

IMPACTS OF FOREST SECTOR GROWTH IN BRUCE COUNTY, OTAGO: A CASE STUDY

P. H. B. ALDWELL and J. WHYTE*

ABSTRACT

This study quantifies and traces financial and employment flows in the rural economy of Bruce County, Otago. Income and expenditure flows for a mix of forestry and pastoral farming properties are examined to determine the nature and effects of increasing afforestation in Bruce County. The flows between the growing site and Port Chalmers (Dunedin) are then traced to identify the likely downstream employment derived from both land uses.

Results indicate that the major employment benefit for the county would come from local processing of the wood resource rather than from servicing the needs of the growing forest. Because the local economy has been set up largely to support pastoral farming, agricultural activity will continue to be the main source of service sector development in the foreseeable future. Analysis suggests that the existing infrastructure is not being threatened by increasing afforestation partly because of the increased carrying capacity of existing farmland and partly because the forest sector deals already with at least 50% of that infrastructure.

INTRODUCTION

Forest industry growth is considered increasingly in terms of its implications for the rural localities in which it occurs (Centre for Agricultural Strategy, 1980; Clutha-Central Otago United Council, 1983). In its draft regional planning scheme the Clutha-Central Otago United Council (1983) listed its primary forestry objective as being: "To develop the region's forestry potential in a manner which is complementary to other primary production sectors and which will result in maximum benefit to local communities."

*Scientists, Economics and Social Science Section, Forest Research Institute, Private Bag, Rotorua.

This policy statement specifies that a major destination of benefits is the "local community", defined in this study as being that group of individuals resident within the same county as the forest. The emphasis on community is important because it represents a move away from the purely economic considerations of returns to the nation and of profitability to the grower. A recent survey of the commercial sector in Milton (Bruce County) indicated that the town was often by-passed by local farmers and that a substantial proportion of farming business was foregone (Business Development Centre, 1983). This finding is endorsed by the results of the present study.

The study focuses on Bruce County, a small county located between Dunedin and Balclutha in the South Island of New Zealand. Bruce County and Milton Borough have a total population of 6429 (1981) with about half living in the townships and the remainder in the countryside. Although primary production and manufacturing are important employers, most growth is occurring in primary production, particularly in afforestation.

The rapid increase in afforestation in recent years has led to some uncertainty among rural business and servicing groups that previously had been structured to meet the needs of the agricultural sector. Some of this uncertainty relates to changes in expenditure patterns arising from a change in land use or from a change in land tenure from that of an individual owner or lessee to that of the State or a public company. The tendency for the latter forms of ownership to centralise their operations and location of purchase is one of the reasons for discontent with large scale forestry development (Smith and Wilson, 1982). There are also suggestions that a larger forest sector, because it requires a different range of goods and services, may lead to reduced demand for local goods and services in communities primarily based on pastoral farming.

This paper considers the effects of a (relatively) large forest estate in a small pastorally based economy and addresses the question of the income and employment effects that flow from the growing and processing of the forest. The basis for the paper is a case study using data from five farms and two forests in Bruce County (Otago) which has an area of 135 694 ha, and which contains 26 272 ha of exotic forest. Employment and expenditure data from these properties are analysed to determine the effects on Bruce County of the change in land use from farming to forestry.

METHOD

The focus of analysis is on the likely changes arising from increasing afforestation in an economy where pastoral farming is a major source of regional income. Sources include survey-based accounting data, non-survey input-output tables (Department of Statistics, 1975; 1978; 1983; Hubbard and Brown, 1981), and case study data. These data are used to determine the location and types of goods and services purchased and to identify employment effects associated with pastoral farming and forestry.

An input-output approach was used to identify and quantify expenditure patterns of pastoral farming and forestry in the Bruce County economy. The input-output flows are shown in Fig. 1 and focus on the ten main industries traded with by each

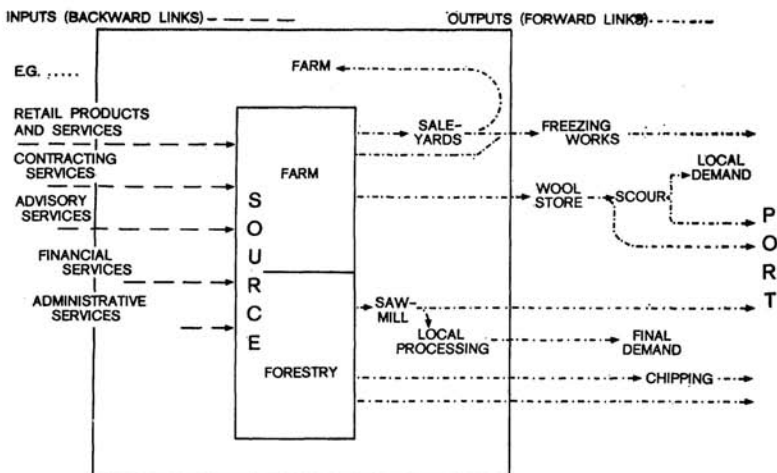


FIG. 1: Flow diagram: sources and destinations of inputs and outputs from alternative land uses.

land use (farming and forestry). The remaining interactions are relatively small and nationally comprise less than 20% of expenditure whereas locally they comprise less than 10%. Pastoral farming (Industry 1, Agriculture and Livestock Production*) is defined as including "dairy and pig farming, sheep farming, beef farming, mixed livestock farming, most stud farming, deer farm-

*Industry classification used here is the same as that used in the 1971-72 Inter-Industry Study of the New Zealand Economy (Department of Statistics, 1978).

ing, goat farming, cropping, and general mixed farming". Though it is recognised that the current trend is for forestry to be located on terrain that is unlikely to be arable or to carry dairy cattle, the Agriculture and Livestock Production category is that which most closely reflects the pastoral system with which this paper is concerned. Forestry and Logging (Industry 6) includes transactions of those "establishments engaged in the planting, tending, maintenance, and conservation of forests, the felling of trees and the rough shaping and extraction of logs from the felling sites to the skids as well as nurseries, . . .". The purchasing patterns of the household sector (*e.g.*, forestry or agricultural staff) are not considered in this study.

