Welsh Forestry Multiplier Study

Final Report

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Introduction

The purpose of this study was to improve the understanding of the role of the forestry industry in the Welsh economy. The forestry industry was defined to include the activities of private forestry owners, Forest Enterprise, forest management companies, timber harvesting, extracting, haulage and marketing companies, and primary processors including saw-mills, wood-based panel manufacturers and paper mills. The research was informed by an extensive questionnaire and interview survey of forestry industry organisations. The financial information generated by the survey was incorporated into an input-output model of the Welsh economy to allow the indirect or 'multiplier' impacts of sector changes to be estimated.

Aims of the Study

The objectives of the research programme were:
- To assess the current activities of the forestry industry in Wales, identifying key inter-linkages between allied forestry sectors – for example, tracking the transactions occurring between timber harvesters, saw-mills and other primary processors.
- To assess forestry industry trading relationships with areas outside Wales, (particularly imports into Wales).
- To estimate the value of Welsh forestry industry output, and industry employment.
- To construct separate forestry industry sectors within the Welsh input-output framework, encompassing different forestry industry sectors (i.e. harvesting, private estates, saw-mills etc.), and different 'genera' of forest (i.e. conifer, and other woodland types).
- To provide estimates of the economic effects of primary processing activities such as saw-milling, panel board and paper production.
- To calculate multipliers for the forestry industry in Wales and for different types of forestry industry activity, and forest types.
- To provide forestry multipliers for two sub-regions of the Welsh economy.

The results of the primary research were also used to simulate the effects of changes in the forestry industry, including the effects of complete sector removal from the Welsh economy, and the potential effects of an increase in timber harvesting activity.

The Forestry Industry in Wales

Forestry and woodland cover an estimated 12% of the total land area of Wales, which represents some 10% of all forestry and woodland in Great Britain (GB). Wales has nearly 247,000 hectares of woodland, of which private woodland constitutes an estimated 129,000 hectares (52%), and 118,000 hectares (48%) is owned and managed by the Forestry Commission.

Area of Forestry Commission and Private Woodlands in Great Britain (1998)

	Forestry Commission		Private Woodlands		Total Woodland	
	000 ha	%	000 ha	%	000 ha	%
Wales	**118**	**48**	**129**	**52**	**247**	**100**
England	219	22	771	78	990	100
Scotland	497	41	705	59	1,202	100
Great Britain	**834**	**34**	**1,606**	**66**	**2,440**	**100**

Source: Forestry Commission.

Study Methodology

The Welsh input-output tables provide a detailed description of the regional economy by quantifying inter-industry transactions (i.e. sales and purchases between industries) as well as the relationships between industries, consumers and government that exist in the regional economy. The basic financial relationships in the tables can be used to estimate the economic significance of different Welsh industries. The use of input-output methods is not without problems when used to model the forestry industry. However, some of these problems are due to data difficulties, which can be partially overcome by the use of detailed survey data on forestry industry activities. The modelling framework was used to derive income, employment, and output multipliers for different forestry sectors, and for defined forest types.

The survey provided evidence of current difficulties within the Welsh forestry industry. Contributory factors include: high sterling - with this leading to cheaper imports and low timber prices; landfill taxes; and increasing diesel prices – the latter reducing margins through the timber supply chain. Estate owners stressed the problems caused by the change in tax regulations affecting investment decisions. There were also concerns expressed about the burden of proposed UK Woodland Assurance Scheme (UKWAS) certification processes, with the possibility of a two-tier market for certified and uncertified timber. Difficult industry conditions have also affected the contracting sector. Harvesting contractors and hauliers have been hit by falling levels of business, together with rising fuel prices, and by pressures to invest in mechanisation at a time of uncertain industry prospects.

The Scale of Welsh Forestry

According to this study the Welsh forestry industry employs an estimated 3,930 full-time equivalents (FTEs). This figure includes a number of employees that work in Wales but live just over the border in England. Around 650 FTEs fall into this category - largely in the panel board and paper sector.

Summary Economic Characteristics of Forestry Related Sectors: 1998*

Sector	All Forest Sectors	Private Estates etc. ***	Harvesting and Allied Contracting	Haulage	Sawmills	Panel Board and Paper
FTEs** in Wales	3,281	728	846	215	557	936
FTEs in Rest of UK	649		90		45	514
Total FTEs	3,930	728	936	215	602	1,450
Gross output £000s	403,448	16,533	43,474	9,352	47,253	286,837
Average Gross Wage £000s	17.6	10.4	19.6	15.1	13.6	24.4
Total non-wage spend in Wales £000s	81,673	5,605	9,293	2,152	26,031	38,592
Total Forestry related purchases in Wales £000s	52,133	4,197	3,875	0	23,514	20,548
All other non-wage spending in Wales £000s	29,540	1,408	5,419	2,152	2,517	18,044
Imports (UK and Overseas incl labour) £000s	166,621	1,354	4,302	1,852	5,703	153,411

*(Financial Figures £000s 1996 prices); **FTEs are full-time equivalent jobs.***including forest management companies, nurseries, and farm woodlands. Row totals may not balance because of rounding.

Gross output of the Welsh forestry industry is an estimated £403.5m, with over 70% of industry gross output accounted for by the panel board and paper sector, and with much of this output concentrated in just two plants. Upstream forestry industry sectors (including

private estates, forest management companies, harvesting and allied contracting, and haulage) accounted for just over 17% of gross industry output. The saw-mill sector accounted for a further 12% of gross industry output.

The Impact of the Forestry Industry

Multiplier impacts varied considerably between forestry sectors. Estimated output multipliers in the Welsh forestry industry ranged from 1.25 in wood-based panel board and paper to 1.94 in saw-mills. Higher multiplier impacts are partly a consequence of the relatively high degree of local (Welsh) purchasing per unit of output. The table below estimates that a £1m increase in saw-mill output would support an estimated £0.94m of output in other Welsh sectors – partly explained by the fact that this sector makes an average of over 80% of its non-wage purchases in the Welsh economy. The defined private estates etc. sector, through their purchasing patterns, would support £0.77m of output in other Welsh sectors per £1m increase in demand for its own output. However, the panel board and paper sector purchased fewer of its non-wage inputs in Wales, supporting just £0.25m of output in other parts of the Welsh economy per £1m increase in demand for its own output.

Demand-Driven Multipliers for Forest Sectors

Forest Sector	Output Effects (£m) per £1m of Output	Output Multiplier**	Employment effects (FTEs*) per £1m of Direct Output	Employment Multiplier
Private Estates etc.	1.77	1.77	59.01	1.34
Harvesting/allied contracting	1.51	1.51	28.94	1.49
Saw-mills	1.94	1.94	31.23	2.65
Panel Board and Paper	1.25	1.25	7.48	2.29
Haulage	1.48	1.48	31.53	1.37

*Full-time equivalents. **Multipliers reported here are total multipliers incorporating 'supplier' and 'induced-income' effects.

There is also variation in the total number of Welsh jobs supported per unit increase in demand for sector output. In harvesting and sawmills a £1m increase in demand for sector output would support an average of around 30 jobs (directly and indirectly), whereas for the private estates sector almost 60 jobs would be supported per £1m change in demand for sector output. In the particularly capital and import intensive panel board and paper sector, each additional £1m of sector demand would support just over 7 jobs in Wales.

Other Key Findings

The report also found that:

- The complete removal of Welsh forestry would result, directly and indirectly, in the loss of £475m of Welsh output, and 4,440 full time jobs.
- A 10% increase in harvesting sector activity in the Welsh economy could result in a total of £12.2m of additional gross output, and the creation of an estimated 232 jobs.
- Forestry industry impacts on the rest of the Welsh economy varied between forest types. The research estimated that a £1m increase in the demand for conifer output would support an additional £0.55m of output in other Welsh sectors, and would directly and indirectly support an average of 36 jobs, whereas a similar increase in 'other' woodland output (mixed, farm and community woodlands) would support a much larger £0.91m of other Welsh industry output, and 57 jobs. 'Other' woodland output features higher labour intensities, fewer opportunities to use the most mechanised methods, and a comparatively higher cost per unit of output.

- Forestry is characterised by a high level of transaction inter-dependence. A result of this is that events affecting any individual sector may be quickly passed through to other parts of the industry. Pressures currently facing separate parts of the forestry industry could quickly become cumulatively multiplied across the whole industry.
- The local impacts of the forestry industry vary considerably across Wales. For example, in Powys, the forestry industry was found to directly and indirectly support around 816 jobs, or over 2% of Powys employment, and support a total of £10m of income. In Neath-Port Talbot, the forestry sector directly and indirectly supported 410 jobs, or just under 1% of area employment, and support around £5m of income. In Neath-Port Talbot, the income supported by the forestry industry sector was estimated to represent 7.4% of primary sector (agriculture, forestry and fishing) gross domestic product (GDP), while in Powys the corresponding figure is estimated as 21.5%.

Conclusions

In 1998 the Welsh forestry industry directly employed almost 4,000 people (FTEs), producing gross output of over £400m. However, this study reveals that the economic impact of the forestry industry goes far beyond the direct employment created, and that changes in any part of the forestry industry have ramifications for industries in Wales, in both the rural <u>and</u> industrial economy.

1. Introduction and Research Objectives.

Much of the debate in the rural Welsh economy has been set against the background of agricultural issues, where policy changes and market pressures have conspired to depress traditional farm incomes and encourage diversification. Much less attention has been given to other elements of Welsh primary production, including forestry. The findings of this study reveal that the forestry industry in Wales (which includes elements of establishment, management, and production, and primary processing) employed around 4,000[1] people directly (including subcontracting) in 1998. The industry has offered employment opportunities in rural areas where income per capita is typically low. Moreover, the forestry industry features significant intra-industry trade linkages with the growing sector often geographically close to other forestry sectors such as saw-milling and other timber processing. Potentially it is these within-industry linkages which can enhance the development potential of the sector as a source of intra-regional trade.

Despite poor market conditions in the UK forestry industry (particularly as a result of the strong pound and competitive imports), Welsh forestry industry output is set to increase in the new millennium in line with earlier establishment, and as a result of new and innovative schemes to increase the quality and quantity of forestry output.

Prospective forestry industry expansion in Wales then needs to be assessed in terms of the impact on jobs and incomes in what are often economically disadvantaged areas. This study aims to quantify the contribution of the forest industries sector to the contemporary Welsh economy. The economic impacts of the sector are analysed within an input-output modelling framework of the Welsh economy in order to assess both the direct and indirect multiplier impacts of sector changes on employment, output and incomes.

In completing this overall research programme primary research was undertaken to meet the following objectives:

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[1]   Although a proportion of these actually live outside Wales.

- To define and map the current activities of the forestry industry sector in Wales, and identify key inter-linkages between allied upstream and downstream sectors – for example, tracking the transactions occurring between timber harvesters, saw-mills and other primary processors.

- To assess forestry industry trading relationships with areas outside Wales (i.e. particularly imports into Wales).

- To estimate the value of Welsh forestry industry output, and employment.

- To construct separate forestry industry sectors within the Welsh input-output framework, where possible encompassing different forestry industry sectors (i.e. harvesting, private estates, saw-mills etc.), and different 'genera' of forest (i.e. upland conifer, and mixed woodland etc.).

- To provide estimates of the economic effects of primary downstream processing activities in areas such as saw-milling, panel board and pulp production.

- To calculate multipliers for the forestry industry in Wales defining different types of upstream forestry sector activity, and forest types.

- To provide multipliers for defined sub-regions of the local economy.

The results of the primary research will also be used to simulate the effects of changes in the forest industries sector, including the effects of complete sector removal, and the potential effects of an increase in the volume of timber harvested.

The remainder of the report is divided into seven further chapters. The second chapter examines the forestry industry in Wales, providing a summary of industry activity, together with a review of forestry upstream and downstream interconnections. This is followed by an examination of the changing structure of the forestry sector in the Welsh economy. The third chapter reviews the modelling methodology, and provides a brief review of other research (particularly that carried out in the UK) that has examined the economic contribution of forestry industry activity within an input-output framework. The chapter includes a description of the Welsh input-output modelling project and previous applications, together with a review of the methodological issues in forestry sector input-output modelling. The fourth chapter of the report details the survey approach. The chapter provides sectoral

definitions, a description of the survey instruments, the nature of data collected, and details of sample frame design. The fifth chapter briefly describes the survey returns, and reports some of the general findings from the questionnaire and interview process, particularly on the strengths and problems of the forestry industry in Wales.

The main empirical findings are reported in chapter six, which also explains the derivation and interpretation of sector multipliers, and reports on the sector simulations. The seventh chapter describes the methodology adopted to calculate local area effects, and provides estimates of these effects from two unitary authority areas in Wales. The final chapter contains conclusions.

2. The Forestry Industry in Wales

2.1. Introduction

This chapter describes the forestry industry in Wales, and includes data on output and employment in the sector, together with rest of Great Britain (GB) comparators. This chapter also outlines the roles of the key players in the forestry industry in Wales, and provides a review of forestry sector interconnections.

2.2. Forestry Activity in Wales

Forestry and woodland cover an estimated 12% of the total land area of Wales, which represents some 10% of all forestry and woodland in Great Britain (Welsh Office, 1998). Wales has nearly 247,000 hectares of woodland, of which private woodland constitutes an estimated 129,000 hectares (52%), and 118,000 hectares (48%) is owned and managed by the Forestry Commission. Compared with the Great Britain average, private woodland is less important in Wales (Table 2.1).

Table 2.1: Area of Forestry Commission and Private Woodlands in Great Britain
(as at 31 March 1998)

	Forestry Commission		Private Woodlands		Total Woodland	
	000 ha	%	000 ha	%	000 ha	%
Wales	**118**	**48**	**129**	**52**	**247**	**100**
England	219	22	771	78	990	100
Scotland	497	41	705	59	1,202	100
Great Britain	**834**	**34**	**1,606**	**66**	**2,440**	**100**

Source: Forestry Commission (1998a)

Table 2.2 shows how total woodland in Wales and the rest of Great Britain is distributed between different woodland types, with relatively high coverage provided by conifers (softwood forests). In 1997/98, just over one million cubic metres of wood were harvested from Forestry Commission forests in Wales, of which 50% were sold as standing timber (see Table 2.3). Some 90% of conifer production in Wales is harvested from the Forestry Commission estate. This volume of conifer production represents 21% of the total conifer harvested from Forestry Commission forests in

Great Britain as a whole, i.e. 4.8 million cubic metres (Forest Enterprise, 1998). The remaining 10% of softwood produced in Wales is harvested from private forests. This proportion is expected to increase to 30% in 20 years' time owing to the relative age class structures of private and Forest Enterprise conifer woods (Minister's Welsh Forestry Group, 1995). Most of the hardwood produced in Wales (from broadleaved woodlands) comes from the private sector. The 1985 forecast of potential hardwood production from Welsh broadleaved woodland indicated a total of 200,000 cubic metres a year. However, due to high harvesting costs from small woodlands and the limited market opportunities for small dimension, low-grade hardwood, only 15% of the sustainable yield of broadleaved woodland in Wales is currently being utilised (Coed Cymru, 1997).

Table 2.2: Area of Forestry Commission and Private Woodlands in Great Britain as at 31 March 1998 (% figures)

| | High Forest | | | | | |
	Conifers (%)	Broadleaves (%)	Coppice (%)	Total Productive Woodland (%)	Other Woodland (%)	Total Woodland (%)
Wales	**68**	**27**	**0**	**95**	**5**	**100**
England	39	49	2	90	10	100
Scotland	82	10	0	92	8	100
Great Britain	**63**	**27**	**1**	**91**	**9**	**100**

1. Private woodland figures are based on data obtained from the 1980 Census of Woodlands and are adjusted to reflect subsequent changes.
2. Other woodland consists of areas where timber production is not a main objective. It includes areas managed chiefly for amenity, conservation and public recreation.
3. Coppice includes coppice with standards. New estimate of area of coppice; other areas re-classified as broadleaves.

Source: Forestry Commission (1998a)

Table 2.3: Volume of Timber Harvested from Forestry Commission Forests in Wales in 1997/98

	Standing volume in 000s of cubic metres over bark
STANDING TIMBER	**503**
FELLED TIMBER	
Sawlogs	252
Paper and paperboard	151
Panel products	88
Other	16
Total Felled	**507**

Total volume sold	1010

Source: Forest Enterprise (1998)

2.3 Forestry Industry Structure and Support

The main organisations involved in the Welsh forestry industry include:

- Private forestry owners – this includes some large private estates of over 500 hectares down to small ownerships such as farmers who may have less than one hectare.

- Forest Enterprise and its employees.

- Forest management companies who are contracted to some owners to manage forests; these include companies such as Tilhill Economic Forestry and Fountain Forestry, and organisations that also undertake more general land management activities.

- Nursery owners.

- Timber harvesting, extracting and marketing companies, the largest of which in Wales is BSW Harvesting at Newbridge; this sector also includes self-employed individuals – often working for larger concerns.

- Haulage companies.

- Primary processors including saw-mills (these often being allied to other activities such as fencing production and furniture making), wood-based panel manufacturers and pulp mills.

In addition a number of other industries in Wales make use of timber, including joinery, furniture manufacturing, craft, and the construction sector. The sectoral definitions adopted in this study are discussed in more detail in chapter four.

According to the 1993/94 Forest Employment Survey, the forestry industry (including primary processing) employed an estimated 4,750 full-time equivalents (FTEs) in Wales (this was around 0.5% of total Welsh FTEs - evidence later in this report suggests this figure had fallen to just under 4,000 by 1998). The 1993-4 figure represented around 15% of the total (34,820 FTEs) employed in Great Britain (Forestry Commission, 1995). Around 55% of the people employed in the forestry and wood processing industries in Great Britain were in England and around 30% in Scotland. Of the total employed in forestry in Wales, the largest share (36%) was accounted for by employment in wood processing industries (see Table 2.4), and

much of this employment (over two-thirds) was in just four organisations: BSW (Newbridge and Senghenydd), Shotton Paper (Deeside), St Regis (Sudbrook) and Kronospan (Chirk).

