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RURAL TRANSPORT STRATEGIES - A NEW APPROACH

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ABSTRACT

The truism that "transport is a derived demand" is seldom applied to the forecasting of travel in rural Australia. In the past, the longer term forecasting of transport needs in rural situations has been carried out either at a very coarse level or, for more detailed assessment, by projecting historical trends. Short term operational planning, especially for rail freight, does occasionally take into account current and future market opportunities.

The factors which influence freight transport demand are land use and economic activity. Using a modification of traditional economic Input Output (I/O) processes, the existing economic structure of a region can be related to its transport needs: tonnages moved and the origin and destination of raw materials and products. By collecting fundamental data for a region in sufficient disaggregation, commodity and mode information is also known.

Forecasting can then be carried out by firstly examining the structural changes in the region's economy which lead to new demands for the movement of product, but also include important and often ignored secondary and tertiary effects. By this method, the impact of changes which radically alter transport patterns can be assessed; for example, changes in livestock production processes with the use of feed lots, a practice which is altering significantly the movement patterns of both grain and beef cattle, or the expansion of specific industries such as mining or timber production.

Once future transport demand is known, the network impacts are readily assessed using traditional transport planning techniques. Regional geographers and transport planners are thus able to complement each other's skills to provide a more powerful forecasting tool than is available to either in isolation.

Two studies carried out in New South Wales have successfully used the technique. The paper describes the methodology and key outcomes: quantifying future freight movements on road and rail, identifying intermodal opportunities and assessing future infrastructure needed to support economic development. It also discusses areas where further work is

required to refine the techniques and to fill in gaps in the profession's knowledge of rural freight flows.

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Introduction

The truism that "transport is a derived demand" is seldom applied to the forecasting of travel in rural Australia. Rural transport studies have traditionally acknowledged that transport is a derived demand, but have rarely attempted to produce a relationship between the activities which create the demand for the movement of goods and the actual quantity of goods moved. In the past, the longer term forecasting of transport needs in rural situations has generally been carried out either at a very coarse level or, for more detailed assessment, by projecting historical trends. This is evidenced in such studies as the National Highway Evaluation (Travers Morgan et al 1993), and Main Road 55 Route Development Study (SMEC 1991). A notable exception to this approach has been the work of Nairn (1995), which uses principles of trip generation and distribution as a function of accessibility.

These techniques have been acceptable in a climate of gradual change in population and employment in regional centres, and little or no change in the structure of the rural economy. However, these conditions can no longer be assumed to be valid in the current context of strategic transport planning in rural areas of Australia.

While the traditional techniques have adopted a top-down approach to estimating future transport demand, starting with traffic volumes, the approach described in this paper uses a bottom-up approach, synthesising traffic flows by examining the underlying factors which create the demand for passenger and freight travel.

This paper describes a process which examines the regional economy and links underlying economic activity to transport demand using Input-Output (I/O) analysis. It briefly describes the use of GIS-based transport planning software to translate transport demand into traffic forecasts for rural areas.

Traditional Approaches to Traffic Forecasting

The growth factor approach to traffic projection is suitable for short term estimation, provided projects under evaluation do not have wider network effects which influence the choice of route of road users. This approach has generally taken several forms, the simplest being simple linear extrapolation of historical trends in traffic volumes. Greater sophistication and robustness is achieved by the expression of traffic volume as a function of key indicators such as regional population or employment.

Where the distribution of traffic over a network is expected to be affected by projects under investigation, it is normal to use a traffic assignment model. In many cases the trip table to be assigned is derived by exogenously applying growth factors to an existing trip table, or using a simple trip generation model. Nairn (1995) has developed this approach to the extent that trip generation is a function of such indicators as land area, population, mining activity and employment. By including accessibility in the function, this provides a good basis for examining the impact of transport infrastructure proposals in a relatively stable economic environment.

There has been substantial structural change to the rural economy of Australia in recent years. The pace of change is continuing and, given the policies of the newly elected Liberal government, is quite likely to accelerate in the coming decade. This has rendered the traditional approaches less reliable for regional planning and necessitated the development of a more robust approach.

The Need for New Approach

The structural change occurring in the Australian economy is manifest in several notable ways:

- The population of much of rural Australia is declining in many Local Government Areas (LGAs) (ABS 1993 and Qld Dept Housing 1994). In those LGAs which exhibit a steady population, the population is drifting into the larger rural cities from the smaller towns and villages and farms.