To establish expenditure patterns for farming and forestry a case study approach was adopted. Expenditure data were collected from seven properties: one State forest, one company forest, two pastoral farms with extensive farm forestry and three pastoral farming enterprises. The data were recorded from invoices, audited accounts, and cheque butts for the study period (1971-1981) and were classified by sector and by location.

All input values cited are in terms of purchasers' prices and thus contain a value-added and mark-up component. Usually input-output matrices are in terms of producers' prices and are recorded as "basic values" (Jensen, 1980). As it was not possible to obtain such data for this study it has been assumed that purchase prices do not distort the structure of the locally based matrix. As White and Miller (1980) argue, most farmers' (and foresters') purchases of items such as fuel, fertiliser, insecticides, and mechanical equipment are from wholesalers, retailers, and other service industries.

To determine the proportion of farming and forestry expenditure spent locally, location-of-purchase for each item was recorded. Four locations were used: Dunedin, Bruce County (including Milton Borough), Rest of Otago, and Rest of New Zealand. Once the geographical purchasing patterns were identified, inter-industry transactions were estimated to derive employment effects of the two land uses.

Employment effects to Free On Board (f.o.b.) were estimated by determining how much throughput of each major product class — *e.g.*, pulp, sawlogs, mutton or wool — is required to support one job in the respective processing industry. Employment on the farms or forests (*i.e.*, direct employment) was estimated by calculating the total labour required for all day-to-day on-site activities requiring permanent labour. Activities such as shearing

or aerial spraying of forests are classified as servicing activities and are part of indirect employment.

To estimate indirect employment each firm trading with the study properties was asked to supply details of its labour force. Indirect employment was then calculated using the procedure outlined in Appendix 1. Indirect employment in the transport, processing and port handling industries was determined on a product throughput basis and then related back to output from the land.

BACKGROUND

To place local forest industry growth in perspective an outline of the local economy is provided.

The Bruce County economy is centred on two production systems (Fig. 2). These are primary production (agriculture, fishing, hunting, forestry, mining, and quarrying) which employs

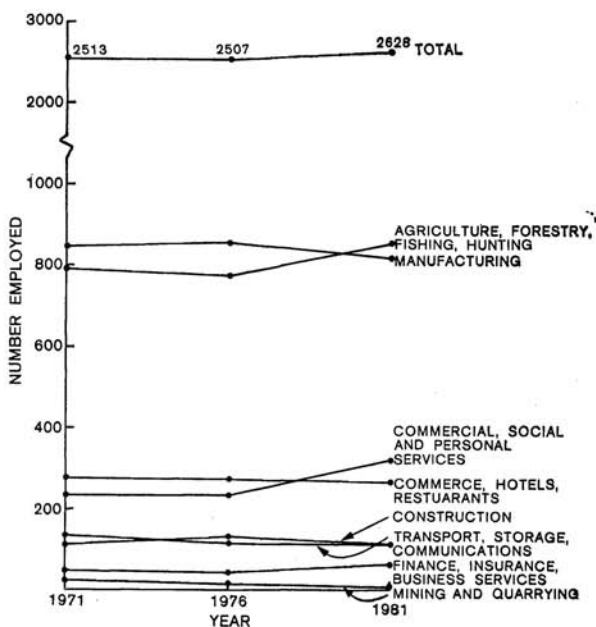


FIG. 2: *Employment by industry (major divisions) of Bruce County population. (Source: Department of Statistics).*

33% of the local workforce, and manufacturing which employs 31% of the workforce. The service sector which comprises retail/wholesale trade, commercial, social and personal services, transport, and construction, employs the remaining 36%. The predominance of the primary and manufacturing sectors is above the national average. The proportion of primary sector employment in Bruce County is three times that of the national average and approximately 1.3 times the national average in manufacturing. On the other hand, the service sector, as defined above, is a lower proportion (between 50 and 75%) than the national average. This could be partly due to the proximity of Balclutha which is larger than any of the service centres in Bruce County.

In addition, despite a 6% (408) drop in the Bruce Geographic County population between 1971 and 1981, there has continued to be an increase in employment in the commercial and personal services industries. As most of the population decline (355) is in the rural county, this suggests that the "urban" population is an important and growing source of income for local businesses.

The reason for the higher than average manufacturing component is the presence in the county of a textile plant, employing 155 people, which in 1980 was threatened with closure, and a ceramics plant which employs 88 people. In addition, there is a meatworks in neighbouring Clutha County and the local people who work there are recorded as being employed in the manufacturing sector. These data suggest that the Bruce County may not be sensitive to rural land use changes.

Another relevant consideration is inter-county mobility. Many Bruce County employees are not dependent on employment within the county. That many Bruce County residents do have jobs outside the county is evident when the number of jobs provided in the county is compared with the number of employed individuals. In 1981 there were approximately 1800 jobs (including self-employed) provided by local enterprises, including farms (Table 1) and yet over 2600 Bruce County residents were employed. This indicates that approximately 800 individuals were employed elsewhere. In an open economy such inter-regional and inter-county mobility is to be expected.

In terms of land use, the local economy has entered a phase of rapid change. Between 1970 and 1980 the afforested area increased from 6 550 ha to 26 272 ha, a growth rate of just over

TABLE 1: EMPLOYMENT PROVIDED WITHIN BRUCE GEOGRAPHIC COUNTY (1981)*

<i>Activity</i>	<i>No. Employed</i>
Agriculture and agricultural services	719
Forestry and logging	115
Fishing	18
Mining and quarrying	12
Food processing	38
Textiles	155
Sawmilling	37
Manufacture of chemicals, soaps, etc.	2
Pottery, china, earthenware	88
Agricultural equipment	27
Jewellery	1
Construction	109
Wholesale/retail	155
Hotels and restaurants	40
Transport and storage	73
Finance, insurance, business services	40
Sewerage, cleaning, pest control	9
Social & community services (education, medical, veterinary) ..	130
Recreation services	9
Personal and household services	24
Total	1801

Source: Department of statistics: Census of Distribution, Agricultural Statistics.

*1981 — Not available for earlier years except in total: 1971:1907; 1976: 1883.