Table 2.4: Forestry Employment in Wales and GB 1993/94

	Wales		Great Britain	
	FTEs	(%)	FTEs	(%)
Forestry Commission	1,270	27	6,650	19
Private estates	1,100	23	10,750	31
Forest management companies	125	3	1,910	6
Timber harvesting companies	515	11	4,295	12
Wood processing industries	1,740	36	11,215	32
Total	4,750	100	34,820	100

1. Forestry Commission figures include contractors working in its forests.
2. Wood processing is the primary processing of timber grown in GB.

Source: Forestry Commission (1998a).

Management of forests lies in the hands of private owners and the Forestry Commission. The Forestry Commission is the government department for forestry and acts as the executive agency for forestry in Great Britain as a whole. This will continue after devolution although the Commission is committed to "*respond[ing] to the needs and policies of the Scottish, English and Welsh administrations*" (Forest Enterprise 1998, p.3). Forestry is a devolved subject and since May 1999 funding for forestry in Wales has come from the National Assembly for Wales, which also has powers of direction over the Forestry Commission in Wales.

The Commission's primary objective, from its inception in 1919, was to increase woodland area for purposes of building a strategic timber reserve, with import saving and rural employment pursued as secondary objectives. The 1990s has seen the gradual emergence of the 'post-industrial forest', characterised by a shift away from the primacy of wood production in policy-making and practice and towards the meeting of conservation and recreational needs and priorities (Mather, 1991). This reflects increasing political and public awareness of the multiple uses of woodlands and their potential value for recreational, educational, social, community, tourist, rural development, carbon retention and bio-diversity purposes. This change is embodied in the objectives of the Forestry Commission which are to:

- Protect Britain's forests and woodlands.

- Expand Britain's forest area.

- Enhance the economic value of forest resources.

- Conserve and improve the biodiversity, landscape and cultural heritage of forests and woodlands.

- Develop opportunities for woodland recreation.

- Increase public understanding and community participation in forestry.

(Forestry Commission, 1998b).

Policy instruments include a mixture of regulatory controls and financial incentives. Felling licences and tree preservation orders control the felling of trees, whilst forestry and woodland grant schemes, forest plans (for the private sector) and forest design plans (for the national estate) serve as the principal mechanisms for granting forestry approvals and supporting economic, community and recreational activities. In January 1998, the UK Forestry Standard set out the criteria and standards required for the sustainable management of all forests and woodlands in the UK. However, other than by withholding grants, and control through felling licenses, there is no absolute control of private silvicultural activity in the UK.

Since 1992, forestry policy has been implemented through the Commission's two arms, the Forestry Authority and Forest Enterprise. Forest Enterprise is the agency entrusted with the management of the national forest estate (i.e. the 34% of the forestry area in Great Britain which is owned by the Forestry Commission). It is charged with the delivery of the environmental, financial, social and other outputs sought by the relevant forestry ministers. The objectives of Forest Enterprise are as follows:

- To maximise financial returns of the assets of the forest estate through wood production and the exploitation of commercial opportunities – using private capital wherever appropriate.

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- To develop the recreational and educational potential of the estate, and to facilitate access by the public on foot.

- To enhance the environmental conservation and amenity value of the estate including biodiversity and landscape, and to conserve and manage sympathetically areas of special natural and heritage interest.

- To be efficient, cost-effective and business-like in all operations, and to set and achieve the levels of service provision set out in the Forest Enterprise Citizen's Charter Standard Statement.

(Forest Enterprise, 1998; p 5).

The territorial office of Forest Enterprise in Wales is in Aberystwyth alongside the Forestry Commission National Office, which is currently being strengthened to provide added support on forestry issues to the National Assembly. Its functions include setting Forest District targets, agreeing their business plans and monitoring performance, and the provision of a regional property management service. There are five Forest Districts in Wales which are each responsible for the implementation of agreed plans in the most cost-effective and efficient manner. Specific functions include forest design and production planning, management of forest operations, contract control and customer care (Forest Enterprise, 1998).

A number of organisations represent the interests of private sector growers, harvesters and processors. The Timber Growers Association (TGA) is the association for woodland owners and business. Its main service areas are the provision of information and advice, and representing members' interests to the UK government and in the European Union (EU). The Forestry Contracting Association Limited (FCA) is the trade association for the contracting side of the industry. The Association provides a range of benefits and services to members including discounted insurance, finance packages, an advisory helpline and a range of forestry training courses. An additional organisation is the UK Forest Products Association (UKFPA). Members include saw-mills, wood-based panel mills, harvesting companies, timber merchants, pallet and packaging manufacturers, fencing manufacturers, bark processors, and suppliers of forestry and saw-mill equipment. Members account for approximately 85% of the

production of sawn British-grown softwood and some 90% of the production of sawn British-grown hardwood. Finally, support for the care and management of broadleaf woodlands in Wales is provided by Coed Cymru, an independent intermediary established in 1985 with the aim of bringing farm woodland back into productive management. It has adopted a supply chain approach and bases its activities on the construction of participatory linkages between primary sources, processors and final users.

2.4. The Changing Structure of the Industry

Total employment in the forestry industry in Britain fell by an estimated 15% between 1988 and 1994 (according to the Forest Employment Survey). The 1993/94 Forest Employment Survey revealed that total employment in Wales had remained relatively unchanged on the level recorded in 1988/89, falling by only 0.5%. However, a significant restructuring in employment has occurred within the industry, with increases in the numbers employed by harvesting and processing activities, as well as in 'other' forest uses such as recreation, conservation and sport. In contrast, employment has fallen in establishment and maintenance activities as a result of lower levels of planting activity and increased labour productivity (Forestry Commission, 1995). Moreover both upstream and downstream forestry industry sectors have experienced significant increases in labour productivity as a result of mechanisation. This is particularly evident in harvesting activity in automated cutting machinery and rapid forwarding to road/ride side. This has led to some restructuring in the harvesting contracting sector. However, there are constraints imposed on the mechanisation in harvesting by the steep hillsides and gullies which need to be accessed to get at timber in Wales, which should maintain the more labour-intensive harvesting methods for the near future.

As well as changes in the nature of employment in forestry in Wales, forestry policy is also changing. The Forestry Commission is no longer actively acquiring land for afforestation, and there has been very little new planting on Commission land in Wales since 1992 (Forestry Commission, 1998a). However, because of declining levels of support to agriculture, farm forestry is being promoted as an alternative. The

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Farm Woodland Premium Scheme (FWPS) is designed to both enhance the environment and create a productive alternative land use through the planting of farm woodlands. The grant, administered by the Forestry Commission, comprises annual payments made by Agriculture Departments. Entitlement depends upon approval under the Woodland Grant Scheme (see below). The amounts paid are increased for better quality land and for plantations which are predominantly of broadleaf species because of their greater environmental benefit (Midmore, 1996).

In addition, the Woodland Grant Scheme (WGS) aims to encourage the creation and management of woodlands by providing money to help towards the cost of work. The WGS includes the provision of aid for woodland planting (conifers and broadleaves), natural regeneration, a community woodland supplement, a better land supplement, short-rotation coppice, native pinewood planting, establishment restocking, an annual management grant, a livestock exclusion annual premium, a woodland improvement grant, and a location supplement grant. These schemes are likely to be brought under one rural development regulation under the Agenda 2000 reform of the Common Agricultural Policy (CAP). As part of the continuing progress towards a policy encouraging multi-functional land use in the countryside, existing forestry and woodland grants are likely to be integrated with other policies to meet overall rural development objectives.

These policy developments, coupled with the progress and expansion of Coed Cymru, have led to increased financial support for, and interest in, the care, management and productive use of the hardwood timber resource contained in native broadleaved woodlands in Wales. Table 2.5 shows the level of new planting and restocking in conifers and broadleaves in Wales in 1997/98.

Table 2.5: Areas of Planting and Restocking of Woodlands in Wales
Hectares, in year ending 31 March 1998

	Hectares		
	New planting	Re-stocking	Total
Forestry Commission:			
Conifers	5	1,763	1,768
Broadleaves	8	166	174
Private woodlands – all grant schemes:			
Conifers	129	570	699

| Broadleaves | 356 | 234 | 590 |
| **Total** | **498** | **2733** | **3231** |

1. Private woodland figures are for planting grant-aided by the Woodland Grant Scheme, including new planting in association with the Farm Woodland Scheme and the Farm Woodland Premium Schemes, and planting aided by old grant schemes.
2. The areas of new planting and restocking include areas of natural regeneration for which the second instalment of grant has been paid.

Source: Forestry Commission (1998b).

2.5 A Summary of Forestry Interconnections

An outline of forestry industry interconnections in Wales is shown in Figure 2.1. It is first necessary to make a broad distinction between upstream (forestry) and downstream (processing) sectors with the dividing line being the mill or processor gate (see later Chapter 4 for the research definitions). Second, the forestry industry has backward linkages reflecting the supply side underlying timber production, and forward linkages in terms of the demand for these timber outputs. It is also necessary to make a distinction between the Forestry Commission supply chain and that of private owners. A basic distinction is further made between activities at the production, harvesting and marketing stages of the supply chain.

As indicated in Table 2.3 above, the timber produced from Forestry Commission woodland in Wales is sold in a number of different forms. This includes standing timber, saw logs and bars, and other products to pulp and wood-based panel makers. These different products are harvested using the labour and mechanical resources of Forest Enterprise, as well as the employment of contractors, and through the sale of standing trees to be harvested and marketed by purchasers (Forest Enterprise, 1998).

Saw logs and standing sales are marketed competitively by auction and tender sales. Saw logs are graded according to Forest Enterprise standards to supply the needs of the major Welsh saw-mills and others over the border. There are also a number of smaller saw-mills throughout Wales. Saw logs are then converted to carcassing timber for the building trade, pallet wood and fencing timber. Other wood raw materials (smaller diameter roundwood) are sold to paper mills such as the Shotton Paper Company (for the manufacture of newsprint), Kronospan in Chirk (for the manufacture of boards), and Cape Boards in Caerphilly (for the production of high quality, fire-resistant, cement-bonded boards). Much of the residue from the largest Welsh saw-mills (wood chippings and sawdust) finds its way to Shotton, and panel makers. A substantial local market exists within Wales for fencing material, and a smaller market exists for firewood and the chippings of branch wood and tops. Although in their infancy, these have the potential to develop into larger markets (Farmer, 1993). In this context a key future development could be the Border

Figure 2.1. A Summary of Forestry Industry Interconnections in Wales
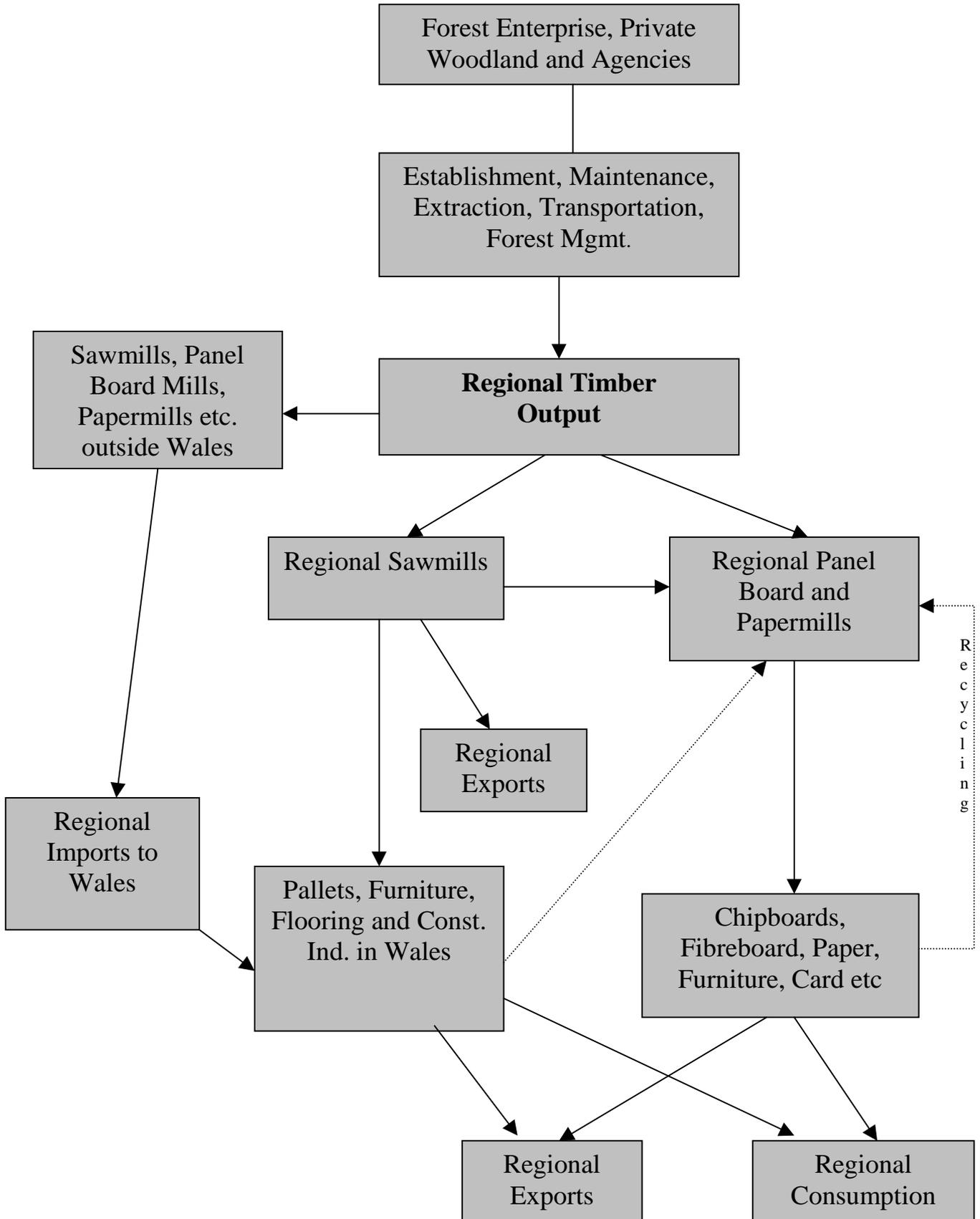
Biofuels project at Newbridge where a proposed wood fuel renewable energy plant (22MW) could produce electricity for up to 40,000 homes, and provide around 50 new jobs. Much of the wood fuel supplies for the proposed project come from forestry residues including tops and tree branches. Finally, Coed Cymru are engaged in applying appropriate methods of silviculture to harvest the small diameter, coppiced material in Wales' broadleaved woodlands, and are also developing prototypes to accommodate low quality hardwoods.

In conclusion, forestry industry inter-connections are fairly complex. The scale and extent of the financial relationships between forest sectors are discussed in Chapter 6.

3. Modelling Forestry Industry Activity

3.1. Introduction

This chapter focuses on input-output modelling techniques, and how these techniques can be applied to the analysis of forestry industry sectors. The general methodological approach is described, and reference is made to previous applications using the Welsh input-output tables. This chapter outlines some of the limitations of input-output modelling, and suggests how the methodology can be modified to overcome some of these problems. The final part of this chapter reviews previous studies which have modelled the economic contribution of forestry-related activities using input-output techniques.

3.2 Input-Output Modelling

Input-output tables provide a detailed description of an economy by quantifying the inter-industry transactions (i.e. sales and purchases between industries) as well as the relationships between industries, consumers and government sectors that exist in that economy in a given time period - usually one year.

The inter-relationships between 'local' industries can also be described within an input-output framework by a detailed analysis of trading patterns that link local and external trade – i.e. imports and exports. In a UK regional context, exports and imports include trade with other UK regions as well as overseas sales or purchases – a factor which is of particular relevance to the forestry sector as some Welsh timber outputs are processed in saw-mills in English regions, while these mills may 'export' residues back into Wales.

One of the primary uses of input-output tables is as a descriptive tool. For example, the absolute size of sectors can be compared in terms of output, incomes, employment, and gross domestic product (GDP). Moreover performance indicators such as the import or labour intensities of different sectors can be quantified. Finally, analysis using input-output tables can indicate the local inter-connectedness of industries. Those industries trading predominantly within the region, either through sales or purchases, will be more financially 'connected' to that regional economy.

Other sectors may depend more on external markets as a source of purchases or as a market for sales.

The input-output table then provides a detailed 'snap-shot' of an economy. The basic relations detailed in that snap-shot can, however, be used to estimate the economic significance of different industries, or to assess the implications of changes in that economy. For example, the linkages of one sector to others can be traced through the supply chain, and the level of output and employment 'dependent' on that industry's activity can be estimated. At the same time if one sector changes its level of production, this will have further impacts on supplier sectors that will in turn require extra inputs and so on. The input-output framework allows these linkages to be identified, and their ultimate impact to be quantified by estimation of a 'multiplier'.

Estimation of the multiplier, or analysis of the impacts of changes on the economy via the input-output model, relies on an assumption of fixed production functions. The demand-driven changes multiply through other sectors via supply relations that are assumed to be linear. For example if industry A produced £10m of output and required £1m (10%) of the output of industry B as an input, then an increase in the output of industry A by £1m is assumed to require a further £0.1m (10%) of industry B's output. Hence no allowance is made in the modelling process for real and pecuniary economies of scale in production or technological progress that would change the production function of industry A. Thus although such models are used to analyse industry changes at the margin, they actually reveal average industry change figures (for a more detailed description of the input-output methodology and assumptions see e.g. Bulmer-Thomas, 1982; Richardson, 1972).