- The total employment in rural areas is declining. As farm efficiency increases, the rural labour force is declining at a rate greater than growth in employment in the service sector.

- There is a trend towards the establishment of value-adding industries in rural areas which is significantly altering the volume and distribution of primary production outputs. For example, the establishment of large feedlots is reducing the volume of grain exported from rural regions and dramatically changing the pattern of transport of livestock.

Input-Output Analysis

Overview of technique

Traditionally, an input-output or transactions table measures the value added as commodities move through the production chain. By also adding the weight and information about the location of the source (input) and destination (output) of each product, the total freight transport demand can be derived. Separate analyses are required to estimate passenger travel generated by other factors such as tourism and service sectors.

Origin-Destination(OD) matrices are developed which identify each zone within the region under study, plus the main external zones which relate to movements into and out of the region using the transport network. Individual OD matrices are developed for the major commodities produced or processed in the region at each stage of production or ownership. These are then aggregated into a total output OD matrix. This table includes movements of products within the region, i.e., products from one sector as inputs to another sector. As an example, for a study in the Tamworth region of northern NSW (SMEC 1995), the total output OD matrix aggregated tables for a wide range of commodity groups including:

- movement of wool bales
- movement of cotton modules to gins
- movement of grains
- poultry production
- egg production
- movement of packed eggs
- movements of logs to mills, and
- sawn timber production.

A separate set of OD matrices is developed for the inputs of the main sectors sourced from outside the region. These are also aggregated into one total input OD matrix. In the two studies quoted in this paper the tables were each composed of 25 sectoral tables such as:

- agricultural inputs: cropping chemical requirements
- agricultural inputs: livestock chemical requirements
- agricultural inputs: livestock/pasture fertiliser requirements
- paper inputs: to paper manufacturing, finance and business services, public administration, and education sectors, and
- household inputs: food.
- restaurants, etc. inputs: food.

The total output OD matrix and the total input OD matrix are then combined into one table in which the overall freight movements are combined. This represents a detailed set of data showing the existing freight movements within, into and out of the region.

Input-Output Methodology

Traditional input-output methodology is well documented in the literature. This section provides a brief overview for readers unfamiliar with the technique.

The compilation of input-output tables entails either the collection of detailed data from all firms in the economy using direct survey methods, using various types of statistical and estimation methods involving essentially no survey work, or, most commonly, a combination of both the above techniques. A "hybrid" methodology, the Generation of Regional Input-output Tables (GRIT) technique, is used to combine superior survey data and computer methods. The analyst exercises judgement as to how much primary data are needed to construct a table suitable for the current exercise and focuses resources on the important elements or sectors.

The GRIT methodology thus relies on the gathering of information from as wide a range of sources as possible, placing most emphasis on the sectors which have a significant contribution to the region. The following steps were taken in the compilation of thirteen new I/O tables for each Local Government Area in the Central West of NSW.

PHASE I	**ADJUSTMENTS TO THE NATIONAL TABLE**
1	Selection of national I/O table (109 sector table with direct allocation of all imports, in basic value)
2	Adjustment of national table for updating
3	Adjustment for international trade
PHASE II	**ADJUSTMENTS FOR REGIONAL IMPORTS**
	(Steps 4-14 apply to each region for which input-output tables are required)
4	Calculation of "non-existent" sectors
5	Calculation of remaining imports

PHASE III	**DEFINITION OF REGIONAL SECTORS**
6	Insertion of disaggregated superior data
7	Aggregation of sectors
8	Insertion of aggregated superior data
PHASE IV	**DERIVATION OF PROTOTYPE TRANSACTION TABLES**
9	Derivation of transactions values
10	Adjustments to complete the prototype table
11	Derivation of inverses and multipliers for the prototype table
PHASE V	**DERIVATION OF FINAL TRANSACTIONS TABLE**
12	Final superior data insertion and other adjustments
13	Derivation of final transaction tables
14	Derivation of inverses and multipliers for final tables

Origin-Destination Tables

Traditional I/O tables do not contain the information that is fundamentally needed by transport planners: the origins and destinations of freight, its mass and mode. Each region's I/O table contains sectoral relationships within the region and the region's imports and exports for each sector. The product of input-output analysis is the value of goods entering the region represented by the I/O table. Provided there is sufficient disaggregation of commodities, it is possible to translate the value into tonnes and derive numbers of trucks or train freight loads.

For the two studies undertaken by the authors, during the collection of superior data, each establishment also provided information on the geographical source and destination of commodities consumed and produced. Estimates of the mass of goods were also made. The mode currently used was recorded, enabling the later production of both road and rail trip tables.