2000 ha per annum or a 309% increase in ten years (Fig. 3). Over 64% of this growth has been in the two State forests: Otago Coast, and Berwick. However, there has also been substantial growth in private forests, including new plantings by farmers and Dunedin City Council, as well as some restocking in a small company forest. If the proposed forestry zone in the Milton-Bruce Pre-review Statement is planted, there is still scope for further new plantings in the Otago Coasts locality and also in the southern part of Berwick Forest (Johnston, Hatfield, Anderson and Partners, 1980). However, it is likely that future growth rates will not be as large as those in the ten years to 1980 and the total area planted in Bruce County is not expected to be much over 30 000 ha, or in total about 22% of the county.

Between 1970 and 1980, twelve blocks of grazing country were purchased by the State for afforestation. The total area of

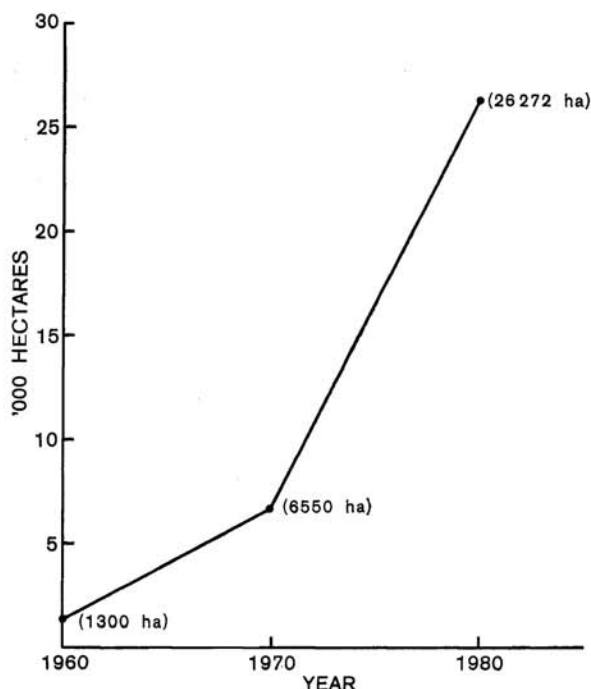


FIG 3: *Afforestation in Bruce County (1960-1980)*. (Sources: N.Z. Forest Service, Department of Statistics).

these blocks was 12 800 ha most of which had a cover of native grasses and tussocks interspersed with gorse and scrub. At the time of sale nine of the blocks were being used for extensive grazing. The remaining blocks were not carrying livestock at all. As with most afforested land in the county, these blocks were principally a mix of Class VI land and Class IV land, with Class VI being dominant. Land that has been forested has usually been low producing and costly to manage for livestock production.

Although the area in grazing has remained relatively static at approximately 106 000 ha between 1971 and 1981, there have been changes in other agricultural parameters. Total sheep numbers have increased by 8.4% while cattle numbers after peaking in 1977 have been reduced by 28.5% in 1981. The decline in cattle numbers has been attributed to drought, poor prices, and a higher relative profitability from sheep (Farm Adviser, MAF). Despite the net growth in sheep numbers over the period, there

has been substantial fluctuation from year to year with a peak in 1978 of over 1.1 million.

The main points to note from this overview of the local economy are:

- (1) There are not enough jobs in Bruce County to meet local demand.
- (2) The Bruce County economy is not a typical pastoral economy because of the amount and diversity of manufacturing activity.
- (3) The local economy has a smaller service sector than might be expected. This suggests that other centres such as Balclutha and Dunedin are satisfying some of the local demand in this sector.
- (4) The type of land afforested is unlikely to lead to reduced farm-related activity.

RESULTS

Expenditure Effects of Pastoral Farming and Forestry in Bruce County

In this section effects of a change in land use from farming to forestry are considered with respect to the case study properties in Bruce County. Particular attention is paid to location of expenditure, the types of goods and services purchased, and factors influencing expenditure patterns.

Geographical Expenditure Patterns

Geographical expenditure patterns are concerned with location-of-purchase of goods and services. The decision to purchase goods and services within a given community has important implications for the ability of that community to supply a diverse range of goods and services and also as a source of employment.

Of the seven study properties, five spent less than 41% of their expenditure on goods and services within Bruce County; the remaining two properties spent 74 and 98% (Table 2). The private forest expenditure was a short-term outlay on harvesting. It suggests, however, that in the harvesting phase the county economic and servicing infrastructure is capable of capturing the substantial business associated with that aspect of the forestry cycle.

From Table 2 it is evident that a substantial proportion of potential income for the Bruce County business community is lost either to Dunedin or to other Otago centres, principally Balclutha. However, for the wider Otago region the position is

TABLE 2: GEOGRAPHICAL EXPENDITURE PATTERNS OF THE CASE STUDY PROPERTIES AS A PERCENTAGE OF INTERMEDIATE INPUTS FOR 1979-80

	Source of Inputs			
	Dunedin %	Bruce Geographic County %	Rest of Otago %	Rest of N.Z. %
Farm				
A	53	31	14	2
B	22	74	3	1
C	27	22	50	1
D	62	14	15	9
E	28	41	29	2
Forest:				
State	65	23	2	10
Private	1	98	0	1

better as a relatively small proportion of goods and services is obtained from outside the region.

Analysis of accounts and discussion with farming and forestry staff indicated that there were several reasons for the relatively low volume of local purchases and for the variation in expenditure patterns.

The two main reasons were:

- (1) The centralisation of purchasing through a district office or firm.
- (2) The "supermarket principle" which implies that if a customer obtains certain key items or services in a given store or location then the customer will tend to obtain other goods and services there.

With respect to the first reason, the New Zealand Forest Service and the stock firms have major offices in either Dunedin or Balclutha or both. Further, the State forests tend to use works and stores orders which are actioned in the district office in Dunedin. As a consequence, few items are purchased in Bruce County towns.

The strength of contact with the stock firms by farmers is largely dependent on whether the farmers have long-term financial commitments with the stock firms. Where this occurs farmers buy more goods through the particular stock firms they are secured to. Those farmers not tied to stock firms are more

independent and obtain goods and services usually influenced by price, availability, and the "supermarket principle" referred to earlier.

Thus farming and forestry have strong links to centres outside Bruce County. This suggests that a change in land use will have less effect on local commercial activity than if either land use conducted all of its business within the county.