In the short to medium term, the fixed and linear input-output assumption is a reasonable one, as technical progress and factor substitution possibilities will be limited. Where such changes can be predicted then the input-output coefficients can be adjusted accordingly. Two further limitations of the input-output approach are the absence of supply constraints and the inability to allow for price adjustment. In response to such difficulties a range of modelling techniques have been used in forestry impact studies (for example, computerised general equilibrium models).

However, the data demands of these methods have precluded their general use for impact analysis, or in some cases incorporation of supply side adjustments have been made at the expense of detailed industrial analysis provided by the input-output approach. Where supply constraints or dependencies can be identified, the input-output framework can again be modified (see McGregor and McNicoll, 1989).

3.3 The Welsh Input-Output Project

The multiplier impacts of the Welsh forestry industry are estimated using Welsh input-output tables for 1996 (Hill and Roberts, 2000). These tables, developed as part of an on-going research project at the Welsh Economy Research Unit, detail trade flows between 67 separately defined sectors of the regional economy. The 1996 tables represent Phase III of this research project, with tables for the years 1994 and 1995 already published (see Hill and Roberts, 1996; Brand, Hill and Roberts, 1998). The tables are constructed using a combination of survey and non-survey techniques. The methodology used to construct the 1996 tables makes maximum use of existing and new survey data for Wales, limiting the reliance on UK-derived information. With the development of the Welsh input-output project, the survey content of the tables increases as new primary research is incorporated within the tables, either from purpose-designed questionnaires, or from the results of other sector-specific studies. The Welsh input-output tables have been used in a range of applications, from sector-specific studies through to policy evaluation and estimation of the impacts of infrastructure developments on the regional economy (see Table 3.1).

Table 3.1. Previous Input-Output Applications in Wales

Study	Summary impact
Arts and Cultural Industries (WERU/DCA 1998)	The 'industry' was divided into 6 separate sub-sectors with inter-sector trading separately identified, and multipliers for each sub-group estimated. Employment multipliers ranged from 1.37 to 2.47.
Coal Industry (Hill, Munday, Roberts 1998)	All major producers in Wales provided details on their sales and purchasing patterns. Employment multiplier estimated as 1.62, significant knock-on effects in, for example, road transport sectors.
Higher Education in Wales (Hill et al. 1997)	Higher education institutions were surveyed to assess their contribution to the regional economy, and to identify their 'Welsh creation' possibilities. Employment multiplier (with.impacts of student expenditure) estimated at 1.82.
Road Infrastructure developments: the Case of the A55 (Bryan et al. 1997)	Input-output methodology was adopted to estimate the economic implications of road infrastructure improvements via transport cost reductions. An estimated 10% cost saving, and an output elasticity of 2 led to a final job impact of just over 354 full time jobs: these were in addition to direct and indirect jobs generated as a result of construction-related activity.
FDI in Wales, Scotland and West Midlands (Brand et al.	This research examined the direct and indirect contributions made by foreign manufacturing companies to the regional economies of Wales, Scotland and the

1999)	West Midlands. Survey data derived from foreign manufacturers in each region was used in conjunction with regional input-output tables to assess regional potential for the future development of backward linkages.

3.4. Specific Methodological Issues in Forestry Input-Output Modelling

Some of the assumptions and limitations of the input-output methodology have been summarised earlier in this chapter. This section outlines the methodological and data issues that are largely forestry sector specific. As suggested earlier, modifications, extensions or alternatives to the input-output modelling approach have been developed in an attempt to overcome some of these problems. More detail on these studies is provided later.

Thomson and Psaltopoulos (1996) summarise the methodological issues in forestry input-output modelling under three headings: conceptual issues; data issues and recreation issues.

3.4.1. Conceptual Issues

Time scales

The annualised accounting framework and linear production functions described within the input-output table enable the estimation of multipliers by further assuming supply availability. As in the example above, if industry A expanded, the methodology assumes extra output of industry B is available as an intermediate input to the production process. In the case of the establishment or growing sector of the forestry industry, with extensive production cycles – often over 75 years, the supply availability assumption to other parts of the forestry and other industries is not appropriate. The 'outputs' of the establishment activities are treated as additions to stocks within the input-output table (i.e. as a sale to final demand), and not as an intermediate input. Purchases of this output by harvesting companies are made via 'sales by final demand'. Disaggregation of forestry activity to separate out planting/establishment activities from the harvesting and maintenance activity can limit these problems, although the supply relationships within this sector are more difficult to interpret in the forestry industry than in most other sectors of the economy.

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Self-employed income

The UK input-output accounting method separates income received by employees from that received by the self-employed work-force. The latter is conventionally included, along with gross operating profits, and rents, in the 'other value added' row of the table. Identification of self-employed income, which can be significant in the forestry industry because of extensive sub-contracting in upstream sectors, is therefore difficult at a UK level without access to primary data. This problem is less serious for most sectors within the Welsh input-output tables, as self-employed income is separated from 'other value added' and aggregated with 'income from employment'. Whilst the published Welsh tables have aggregated forestry with agriculture and fishing, the survey method adopted for this study will enable full estimation of incomes from all sources.

Supply dependency

The other main conceptual difficulty relates to the supply linkages of forestry activities to downstream processors such as saw-mills, wood-based panel and paper/pulp manufacturers. The significance to the local economy of changes in forestry activity will partly depend on the supply relationships between upstream and downstream users. If forestry output declined, some downstream users may be able to replace local wood purchases with saw-mill residues, recovered wood waste or recycled paper. In other cases imported raw materials can be used. McGregor and McNicoll (1992) took explicit account of such dependencies in their study of forestry in the UK, and developed alternative scenarios of supply relationships.

3.4.2. Data-Related Issues

Data provided within UK level input-output tables have traditionally aggregated forestry with other sectors such as agriculture and fishing. This has also been the case in Wales, whilst input-output tables for Scotland define separate forestry activities. The most recent input-output balances (which do not separate UK and overseas trade flows) for the UK do however identify a single forestry sector, although problems of self-employed income as well as aggregation difficulties, as mentioned earlier, still

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remain. Other data-related issues include difficulties in estimating private sector forestry output, as well as estimating levels of self-employment. Such problems, which are magnified at a regional level, necessitate detailed surveys of forest related activities, for reliable estimation of forestry impacts to be made. Such a survey programme is described in the next chapter.

3.4.3. Recreational and Other Aspects

Part of forestry industry activity relates not only to planting, harvesting and production, but to the recreational use of forests by visitors. Placing a value on this activity can be difficult, and this is traditionally estimated by the value of expenditure necessary to create this recreation 'output' during the accounting period, i.e. through maintenance work, visitor centre expenditures, labour costs etc. Separation of these costs from those of more traditional forestry sectors can be a problem, just as the identification of tourist or consumer expenditure on 'forest visits' may be difficult.

In summary, using input-output methods to model forestry activity presents a number of methodological problems, such that the results of such modelling processes should be interpreted with care. Many of the problems outlined above, however, have data difficulties at their source. Adopting a more flexible modelling framework, and incorporating detailed survey data will limit these difficulties to produce a more reliable and meaningful picture of forestry in Wales.

3.5. Previous Research

A number of different methods (see also Appendix 1) have previously been applied to estimate the impact of the forestry sector on a number of economic outcomes, such as output, employment, income distribution and the environment. The international literature on the impact of the forestry sector is extensive and Table 3.2. summarises a selection of studies. A smaller body of forestry industry impact literature exists for the UK and with a narrower application of methods used. This is now briefly reviewed.

Table 3.2. A Summary of Previous Research

Dickerman and Butzer, 1975	Explores in an input-output framework the importance of the forestry industry in the local economy, with cases from the Pacific coast and Montana with attention given to the potential of timber management to impact regional growth.
Connaughton and McKillop, 1979	Estimation of small area multipliers for the wood processing sector across 19 counties in Northern California.
Long and Hines, 1984	Idaho based case demonstrating susceptibility of forest based economies to changes in lumber demand, prices and government policy. Input-output framework.
Vincent, 1986	Used input-output analysis to examine the regional impacts of timber supply increases on Itasca county in the US.
Pedersen et al., 1989	Examined historic and projected forestry industry activity in the Great Lakes area, and calculated the direct economic effects associated with forest products, wood energy and recreation sectors in an input-output framework.
Flick and Teeter, 1988	Analysis in an input-output model demonstrated that forest industries had a greater than average impact on the local and regional economies in which they operate – particularly wood products and paper industries. Relevant multipliers calculated for 8 states of the US.
Gibbs, 1993	Assessed the economic effects of restrictive forest policies in New South Wales in terms of output losses in downstream sectors.
Marcoullier et al., 1995	Utilised a social accounting framework to demonstrate the economic impact of potential levels of intensive production and processing of timber by various forest ownership types, and examined forward linkages to wood processing sectors. Analysis also demonstrated that timber production affects medium to high income households much more than low income households.
Alavapati, Adamowicz and White 1998	Assessment of the economic impacts of forestry development in Alberta using input-output analysis and computerised general equilibrium models (CGE).

An early attempt to assess the impact of forestry and related activities on UK output and employment used conventional input-output analysis (McGregor and McNicoll, 1989, 1992). Using 1984 transaction tables amended to include superior flows and coefficient information on forestry/wood processing for 1984, McGregor and McNicoll were able to estimate forward and backward linkages. They accomplished this by comparing actual 1984 UK industry activity levels with those obtained from counter-factual experiments, for example, assuming the non-existence of domestic forestry/timber sectors. They found that the absence of UK forestry (in terms of the outputs from upstream activity in establishment, maintenance and harvesting etc.) would have reduced total gross output by £1.65 billion implying a multiplier of 5. The absence of forestry was also found to impose a heavy cost in terms of the contraction of employment – with a multiplier of 1.7. Another key finding was that the economic impact of forestry activity was heavily concentrated in England, despite a relatively greater forestry presence in Scotland and Wales.

McGregor and McNicoll also estimated that in 1984 forestry-related output in Wales was approximately £71 million, and that Wales had 11% of total UK direct forestry output, but only 6% of total UK secondary forestry-related output effects. This was a result of the small open nature of the local economy where much of the multiplier impact of forestry is realised in the UK – especially England. The study estimated that Welsh forestry output, together with the value of output in downstream sectors that were wholly dependent on local timber supplies, was £135.5 million in 1984 (this was 91% greater than the output of forestry alone). This illustrates the extent to which domestic timber users are genuinely dependent on domestic activity. The Welsh share of UK secondary forestry-related effects falls to 5%, where again Wales is relatively unspecialised in sectors in which critically supply dependent sectors have their greatest impact.

Input-output analysis has also been applied to analyse the role of forestry in the rural Scottish economy (Psaltopoulos and Thomson, 1993). Their results demonstrated that an increase in the output of forestry leads to significant increases in total output and income in rural Scotland. Moreover, because of the relatively low wage rates in the forestry sector there are also high employment effects. Whilst the labour-intensive forestry sectors offered potential for improving economic activity, this was because of the high direct impact of forestry in the economy, rather than its backward linkages with other rural industries, which were found to be weak. The research demonstrated that wages and salaries accounted for a high proportion of total inputs in forestry, generating high levels of spending in rural areas, and consequently contributing significantly to total rural output. In the Scottish timber processing sector output and income effects were found to be low because of the high proportion of imports in total inputs, although income multipliers were high due to the sector backward linkages. Backward linkages with the rest of the economy were also strong in the paper industry. However the potential to create economic activity in the area was expected to be limited due to low direct effects.

Finally, Bateman et al. (1993) used the Welsh agricultural input-output model to simulate the impacts in less favoured areas of Wales of different forestry activities on farms. The study compared the estimated impacts of increases in farm forestry conifer plantations with the impacts of bringing existing broadleaf forestry back into management. Their conclusion, from the point of view of income generation in rural Welsh areas, as well as on farms, was that a more stable pattern of income generation would result from a gradual policy of bringing farm woodlands back into active management, but that an absolute decline in incomes would occur if an over-accelerated programme was implemented. Moreover the policy of bringing existing woodlands into management was expected to generate greater local economic benefits than the farm plantation of conifer forests.

In conclusion, a variety of techniques have been used to assess the impact of forestry activity, varying from descriptive analysis to complex computer-generated modelling techniques. Input-output based techniques have been commonly used to assess forestry activity in a range of studies. It is, however, important to recognise that such approaches are not without shortcomings.

4. Research and Survey Methodology

The direct and indirect economic impacts of the forestry sector in Wales was estimated by analysis of financial and employment data collected from a representative number of forestry industry organisations. These financial data informed the construction of forestry industry sectors in the Welsh input-output tables, and from this modelling framework income, employment, and output multipliers were derived. The research process sought to develop multipliers for:

- The different upstream and downstream forestry sectors.
- Defined forest types.

The calculation of local area multipliers was not undertaken within an input-output framework. The method adopted to estimate local area multipliers, and results from this process, are dealt with separately in Chapter 7.

4.1. Forestry Industry Sectors

For the purposes of the research programme the forestry industry in Wales was divided into upstream and downstream activities where the dividing line is the saw-mill or 'other' processor's gate. There are three central upstream forestry activities:

- Forest establishment and nurseries; this includes activities associated with forest planting, ground preparation, beating up, weeding and initial management. Typically these activities are focused in years 0-10 of a commercial rotation.
- Maintenance and management; forestry activities (excluding thinning) occurring between year 10 and the processor gate. Activities here include monitoring, forest protection, disease control, and crop nutrition.
- Harvesting and extraction; this includes both final and intermediate felling (thinning), cross-country extraction and haulage to destination.

These three categories do not fully encompass all upstream activity. Other upstream activities include road and bridge construction and repair which may occur at intervals during the rotation cycle (included in harvesting and allied contracting later in this report – see Section 6.2), together with more general clerical, technical, and

managerial activities supporting upstream activity, particularly those in organisations such as the Forest Enterprise, forest management companies and Coed Cymru.

The main upstream players include Forest Enterprise, private woodland owners (many of whom are members of the Timber Growers Association), forest management companies and consultants (including Tilhill Economic Forestry, Fountain Forestry, Woodland Managers and Strutt & Parker), and timber harvesting companies (the largest of which is BSW Harvesting at Newbridge).

The downstream sector is potentially extensive, including primary processing activities, as well as those who use finished/semi-finished wood in manufacturing and construction processes. The focus in this report is on the primary processing activity including:

- Saw-milling, planing and preparation of wood (Standard Industrial Classification 1992 - SIC 20.1). This includes milling of hard and softwoods. Residues for saw-milling may go on to other primary processors. In Wales there are an estimated 80 saw-mills. These include saw-mills that are part of estate operations, saw-mills involved in processing imported timber, and those that use a large proportion of Welsh produced timber. It is estimated that over 80% of industry output is concentrated in the largest mills which include Kronospan (Chirk), BSW (Senghenydd and Newbridge-on-Wye) and Gwent Timber Products (Newport). Some Welsh timber also leaves the region for saw-milling, and there are several large automated mills just within England including ETC (Ellesmere), Charles Ransford (Bishops Castle), Pontrilas (Hereford), and Forest Fencing (Stamford Bridge, but with smaller mills at Llangadog and Sennybridge in Wales).

- Pulp, paper and paperboard (SIC 21.1) including manufacture of newsprint, coated paper, carton board, and fluting – the scope of the study here was limited to integrated pulp/paper mills i.e. excluding processors that used only recycled paper and imported pulp. Welsh production and employment here is concentrated in just two plants that actually use wood-based products as inputs: Shotton Paper Co uses an estimated 200,000 tonnes of soft roundwood, and 300,000 tonnes of wood chippings per annum (as well as half a million tonnes of recycled paper per

annum) at its newsprint production plant on Deeside, while St Regis at Sudbrook uses some hardwood inputs to produce semi-chemical fluting, for use in corrugated paper and packaging.

- Wood-based panels and chipboard (SIC 20.2) including production of particleboard, fibreboard and veneered sheets. Production and employment here is currently dominated by three facilities: Kronospan (particle board and medium density fibreboard (MDF, Chirk), Cape Boards (cement bonded particle board, Caerphilly), and Imperial Boards (wood fibre boards, Ebbw Vale).

For sample frame construction purposes estimates of the size of the defined forestry industry sector in 1997-98 were made using several data sources. The Forest Employment Survey for 1993-4 provided estimates of the size of forestry sectors in terms of employment and activity which are shown in Table 4.1.

Table 4.1. Employment in the Welsh Forestry Industry Sector in 1993-94

	Establishment (inc. nursery)	Maintenance and Management	Harvesting	Processing	Other	Total
Forestry Commission	40	65	75	0	405	585
Private Estates and Management Companies	95	195	90	275	105	760
Contractors	125	140	1145	0	255	1665
Primary processors	0	0	0	1740	0	1740
Total	260	400	1310	2015	765	4750

Source: Forest Employment Survey, 1993-94
Note: Employment in Forestry Commission and private estates excludes contractors.

The only other contemporary evidence of sector scale came from the 1996 Census of Employment showing that forestry and logging employed 1,169 persons, and that the defined processing sectors employed 2,754 persons, a total of 3,923 persons (including 235 part time). However, the Census does not provide data on self-employment which is important in forestry sectors such as contracting. The results of the new Forest Employment Survey for 1998 were not available at the time of the primary research. Then for the purposes of sample decisions and scale, Table 4.1 provided a reasonable estimate of the employment population at 1998.

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4.2. Forest Types

The descriptive factors underlying the selection of generic forest types included:

- Elevation – with this factor having an impact on timber quality, size and hence final destination.

- Rotation period i.e. with commercial conifer plantations having a rotation period up to 75 years (but typically 45-55 years), as opposed to the longer rotations of some broadleaved species in Wales.

- Harvesting methods – i.e. with conifer plantations often featuring a clear felling policy as opposed to the selective felling sometimes practised in broadleaved woodlands.

- Natural, semi-natural or artificial establishment.

- Degree of management and maintenance activity.