The Development of Scenarios

Depending on the nature of the study, one or more future development scenarios may be prepared, with the potential to allow analysts the flexibility to vary the scenarios should they wish. The features of the approach include the identification of development components that reflect the various contributors to development that will impact on freight movements. They include the following.

- Specific industry development effects that are lower or higher than average and that may involve specific location effects.
- General industry growth effects and any variation that may occur within the region.
- Any population effects that may not be related to the growth in the industry and the location of those effects.
- Any transport effects that might arise from changes in transport infrastructure, services and networks.

The I/O tables are modified using the relevant sectoral growth factors. Multipliers that reflect the cross sectoral implications are used to estimate the effects arising from varying magnitudes of change in industry output or population.

Such an approach enables the projections to incorporate a mixture of general effects and specific effects based on the assumption that, apart from specific changes being considered, everything else remains the same or will respond by changing proportionately. In other words, the assumptions are equivalent to those that are applied in conventional applications of input-output based economic impact analysis.

For example, if a new cement manufacturing plant is established, the additional freight requirements will be determined for the industry itself, while the flow-on effects will be calculated through the application of constant output/freight ratios for the sectors that experience the flow-on effects.

In recent applications, the authors have generally used two development scenarios. For the Tamworth Study, an optimistic outcome where expected growth is higher than the trend over the past decade and a low development scenario in which growth is lower than in the recent past were adopted. For the Central West, a scenario which reflected current trends plus known structural changes, especially in timber production, was the main focus of forecasting. The implications of an international freight airport at Parkes were also tested.

The optimistic outcome is presented so that an assessment of the upside needs for freight is provided if most things started to 'go right'. This might involve considerable success in regional development of industry (both in terms of individual projects and some tilting of the playing field toward rural areas, as often espoused in state government policies).

Scenario Mode Split

Several different approaches are taken to the calculation of mode split for freight tasks. Unlike the urban passenger mode choice problem, many freight tasks are captives of either road or rail by virtue of their nature, location or government policy. These are identified and separated initially into road or rail OD matrices. The discretionary freight movements are then split between the modes using an appropriate algorithm. Standard assignment techniques can then be used to estimate rail freight volumes and truck volumes on roads.

Case Study - Tamworth Region

The objective of this study was to develop a network strategy for State Roads in the NSW Roads and Traffic Authority's Tamworth Zone in the northern tablelands area of the state. I/O techniques were used to produce truck travel demands for existing conditions and for two future scenarios. Forecasting of future road traffic enabled the identification of routes or locations which met a set of trigger standards for prototypical improvements.

Economic Projections

Particular regional scenarios were developed against a background of general trends in the economy and the region. These scenarios were developed primarily with the growth of industry in mind. There are likely to be some demographic effects as well, partly associated with changing employment opportunities and partly other factors that may lead to changed regional population.

Over the decade to 1990-91, the Northern Statistical Division (which is the major part of the RTA Tamworth Zone) experienced growth in gross output of 27 per cent (Chalmers 1994) equivalent to an annual growth of about 2.5 per cent. Population in the Northern Statistical Division increased by only 2 percent over that decade. Thus, the recent past has featured modest industry growth and negligible population and employment growth. In that context, it should be noted that 1990-91 was also a recession year with high unemployment in the economy (9.5 per cent, Australia; 8.6 percent Armidale area; 8.9 percent Tamworth area in 1991).

The Department of Urban Affairs and Planning's high projections of population growth in the RTA Tamworth Zone over 1991 to 2001 was 4.4 per cent, while the low projections were for no growth in population. Those projections are essentially extrapolations of past trends. In all cases, the bulk of the population growth occurs in the Armidale, Tamworth and surrounding shires. The predominantly rural LGA's show declining population.

The scenarios discussed below are summarised on Table 1 for the decade to 2002-03.

Table 1 - Tamworth Growth Scenarios

Scenario	Parameter	Expected Increase
Optimistic	**Gross Output**	**35%**
	Population	**10%**
Low	**Gross Output**	**12%**
	Population	**3%**

These may be compared with the decade to 1990-91 of:

Gross Output Increase	27.0 %
Population Increase	4.4 %

The Optimistic Scenario

The optimistic scenario was based on projections for the next decade. This scenario has a number of elements which are listed below. In total, for the purposes of estimating economic activity, it was assumed that there will be a growth of population in the region overall of one per cent per year for the next ten years. This is considerably higher than has been achieved in the past, but would be much lower than the national population growth rate. It would require some increase in the number of people coming into the region from other areas as well as a reduction in the number of people that leave the region.