From Table 3 it can be seen that while the pastoral farming properties tended to spend more annually on goods and services than Berwick forest they tended to spend less on labour. This is partly because the forest sector wages are slightly higher and because pastoral farming is less labour intensive than forestry (Aldwell, 1984; Meat and Wool Board's Economic Service, 1983). Thus in terms of the local economy it is important to have the forest workforce resident in the county. These estimates also suggest that, if the Forest Service decentralised its purchasing to include Milton, the local economy would receive greater benefit from the substantial area in State forest.

TABLE 3: ESTIMATE OF ANNUAL EXPENDITURE PER HECTARE OF STUDY PROPERTIES

	<i>Pastoral Farms</i>	<i>Berwick Forest</i>
<i>Total expenditure effect</i>	(\$)	(\$)
Goods and services	93.75	45.83
Labour	13.67	101.46
Total	107.42	147.29
<i>Bruce County effect</i>		
Goods and services	32.81—37.50	9.16—11.45
Labour	5.46—8.20	40.58—60.88
Total	38.27—45.70	49.74—72.22

Centralisation is also a major reason for the relatively high amount of purchases in Dunedin by State forests. Most stores orders and works orders from Berwick Forest are processed in the Dunedin District Office (NZFS) and thus the goods or services are usually sent out from Dunedin. Local inputs to forestry operations include road transport, vehicle repair, quarry materials, roading, and rates. These items comprise 96% of Berwick Forest expenditure in Bruce County with forest roading and quarry materials accounting for about half of this.

The private forest has just completed an extensive roading and harvesting programme with most of this work contracted out to a local firm, although this is unlikely to occur every year. The high local expenditure (98%) derived from a private forest operation does, however, indicate that local contractors are competitive, that they have the equipment and ability to do the work, and that private forest companies have taken these smaller local firms into consideration.

Expenditure patterns of the case study properties suggest that only a narrow range of local firms are providing inputs to both pastoral farming and forestry and that expenditure patterns are influenced by stock firm association and by the tendency for State forests to buy through Dunedin. Because of these factors a change in land use from pastoral farming to forestry has a lesser effect on the Bruce County economy than if farmers purchased more of their goods and services locally. Under current purchasing patterns, an increase in farming or forestry area, or even an increase in productivity, is likely to have greater benefits for Dunedin and Balclutha than for Bruce County.

This section has considered location effects of expenditure; the following section considers industries sensitive to a change in land use.

Inter-industry Expenditure Patterns and Land Use Change

Inter-industry expenditure patterns show interaction between the different industries in an economy. They can be examined to identify the volume of trade between one industry and all other industries and also the number of linkages between one industry and all other industries. Table 4 provides a comparison of the number of industries traded with by farming and forestry in

TABLE 4: INTER-SECTORAL LINKAGES OF AGRICULTURE AND FORESTRY

	<i>Study Properties (Bruce County)</i>		<i>National Tables (1971-1972)*</i>		<i>Mangonui County†</i>	
	<i>Forestry</i>	<i>Agriculture</i>	<i>Forestry</i>	<i>Agriculture</i>	<i>Forestry</i>	<i>Agriculture</i>
Linkages	37	59	41	78	41	50
Linkages in common	34		39		28	

*Department of Statistics, 1978.

†Grant, 1979 (not strictly comparable as this study is based on 1965-6 inter-industry tables).

Bruce County, nationally, and in Mangonui County (Grant, 1979).

Two important points from Table 5 are that forestry trades with fewer industries than the farming sector and that there is substantial overlap between the trading patterns of farming and forestry. This implies that many (about 50%) industries linked to agriculture will also derive income from forestry. The extent to which this occurs is shown in Table 5 which lists the main farming and forestry linkages of the study properties.

The strongest linkage common to both land uses is retail and wholesale trade. Other major industries in common are road freight, vehicle repair, and public administration which includes rates or payments in lieu of rates. These four industries are likely to benefit most from a change in land use. However, it should be borne in mind that this analysis was conducted when tree harvesting was at a low level. Analysis of harvesting requirements in the private forest suggests that road freight and associated vehicle and plant repair inputs would increase in importance.

Of those industries with specific and strong linkages to agriculture, there are three which could be sensitive to a change in land use. These involve livestock sales and acquisitions, some agricultural services, and fertiliser sales.

Fluctuations in livestock numbers have implications for the stock replacement market, for agricultural services (especially animal health), and possibly for the fertiliser industry. Because of the rapid increase in afforestation in pastoral farming localities, it has been suggested by some that afforestation leads to decreasing stock numbers, a decreasing demand for fertiliser, and also a decrease in demand for agricultural services (Fairgray 1983). Because of the large proportion of Bruce County in exotic forest this problem is considered in more detail.

Analysis of livestock trends indicates that during the period of peak growth in afforestation there was a simultaneous growth in stock numbers and a marked increase in the tonnage of fertiliser applied per year (Figs. 4 and 5). This suggests that development and growth are occurring in the local pastoral farming industry despite a 20 000 ha expansion in forestry. It also suggests that the local pastoral industry has been operating below maximum efficiency and that the demand for fertiliser is not yet fully developed. Fluctuations in stock numbers and fertiliser use have arisen because of national and in some cases international

TABLE 5: "TOP TEN" LINKAGES FOR FORESTRY AND AGRICULTURE IN BRUCE COUNTY

<i>Forestry (Berwick only)</i>		<i>Agriculture (mean for 5 properties)</i>	
<i>Sector</i>	<i>% of Total Expenditure</i>	<i>Sector</i>	<i>% of Total Expenditure</i>
1. Mining and quarrying/forest roading	31.0	1. Retail/wholesale	24.3
2. Retail/wholesale	23.4	2. Agriculture and livestock	17.2
3. Road freight	21.4	3. Agricultural services	11.1
4. Forestry	5.4	4. Fertiliser	8.6
5. Chemical products	4.8	5. Road freight	7.4
6. Repairs and maintenance (vehicles)	4.6	6. Repair and maintenance (vehicles)	6.2
7. Public administration	3.4	7. Petrol fuels	6.1
8. Sawmills	1.7	8. Public administration	5.8
9. Repair services	1.4	9. Insurance	5.3
10. Renting or leasing of machinery	0.6	10. Finance	3.0
Total of 10 linkages	97.7		95.0