These are just some of the factors that determine underlying differences in forest establishment, maintenance and harvesting costs and the nature of scale economies. The research process initially[2] sought to estimate multipliers for selected generic forest types/groups:

- Upland/commercial conifer plantations (i.e. generally characterised by relatively short rotation, clear felling, continuous production, and featuring some large individual estates).

- Mixed commercial lowland plantations (i.e. mixed conifer/broadleaf forests featuring elements of selective and clear felling, and continuous/non-continuous production).

- Farm woodlands (i.e. semi-natural and partially managed woodlands, largely broadleaf, selective or non-planned production (continuous cover), niche markets for outputs).

- Community woodlands (i.e. recently established woodlands featuring little planned timber production but heavy expected recreational use, and where costs are largely in terms of establishment and maintenance).

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[2] Due to data problems (see Chapter 6) multipliers were only developed for conifer and 'all other' categories.

4.3 Study Areas

The research process sought to estimate economic impacts of the forestry sector in Wales as whole. However, local estimates of Keynesian income multipliers for forestry activity are provided for two defined Welsh unitary authority areas (see Chapter 7 for method and results).

4.4. Survey Sample Data Sources

In constructing a sample for the questionnaire and interview survey a number of sources were used. In the first instance data for Forest Enterprise activities were collected at the all-Wales level, such that data included the activities of each Welsh forest district.

For other upstream sectors a variety of organisations assisted directly or indirectly in the construction of a sample e.g. some contacts from these organisations were accessed through Forestry Commission databases. The original source organisations for the listings from which sample were drawn include:

- Timber Growers Association (TGA). The TGA is an association for woodland owners and forestry businesses and has around 140 members in Wales.
- The Forestry Contracting Association. The FCA is the main trade association for the contracting side of the upstream forestry sector and has around 100 members in Wales.
- The Association of Professional Foresters.
- Jordan's and other general trade directories.
- Forest Enterprise lists of approved contractors.
- Woodland grant scheme recipients from the WGS Database at Edinburgh.
- National Farmers Union, Farmers Union of Wales, and Coed Cymru.

For downstream processing organisations contact points were available from the following sources:

- Forestry Commission/Forest Enterprise.
- Jordan's and Company Directories – particularly for primary processing.
- The UK Forest Products Association.
- Forestry Industry Council publications.

4.5. Sample Derivation

Table 4.2. reveals the selected sample frame for the questionnaire survey and the interviews (this excludes Forest Enterprise where data was provided directly). The objective here was to generate a sample for forestry industry sectors which would give a comprehensive representation of activity in each sector as the basis of further analyses and grossing up of returns. Where possible organisations representing at least 70% of the employment population were contacted. The exception was farm woodlands where the real population is large, with many farms possessing some woodlands in excess of 0.5ha, but with fewer actually managing them.

The figures in the second column provide an estimate of the sector employment covered by the proposed questionnaires. Given the small numbers of organisations in some important downstream sectors such as panel/board and pulp an attempt was made to contact the entire population for interview.

Table 4.2. Sample Frame for Postal Questionnaire

	Total Contacted by Postal Questionnaire	Estimated proportion of population in employment terms to be contacted[2]
Private estates	130	>80%
Forest management companies	5	>80%
Nursery owners	6	>95%
Contractors	72	>70%
Farm woodlands	114	<5%
Saw-milling (and other primary processing ex panel/pulp)	62	>95%
Panel board/Pulp[1]	6	>95%
Total	395	Na

1. Panel board and pulp mills were not sent the postal questionnaire but were contacted by letter for interview because the general survey questionnaire was designed to be completed by upstream sectors and saw-mills, as opposed to wood panel producers and paper mills which differed from other parts of the forestry industries sector in the nature of their purchasing patterns.
2. The estimates of the population coverage were derived from secondary sources, and through discussion with the project Steering Group.

4.6. Survey Instruments

In designing the postal questionnaire a balance had to be struck between levels of financial detail required, and minimising managerial time in completing the forms, with the latter often affecting response rates. The overall objective was to have a questionnaire that could be completed in less than 30 minutes, but that would provide key information to track sector transactions. The questionnaire also had to be

designed to be applicable to a wide range of organisational types from the larger private estates to the smaller subcontracting companies and self-employed individuals. The survey questionnaire is found in Appendix 2. In summary completion of the questionnaire required respondents to provide the following:

- General information on the company and the time period of the financial data.
- Business activity (main and subsidiary activities).
- Employment and earnings data for direct and sub-contracted employees.
- Output data, and summary information on destination of outputs.
- Expenditure broken down into 13 broad categories, with estimates on proportion purchased in Wales, rest of UK, outside UK.
- Revenue sources broken down into 6 defined categories, with estimates of proportions of categorised revenues from Wales, rest of UK etc.

A follow-up interview process was also undertaken amongst a sub-sample of respondents who had completed (or who in some cases had not fully completed) the postal questionnaire. The interview programme had a number of purposes. Firstly, the interviews served to clarify financial details provided by respondents (and in the cases of panel board and pulp producers were the first contact point for collection of financial information). In addition a number of respondents who received the postal questionnaire had not provided full information or had selected not to fill in financial details themselves, but had agreed to be interviewed, and then provide selected data. Second, the interview process informed the research team on the specific characteristics of different forestry industry sectors, providing insight into the specifics of sector financial transactions and direction which are critical for the construction of forest sectors in the Welsh input-output table, and the appreciation of supply dependencies. Third, the interviews provided a forum to discuss more general industry issues which have an important bearing on the interpretation of multiplier estimates. These issues included those pertaining to finance and human resource availability; local economic effects; industry location; technological and operational change; supply shortages; new investments; and strategic industry directions – some of the findings from the interview process are reported in the next chapter.

Two interview schedules were designed – one tailored for upstream activities and the second for primary processors with an emphasis on final output usage. These are also reproduced in Appendix 2.

4.7. Survey Process

The draft postal questionnaire was piloted to a small number of forestry industry organisations during February 1999 to assess the appropriateness of questions, and to identify difficulties that respondents might have in providing answers, particularly with financial data on purchases. As part of the pilot process respondents were also asked for suggestions for ways in which the survey instrument could be improved. The draft questionnaire also benefited from the comments of the Project Steering Group which was made up of personnel from the Forestry Commission, Timber Growers Association and Welsh Development Agency. The survey also had the appropriate permissions to comply with Survey Control procedures.

The postal questionnaire process was largely administered by the research team. However, special arrangements were made with the Timber Growers Association to mail their own members in Wales, with an appropriate covering letter, and the questionnaire. The remainder of the postal questionnaires were sent out with a supporting letter from the Forestry Commission detailing the purpose of the survey, the sponsors, and the research team, and providing contact numbers in case of difficulty. An amended letter was sent to the primary processing sectors that were not being surveyed directly through the questionnaires (6 cases - the panel board makers and the pulp mills) requesting an interview.

The postal questionnaire was mailed out during March 1999, and a reminder was sent out during April 1999. Respondents for interview were selected following an initial analysis of returns. Telephone follow-ups for the 'interview only' sample of wood panel makers and paper mills were also made.

4.8. Data Analysis and Grossing Up *(see also section 6.2).*

The completed questionnaire returns were allocated to a set of defined forestry sectors within the sample frame, and separately analysed. The representativeness of survey sectors was then tested using various data sources such as number and size of known operators within the sample group. This approach was similar to that adopted in the study of arts and cultural industries in Wales (DCA/WERU, 1998). In this project, almost 50 separate arts sectors were identified, ranging from entertainers to theatre groups to museums and photographers. Each of these sub-sectors was separately analysed for representativeness, and returns grossed-up using a range of data sources reflecting activity in terms of employment and output. At a later stage in the analysis, and for presentation of results, these sub-groups were aggregated into 6 larger sectors, such as the performing arts, media and literature and publishing. This micro level approach enables the structured and systematic construction of the 'new' sectors within the input-output framework, and was applied where possible in this study of forestry activity in Wales. Manipulation of the defined forestry sectors in the 1996 Welsh input-output table then provides estimates of output, income and employment multipliers.

5. Survey Returns and Industry Commentary

5.1. Introduction

This chapter provides a description of the returns received from the postal questionnaire and interview survey. The chapter goes on to summarise the comments made by respondents in the 'open' section of the questionnaire and interview survey about the current state, opportunities and problems of the forest industries sector.

5.2. Survey Returns

Table 5.1. reveals the overall pattern of survey returns. The overall response rate was 28% but with a considerable variability in the quality and number of returns between different sectors. The burden of information required in input-output style questionnaires is quite large for smaller organisations, and the self-employed, which is reflected in the fact that for some sectors there was a higher proportion of partially usable returns, with some of the key financial data absent. It is also important to note that the classification of returns in Table 5.1. is partly judgemental – although respondents were asked to list their main subsidiary activities, it was sometimes difficult for them to do so. For example, some owners of woodland were involved in timber processing activities.

Table 5.1. Survey Returns and Interviews Undertaken by Sector

	Sample frame	Returns by main activity	Return rate (%)	Interviews completed [1]
Saw-mills and Other Processing ex Pulp/Paper	62	21	33.9	7
Contractors and Hauliers	72	11	15.3	6
Private Estates	130	28	21.5	12
Management Companies	5	5	100.0	2
Farm/Small Woodlands	114	41	36.0	5
Nurseries	6	1	16.7	0
Panel and Pulp/Paper	6	4	66.7	4
Total	395	111	28.1	36

1. Interviews were selected from the returns listed in column 3.

The return from saw-mills/other processors was good although several of the smaller mills contacted had actually closed or did not consider themselves to be doing enough 'forestry' activity to contribute. Importantly, there were completed returns from the

largest saw-mills in terms of output and employment. Moreover, the return also covered a variety of smaller saw-mills, sometimes connected to other processing such as fencing, or panel production, together with saw-mills attached to private estates. Interviews were undertaken with seven organisations in this sector including the two largest saw-milling respondents.

The Timber Growers Association sent out questionnaires to 130 of their members in Wales. The returns from this sector were overall of a good quality in terms of respondent efforts to complete all parts of the questionnaire. The returns covered private estates totalling some 3000 hectares – the largest estates were around 400-500 hectares. The private estate returns came from a variety of Welsh areas, and covered both mixed lowland plantations and upland/commercial blocks. In several cases estates or upland blocks were being managed by specialist companies. In two cases of smaller upland conifer blocks, the owners stated that that their holdings were essentially 'hobby forests'. In four cases the private estate featured other processing operations – in three cases this was saw-milling (including one which produced fencing/other products), and in one case the estate was supporting charcoal making. A total of 12 interviews were undertaken with 'private estates', either with owners (9 cases), or their estate managers (2 cases), and one case where the same management agent was authorised to speak to the research team on behalf of two different private owners.

The returns from contractors and hauliers varied in quality. There were just 11 survey returns including general harvesting contractors (9 cases) and two haulage contractors. As noted above, the small size, and limited time available to some contractors undoubtedly meant that questionnaire completion was seen as over-burdensome. However, the research team did have returns from the two largest employers of forestry contractors in Wales, and in both cases details had been given about their respective sub-contracting bases.

Farm woodlands provided 41 questionnaire returns. The returns again varied in quality, with most respondents giving descriptive details of their woodlands, but with

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few cases of any significant expenditure following initial establishment. Moreover, the life-cycle profile of the farm woodlands in the sample made for very limited outputs or employment. Only five interviews were undertaken with respondents because of the relatively small output and employment supported in the sector.

A total of five questionnaires were received from forest management companies. This included a return from the largest forest management company in Wales. Interviews were undertaken with two of the largest companies. As noted above an additional forest management company was interviewed 'indirectly' because two private estate owners had asked them to respond on their behalf. Moreover, some of the private estate owners in the TGA sample also undertook forest management projects. There was only one response from the nursery sector, and no interviews were undertaken.

In the case of the wood-based panel and pulp/paper sector six letters were sent and four companies were subsequently interviewed directly to establish the nature of financial transactions. The interviewed companies represented well over 95% of known sector employment and output in Wales.

5.3. Summary Industry Commentary

Chapter 6 will present the empirical results derived from the financial information contained in survey returns. In this next section the focus is to summarise briefly some of the qualitative information derived from the postal questionnaires and interview survey – basically this encompasses the respondents' views on current industry prospects.

5.3.1. Overall Depressed State of the Upstream Sector

The questionnaires indicated the very low level of optimism in the upstream growing sector – few estate owners involved with either commercial conifer or mixed lowland plantations saw any sign of an improvement in industry prospects in the medium term. The main factors contributing to the poor state of industry were high sterling, leading to cheaper imports and low timber prices; the cancellation of tax concessions to the

private growing sector; landfill taxes (these effectively influencing paper mill demand for wood over recycled material); and increasing diesel prices – these reducing margins down the timber supply chain. Some owners continue to stress the heavy toll on the industry caused by the change in tax regulation. One owner of a mixed lowland estate reported that:

"Since the cancellation of the Schedule B/D concession I have failed in every year not to make a loss, and have had to add funds from the farm rents to the forest estate...if it was not for the need to maintain the shooting facilities I would have locked my forest gates. The new forest certification may force me to do this for economic reasons anyway".

Owners with no farm accounts with which to 'offset' some proportion of forest costs appeared to be particularly hard hit by recent conditions. However, the main influence on poor prospects continues to be the low price of timber. One private owner of an upland conifer block reported that:

"This (plantation) is an even aged conifer forest of 175ha. Revenue for the financial year ending in 1997 was only slightly above expenditure, and this did not allow for management which I do myself.....a corresponding questionnaire for 1999 would reflect the collapse of timber prices by about £8 per cubic metre, bringing the revenue down by about half....I have calculated that the forest's sustainable revenue has dropped from about £36,000pa to £18,000 pa as a result of the recent price falls, with another £1,000 off as a result of the reduction in restocking grant 2 years ago"

The majority of private estates surveyed appeared to be doing no better than breaking even in the current climate, with several cases of forestry maintenance being subsidised by other activities (including charcoal making and coppicing). The upkeep of forest estates, often at a financial loss, was in some cases due to the personal dedication of owners. The apparent 'inequality' between farm-related subsidies and those available to the forestry industry sector was a common theme in the returns. Added to this were concerns on the 'invisibility' of the sector to regional and national government together with what several estate owners described as 'a feeling of operating outside the new countryside remit' where 'environment and conservation have taken precedence over forestry and silviculture'.

5.3.2. Impacts on the Contracting Base

Survey returns from contractors and hauliers also showed evidence of mounting pressures, although with mixed evidence of exit from the sector. Responding harvesting contractors and hauliers had been hit by falling levels of business, together

with rising fuel prices (particularly hauliers) and by pressures to invest in mechanisation at a time when the industry prospects were poor. Several contractors mentioned that the nature of contracts from the largest harvesting organisations made it extremely difficult to plan capital purchases with some harvesting machines costing up to £250,000, and finance companies unwilling to offer the necessary loans on the basis of short-term harvesting contracts. There was a widespread desire for longer term relationships between buyer and service supplier to allow contractors the opportunity to invest. Very few of the responding contractors reported access to grants or financial assistance, and there was little indication that attempts had been made to find alternative funding arrangements.

There were also concerns expressed over the longer term capacity of the contracting sector if timber markets did improve, with contractors reporting a lack of younger people entering the sector. In particular, there were fears of future supply shortages in the skills needed to harvest trees from more difficult environments. Private estate owners also reported problems finding multi-skilled contractors for smaller parcels of maintenance work. An unwillingness amongst some contractors to undertake such work was combined with more general shortages of 'skidding and skyline gangs'. Longer term prospects for forestry contracting have also been hit by the low level of earnings reported in the sector. The difficulties that some private estate owners were having in finding suitable forestry workers and contracting staff had led to a shift towards standing sales in some cases with the largest harvesting companies.

5.3.3. Industry Structure, Certification and Regulations

Private estates were unified in concerns about proposed UKWAS certification processes with the possibility of the creation of a two-tier market for certified and uncertified timber. One respondent reported that the burden of certification in terms of drawing up statements of policy and employment practices would fall particularly heavily on medium sized estates – with the largest estates able to bear the cost burden of certification more easily, whilst smaller estates may be able to get assistance in these processes from organisations such as Coed Cymru. Suggestions were proffered for group certification procedures, or even a Woodland Grant Scheme element to

support certification.   More support was also required in terms of promoting knowledge of final timber markets, with some growers reporting that they knew very little about the markets that they were actually growing for, and that there was little advice available on the type of trees that should be grown in the context of emerging timber markets. Growers in the hardwood sector also noted the absence of any detailed survey of the quality and quantity of Welsh hardwoods to inform manufacturers on material availability. Other more specific and 'regulatory' issues concerning timber growers were the low level of grants for restocking old woodlands compared with genuine new planting, and the need for public meetings to discuss large new plantings in the future.

The emerging pattern of cross-shareholdings and take-overs in the forest industries sector in Wales was seen by some respondents as in danger of effectively narrowing the supply chain into downstream processors owned by a smaller group of interests, with associated dangers of undue influence upon prices.   Further restructuring in the downstream processing sectors – particularly saw-mills – was expected in the new millennium. Selected border saw-mills and paper mills exist at the end of a narrow supply chain that can potentially take as much softwood as Wales is capable of producing in the medium term. A tightening supply chain could affect prospects for small and medium-sized mills in the Welsh periphery and on private estates.

Several respondents observed the reduction of saw-mill capacity in the north west and south west of Wales, where opportunities to add value to locally produced timber were being lost. Significantly the closure of these mills has ramifications for timber growers in the Welsh periphery that are forced to send saw logs and bars over greater distances for processing which would hit the already poor margins.

5.4. Conclusion

The commentary reveals that many of the constituent parts of the upstream Welsh forestry industry sector are under increasing pressures. Much of the timber growing sector is experiencing poor returns, which has further impacts on the contracting sector, and contributes to the ongoing restructuring process. The next chapter reports

the derivation of forestry industry multipliers through which it will be possible to gain a more complete understanding of how far changes in the forestry industry sector have wider ramifications for prosperity of the local economy.