In addition to employment growth, an expected two per cent increase in labour productivity will lead to a general growth in regional production over all sectors of around three per cent. This requirement can be approximated by a cumulative increase in gross output of almost 35 percent over a decade. This would not provide for any decrease in unemployment through the creation of local jobs. For that to happen, the increase in gross output would need to be in the order of four per cent - a figure that is comparable to the national growth rate that is required to reduce unemployment.

The optimistic scenario is based on the overall growth in regional industry averaging 35 per cent over the decade. Since this is expected to be non-uniform across industry and the region, adjustments were made to allow for the different rates of growth among industries and locations. Further, not all industries have the same freight demands, thus growth rates were considered explicitly.

The following indicates the changes in specific industry growth rates. The balance of the sectors (mostly tertiary sectors) then expand at a rate (32%) sufficient to achieve an overall growth rate of 35% over the decade.

- Horticultural production increases by 50% (from the existing low base)
- Cotton production (in the plains) increases by the average rate of 32%
- Feedlot cattle production in the Gunnedah, Inverell and Quirindi/Murrurundi Shires also increase by the average 32%
- The rest of agricultural production only increases by 10%
- The proposed new cement manufacturing development at Attunga in Parry Shire is included (currently on hold)
- Food manufacturing increases by 50%
- Vehicle manufacturing increases by 50%, and
- All other manufacturing in the major cities increases by 40%.

For gross output to increase by 35% most of the sectors in the economy need to grow by 32% to offset the different growth rates in the selected sectors (and the addition of the new cement processing sector) above.

This scenario would appear to have a good chance of being achieved. The industry growth target is certainly achievable while the population growth represents the main optimistic element in this scenario.

Low Growth Scenario

The low growth scenario covering the next ten years was calculated as being the existing freight OD matrix plus one third of the difference between the OD matrix for the optimistic scenario and the existing OD matrix representing the 1992-93 financial year.

This scenario would involve regional output growth that is slower than the growth achieved in the past decade and would accommodate the lowest estimates of population for the zone.

Such an outcome would be the result of a very poor performance by the agricultural sector and little growth in manufacturing and the other service sectors. It would be difficult to conceive of this situation without something remarkable happening to the agricultural situation and/or the Australian economy as a whole, although the effects of continued drought and subsequent recovery, described below, are assumed to be included in this scenario. This scenario may therefore reasonably be regarded as the lower bound for the situation over the next decade.

Comment on Drought Effects

There is a need to recognise that the drought is likely to have some impact on what happens over the next few years. This is a poorly researched and understood process and, while this study has speculated on some of the effects, it clearly is an important factor in limiting the impact of the recovery in the Australian economy on the Northern NSW area.

It is likely that continued drought will lead to lower growth in the regional economy which in turn is likely to lead to lower freight needs and lower levels of passenger movements. This would stem from the reduced production capacity in the farm sector, the possible rationalisation and closure (failure) of some businesses and some effect from a stronger perception in metropolitan areas that rural areas are a risky place to be in business.

In the short term, the effects on freight needs are likely to be mixed. There is increased movement of livestock and fodder, but there are likely to be lower movements of some consumer and capital goods as expenditure contracts and capital expenditure is put on hold. Cotton and grain movements around and out of this region will be reduced and local intensive livestock producers and grain processors will need to source their inputs from outside the region and, when necessary, from overseas. This increases freight movements with origins outside the zone.

Once the drought breaks, there will be a further downward shift in freight movements as the fodder and stock movements will slow and it will be some time before expenditure begins to grow back to normal levels. At the same time, freight movements of grain and cotton across the region's state roads will increase as local processors and livestock producers will be able to source their main inputs locally.

Regional Demographics

A number of sources were used to derive population projections for the LGA's in the Zone, including NSW Department of Planning, ABS and Queensland Department of Planning. No organisation was able to provide estimates of employment to supplement the population projections. Fortunately, the modelling method employed obviated the need for employment projections, which are not readily available from third party sources. The impact of increasing employment as a result of economic activity is reflected in the secondary freight movements included in the input-output analysis.

An increase in journey-to-work trips would occur largely within or close to urban areas. It is expected that an improved rural economic outlook, particularly with the breaking of the drought, will not have any net effect on rural journeys to work, since it is understood that currently a larger than normal percentage of farm dwellers are in employment in towns as a result of the economic circumstances.