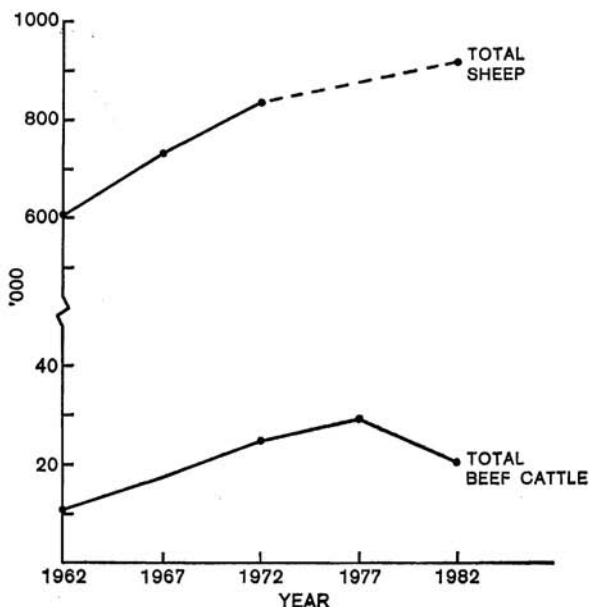


FIG. 4: Livestock numbers of Bruce County. (N.B.: 1977 sheep total not available). (Source: Department of Statistics — Agricultural Statistics).

events such as government policies on subsidies, prices for meat and wool, and because of climatic events such as drought (Kerr, 1980; Petrie, 1982; Quin, 1983).

As forestry is a small user of fertiliser there is some concern that a large increase in afforestation might affect the fertiliser industry and those sectors linked to it. Although it has not been possible to determine what would happen to fertiliser demand in Bruce County if afforestation had not been so extensive, it can be seen that demand has not fallen off (Fig. 5). In fact, the area topdressed has increased from 52 000 ha annually in 1971 to 65 750 ha in 1981, a growth of over 26%. Total tonnage of fertiliser applied has also increased; from 18 300 tonnes in 1971 to 30 600 tonnes annually in 1981, an increase of 67% over ten years.

Agricultural services used by the forest industry tend to be those engaged in land preparation and in the application of sprays for weed and pest control. Animal health services are a notable omission from forest purchases and probably account for the reason why agricultural services ranked third in importance for farming properties and eleventh for forestry.

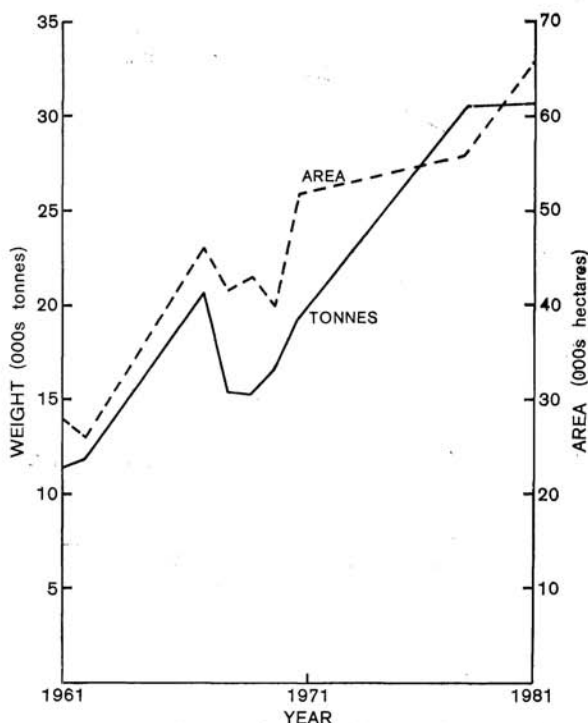


FIG. 5: Fertiliser application in Bruce County. (Source: Department of Statistics).

The strongest local linkage to the forest industry is with mining and quarrying. The mining and quarrying industry supplies materials for forest roading, an important item in many forests and averaging 5% of gross expenditure in Berwick Forest during the last ten years. As forest roads are improved and maintained for harvesting, the demand for roading materials will provide an important ongoing source of income to the mining and quarrying sector and those industries such as road transport that service it. The sale of these inputs, even for a relatively small private forest, is quite large. In Bruce County over \$100 000 was spent serving a 200 ha forest only part of which was clearfelled.

A second group of linkages, those important to both industries, includes expenditure on rates (Public Administration) and repair of vehicles, fuels, and road freight. These three industries are among those least likely to be reduced as a result of a change in land use. As the county forests mature and widespread harvesting

commences these linkages will probably strengthen further. It is possible that the established transport industry in Bruce County could become a freight maintenance centre for the forest industry. However, this would require both industries to maintain close contact with forest industry developments. As vehicle repair is the second most important input (after retail) to the transport industry it follows that given a growth in the transport industry one can expect vehicle repairs and fuel supply to expand as well. However, much depends on the willingness of local businesses to seek out this market. A common feature of smaller businesses is their unwillingness to increase throughput (Business Development Centre, pers. comm.). Informal discussions with local vehicle repair firms indicated little interest in business expansion. If this attitude prevails then many benefits from forest expansion are likely to go to centres offering a more extensive and rapid service.

A third group of linkages comprises a number of industries of lesser importance. These include inputs from the wood processing industries, finance and insurance, and electricity. Future growth in this group is most likely to be in finance and insurance as more plant is required to meet the needs of harvesting and transport sectors. However, unless local agencies develop, much of this growth is likely to occur in either Dunedin or Balclutha.

Variability of Expenditure Patterns

Although it is useful to compare expenditure patterns of industries in any given year, it is perhaps more useful to know how such patterns change over time. Expenditure patterns of five study properties were considered for the ten years to 1980. It was not possible to obtain historical expenditure for the private forest or for one farm property.

Analysis of the accounts of these five properties suggests that geographical expenditure patterns vary over time while inter-industry patterns varied little. Two farms marginally increased local expenditure, one farm showed a marked drop from 85% local expenditure to 36%, the other farm property remained constant at approximately 10% local. For Berwick Forest both geographical and inter-industry linkages remained constant with 20% of expenditure occurring locally. When asked if they had made any conscious decision to change purchasing patterns or links with particular firms the response from all farmers was "no". All four farmers indicated that they thought there had been no change in their geographical purchasing patterns during

the study period. However, analysis of farm accounts suggests that there had been substantial change in some instances. The largest change involved a decline in local expenditure of over 40% of income in one year as a result of a farmer trading through the Dunedin branch of a stock firm rather than through the Milton branch.