6. The Economic Impacts of Welsh Forestry Industries.

6.1. Introduction

This chapter analyses the survey findings within the Welsh input-output modelling framework. The next section describes the process through which the survey data were scaled up to estimate industry and sector totals. The third section provides a commentary on the overall scale of sector activities, and for key groups of activity within the industry. The purpose here is to summarise the transactions characteristics of the industry, emphasising the scale of local activity. The fourth section assesses forestry sector multipliers. The fifth section extends the input-output modelling framework to examine alternative sector aggregations and to simulate the impact of changes in forestry activity. The information in this chapter refers to the calendar year 1998[3], however for modelling purposes the financial data has been deflated to 1996 prices.

6.2. Estimating the Scale of the Forestry Industry in Wales

Chapter 4 outlined the survey method, while Chapter 5 summarised questionnaire response rates and numbers of interviews attended. These survey data were used together with other industry information to allocate the purchases and outputs of the forestry industry, and to estimate the size of the industry in Wales. As Table 5.1 demonstrated, survey coverage varied considerably by sector. In scaling maximum use was made of the primary data, which was then supplemented where necessary with data from other sources.

For analytical purposes, the industry was disaggregated into 9 separate sectors (see below). These sectors were working definitions, which enabled each forestry company or organisation to be allocated to a specific sector – these were industry rather than activity definitions. For example, All Forest Enterprise activities (including establishment, maintenance, restocking and harvesting) have been allocated to the harvesting and allied contracting sector.

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[3] The questionnaire requested data for the 1997/8 financial year, however the information returned often referred to other periods. Data has been adjusted where necessary to approximately represent the 1998 calendar year.

The disaggregation of the forestry industry aided the estimation of inter-sectoral trade, and enabled possible double-counting problems to be avoided. For example, where there was substantial intra-sectoral trade (such as harvesting companies sub-contracting to other harvesting companies), then output and direct employment scalars were applied, to avoid double-counting outputs (see also section 6.4).

For each sector, questionnaire returns were grouped, and then separately analysed for representativeness. Where necessary, sub-sectors were defined to scale the sectors more accurately. For example, in the saw-mill sector, where survey coverage was fairly complete, large and small saw-mill sectors were separated before scaling, to avoid the sector being too heavily biased toward the production structure of the larger mills (see section 6.5.3 for analysis of small saw-mill sector impacts).

The overall size of each forest sector, in terms of output and full-time equivalent (FTE) employment was then estimated, and the questionnaire data grossed up accordingly. The principal data sources used to scale each selected sector are shown below:

■ *Private estates*
Questionnaire data were scaled up using information on the number of private estates in Wales.

■ *Forest management/technical services*
Survey coverage was good for this sector, with all of the major organisations returning questionnaires. Questionnaire data were then scaled up to represent known non-respondents.

■ *Harvesting and allied contracting*
Survey information was available for large parts of this defined sector, including all of Forest Enterprise. A number of smaller harvesting contractors also returned questionnaires. This information was used to augment data for the (relatively small) missing part of the sector. This was then scaled using information on the number of contractors, and by consultation with industry representatives.

■ *Haulage*
Questionnaire coverage was poor for this sector. However, the few questionnaire returns received were of good quality. The size and dimensions of the sector were established largely from questionnaires in other sub-sectors, who detailed their expenditure on local haulage through sub-contacting. For modelling purposes, the

purchasing structure was assumed to match the sector average (from the Welsh input-output tables), but with output destinations separately determined using survey data. The overall size of the sector, in terms of FTE employment, was estimated using the Forest Employment Survey, 1994.

▪ *Saw-mills*
Survey returns were received from most companies in this sector. Non-respondents were identified from databases of saw-mills/timber processing companies, with selected survey returns grossed up to represent a small number of missing companies (see also note above, and section 6.5.3).

▪ *Panel/Board*
Survey coverage for this sector was good, with other secondary data available to allow missing operations to be added to the sector.

▪ *Paper*
Survey coverage was complete for this defined sector.

▪ *Farm woodlands*
Questionnaire returns were received from a number of small farm woodlands. The questionnaire data were grossed up using industry information on hectarage of farm woodlands in Wales.

▪ *Nurseries*
Survey coverage was poor for this small sector, with little information available from other sources, such as Jordan's FAME Database. The returns in this sector were grossed up using estimates of the total number of nurseries in Wales.

6.3. Dimensions of the Forestry Industry in Wales

Table 6.1. reports the estimated scale of the forestry sector, and the nature of key transactions. This is presented for the industry as a whole, and then divided into groups of sector actors combined here as harvesting, which includes all of Forest Enterprise, saw-mills, panel board and paper, and haulage. The other category covers private estates and other activities such as forest management/technical services, nurseries, and farm woodlands.

Table 6.1. Summary Economic Characteristics of Forestry Related Sectors
(Financial Figures £000s 1996 prices)

Sector	All Forest Sectors	Private Estates etc	Harvesting and Allied Contracting	Sawmills	Panel Board and Paper	Haulage
FTEs* in Wales	**3,281**	728	846	557	936	215
FTEs in Rest of UK	**649**		90	45	514	
Total Ftes	**3,930**	728	936	602	1,450	215
Gross output	**403,448**	16,533	43,474	47,253	286,837	9,352
Av Gross Wage	**17.6**	10.4	19.6	13.6	24.4	15.1
Total non-wage spending in Wales	**81,673**	5,605	9,293	26,031	38,592	2,152
Total Forestry related purchases in Wales	**52,133**	4,197	3,875	23,514	20,548	0
All other non-wage spending in Wales	**29,540**	1,408	5,419	2,517	18,044	2,152
Imports (UK and Overseas incl labour)	**166,621**	1,354	4,302	5,703	153,411	1,852

*FTEs are full-time equivalent jobs.

The forestry industry as a whole in Wales employs an estimated 3,930 FTEs. This is lower than the 1993-1994 Forest Employment Survey estimate of forestry employment in Wales which suggested that the sector employed 4,750. However, this 3,930 includes a number of employees that work in Wales but live just over the border in England. An estimated 650 FTEs fall into this category, largely in the panel board and paper sector.

The gross output of the industry is estimated at £403.5m. Note that over 71% of this industry gross output is accounted for in the panel board and paper sector, and much of this output is concentrated in just two plants. Broadly defined upstream sectors (including haulage) accounted for just over 17% of gross industry output, with almost 12% of output in the saw-mill sector.

The distribution of employee income in the forestry industry sectors is very different from the distribution of output. Total gross wages in the industry were £57.8m (not separately shown in table), with just 40% of these incomes derived from the more capital-intensive panel board and paper industries. The average gross wage in the

forestry industry was estimated at £17,625[4]. The highest earnings were found in the panel board and paper sectors, also characterised by the highest labour productivity. Gross output per FTE in panel board and paper was £197,820, compared with £78,478 in the saw-mill sector, and £46,460 per FTE in harvesting (average gross output per FTE in Welsh manufacturing was approximately £120,000 in 1996). Lower levels of earnings are found in the saw-mills and private estates sector. The average gross earnings figure for the defined private estates sector should be treated with caution because of the difficulty in estimating employment in this sector. The survey identified high levels of part-time and casual working, whilst assessing FTEs on farm woodlands was problematic. The reported figure of £10,400 is an average across private estates, farm woodlands and forest management companies and nurseries. Then, for example, it is estimated that gross earnings on private estates themselves are just over £13,000 per fte.

Table 6.1 shows total non-wage spending in Wales for all forest sectors as an estimated £81.7m, comprising of just over £52.1m of forestry related purchases in Wales, and a further £29.5 of other Welsh purchases. These purchasing patterns also vary significantly by sector. For example, the local forestry related purchases of Welsh saw-mills was an estimated £23.5m, with a further £2.5m spent on other supplies within Wales, out of a gross output value of £47.3m. This compares to the panel, board and paper sector, where a much higher share of total spending is on imported (from the rest of the UK or overseas) goods and services (including labour), an important part of which is energy. Overall, just under £63m or 68% of forestry industry Welsh purchases (including standing timber and recycled – see figure 6.1) are from other parts of the forestry sector (the pattern of intra-industry transactions is discussed in more detail below).

Table 6.2. provides a summary of transactions within the forestry industry. This shows for example that the saw-mills sector purchased £19.6m from the harvesting sector, while panel board and paper purchased £6.6m from harvesting and a £8.6m

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4 For comparative purposes average earnings in all Wales industries from the New Earnings Survey were £16,281 for a similar period, and for manufacturing (males only) were £18,700.

from the local saw-mills sector. Haulage sold £3.7m of its output to harvesting, and £3.3m to the panel board and paper sector. Note that the table does not show purchases of standing timber by the harvesting and panel board and paper sectors, which are treated separately within the input-output modelling framework (see conceptual issues in 3.4.1). A summary of forestry industry transactions are shown in Figure 6.1.

Figure 6.1. Summary of Forestry Industry Transactions

OUTPUTS

| Forestry Related Sales **£52.1m** | Other Sales within Wales **£28.6m** | Exports from Wales **£308.1m** | Stocks **£14.6m** |

Gross Industry Output £403.5m

| Welsh Forestry Inputs **£52.1** | Other Welsh Inputs **£29.5m** | Labour (Local) **£57.8m** | Recycled Products from Wales **£1.7m** | Standing Timber **£9.2m** | Imports and Other V.Added **£253.1m** |

INPUTS

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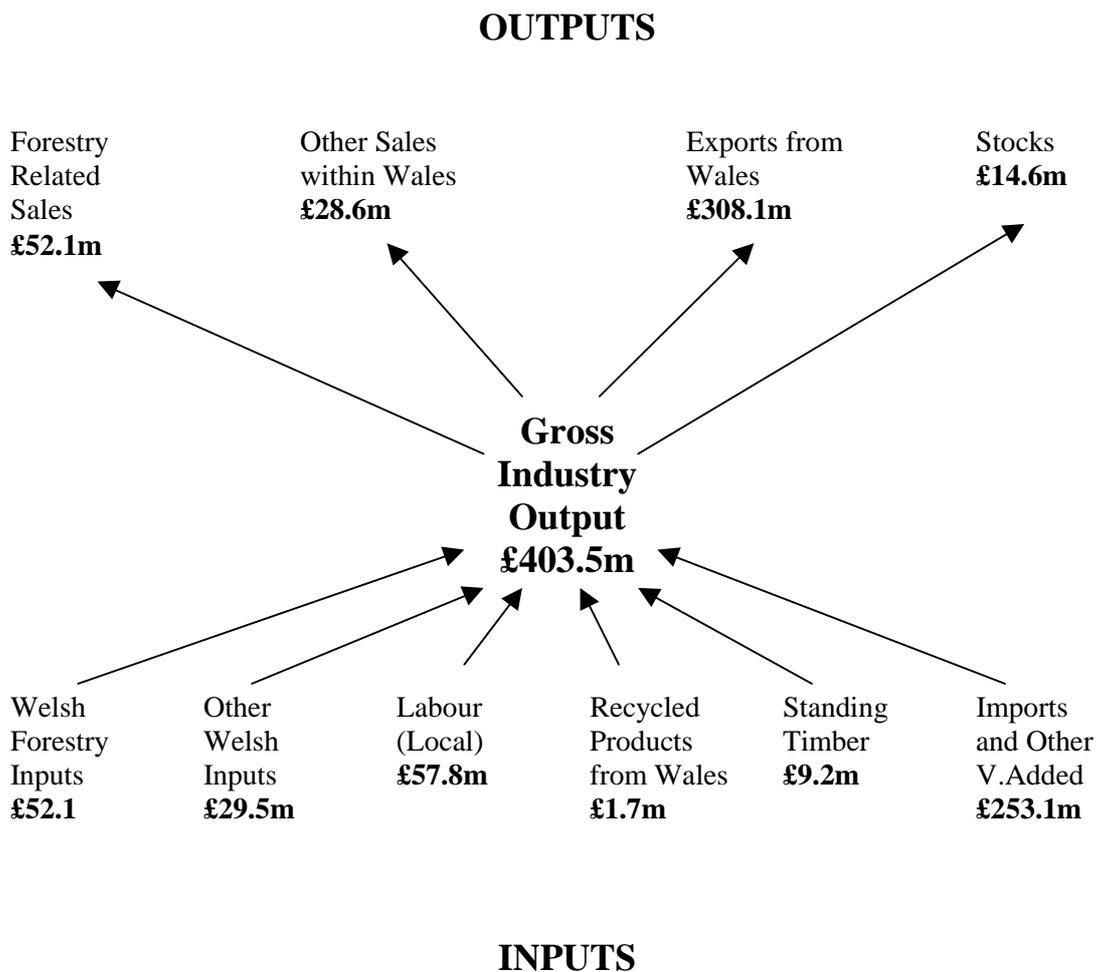
Table 6.2. Intra-Forestry Industry Sales and Purchases (£000s 1996 prices)

Sales to>

Sector	All forest sectors	Pvt.Estates Etc.	Harvesting and allied contracting*	Saw-mills	Panel Board and Paper*	Haulage
Private estates etc.	**5,416**	147	155	3,096	2,018	-
Harvesting	**30,050**	3,883	0	19,560	6,607	-
Saw-mills	**9,102**	28	18	411	8,645	-
Panel Board and Paper	**-**	-	-	-	-	-
Haulage	**7,565**	138	3,702	447	3,278	-
Total Forestry related purchases in Wales	**52,133**	4,197	3,875	23,514	20,548	-
All other purchases in Wales	**29,540**	1,408	5419	2,517	18,044	2,152
TOTAL purchases from Welsh industry	**81,673**	5,605	9,293	26,031	38,592	2,152

Note: * The table does not include purchases of standing timber, or recycled goods by these sectors. These are found in the row sales by final demand in the input-output modelling framework and were estimated at £9.2m and £1.7m respectively (see 3.4.1.conceptual issues earlier). The (notional) purchase of standing timber by Forest Enterprise (from itself), which is then harvested, is included in these estimates.

6.4. Forestry Industry Multipliers

Table 6.1. and 6.2. demonstrated the nature and scale of estimated inter- and intra-forestry industry trading relationships. These inter-relationships have a significant influence on the overall multipliers for the industry, as changes in the level of economic activity in any of the forest sectors will have consequences for other parts of the industry.

The multipliers reported below in Table 6.3 estimate the ultimate impact on the Welsh economy of changes in demand for individual forest sector output. These numbers should be interpreted with care because of the particular treatment of forestry activity. For example, a number of the larger organisations sub-contract a high percentage of activity to other similar companies (such as a timber harvesting company sub-contacting to another harvesting company), hence the direct employment to output ratio is low. However the total employment impact, accounting for sub-contractors in the same industry, (part of the multiplier impact), would be relatively high. On the

other hand if these sub-contractors were treated as direct employees, the direct impact would be high, with lower indirect 'multiplier' employment generation. The ultimate impact on employment in both cases would however be the same. In this study the latter approach was adopted, with sub-contractors included as direct employees.

The multipliers shown in Table 6.3 include 'supplier effects' and 'induced-income' effects. The supplier effects are the result of forestry sector trade with other Welsh industries. An increase in forestry activity in Wales would have impacts on forestry suppliers, whilst these suppliers will in turn require extra inputs and so. Any increase in forestry activity would also (using the fixed production functions assumed by input-output analysis) require extra labour inputs, (in forestry and in supplier companies) adding to local incomes. Some of this extra income will be spent on locally produced goods and services, generating further demands, employment and income. These 'induced-income' effects are added to the supplier (or Type I) effects to give the total (Type II) multiplier.

The output multipliers in Table 6.3 for Wales range from 1.25 in panel board and paper to 1.94 in saw-mills. Higher multiplier impacts are partly a consequence of the relatively high degree of local (Welsh) purchasing per unit of output. Thus a £1m increase in the demand for saw-mills output would support another £0.94m of output in other Welsh industry sectors. As was noted in Table 6.1, a high share of total saw-mill spending is with other Welsh forestry sectors. Similar factors explain the comparatively high output multiplier in the private estates and other category. Conversely, by its nature and location, the panel board and paper sector purchases a much lower share of total inputs within Wales (with large volumes of chemical inputs, as well as energy and some wood inputs purchased from the rest of the UK).

Income and employment multipliers are derived by dividing the ultimate income or employment generated per unit of output (shown in the table) by the initial income or employment per unit of output. So, for example, a £1m increase in demand for harvesting sector output would directly support £0.32m of disposable income (not shown in the table). However, once the supplier and induced-income effects of the

£1m of harvesting output are spread through the Welsh economy, then this will generate a total of £0.42m of disposable income. The multiplier is then calculated by dividing 0.42 by 0.32 i.e. 1.3. Similarly, each £1m of harvesting output supports around 19 jobs directly. When the economic impacts of the £1m of output are spread through the local economy then a total 29 jobs are supported, giving an employment multiplier of around 1.5. Harvesting sector multipliers have to be treated with some caution. As seen above a high proportion of sector spending is included in direct effects because of the particular treatment of sub-contracting. Expected increases in forestry industry prime outputs into the next 25 years could then have substantial impacts as more harvesting is undertaken. In Table 6.3, the 'standardised' income and employment effects in Wales per £1m of output add more to an understanding of the significance of potential changes in sector activity, than the Type II multipliers alone, which, as already discussed, have to be interpreted with caution.

The demand-driven multipliers for the harvesting sector shown in Table 6.3 could be used to estimate the potential impact of a reduction in harvesting activity on the Welsh economy. However, the actual impact is likely to exceed that estimated by the demand-driven multiplier, because of the dependence of processors (such as saw or board-mills) on Welsh harvesting inputs. A reduction in harvesting output is likely to further reduce saw-mill output (if use of imports is not possible). Indeed, the survey process identified high levels of supply dependence between timber processors in Wales and the upstream forestry sector. These issues should be kept in mind when interpreting the multiplier estimates.

