.865	1.123
Total	104.449	183.424	187.424	103.295

APPENDIX H

LIST OF VARIABLES USED IN THE ANALYSIS

Y_1 = Per capita sawn timber availability from trade (c.ft.)

Y_2 = Per capita sawn timber availability from trade and domestic (c.ft.)

Y_3 = Per capita total sawn timber availability from cross-sectional country data (c.ft.)

Y_4 = Per capita newsprint availability (lbs.)

Y_5 = Per capita printing and writing paper availability (lbs.)

Y_6 = Per capita wrapping paper availability (lbs.)

Y_7 = Per capita paper board availability (lbs.)

Y_8 = Per capita other paper availability (lbs.)

Y_9 = Per capita total paper and paper board availability (lbs.)

Y_{10} = Per capita cultural paper availability (lbs.)

Y_{11} = Per capita industrial paper availability (lbs.)

Y_{12} = Total cultural paper availability from cross-sectional country data (million pounds)

Y_{13} = Total industrial paper availability from cross-sectional country data (million pounds)

Y_{14} = Per capita cultural paper availability from cross-sectional country data (lbs.)

Y_{15} = Per capita industrial paper availability from cross-sectional country data (lbs.)

Y_{16} = Per capita hardwood sawn timber availability from cross-sectional country data (c.ft.)

X_1 = Per capita G.D.P. at constant 1961/62 prices ($A)

X_2 = Per capita G.D.P. at market prices ($A)

X_3 = Per capita P.D.I. at market prices ($A)

X_4 = Sawn timber weighted prices ($A/c.ft.)

X_5 = Bamboo weighted prices ($A/100)

X_6 = Brick prices ($A/1000)

X_7 = Deflated sawn timber weighted prices ($A/c.ft.)

X_8 = Per capita G.N.P. at factor cost from cross-sectional country data ($U.S)

X_9 = Hardwood wood availability index

X_{10} = Combined wood availability index

X_{11} = Newsprint prices ($A/lb)

X_{12} = Printing and writing paper prices ($A/lb)

X_{13} = Wrapping paper prices ($A/lb)

X_{14} = Paper board prices ($A/lb)

X_{15} = Other paper prices ($A/lb)

X_{16} = Total paper and paper board prices ($A/lb)

X_{17} = Total G.D.P. at market prices from cross-sectional country data (million $A)

X_{18} = Total G.N.P. at market prices from cross-sectional country data (million $A)

X_{19} = Per capita G.D.P. at market prices from cross-sectional country data ($A)

X_{20} = Per capita G.N.P. at market prices from cross-sectional country data ($A)

X_{21} = Literacy index (percent)

X_{22} = Countries' population

X_{23} = Deflated bamboo weighted prices ($A/100)

X_{24} = Deflated brick prices ($A/1000)

X_{25} = Consumer price index (1957/58 = 1)

X_{26} = Per capita G.N.P. at factor cost from hardwood consuming countries

X_{27} = Newspaper circulation in thousand