As forestry is relatively new in the county and the majority of the forest has yet to complete one rotation, changes in inter-industry expenditure patterns are likely to occur especially in forests where harvesting and roading are not yet in place. Principal changes in trade between the forest industry and other industries to date involve links with the quarrying and road metal transport industries.

In the future, as harvesting develops, it is likely that considerable changes will ensue. Much of this will be related to processing activity, but those industries closely tied to the harvesting and transport of wood such as plant, vehicle, and road maintenance industries will also benefit.

Employment Effects

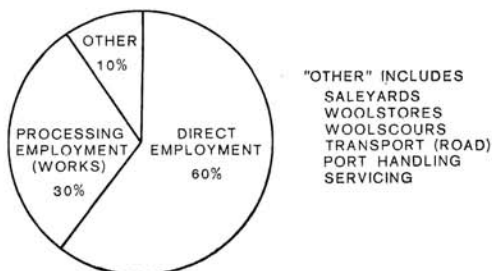
Direct and indirect employment effects in the country have been calculated from pastoral farming and/or forestry land uses on six study properties. Since afforestation is most likely to occur on land also suitable for pastoral farming, no comparison is made between employment from forestry and that from other agricultural land uses (e.g., dairying, arable cropping).

The components of employment, and the relative importance of each for farming and forestry are illustrated in Fig. 6.

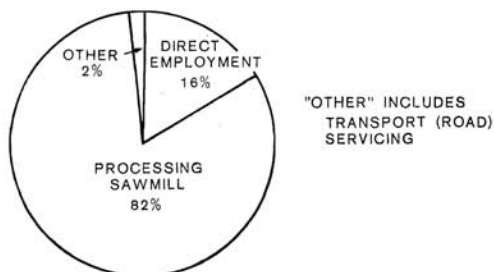
Employment from the servicing sector accounts for between 15 and 25% of total pastoral farming employment and less than 1% from forestry (Fig. 6). Two-thirds of employment from agriculture is direct employment, while processing employment accounts for most of the rest. This direct employment is dependent in part on the productivity of the farm: although, at the margin, increased labour demand may be met by contractors and this would increase servicing (indirect) employment instead. Conversely, increases in farm output lead to increases in processing, transport, port handling, and servicing employment albeit by only a small amount.

Within the forest industry, however, direct employment is only a small part of that generated from each hectare of forest. Downstream employment effects count for over 80% of the total for domestic sawn timber, and over half for an export log option.

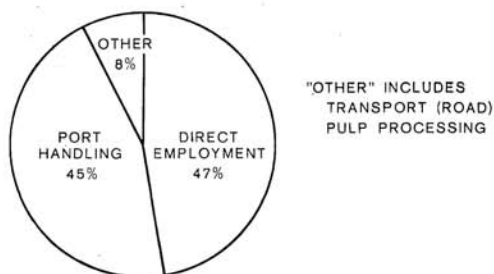
(A) PASTORAL FARMING



(B) DOMESTIC SAWN TIMBER REGIME - FORESTRY



(C) EXPORT LOG REGIME - FORESTRY

FIG. 6: *Relative employment generation.*

Although employment is shown for pastoral farming (sheep and beef only), domestic sawn timber, and export logs, only the first two will be considered in detail since export logs is not a likely option for most timber from the study area (NZFS, per. comm.).

The most striking difference between farm and forestry production is the comparative lack of importance of *direct* employ-

ment in the sawn timber option. In terms of labour per hectare, direct employment is similar for both farming and forestry; however, the very high employment generated within forestry processing makes direct employment seem relatively unimportant.

Processing employment from forestry accounts for seven times as much employment as that from pastoral farming. This difference can be explained by comparing the total volume of output produced from forestry over a 30-year rotation (500 tonnes/ha) with that from pastoral farming for the same period (4.5 tonnes/ha) (Meat and Wool Boards' Economic Service, 1983).

Individual wood processing mills show a large variation in the employment generated per cubic metre of roundwood input (from 1.69 man-hours/m³ to 6.06 man-hours/m³). These production rates, when compared with those of sawmills in other countries, indicate that the Otago mills are relatively efficient. For example, a study in Victoria (Australia) showed that local mills have a labour output ratio of 2.11 man-hours/m³. The weighted average for the surveyed Otago mills is 1.85 man-hours/m³. This could be attributed, in part, to the capital invested which varies from mill to mill. Increasing productivity (or efficiency) of existing processes through capital investment is thought to have a negative effect on the need for labour (Dargavel, 1982). This was borne out in the sawmills studied where the more capital invested in the mill, the higher the output per man and the less labour required for processing a given volume of wood. Productivity per man-hour was lowest in the least capital-intensive (and most labour-intensive) mills.

On the other hand, there is very little variation in the employment generated between individual agricultural processing plants. These plants generally have similar capital development, labour employed, and productivity (Waitaki NZR, pers. comm.).

In total (*i.e.*, from the land to the port), forestry employs four and a half times as much labour per hectare as agriculture (Table 6) — an important feature considering that there is a wood processing base already well established within the county. By locating new industry within the county it is more likely that employment will come from within the county.

Currently there are agricultural processing activities at Dunedin/Mosgiel and at Balclutha, so it is unlikely that an additional meat processing plant would be built in Bruce County. However, the Finegand meatworks at Balclutha is close enough for employees to travel from within Bruce County to work there.

TABLE 6: DIRECT AND INDIRECT EMPLOYMENT GENERATED FROM PROPERTIES STUDIED: BRUCE COUNTY (man-hours/ha/yr)

	<i>Farm/Forestry</i>			<i>Farm</i>		<i>Forest</i>	
	A	B	C	D	E	F	
<i>Farming</i>							
Servicing	4.78	1.67	3.77	3.3	5.30		
Direct	16.43	4.01	6.64	9.94	10.70		
Transp. to works	0.054	0.009	0.041	0.023	0.044		
Processing	9.53	1.940	7.90	6.310	4.62		
Transp. to port	0.170	0.020	0.243	0.019	0.070		
Port handlings	0.180	0.039	0.160	0.15	0.10		
	31.14	7.69	18.75	19.74	20.83		
<i>Forestry</i>							
Servicing	(0.01	man-hours/ha/yr incl. above					0.20
Direct	14.48	14.48					21.72
Transp to mill	0.78	1.18					1.03
Processing	71.90	69.14					66.37
	87.16	84.80					89.32
Weighted total employment from farm and/or forest (man-hours/ha/yr)	44.18	17.0	18.75	19.74	20.83		89.32

Sources: The direct employment figures have been calculated from data from the study properties, and relate to results of work done by New Zealand Meat and Wool Boards' Economic Service (Report No. 1893) in agriculture and from work studies by private forest companies (N.Z. Forest Products, pers. comm.).