Table 6.3 Demand-Driven Multipliers for Forest Sectors

Forest Sector	Output Effects (£m)*	Type II Output Multiplier	Disp Income Effects (£m)*	Type II Income Multiplier	Employment effects (FTEs)*	Type II Employment Multiplier
Private Estates, etc	1.77	1.77	0.57	1.49	59.01	1.34
Harvesting/allied	1.51	1.51	0.42	1.33	28.94	1.49
Saw-mills	1.94	1.94	0.39	2.90	31.23	2.65
Panel Board and Paper	1.25	1.25	0.12	1.76	7.48	2.29
Haulage	1.48	1.48	0.34	1.40	31.53	1.37

Multipliers are highest in the saw-milling sector. On average, each saw-mill job created by an increase in sector demand supports a further 1.65 jobs in Wales. Similarly, every £1m of income created by an increase in saw-mill output creates an estimated additional £1.9m of disposable income in the Welsh economy. A £1m increase in demand for saw-mill output would ultimately generate an estimated £0.39m of income and 31 jobs. Once again this strong local effect reflects the localised direction of saw-milling purchases. This also provides some indication of the local impacts of the recent closures of saw-mills in the Welsh periphery, and the future impacts of any sector consolidation. In interpreting these multipliers it is necessary to note that the input-output framework assumes that there are no supply constraints, such that if processors wished to expand output, appropriate timber supplies would be available (see conceptual issues earlier.) A significant part of the multiplier impact of any of these separate forest sectors is then within other forest sectors.

In the panel board and paper sector each additional £1m of sector demand supports (after multiplier effects) just £0.12m of disposable income and 7.5 jobs. The employment multiplier is comparatively high, but this must be related to the fact that this is an extremely capital-intensive sector, such that each additional £1m of sector output only creates just over 3 jobs directly. Lower overall income and employment effects are also affected by the high imports of labour from the rest of the UK in this sector.

The private estates and 'other' category generate the highest income and employment effects when standardised in terms of additional output. Each £1m of private estates and 'other' output leads to an additional £0.57m of disposable income in Wales, and 59 FTEs. This is largely a consequence of high direct effects (because of the relative labour intensity of production, directly requiring 44 ftes per £1m of output) rather than multiplier impacts. The comparatively low earnings levels in this sector, together with low levels of spending in other forest sectors, result in relatively low multiplier effects in other areas of the Welsh economy.

Moreover, using the demand-driven input-output methodology, an increase in demand for saw-mill, panel board, and paper output would have significant impacts on the rest of Wales, particularly in timber harvesting which supplies raw materials for the production process.

Table 6.3 provides estimates of the potential impact of demand-driven changes in forestry industry activity on the Welsh economy. If one industry expands, then inputs of raw materials, labour etc. are required to produce this output, stimulating further demand increases elsewhere in the economy. Earlier sections have already demonstrated the interconnections within the forestry industry, and these relationships can also be analysed using supply-driven analysis. For example, the forestry haulage sector, according to Table 6.2, has few purchases from other forest sectors in Wales, hence the demand-driven impact of haulage on other forest sectors in Wales will be negligible. However, the haulage sector supplies other forest sectors in Wales with output. The supply-driven multiplier analysis assumes fixed output relationships. For example, if the haulage sector were to expand, this methodology assumes that output in private estates etc., harvesting, saw-mills and panel, board and paper (who use haulage as an input) will also expand to absorb the extra haulage output. Similarly, if the timber harvesting sector were to expand, this approach assumes that saw-mills (an important user of harvesting output) would also expand. The supply impacts of these changes, after taking account of successive rounds of impact through the economy, are summarised in Table 6.4. Note that these calculations assume no price effects as a result of extra supply, and present an alternative modelling approach to the demand-driven methodology outlined above.

Table 6.4 Supply-Driven Multipliers for Forest Sectors

Forest Sector	Output Multiplier	Employment effects per £1m of Direct Output
Private Estates etc	1.48	49.78
Harvesting/Allied	2.13	36.60
Saw-mills	1.69	23.55
Panel Board and Paper	1.06	4.63
Haulage	2.32	40.96

As expected, the supply-driven output multipliers are low in those sectors which supply little or no output directly to other industries in Wales. For example, much of the output of panel board and paper leaves Wales as exports to the rest of the UK and overseas. In other sectors, where forward linkages are relatively strong between forest sectors, output multipliers are significantly higher. The final column of Table 6.4 translates the output impacts into employment consequences. As in the demand-driven approach, the employment impact per £1m of output in private estates etc. is high, due almost entirely to the direct impact of this sector (i.e. the employment multiplier component is small). However, in saw-mills, for example, the multiplier component is more substantial. As already discussed, due to the location and the production processes of panel board and paper producers in Wales, the direct employment to output ratio is small, whilst in the supply-driven model, the forward multiplier impact on employment is also relatively small.

6.5. Modifications and Simulations within the Input-Output Framework.

This section uses the input-output framework to assess the impacts of changes in the forestry industry, and to examine alternative sector aggregations. Four examples are used:

- Complete elimination of the Welsh forestry industry,
- Analysis of generic forest group multipliers,
- Estimation of 'small' sawmill multipliers,
- Increases in harvesting activity.

6.5.1. Elimination of Welsh Forestry Industry

Table 6.5 estimates the 'economic significance' of the forestry industry by quantifying the impact on the rest of Wales, outside the forestry industry. An estimate of economic significance can be derived by estimating the impact of the complete removal of the industry from the Welsh economy. For this analysis the purchases of forestry output by other industries in Wales (such as those made by the construction or furniture industries) are assumed to be replaced by imports, whilst suppliers to the Welsh forestry industry are assumed to contract due to the loss of forestry business. Table 6.5. shows the direct impact of forestry in Wales, (i.e. £403.5m of output,

£47.6m of disposable income and 3,281 FTE jobs), while the 'total' column includes the impact on other Welsh industries. The Welsh forestry industry supports (directly and indirectly) almost 4,440 direct FTE jobs in Wales, £61m of disposable income and £475m of output. The 'multipliers' shown in Table 6.5 (derived by dividing the total impact by the direct forestry impact) are different from those used earlier. The usual input-output multipliers, arising from a stimulus to the forestry industry (those used in Table 6.3), would be higher than the economic significance multiplier, because feedback effects to other parts of the forestry industry would be included in the former calculation, giving a higher ultimate effect.

Table 6.5 The Economic Significance of Forestry Related Industries in Wales

	Output, £m		Income, £m		Employment, FTE	
	Forest direct	Total	Forest direct	Total	Forest direct	Total
Total	403.5	474.6	47.6	60.7	3281	4438
Multiplier		1.18		1.27		1.35

6.5.2 Generic Forest Group Multipliers

This section reports on the derivation of generic forest group multipliers. The methodology involved a re-aggregation of industry groups defined earlier, which were then divided into generic forest groups. The industry groups involved in this process were private estates, forest management/technical services and harvesting and allied contracting. This newly aggregated sector then comprised establishment, maintenance, harvesting and management of all generic forest groups in Wales. Many private estates and farm woodlands include a mixture of generic forest groups. The original intention was to provide four sets of estimates, for conifer, mixed, farm and community woodlands. However, due to data difficulties, only two sub-sector estimates were possible, for conifer and 'all other'. The main information source for these estimates was Forest Enterprise, who provided cost and income data for generic forest groups. This information was augmented where possible, with data from other questionnaires, where generic forest type could be closely related to cost and income data. Whilst information on the costs and total income was obtainable for conifers and other forest types, assessing the destination of output was more difficult. The quantitative survey data did not allow reliable estimates of potential differences in sales patterns to be made. Whilst the qualitative information, obtained through the

interview process, suggested these sales patterns may differ by forest type, this was not sufficient evidence for the quantitative analysis in this section. Sales patterns for these two sub-sectors have therefore been assumed to match the sector average, hence forward linkage patterns for these two groups will be the same. Supply-driven multipliers will not therefore be reported here. The estimates reported in Table 6.6 should be treated with care, and only used as an indicator of relative differences between generic forest types. The multipliers estimated for these two sub-sectors then represent a mix of activities, including harvesting, establishment, maintenance and management of conifers and 'others'.

Table 6.6 Forest Group Multipliers

Demand-driven multipliers	Type II Output Multiplier	Employment Effects (FTEs)
Conifers	1.55	35.53
All other	1.91	56.76

The average Type II output multiplier for conifers was an estimated 1.55, with almost 36 FTE jobs generated per £1m increase in demand. The survey data suggested that conifer woodlands required less direct labour and inputs of materials and services per unit of gross output, which reduced the multipliers for this sector compared to other woodland types. A £1m increase in demand for the output of 'other woodlands' would therefore generate higher multiplier impacts in the rest of the economy (a total £1.91m of output and 57 fte jobs) than an equivalent £1m increase in the demand for conifer output.

Whilst the relative impact of changes in other woodland output would be higher than for conifer, other woodland represents a smaller absolute proportion of total forest coverage and activity in Wales (see for example Tables 2.2 and 2.5 earlier).

6.5.3 'Small' Saw-mill Sector Multipliers

Earlier tables have presented information on the economic characteristics of the defined Welsh saw-mill sector with no analysis of differences within the sector. This section provides estimates of the characteristics of small saw-mills in Wales. For this

analysis the small saw-mill sector is defined to include those companies with less than 25 employees. This categorisation was chosen to separate the effects of the small number of large mills, which dominate total sector output, from other parts of the sector. Smaller saw-mills, often operating in the more peripheral parts of Wales, are likely to have different characteristics from companies processing larger volumes of timber, and benefiting from scale economies in production.

As outlined in section 6.2, large and small saw-mill sub-sectors were separated for scaling purposes, to ensure a more accurate representation of the total saw-mill sector. This section uses these separately defined sub-sectors to analyse differences in economic characteristics. For this analysis, the 'small' sector was disaggregated from the total saw-mill sector within the input-output framework, and multipliers re-estimated.

Table 6.1 presented summary characteristics of the defined Welsh saw-mill sector. For example the sector as a whole employed an estimated 602 people, and produced gross output of £47.3m, or approximately £80,000 per employee. In the small saw-mill sector, labour productivity is almost 35% lower (which increases the direct full-time employee requirement per £1m of gross output). Approximately 50% of saw-mill gross output stays within Wales for further processing, whilst for 'small' saw-mills, local sales represent over 75% of gross output (increasing forward linkages).

Table 6.7 shows estimated multipliers for small saw-mills, together with figures for the sector as a whole (also shown in Table 6.3 and 6.4) .

Table 6.7 Saw-mill Multipliers

	Type II Output Multiplier	Employment impact per £1m of gross output
Demand-Driven multipliers		
Small Saw-mills	2.08	39.18
All Saw-mills	1.94	31.23
Supply-Driven multipliers		
Small Saw-mills	2.19	43.31
All Saw-mills	1.69	23.55

The relatively high demand-driven multiplier impacts of the small sawmill sector are largely a consequence of the higher input requirements (including labour) per unit of output required in small sawmills. The Type II output multiplier in small sawmills is estimated at 2.1, compared with 1.9 for all sawmills, whilst the higher direct labour requirement increases the employment impact of smaller sawmills per £1m of direct output.

The lower half of the table shows the supply-driven multiplier impacts. As outlined above, small sawmills sell a higher proportion of their output to other Welsh industries compared with the sector average, increasing forward linkages. Again the higher direct labour requirement increases the employment impact per unit of output. In this case the final employment impact of small sawmills per £1m of direct output is over 80% higher than the sector average.

Whilst the multipliers are estimated to be higher in small sawmills than in larger mills, their absolute economic significance will be lower, with output and employment in this sector dominated by the largest mills.

6.5.4 Expansion of Harvesting Activity

This section explores the possible impact of an increase in harvesting activity on the Welsh economy within the 1996 input-output framework. Earlier sections have presented and discussed the demand-driven and supply-driven multipliers, and the underlying assumptions. For the demand-driven multipliers, the input structure is assumed to be fixed in relation to gross output level, whilst in the supply-driven multiplier estimation process, sales patterns as a proportion of gross output remain fixed. These two estimation processes present alternative approaches to modelling economic behaviour, not easily combined without further modification[5]. A further difficulty in analysing the potential impact of this scenario, within the input-output

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[5]   Full integration of supply and demand side impacts of economic changes, including price adjustments, is possible using other modelling approaches, such as computable general equilibrium (CGE) models (see Appendix 1).

methodology, is that the potential change in harvesting output would be largely a result of establishment and maintenance activity in earlier decades, rather than a conventional exogenously determined demand shock, which is modelled using demand-driven multipliers. In other words, the increase in harvesting would not just be a consequence of increasing demand by processing sectors (i.e. new capacity), but would be mostly a result of earlier establishment activity.

For this analysis the structure of the harvesting sector is assumed to stay constant, i.e. no changes in labour productivity or input use patterns result from expansion. In addition, this impact is imposed on the Welsh economy in 1996, however changes in harvesting output would not occur for many years, when the Welsh economy, and the forestry industry may look very different.

This section estimates the potential economic impact of an increase in the defined harvesting sector, by incorporating both demand and supply-driven effects. The approach adopted here is to use the derived input-output table data to estimate likely consequences. If the increase to the harvesting sector is assumed to arise through an exogenous demand change, consequent demand-driven effects are relatively easy to predict (i.e. using the multipliers in Table 6.3). However, the strong forward linkages of this sector may also result in changes in processing industries. The supply-driven multipliers assume the relationship between sales and output is fixed, and that changes in the supply of harvesting output will change output in the processing sectors. However, even if harvesting output is used by processing sectors (further assuming no price changes as a result of extra supply) then the output of processors may or may not change. For example, in the case of board or saw-mills, the extra supply of local timber may simply result in import substitution, with no output change (i.e. the same amount of timber is used, but the local content is higher). Whilst this will increase the multiplier impacts of saw and board-mills, there will be no direct saw and board-mill output change. To estimate the potential impact of harvesting output changes on the local economy, assumptions about likely changes in processing outputs and import substitution need to be made. In the case of saw-mills, the main users of harvesting output, it is likely that some import substitution will occur.

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However, the defined Welsh saw-mill sector already buys over 90% of their wood inputs from within Wales[6]. Hence, if the extra output is assumed to be absorbed by local users, then some increase in saw-mill output would be likely. In the case of board/paper manufacturers, there are more possibilities for import substitution, hence any output change is likely to be small. The other main user of harvesting output is the private estates sector (generally buying sub-contracting services). These sectors also buy most of these services locally, hence, under these assumptions, output changes are likely to occur as a result of increasing harvesting output.

The methodological approach adopted was to develop, for each sector, potential output changes that could occur as a result of the direct harvesting change (in this case a 10% output increase), and as a result of changes in the output of wood processors and private estates (the forwardly-linked sectors). The ultimate impacts of these changes are then derived using the conventional demand-driven input-output methodology, incorporating the effects of changes in the processing sectors, and adjusting for double-counting. Then, for example, the backward linkage effect of saw-mill output changes can be fully incorporated, whereas use of the supply-driven or demand-driven approaches alone (or even together) would exclude these impacts.

Table 6.8 presents the results of this estimation process in terms of direct and ultimate output and employment changes. The first part of the table shows the potential increase in harvesting output alongside the estimated economy-wide impacts. For example, if harvesting gross output expands by 10%, an extra £4.3m of output will be generated directly by the harvesting sector. However, as discussed above, the users of Welsh harvesting output are also likely to expand their output as a result. This figure, in column 3, is influenced by assumptions about import substitution and the production structure of the processing sectors. In the 10% scenario, users of harvesting output are assumed to increase their own outputs by a further £4m. As a result of these increases, suppliers to harvesting companies, and to the processing sectors expand production to meet this extra demand, whilst direct and indirectly

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[6]   It is worth noting here that one factor adding to this is restrictions on the export of the Welsh over-bark timber as a result of pest infestation of bark (Dendroctonus micans).

supported employees will generate further demand. The ultimate impact of these changes is shown in the final column. The 10% increase in harvesting output is estimated to generate total output exceeding £12m. The table also translates these output changes into employment impacts. The ultimate employment change is estimated at 232 FTE jobs (including 84 directly generated in the harvesting sector).

The fixed production functions assumed by the input-output methodology mean that the 20% and 30% scenario would normally be obtained simply by doubling or trebling the 10% example. However, whilst this applies to the direct impact on the harvesting sector, the effects on other sectors are unlikely to be linear. Further increases in the availability in local harvesting output may result in an even larger proportionate change in Welsh saw-mill output (as import substitution possibilities are more than exhausted). Conversely, Welsh saw-mills, and other users may not make further output changes if the extra timber is exported[7]. Furthermore, using the fixed-price and production technology assumptions of input-output becomes even more difficult as the output change increases. However, with these assumptions and problems noted, and in the absence of other data, an indication of the potential impacts of larger output changes can be obtained using linear changes in processing sector outputs. By simple multiplication, a 30% increase in harvesting sector activity could then generate an extra £36.8m of output in the Welsh economy, supporting almost 700 jobs (250 of which would be directly supported in the expanded harvesting sector).

Table 6.8 Estimated Impacts of a 10% Increase in Harvesting Sector Activity
(Financial Figures in £000s 1996; Employment in FTEs)

Output	Direct impact on harvesting sector	Direct Impact on forwardly linked sectors	Multiplier impacts	Total
10% increase	4,347	4,000	3,917	12,264
Employment				
10% increase	85	75	72	232

The focus of this chapter has been on the regional impacts of forestry industry activity and sub-activities. The next chapter contains an assessment of the effects of forestry industry activity at a more local level.

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[7]   See footnote 4 on current export restrictions of the Welsh over-bark resource.