It is clear that there is unlikely to be any significant change in the population levels in the region over the next ten years. While the total population will change little, there will most likely be some continued drift from rural areas to the largest towns and cities. Regardless of the strength of economic activity in the region, as a result of this trend the base non-commercial traffic level, which is largely a function of population and employment, is unlikely to change on the State Roads outside of the urban areas.

Table 2 shows the current and expected future total population expectations of the Zone for three growth scenarios.

Table 2 - Summary of Population Projections, Tamworth Study

Scenario	Total Zone Population		
	1991	1996	2006
Low growth	206,300*	207,400	207,500
Medium growth		211,110	213,500
High growth		214,300	222,500

Source: *NSW Department of Planning*
** - ABS, 1991 Census.*

Regional Tourism

Estimates of current and future tourist travel by car were obtained from a study carried out for RTA (*Nairn 1992*). This study breaks the state into 21 regions (including interstate destinations), one of which is the Tamworth Zone area and provides two scenarios - a trend scenario and a higher growth scenario termed "interventionist". A demand matrix for trips related to Tamworth Zone, or passing through it, was extracted from the matrices in that report.

This provides a reasonable estimation of tourism trips which have their origin and/or destination outside the study area. Since the population will be relatively static it has been assumed that local tourism traffic is adequately accounted for in the base traffic load.

Program development

The existing travel demand was loaded onto the road network using traditional transport planning assignment technique. The conversion from tonnes of freight to vehicles per day or per year was a significant source of potential error. Data were scarce, and the conversion was based on a limited number of CULWAY sites where vehicle gross and nett mass is estimated. The I/O sourced OD matrix was thus converted from tonnes to vehicles and calibrated against observed traffic data. The initial estimates of average tonnes per vehicle were modified to achieve reasonable calibration.

Forecasting of future freight was then undertaken to arrive at estimates of traffic volumes on individual links in the strategic road network.

Case Study - Central West NSW

The Central West Study was carried out for the Central West Regional Organisation of Councils with sponsorship from various NSW State Government instrumentalities. The study examined the road and rail system in terms of freight movement and developed options for strategies in the next 20 years based on the demand derived from existing and future landuse and economic activity. The potential for modal transfer of freight from road to rail was an important component of the study.

The assessment of freight transport demand was made by creating 13 input-output tables, one for each Statistical Local Area in the study area, based on detailed local knowledge and with supplementary surveys of local industries. Freight was allocated to road or rail as relevant.

The demand for road passenger movement was assumed to be from two major sources, tourism movements and locally made trips for business and other purposes. There are some movements between and around local centres which do impact on the strategic road network and these were considered. As with freight movements, the activities occurring within each SLA on local roads were not considered.

A base year was adopted for analysis so that all future scenarios could be compared on a consistent basis. The financial year 1992/93 was chosen, primarily because it represents a period when the region was not in drought, and when the economic climate was reasonably stable. This resulted in a year when agricultural production was average, and thus freight movements were not biased by, say, the importation of grain for stock feed outweighing the movement of export grain.

Public passenger patronage - rail, coach and air - was also examined by the study in the light of anticipated population growth. Future demands for services were estimated, then the future service levels were assessed.

Economic Projections

The techniques described in this paper were used in the creation of the 13 I/O tables and the consequent scenario development. Agricultural, manufacturing, other sector and employment growth rates were all taken into account. Tables 3,4,5 and 6 show the historic rates for the region.

Table 3 - Agricultural Growth Rates CENTROC, 1981/83 to 1991/93

Sector	Real annual growth rate (%)
Sheep	6.01
Cereal/grains	1.63
Beef cattle	1.08
Dairy/pig	3.23
Poultry	-1.97
Other agriculture	1.98

Table 4 - Manufacturing Growth Rates Central West SD 1980/81 to 1990/91

Sector	Real annual growth rate (%)
Food manufacturing	2.70
Wood/paper manufacturing	5.45
Mine manufacturing	3.12
Metal manufacturing	3.31
Equipment manufacturing	4.05
Other manufacturing	3.75

Table 5 -Employment Growth Rates Central West SD 1981 to 1991

Sector	Real annual growth rate (%)	Sector	Real annual growth rate (%)
Sheep	-0.65	Mine manufacturing	-1.04
Cereal grains	-10.37	Metal manufacturing	-1.36
Beef cattle	-0.21	Equipment manufacturing	0.40
Dairy/pig	-2.94	Other manufacturing	-2.87
Poultry	2.59	Utilities	-1.92
Other agriculture	1.30	Building	-0.48
Agricultural services	2.99	Trade	0.70
Forest	1.13	Transport	-2.79
Coal mining	-2.33	Communication	-5.23
Other mining	2.20	Finance/business	1.36
Food manufacturing	1.84	Public administration	0.29
Wood manufacturing	-0.30	Community services	2.04
Paper manufacturing	2.14	Personal services	2.04