Seasonal employment may have some bearing on this since many freezing workers also do casual farm labouring or contract silviculture in their off season. Meat processing and contract shearing both complement contract silviculture and there are several gangs and many individuals within the county who maintain full employment by combining shearing or slaughterhouse work in the summer with forestry work in the winter.

Both forestry and farming generate relatively small amounts of labour in road transport and at the port (Table 7); the latter is largely because of the mechanised port handling facilities. The road transport industry is developed for both land uses such that most firms within the county are listed as "general carriers". This suggests that, even if there is a marked change in land use, employment in road transport and port operations will not be noticeably affected.

Implications

Afforestation has been most rapid during the ten years to 1981 when total afforested area was 26 272 ha. Though it is possible that this total will increase to about 30 000 ha it is unlikely to be much more. If we assume this to be so, then it is likely that, once sustained yield is attained, 1000 ha per annum will be available for harvest from Bruce County forests. The South East Otago Management Plan (NZFS, 1982) suggests that annual sawlog production will rise from 25 000 to 32 000 m³ in 1990 and up to 500 000 m³ in 2000. By the year 2000 these forests will be producing about twenty times the present volume — an increase from 83 to 1700 truckloads per month. Thus, although the effects of afforestation have been marginal, this can be expected to change with widespread implications for the local economy — in terms of future processing possibilities.

Implications of Forestry Expansion

The rapid growth of forestry in Bruce County has a number of implications. Because of the presence of an active manufacturing sector and because of the large leakage of expenditure to Dunedin and Balclutha, the implications of a change in land use may be more complex than initially believed. Further, the relatively weak patronage of local businesses and services by farming suggests that the local economy is more dependent on other sectors (probably manufacturing and households) and thus any change that reduces the scale of agricultural activity in the county is of less importance. However, as noted earlier, afforestation has not led to a decline in agricultural activity nor is there evidence of a forestry-related decline in agricultural services.

Despite high leakage to centralised agencies in Dunedin, forestry development has created additional income for some activities, particularly those involved in road transport, quarryings, vehicle and plant repairs, and land development. Local contractors appear to be in a good position to win logging contracts. However, there is evidence to suggest that Bruce County may miss out on a relatively large source of demand for goods and services if current centralised buying practices and business links of pastoral farming and forestry prevail. From the county's viewpoint the central position of Milton with respect to Berwick and Otago Coast Forests suggests that it would be a suitable location for a single administrative base for both forests. The presence of a local office would increase the likelihood of local

servicing of plant and vehicles and of purchases occurring in Milton. Such a move would also bring forest growers closer to local wood processors, thus facilitating contact.

The diverse structure of the Bruce County economy to some extent insulates it from changes brought about by the arrival of a new industry. Few rural counties have such a large proportion of the labour force employed in local manufacturing. In Bruce County the manufacturing sector is almost as large as the primary producing sector. A relatively diverse infrastructure such as this makes it less likely that a marginal change in demand for local inputs from the agricultural industry would be easily noticed.

Because the forest growing industry obtains most of its input from sectors supplying pastoral farming it is likely that there will be a strengthening of the existing infrastructure rather than increased diversification as a result of increased afforestation. This trend is already evident in transport and vehicle and plant maintenance. Diversification is more likely to occur with the increase in harvesting and processing of the forest resource. However, unless the local business community presses for stronger links to occur and increases its profile then it is possible that these potential benefits could go to Dunedin and perhaps Balclutha.

The implications of afforestation for the farming industry may be seen as supportive rather than detrimental. Those industries sensitive to a change in land area such as the fertiliser industry show signs of continued growth. Although there is no indication of how animal health services have changed, given the increase in stock numbers, it is unlikely that afforestation of the less productive country has had any effect on these services. Correspondence with local stock firms indicates that they are not sensitive to this type and scale of land use change. Where local forestry expenditure has occurred, it has been in those industries important to the maintenance of agricultural services. This includes rural contractors involved in land development, the road transport industry, and the employment of shearers in the off-season.

In terms of employment generation, the county is likely to derive greater direct and indirect employment from a given area of forestry development than from a similar increase in pastoral activity. Most of the difference would occur as a result of local processing of the resource. However, the proportion of employ-

ment in sawmilling is likely to decrease as new technologies are used.

The Milton-Bruce Pre-review Statement proposed a 9% increase in forestry, bringing the total proportion of forestry in Bruce County to 22% of the total land area. The employment derived from such a change in land use would result in an increase in total county employment available of 4%. Taking an extreme view, an increase in the forestry area of, say 20% would reduce the area available to agriculture by only 5%, but increase total available employment by 8%.

Should agriculture be expanded to the extent that the farm area was *increased* by 20% (to 96% of county area) the effect would be to decrease forestry land by 79% and reduce total employment by 33%. In other words, a large decrease in the forestry area within the county would reduce the available employment by one-third.

Important employment benefits for Bruce County come from established forest industry. Despite the fact that the area in farming is four times that in forestry, almost the same number of people are employed by each industry. In the industries and properties studied here, forestry supports up to four times as much direct and indirect employment as pastoral farming.

If Milton and other rural towns are to increase their income from surrounding farm and forestry properties, a positive step would be to encourage stock firms and forestry developers to increase their presence in the locality. This is particularly important if such localities are to derive increased income from a rapidly expanding forest industry.