7. Calculation of Local Impacts of Forestry Industry Activity

7.1. Introduction

The location characteristics of timber production and the high transport costs of the raw material, mean that it is likely that the impact of industry activities is relatively more significant with respect to certain local/rural economies. This chapter explains and justifies the different approach taken to estimate forestry industry linkage effects at this spatially disaggregated level.

7.2. Measuring Local Impacts

In principle, linkage effects can be identified using similar methodology at any spatial level, although the magnitude of different components will vary considerably, according to the structure of activities and the degree of openness (see Wagstaff, 1973, McNicoll, 1981, for a comparison of input-output, economic base and Keynesian regional multipliers). The smaller the local economy under investigation, the less industrial diversity there is likely to be: therefore smaller economies are likely to experience greater leakages. The implications of this for analysis of interdependence are as follows. The input-output approach is able to identify the forward and backward inter-industry effects that stem from supply chain linkages. It may also, if modified, take into account income and consumption effects: yet most analysts would accept that these total input-output multipliers only crudely capture such additional (induced income) impacts because of the assumed linear income-consumption coefficients. It has been argued (Midmore, 1996; see also Sonis and Hewings, 1993) that a hierarchy of approaches should be employed. On a regional scale, linkages in production will be relatively large compared with consumption feedbacks, and the restrictive Leontief technology assumptions are less serious in their implications. However, at local level, because the degree of economic integration is more limited, the resulting linkages related to production flows are likely to be negligible. In such circumstances, the use of Keynesian regional income and employment multipliers is more appropriate.

In essence, the framework of a Keynesian regional multiplier is identical to that used in aggregate national models. Indeed, it is more likely to correspond to the fixed interest, fixed exchange rate framework in which the original ideas were formulated. The basic components of the multiplier, k, are captured by the following, simplified equation:

$$k \quad = \quad \frac{1}{1 - (1 - t)(c - m)}$$

where t is the rate of direct tax on additional increments of income, c is the fraction of additional income spent on goods and services, and m is the fraction of additional income spent on imported goods and services. Since marginal tax rates can be estimated regardless of locality, and marginal propensities to consume are to an extent generally uniform, the most important part of the equation above is the m, the so-called marginal propensity to import. This is significantly influenced by two factors: the size of the economy and its structure. Smaller, less diversified economies are more dependent on trade and consequently are prone to higher levels of leakage. This means that the total benefit of any injection will be smaller, but also that the losses associated with withdrawals such as perhaps a decline in local harvesting activity will be smaller. There are other influences: proximity to other labour markets may increase leakages of incomes due to commuting in of some of the labour force, and the social structure may influence the value of the savings rate since poorer people save less out of additional incomes. Equally, the effect of welfare benefits which shelter people from loss of incomes due to unemployment have balancing impacts.

Since Archibald's (1967) pioneering study of local income multiplier effects, many further investigations incorporating refinements of its basic method have been carried out. These have been consolidated into a generalised modelling approach by Ashcroft *et al*. (1988), in which considerable emphasis is given to calculation of the multiplicand and the first round effects.[8] These, discussed in more detail in Ashcroft and Swales (1982) and Sinclair and Sutcliffe (1982), demonstrate the importance of

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[8]   As far as the multiplicand is concerned, considerable amounts of external expenditures may leak out before they have any influence on local income: the first round effects take into account in-

accurate calculation of an initial change in determining the overall impact of a change in incomes on a locality.

In view of the wide range of multipliers already calculated, and the limited resources available for this study, effort was devoted to the accurate calculation of the multiplicand in the case-study areas, and a range of estimates of the multiplier process applied to it to estimate the overall impact of forestry and the wood-based industries. The table below provides a review of evidence accumulated from recent studies, together with their subject matter.

Table 7.1. Local Multiplier Studies

Source	Type of Impact	Location	tax fraction (t)	consumption fraction (c)	import fraction (m)
Ashcroft and Swales (1982)	Civil service relocation	Cleveland	0.28	0.87	0.6
Ashcroft and Swales (1982)	Civil service relocation	South Glamorgan	0.26	0.88	0.57
Nairn and Swales (1987)	Urban renewal	Glasgow	0.11	0.89	0.67
Sinclair and Sutcliffe (1989)	Tourism	Malaga	0.30	0.90	0.6/0.5
MacDonald and Swales (1991)	Hypermarket	Not specified	0.25	0.89	0.67
Bleaney *et al*. (1992)	University	Nottingham	0.22	0.90	0.67
Armstrong (1993)	University	Lancaster	0.27	0.88	0.74

It is significant that, of the parameter values reported in these various studies, the variation is greatest amongst the import fraction, *m*, reinforcing the earlier discussion. The largest reported marginal propensity to import, from Armstrong's (1993) study, relates to the Lancaster economy. Though a city, this economy has some characteristics similar to the market towns of rural Wales, in that it is relatively undiversified, and separated from other major urban areas by a considerable expanse of rural hinterland. This may be taken as a lower limit. Even so, the level of leakage is

migration and other, similar effects that have different implications for tax, saving and sourcing of goods and services from outside the locality.

likely to be considerably more variable. Therefore, the values assumed for the local multipliers in these case-studies are as follows:

t 0.25

c 0.90

m 0.75 (low) - 0.80 (high)

These numbers yield a value for the basic multiplier of between 1.081 and 1.127. In calculating the impact of changes in forest-based activities in rural Wales, account also needs to be taken of the likely payments of unemployment benefits, and leakages that occur from any initial change (the so-called first round effect). Further sophistication (especially, for example, differentiating between losses of labour and rental incomes and profits) would probably risk attributing spurious accuracy to the estimates on the basis of the assumptions made here.

The procedure proposed for the case-studies was as follows. Two local areas (Neath-Port Talbot and Powys unitary authority areas[9]), were selected as representative of the main forest systems in Wales. The income value generated by forest-based employment and self employment in these areas was estimated, before calculating the range of likely impacts on the economy as a whole, expressed as a proportion of total income and employment within the unitary authority areas. Details of this process are given in the next section.

7.3. Employment and Income Data for the Forestry Sector

Information sources on general industry employment at the sub-regional level include:

- Labour Force Survey (LFS: resident-based sample survey).
- 1991 Census of Population.
- Annual Employment Survey (AES).
- Company-specific databases (e.g. FAME).
- Survey questionnaire returns.

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[9]   Originally the research team intended to calculate multipliers at the travel to work area level – but reliable estimates of forestry sector incomes and employment at such a level of disaggregation were not available.

In the case of the LFS and Census, the information was insufficiently detailed to make estimates of forestry sector employment at the unitary authority level. It was therefore decided to use data from the AES and FAME, together with information gathered during the survey in order to estimate direct employment at the unitary authority level.

Data from the 1997 AES were used to provide an indication of the spatial dispersion of employment within Wales for the forestry industry as a whole. Then overall forestry employment in Wales estimated from the previous analysis (i.e. 3281 FTEs) was apportioned to UA's according to their share of AES reported forestry industry employment in 1997 (this methodology assumes rates of self-employment within sub-sectors are broadly similar throughout Wales). The resulting employment estimates were assessed against other data sources, including survey returns, known employment sites and FAME. The figures for employees and self-employed in forestry industry were as follows:

- Neath-Port Talbot   379 FTEs.
- Powys   755 FTEs.

Information on forestry sector disposable incomes was estimated from the survey returns data. Average earnings in the defined forestry industry and primary processing sector are highest in the panel board and paper sectors. However, within the defined unitary authority areas it was known that there were no such facilities, hence the average earnings figure for the two unitary authority areas, and hence the calculation of disposable income, was calculated net of board and paper industries. An implicit assumption made here is that, allowing for the absence of board and paper industries, the spread of forestry activity in the two unitary authority areas is the same as that in Wales as a whole; i.e. the split between employment in private estates, harvesting contractors, saw-mills etc. at the unitary authority level is the same at the Welsh level. On this basis a working estimate for disposable average income in Welsh forestry (based on private estates, forest management, harvesting, saw-mills and haulage) was £12,200 per annum.

7.4. Application of Multipliers to Employment and Income.

Multiplying the estimated full-time employment figures above by the range of multipliers for the Neath Port Talbot and Powys UA areas yields a range of 410-427 jobs in Neath-Port Talbot, and 816-851 jobs in Powys. Then multiplying the range of estimated forestry FTEs by the disposable income provides an indication of the income supported by the forestry industries sectors in the two unitary authority areas. The results of this process are shown in the table.

Table 7.2 Local Impacts of Forestry Industry Activity

	Neath-Port Talbot	Powys
Estimated forestry FTEs	379	755
Estimated FTEs after multiplier effects	409.7-427.1	816.2-850.9
Estimated FTEs after multiplier effects as percentage total UA FTEs (%)	0.95-0.99	2.10-2.19
Estimated total income from forestry industries £m	5.00-5.21	9.96-10.38
Total income as a percentage of UA area GDP* (%)	0.45-0.47	1.04-1.09

Note:* UA GDP was estimated using 1995 data from the report, *Local Prosperity in Wales*, WERU (1997).

The table reveals that the forestry industries sector in the Neath-Port Talbot area supports an estimated £5.0-5.2m of income, which is rather less than the total income supported in Powys of between £9.96-10.38m. The forest industries sector is absolutely and relatively more significant in rural Powys than it is in Neath-Port Talbot which is an area with a relatively high proportion of manufacturing employment. The final column of the table shows the range of supported incomes as a proportion of estimated unitary authority area GDP. It should be noted that GDP includes other value added, and taxes. However, these figures do provide some indication of the magnitude of the forest industries sector in these localities. In Neath-Port Talbot the income supported by the forest industries sector was an estimated 0.45-0.47% of GDP, whilst in Powys the figure was 1.04-1.09%. It is also possible to estimate the significance of forestry activity within the primary production sector (agriculture, forestry and fishing) in the two UA areas. In the case of Neath-Port Talbot, the income supported by the forestry industry sector was estimated to represent 7.4% of primary sector GDP, while in Powys the corresponding figure is estimated as 21.5%.

8. Forestry Multiplier Study Conclusions

This research project marks what is possibly the first attempt to quantify the economic impacts of the whole forestry industry sector in Wales comprising both upstream production activities and downstream primary processing. The study used an input-output model of the Welsh economy to assess the direct and indirect economic consequences of a defined forestry industry upon Wales. The modelling methodology employed is not without problems when applied to a forestry industry sector where prime inputs may take over 50 years to come to maturity. However, the modelling framework does permit the estimation of the economic significance of forestry activity, and how changes in forestry industry output might be expected to affect other sectors of the regional economy.

The findings from the study suggest that the Welsh forestry industry sector (comprising here elements of forestry establishment, maintenance, management and harvesting, together with primary processing sectors) directly employs 3,281 people in Wales, creates £404m of output, and £48m of disposable income. Over 70% of forestry industry output in Wales is generated by the panel board and paper sector. In this sector activity is concentrated in just a few producers adjacent to the English border. However, much of forestry industry employment occurs in harvesting, growing and sawmill activity across the Welsh economy. Indeed, many of these jobs occur in areas where there are few alternative employment opportunities.

The forestry industry in Wales, does, however, have a wider economic significance. The modelling framework allowed the estimation of the potential effects on other regional industry sectors in Wales, of the complete removal of the Welsh forestry industry. This revealed the forestry industry supports a total of £475m of output, 4,440 full time jobs, and disposable income of £61m.

The above reveals the aggregate impact of the forestry industry. However, there was an expectation that some sectors of forestry activity were more significant in their regional multiplier impact than others. For example, the research demonstrated that a

£1m increase in demand for saw-mill output would support an estimated additional £0.94m of output in other Welsh industry sectors. A key driver here was the high proportion of saw-mill non-labour purchases that occur in Wales. Likewise, private estates, through their purchasing patterns, would also support £0.77m of further output in other Welsh industry sectors per £1m increase in demand for their own output. However, the panel board and paper sector was found to purchase fewer of its non-wage inputs in Wales, and consequently its linkages with other industries would be smaller, and just £0.25m of output in other Welsh industries would be supported per £1m of extra sector demand. This report also translated these output impacts into employment consequences. For example, in harvesting and saw-mills each £1m of direct sector output demand would support an average of around 30 jobs, whereas in the private estates sector it is nearly twice this number per £1m of output. In the capital and import intensive panel board and paper sector each additional £1m of extra sector demand would support a total of just 7 jobs in Wales.

Industry impact on the wider Welsh economy was also assessed in terms of the activities undertaken in different forest types. For example a £1m increase in the demand for conifer output would support an additional £0.55m of output in other Welsh sectors, and would directly and indirectly support an average of 36 jobs, whereas a similar increase in 'other' woodland output (mixed, farm and community woodlands) would support a much larger £0.91m of other Welsh industry output, and 57 jobs. Clearly, the difference in the magnitude of estimated effects is partially tied to the higher labour intensities observed in the production of outputs in non-conifer woodlands, and perhaps fewer opportunities to use the most mechanised methods. Basically, non-conifer production is associated with a significantly higher cost per unit of output.

Importantly this study also illustrated the tight financial inter-linkages between the forestry industry upstream and downstream from the forest gate. The industry sector features a high degree of inter-dependence, such that events affecting one sector are quickly transferred across the industry. In view of this factor, the economic pressures currently facing separate parts of the forestry industry sector could become

cumulatively multiplied across the sector fairly rapidly. Examples of these different pressures include high sterling, increasing the competitiveness of imports and depressing timber prices, restrictions on Welsh over-bark exports, new industry certification and quality assurance procedures, and investment conditions. The survey findings from this research revealed that few parts of the private growing and contracting sector are currently profitable. Of particular concern is how a damaged industry infrastructure and contracting base can respond in the longer term if market conditions actually do improve. Moreover, the tight industry inter-linkages mean that upstream sectors would be very vulnerable to the closure of primary processing capacity in Wales – a prospect which is becoming more likely in the context of current economic conditions in the wider industry. Conversely, downstream processing activity, particularly the saw-mill sector, would also be vulnerable to a reduction in the supply of locally produced timber materials. The high costs of transporting raw timber resources may partially exclude the possibility of import substitution from other UK regions, although for processors close to the border the availability of quality logs from Scotland or England could partially offset higher transport costs.

The modelling framework permitted the estimation of how changes in the forestry industry activity would affect the Welsh economy. An important expected change is an increase in harvesting activity into the new millennium. This study showed that if harvesting activity were to increase by 30%, then this would lead to an estimated £13.0m increase in harvesting output, but that this harvesting output could be further associated with almost £24m of output as a result of changes in timber processing activities (e.g. expansion in saw-milling output) and the associated demand-driven multiplier impacts. Similarly, a 30% increase in activity would directly create 254 jobs in the harvesting sector, but that a total of 696 jobs could be supported in other areas of the regional economy as a result of linkage effects. It is not just the magnitude of job creation that is important. As noted above a proportion of such direct jobs may be created in particularly needy areas of the Welsh economy where opportunity is limited.

Finally, here, and as intimated above, the impact of the forestry industry sector varies across Wales. Some sub-regions of Wales have higher levels of forestry industry activity than others. The input-output methodology was unsuitable for modelling the local effects of forestry industry activity. In assessing local effects (at the unitary authority level) a Keynesian regional income multiplier was estimated and applied. Two case areas were selected with differing levels of forestry activity – the Neath-Port Talbot and Powys Unitary Authority areas. In Neath-Port Talbot it was estimated that the forestry industry sector directly and indirectly supported just under 1% of local employment, whereas in Powys the figure was around 2.1%. The total income in Neath-Port Talbot and Powys supported by the forestry sector was estimated at around £5.1m and £10.2m respectively.

The presentation of economic data on Welsh industry usually includes some elements of upstream forestry activity within the much larger agriculture sector, and other processing elements are found in manufacturing sectors. The absence of a forest industries sector in much economic data on Welsh industry is unfortunate as the forestry industry is in fact distinct. The paucity of transactional information on the whole forestry industry in Wales has been of some concern given the importance of the sector in Wales compared with many other regional economies, its significance in poorer areas of the Welsh economy, and in the context of any future policymaking on the sector being informed by the best data. This study provides a starting point in increasing the understanding of the impact of forestry activity to the Welsh economy, and in improving data on the significance of the financial transactions that occur both within the forestry sector, and between it and other Welsh industry sectors.

References

Alavalapati, J. Adamowicz, W. and White, W. (1998), A comparison of economic impact assessment methods: the case of forestry developments in Alberta, *Canadian Journal of Forest Science*, 28, 711-719.

Armstrong, H.W. (1993), The local income and employment impact of Lancaster University, *Urban Studies*, 30, 1653-1668.

Ashcroft, B. and Swales, J.K. (1982), The importance of the first round of the multiplier process: the impact of civil service dispersal, *Environment and Planning A*, 14, 429-444.

Ashcroft, B. Holden, D. Smith, J. and Swales, J.K. (1988), A generalised augmented keynesian local multiplier model. In: Harrigan, F. and McGregor, P.G. (eds.) *Recent advances in regional economic modelling*, London: Pion.

Bateman, D. Hughes, G. Midmore, P. Lampkin, N. and Ray, C. (1993), *Pluriactivity and the rural economy in the less favoured areas of Wales*, Aberystwyth: Department of Economics and Agricultural Economics.

Bleaney, M.F. Binks, M.R. Greenaway, D. Reed, G.V. and Whynes, D.K. (1992), What does a university add to its local economy? *Applied Economics*, 24, 305-311.

Brand, S. Hill, S. and Munday, M. (1997), *Assessing the regional consequences of FDI,* Economic and Social Research Council Report.

Brand, S. Hill, S. and Roberts, A. (1998), *Input-Output Tables for Wales 1995*, Cardiff: University of Wales Press.

Bryan, J. Hill, S. Munday, M. and Roberts, A. (1997), New road infrastructure and economic development in the periphery: the A55, North Wales and inward investment, *Transport Geography,* November, 227-237.

Bulmer-Thomas, V. (1982), *Input-Output analysis in developing countries: Sources , methods and applications*, Chichester: Wiley.

Coed Cymru (1997), Biennial Report 1994-96, Newtown: Coed Cymru.

Connaughton, K. and McKillop, W. (1979), Estimation of small area multipliers for the wood processing sector – an econometric approach, *Forest Science*, 25, 1, 7-20.

DCA-WERU (1998), *The economic impact of the arts and cultural industries in Wales,* Cardiff: UCW.

Dickerman, A. and Butzer, S. (1975), The potential of timber management to affect regional growth and stability, *Journal of Forestry*, 73, (5), 268-269.

Farmer R. (1993), Forestry in South Wales, *Forestry* 66, 113 – 134.

Flick, W. and Teeter, L. (1988), Multiplier effects of the southern forest industries, *Forest Products Journal*, 38, 11-12, 69-74.

Forest Enterprise (1998), Forest Enterprise *Annual Reports and Accounts 1997-98*, Edinburgh: Forest Enterprise.

Forestry Commission (1995), *Forest Employment Survey 1993-94: Employment in Forestry and Primary Wood Processing*, Edinburgh: Forestry Commission.

Forestry Commission (1997), Forestry Commission: *Annual Report and Accounts 1996/97*, Edinburgh: Forestry Commission.

Forestry Commission (1998), *Facts and Figures 1997-98*, Edinburgh: Forestry Commission.

Forestry Commission (1998b), Forestry Commission *Annual Report Highlights 1997/98*, Edinburgh: Forestry Commission.

Gibbs, D. (1993), Economic impacts of the New South Wales rainforest policy decision of 1982 on the timber industry of the far north coast, *Australian Forestry,* 55, 80-89.

Hill, S. and Roberts, A. (1996), *An Input-Output Model for Wales 1994*, Cardiff: University of Wales Press.

Hill, S. and Roberts, A. (2000), *An Input-Output Model for Wales 1996*, Cardiff: University of Wales Press, forthcoming.

Hill, S. Roberts, A. and Thomas, M. (1997), *The impact of the higher education sector on the Welsh Economy: Measurement, analysis and enhancement,* Cardiff: UCW.

Hill,S. Munday, M. and Roberts, A. (1998), *The Future for Coal in Wales*, Cardiff Business School/Welsh Office.

Long, R. and Hines, G. (1984), Analysing a forest resource based region facing economic change, *Forest Products Journal*, 34, (10), 51-58.

MacDonald, R. and Swales, J.K. (1991), The local employment impact of a hypermarket - a modified multiplier analysis incorporating the effect of lower retail prices, *Regional Studies*, 25, 155-162.

Marcouiller, D. Schreiner D. and Lewis D. (1995), Distributive economic impacts of intensive timber production, *Forest Science*, 41, (1), 122-139.

Mather A. (1991), 'Pressures on British forest policy: Prologue to the post-industrial forest', *Area* 23, 245 – 53.

McGregor, P. and McNicholl, I. (1989), *The impact of forestry on output and employment in the UK and its member countries*, Report for Scottish Forestry Trust, Edinburgh.

McGregor, P. and McNicholl, I. (1992), The impact of forestry on output in the UK and its member countries, *Regional Studies*, 26, 69-79.

McNicoll, I. (1981), Estimating regional multipliers: Alternative techniques, *Town Planning Review*, 52, 80-88.

Midmore P. (1996), Forestry, farming and the rural economy, in Midmore P. and Hughes G. (eds) *Rural Wales: Economic and Social Perspective*, Welsh Institute of Rural Studies: Aberystwyth.

Midmore, P. (1996), Future directions for multi-sectoral modelling and rural economics, in Midmore, P. and L. Harrison-Mayfield (eds.) (1996). *Rural Economic Modelling: an Input-Output Approach*, Wallingford: CAB International.

Minister's Welsh Forestry Group (1995), *The Way Ahead for Welsh Forestry,* Cardiff: Welsh Office.

Nairn, A.G.M. and Swales, J.K. (1987), Area policy impacts - a multiplier analysis of GEAR, *Urban Studies*, 24, 31-45.

Pedersen, L. Chapelle, D. and Lothner, D. (1989), *The economic impacts of Lake states forestry: An Input-Output study*, USDA Forestry Service, Michigan State.

Psaltopoulos, D. and Thomson, K. (1993), Input-output evaluation of rural development: a forestry centred application, *Journal of Rural Studies*, 9, 351-358.

Richardson, H. (1972), *Input-output and regional economics*, New York: Wiley.

Schallau, C. and Maki, W. (1983), Inter-industry model for analysing the regional impacts of forest resource and related supply constraints, *Forest Science,* 25, 607-661.

Sinclair, M.T. and Sutcliffe, C.M.S. (1982), Keynesian income multipliers and first and second round effects: an application to tourist expenditures, *Oxford Bulletin of Economics and Statistics*, 44, 321-338.

Sinclair, M.T. and Sutcliffe, C.M.S. (1989), Truncated income multipliers and local income generation over time, *Applied Economics*, 21, 1621-1630.

Sonis, M. and Hewings, G.J.D. (1993), Hierarchies of regional sub-structures and their multipliers within input-output systems - Miyazawa revisited, *Hitotsubashi Journal of Economics*, 34, 33-44.

Sullivan, J. and Gilless, J.K. (1990), Hybrid econometric input-output modelling of the cumulative economic effect impact of national forest levels, *Forest Science*, 36, 863-877.

Thomson, K. and Psaltopoulos, D. (1996), Methodological issues in forestry input-output modelling, in Midmore, P. and Harrison-Mayfield, L. (eds) *Rural Economic Modelling: An Input-Output Approach,* Wallingford: CAB International.

Vincent, J. (1986), Input-output models and forest resource constraints: A comment, *Forest Science*, 32, 397-401.

Wagstaffe, H.R. (1973), Employment multipliers in rural Scotland. *Scottish Journal of Political Economy*. 20, 239-262.

Welsh Office (1998) *Welsh Agricultural Statistics 1997*, London: The Stationery Office.

Appendix 1 – Forestry industry Modelling Frameworks

A wide variety of techniques have been used to model the effects of the forestry sector, ranging from relatively simple historical statistics to general equilibrium modelling. Whilst historical statistics can provide an overview of the relative size of the forestry sector, they state nothing about how output will be affected following a change in expenditure in the forestry sector. To overcome this problem and to assess inter-industry impacts input-output modelling frameworks have been developed.

The input-output approach originates from the double accounting principles of the transaction tables employed in national accounts. A major advantage of the input-output method is its ability to analyse the regional impacts of external shocks (for instance, policy measures, or increased expenditure in saw-mills). Previous work based upon UK input-output tables has attempted to assess the impact of forestry on different regions (McGregor and McNicoll, 1989). A major problem of the input-output method is that it typically emphasises demand relationships, but with a scarcity of natural resources it is reasonable to expect the supply side of the market also to be of relevance. A number of different approaches have been adopted in an attempt to relax the assumptions underlying the input-output methodology of fixed input and output prices. For example, the fixed price assumption does not allow the model to capture the behaviour of producers and consumers with respect to changes in prices of inputs and outputs, whilst the fixed price assumption negates substitution possibilities.

In attempting to overcome some of the above problems input-output analysis has been modified to develop forestry's backward and forward linkage impacts (McGregor and McNicoll, 1992). In particular there are likely to be supply constraints in the forestry industry. Consequently, such dependencies tie timber using sectors to the outputs of the domestic forestry industry. One method developed to take account of this has been to make alternative assumptions about import substitution (McGregor and McNicoll, 1992). This can be achieved by simulating the impact of the forestry sector when foreign import substitution is suppressed vis-a-vis a simulation of forestry activity under the assumption of critical supply-dependence in timber processing and pulp, paper and boards.

Alternative approaches have relaxed the assumption of fixed backward linkages (Schallau and Maki, 1983). In the demand input-output model, purchases are linearly related to gross output, whilst in the supply input-output model sales are linearly related to gross output. As a consequence, in the demand model, the purchasing pattern of inputs by a given sector (its backward linkages) are assumed to be fixed. However, in the supply model, it is the sales pattern of outputs (forward linkages) that are assumed fixed. Although total sales of a sector must equal its total purchases of inputs for both models, production increases feed into quite dissimilar sets of linkages and activities.

Computable general equilibrium (CGE) modelling is an alternative approach which attempts to provide increased flexibility in comparison with input-output analysis, whilst explicitly accounting for supply side influences (Alavalapati, Adamowicz and White, 1998). For example, CGE allows prices to vary as a result of economic changes. A variety of production functions can be used which, for example, allow the impact of import substitution to be modelled (i.e. replacing more expensive inputs with cheaper alternatives). Alavalapati, Adamowicz and White (1998) consider two types of input-output model applying different assumptions about economic leakages. Input-output without leakages (IOWOL) assumes that the demand for commodities is met solely by domestic production. The second type of input-output model is IOWL (with leakages) where demand for commodities is met by domestic

demand and imports. Both input-output models are closed by considering the impact upon household income via changes in sectoral outputs.

Whilst CGE methods recognise factor-input substitution, the analysis is data intensive. Alternative methods have been used to assess the supply impact of factor substitution. Hybrid econometric input-output (HEIO) modelling combines the desirable properties of both the input-output approach and CGE. This type of framework can provide more accurate estimates of the coefficients for the significant industries under scrutiny without imposing any restriction on functional form. This method has been used previously to model the labour market in forward-linked wood product industries (Sullivan and Gilless, 1990).

Another approach to estimating the impact of forestry industry activity, and the forward linkages to wood processing on regional household income, is to use a social accounting matrix (SAM) (Marcouiller, Schreiner and Lewis, 1995). A SAM is used to estimate the distributive impacts from production potentials for a region heavily dependent on timber and wood products. Whilst input-output identifies regional economic structures and specifies economic impacts on factors such as employment, output and value added, its disadvantage is that it may not focus on specific household incomes or on the general distributive impact analysis of factor incomes. Arguably, these distributive impacts, resulting from public policies or market-driven forces are more effective measures of rural welfare improvements and the general economic development of the region.

This appendix has briefly considered some of the methods adopted to assess the impact of the forestry sector. At the UK level, input-output analysis has been the main tool for quantifying the impact of the forestry sector, with other extended methodologies limited by data constraints. In the US alternative methods such as CGE and SAM have been used for forestry industry analysis.

Appendix 2 Interview Schedules Used for Downstream and Upstream Forestry Sectors and Survey Questionnaire

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Forestry Multiplier (Wales) Study

Interview Schedule for **Downstream/Primary Processing** Sector
Welsh Economy Research Unit

Estimated interview time 30-40 min

RESPONDENT:
Interviewed by:

A.   Organisation Structure, History & Location

- How would you best describe your business activities and sectors in which you operate?

- What is the structure of your organisation, in terms of legal status and general operation?

- How long have you been undertaking operations in this location? How long has the organisation been in existence, and how & where did it start?

- If you are part of an international group could you please describe your organisation position within the group.

- Have there been any major changes in the method of operation, or the structure of your organisation, since it started?

- Why are you located in this part of Wales? Is the geographical position of your business important?

- Is this the most advantageous part of Wales for your business? If not, do you have the option to move?

B.   Finance, Capital & General Resources

- Is your business currently financially successful? How do you measure financial success?

- Have sales & profit increased or decreased in the last 5 years?

- Do you have any sources of income for your business apart from income generated from sales or provision of services – e.g. grants. Can you specify these income sources?

- What are your main sources of finance for capital investment and operating costs?

- What are your main sources of business information, and market intelligence?

C. Human Resources

- Do you feel you have the full range of skills and abilities available among the staff of your organisation to be able to compete effectively in your industry?

- If not, in which areas, in terms of skills & occupations, are there gaps in your workforce?

- Is there anything preventing you from obtaining these skills, either through recruiting someone or through training of existing staff?

- Is this problem specific to your organisation, or generally a problem throughout the industry? How can these problems be solved?

- What proportion of your staff live within i.10 miles ii. 25 miles iii. 50 miles of your main operations base?

- What proportion of your staff are full time employees, and what proportion part time? Do you employ staff on seasonal contracts at different times of the year?

- Are your operations moving towards mechanisation (replacing staff with machines), towards employing more staff rather than machines, or neither? Are there opportunities to shift this balance, and are there advantages in doing so?

D.   Supply

- What proportion of your purchases of timber based inputs (if applicable) comes from within Wales?

- Please describe the nature of wood based inputs sourced from Wales, and (if known) from what type of forest genera these inputs typically come from? (i.e.hardwood/softwood, commercial conifer, mixed estate, farm woodlands etc).

- What determines the proportion of wood products sourced in Wales?

- Do you expect this proportion to increase or decrease in the future and why?

- Could you list sources of timber supply from i.Wales ii.England iii.Scotland iv. Overseas?

- Please describe your supply chain for timber based inputs. Please comment on proportions of timber based inputs from saw-mills, wholesalers or primary producers?

- Please describe (if applicable) the nature of recycled inputs and recent trends in your use of these products. (i.e. recycled paper fibre and wood).

- Are there opportunities for your organisation to substitute timber imports? Are these opportunities being taken? If not, why not?

- How critical is it for your organisation to be able to purchase timber inputs within Wales?

- How easy is it for your organisation to import timber based inputs from the rest of the UK or overseas, in place of Welsh supply?

- What areas of your business would be most badly affected by a failure to be able to purchase timber/allied inputs in Wales?

- Please comment on other difficulties in locating product supply in the Welsh economy.

E.   Demand and Markets

- What proportion of your business or product is sold within Wales?

- Do you expect this proportion to increase or decrease in the future and why?

- What are the factors that determine the proportion of your sales which occur in Wales?

- Are there opportunities for your Welsh customer base to purchase more processed timber within the region?

- Please comment on the final use and destination of your products.

- Can we have a list of your main customers in i. Wales ii. England iii.Scotland iv. Other?

F.   Longer Term Opportunities

- Ideally, how would you like to see your business develop over the next 5-10 years

- Is there anything you need to help your business develop in this way? Are there particular obstacles to this development?

- If you are part of an international group how might longer term changes in group strategy impact upon the nature of your Welsh operations?

- Is there a role for other bodies or support agencies to help your business develop?

- Do you see the sectors in which you operate growing/contracting in the next five years?

- What would you would like to see agencies/organisations doing to aid sector growth?

| Forestry Multiplier (Wales) Study – |
| Interview Schedule for **Forestry Industry** Organisations
Welsh Economy Research Unit |

Estimated interview time 30-40 min

RESPONDENT:

Interviewed by:

A.   Structure, History & Development

- How would you best describe your forestry activities?

- What is the structure of your organisation, in terms of legal status and general operation?

- If you are a woodland owner/manager could you please describe the nature of woodland under management?

- How long has you/your organisation been involved in the forestry sector?

- Have there been any major changes in the method of operation, or the structure of your organisation, since it started?

- *[if applicable]* Is the geographical position of your business important?

- *[if applicable]* Is this the most advantageous part of Wales for your business? If not, do you have the option to move?

B.   Finance, Capital & General Resources

- Do you feel your operations are currently financially successful? How do you measure operational and success?

- Please comment on trends in sales & output in the last decade?

- Do you have any sources of income for your operations apart from income generated from timber sales or provision of forestry related services – e.g. grants. Can you specify these income sources?

- What are your main sources of finance for capital investment and operating costs?

C.   Human Resources

- Do you feel you have the full range of skills and abilities available among the staff of your organisation or sub-contractors to be able to compete effectively in your industry?

- If not, in which areas, in terms of skills & occupations, are there gaps in your workforce, or your contractor's workforce?

- Is there anything preventing you from obtaining these skills, either through recruiting someone, through training of existing staff or through further sub-contracting?

- *[if applicable]* Is this problem specific to your organisation, or generally a problem throughout the forestry industry? How can these problems be solved?

- What proportion of your staff live within i. 10 miles ii. 25 miles iii. 50 miles, of your main operations base?

- What proportion of your staff are full time employees, and what proportion part time? Please comment on the nature of your contract labour force *[if applicable]*

- Could you comment on the distribution of your staffs between different activities (such as establishment, maintenance and harvesting etc)?

- Are your operations moving towards mechanisation (replacing staff with machines), towards employing more staff rather than machines, or neither? Are there opportunities to shift this balance, and are there advantages in doing so? Please give examples/case.

D.   Products and Markets [with reference to questionnaire return]

- What proportion of your purchases (if applicable) comes from within Wales?

- Please comment on the availability of inputs, excluding labour, in Wales and the nature of products and services you have difficulty purchasing in Wales.

- Could you please provide the names of major supplier organisations for goods and services (excluding sub-contractors) to your operation?

- Do you expect your purchasing patterns to change markedly in the next five years?

- What proportion of your product is sold within Wales? Please describe the main outlets.

- Do you know the final use and destination of the wood which you deal with? If not, do you know the main use?

Use	% of total production	To Welsh customers	To other UK customers	To overseas
Chipboard/Panels				
Packaging, paper & print				
Joinery merchants				
General construction				
Fencing				
Other wood products				
Other *(specify):*				

- Can you supply summary details of your client base?

- Do you feel there are new/potential markets for your products in Wales? If so, where? What are the factors that could inhibit your selling into these markets?

- Do you feel there are new/potential markets for your products in the UK/overseas? If so, where? What are the factors that could inhibit your selling into these markets?

- Please comment on the Welsh sectors which in your opinion are using wood, imported from other UK areas/abroad. Are there possibilities for import substitution. If not, why not?

E.   Future Opportunities

- Ideally, how would you like to see your operation developing over the next 5 years.

- Is there anything you need to help your operation develop in this way? Are there particular obstacles to this development.

- Is there a role for other bodies or support agencies to help your business develop?

- Do you see the sectors in which you operate growing or contracting in the next five years?

- Is there anything you would like to see agencies or organisations doing to help the sector develop?