CONCLUSION

Despite almost one-fifth of Bruce County being planted in exotic forest there is no evidence that agricultural servicing industries are being threatened. This is partly because a large number of industries are common sources of inputs to both forestry and pastoral farming, and partly because most afforestation has occurred on under-developed land. Those industries not linked to forestry such as chemical fertilisers and animal health services show no signs of decline because many properties were understocked and because government assistance in the form of land development grants and fertiliser subsidies have led to increases in county livestock numbers and fertiliser application. These two aspects of farm servicing, both potentially sensitive to de-

creasing area in livestock, have thus shown increases at a time when the rate of afforestation peaked.

The tendency for farming and forestry to obtain more than 50% (by value) of intermediate inputs from outside the county suggests weak linkages between local businesses and the farming and forest sectors. Improved communications, high overhead costs and a reduced growth rate in pastoral farming make it unlikely that pastoral farming services will increase their presence in the county. For this reason it is likely that pastoral farmers will continue to spend less locally. There are many industries in Bruce County capable of servicing forest industry requirements. It is up to local businessmen to become familiar with forest industry strategies and to be prepared for the prospective increase in demand.

In summary there are three factors important to the future development of Bruce County:

- (1) The location of forest industry workforce and administrative offices (*e.g.*, forest headquarters) in Milton.
- (2) Increased effort by local firms to capture more business from farming and forestry industries.
- (3) The processing of wood products within the county.

The complementary nature of the farming and forestry infrastructure in Bruce County could be further developed to the mutual advantage of local communities and primary industry. However, the extent to which this will occur depends on the competitiveness of local industries servicing the primary sector and on the willingness of the primary sector to decentralise purchasing.

Further Research

It is unlikely that existing purchasing patterns, infrastructure, and forestry employment will change much before 1995. The findings of the present study will then need to be reassessed to determine the effects of new technology and decisions about wood processing. In the meantime, the next major step is to identify the locational spending patterns of forestry and farming employees. Such research would determine the extent to which a major source of forestry related income is redistributed throughout the Bruce County economy.

The role of agroforestry in the rural economy is a further factor requiring investigation. This form of afforestation is being promoted by some, partly on the basis of its social and economic benefits over large-scale forestry. However, there is no known

research that has considered the differences between the two. Once more data become available and a larger number of farm forests mature, the comparative social and economic effects can be usefully analysed.

ACKNOWLEDGEMENTS

The authors would like to thank the farmers, foresters, and business communities of Dunedin and Bruce County for their willing assistance with this study. The collection of farm data and information provided by the Ministry of Agriculture and Fisheries staff (Balclutha) is gratefully acknowledged. The authors also wish to thank Dr J. Fairweather, Dr Ruth Houghton, R. Hancock, H. Jagger, and W. Ramsey for their constructive comments.

REFERENCES

- Aldwell, P. H. B., 1984. Some social and economic implications of large scale exotic forestry in Waiapu County. *N.Z. For. Serv., For. Res. Inst. Bull.* (in press).
- Business Development Centre, 1983. *A Promotional Strategy for the Milton Business Association*. University of Otago, Dunedin.
- Centre for Agricultural Strategy, 1980. *Strategy for the U.K. Forest Industry*. University of Reading, U.K.
- Clutha-Central Otago United Council, 1983. *Regional Planning Scheme — Principal section* (Draft). Clutha-Central Otago United Council.
- Dargavel, J., 1982. Employment and production: the declining forestry sector re-examined. *Aust. For.*, 45 (4): 255-61.
- Department of Statistics, 1975. *Inter-industry Study of the N.Z. Economy 1965-66*. Department of Statistics, Wellington.
- 1978. *Inter-industry Study of the N.Z. Economy 1971-72*. Department of Statistics, Wellington.
- 1983. *Inter-industry Study of the N.Z. Economy 1976-77*. Department of Statistics, Wellington.
- Fairgray, J. D. M., 1983. *Afforestation Directions: The Hawke's Bay Case Study*. Central North Island Planning Study, Ministry of Works and Development, Wellington.
- Grant, R. K., 1979. Managing the regional impact of forest development programmes. *N.Z. J. For.*, 24 (2): 198-204.
- Hubbard, L. S.; Brown, W.A.N., 1981. *Multipliers from Regional Non-survey Input-Output Tables for N.Z.* Research report, Agricultural Economics Research Unit, Lincoln College.
- Jensen, R. C., 1980. The concept of accuracy in regional input-output models. *Int. Regional Sci. Rev.*, 5 (2): 129-54.
- Johnston, Hatfield, Anderson and Partners, 1980. *Milton-Bruce Combined District Scheme. Pre-review Statement*. Mosgiel, Milton Borough and Bruce County Councils.
- Kerr, A., 1980. Fertiliser usage and price. *Agric. Econ.*, 1 (2): 21-2.

- Meat and Wool Boards' Economic Service, 1983. *Sheep and Beef Farm Survey 1981-82*. N.Z. Meat and Wool Boards' Economic Service, Wellington.
- N.Z. Forest Service, 1982. *South East Otago Regional Management Plan*. N.Z. Forest Service, Wellington.
- Petrie, C., 1982. Fertiliser demand. *Agric. Econ.*, 3 (2): 29-31.
- Quin, B., 1983. Nutrient-based fertiliser subsidy. *Agric. Econ.*, 4 (2): 26-30.
- Smith, B.; Wilton, P., 1982. Attitudes to growth and development in New Zealand's far north. *N.Z. Jl For.*, 27 (1): 101-21.
- White, F. C.; Miller, W. R., 1980. Determining multiplier effects of agriculture on the rest of the economy. *Agric. Finance Rev.*, 40: 19-25.

APPENDIX I

Determination of Indirect Employment Generation: Example

If a forestry operation pays its accountant \$500 for a year's professional services, some proportion of that \$500 is returned to the staff and business as wages and salaries. It may be 60%, so \$300 is returned.

To determine the employment generated by this \$300 it is necessary to know:

- Total wage and salary bill of the business.
- The total man-hours employed by the business.

e.g., Assume wages and salaries bill = \$60 000 per year.

Assume the following people are paid for their services:

		man-hours/yr
Cleaner	.....	105
Carpenter	.....	60
Electrician	.....	36
Secretary	.....	1880
Assistant	.....	1880
Accountant (self)	....	1880
		<hr/>
		5840

} Assumes 235 man-days/yr
and an
8-hour day

Thus the employment derived from accountant's services to a forestry operation = $(\$300/\$60\,000) \times 5840$
= 29.2 man-hours/yr.