Table 6 -Other Sector Growth Rates Central West SD 1981 to 1991

Sector	Real annual growth rate (%)	Sector	Real annual growth rate (%)
Agricultural services	2.99	Other manufacturing	-2.87
Forest	1.13	Utilities	-1.92
Coal mining	-2.33	Building	-0.48
Other mining	2.20	Trade	0.70
Food manufacturing	1.84	Transport	-2.79
Wood manufacturing	-0.30	Communication	-5.23
Paper manufacturing	2.14	Finance/business	1.36
Mine manufacturing	-1.04	Public administration	0.29
Metal manufacturing	-1.36	Community services	2.04
Equipment manufacturing	0.40	Personal services	2.04

Table 7 -Estimated Average Growth Rates CENTROC 1991/92 to 2007/9

Sector	Real annual growth rate (%)	Sector	Real annual growth rate (%)
Sheep	2.00	Mine manufacturing	3.12
Cereal grains	1.63	Metal manufacturing	3.31
Beef cattle	1.08	Equipment manufacturing	4.05
Dairy/pig	3.23	Other manufacturing	3.75
Poultry	-1.97	Utilities	3.93
Other agriculture	1.98	Building	1.26
Agricultural services	3.64	Trade	4.07
Forest	4.00	Transport	-1.42
Coal mining	1.19	Communication	0.26
Other mining	5.00	Finance/business	3.77
Food manufacturing	2.70	Public administration	1.39
Wood manufacturing	4.00	Community services	2.04
Paper manufacturing	3.00	Personal services	3.00

Future Scenarios

Two future scenarios were developed:

Scenario 1 - 'Most Likely'
This scenario uses growth rates for various sectors of the economy which follow prevailing trends and anticipated changes in economic structure. Major deviations from current activity, such as the expansion of timber manufacturing, were included. The wood manufacturing sector is the fastest growing sector with an annual growth rate of over 7%. Other sectors with growth rates exceeding 5% per annum are forestry, other mining (ie non-coal), equipment manufacturing, food manufacturing and finance.

Scenario 2 - Inland Freight Airport at Parkes
The Inland Marketing Corporation, a joint venture between Parkes, Forbes, Cabonne and Lachlan Councils, is promoting a regional development scheme based on direct importing and exporting of product by air from Parkes. The proposal has three aspects:

- the development of Parkes airport to handle international freight,
- a shift in agricultural production from lower value bulk commodities to higher value crops or horticultural products for export direct to Asian markets, and
- the gradual development of value adding such as pre-packaging, warehousing and eventually manufacturing and assembly industries.

The resultant productions are shown on Table 8.

Table 8 - Total Production for each Local Government Area

Local Government Area	1992/93		2007/08			
			Scenario 1 - Most Likely		Scenario 2 - Parkes Freight Airport	
	Value (92/93 $mill)	Mass Tonnes ('000)	Value (92/93 ($mill)	Mass Tonnes ('000)	Increased crop value (92/93 ($mill)	Mass Tonnes ('000)
Bathurst	998	580	1819	1066	6	1066
Blayney	397	333	796	686	4	686
Cabonne	217	767	309	1350	34	1341
Cowra	375	365	616	719	22	719
Evans	47	337	72	680	5	680
Forbes	298	666	452	1158	20	1158
Lithgow	1048	7716	1471	10137	1	10137
Mudgee	702	5587	1038	6866	11	6866
Oberon	188	566	496	1579	3	1579
Orange	1207	417	2331	824	18	824
Parkes	425	592	725	1288	5	1774
Rylstone	152	1429	214	2393	2	2993
Wellington	195	239	289	404	6	404
Total	6249	19594	10628	29090	137	30227

External Freight Movements

The demand for freight movements was generated from two sources. For freight generated by the study area, that is moving within or to and from the region, the economic forecasts provided the demand in tonnes per year for all commodities by both road and rail. However, the regional economic forecasts did not take into account freight movements through the study area with origins and destinations outside the region. These movements were estimated on the basis of Australian Bureau of Statistics freight surveys for the base year (ABS 1995), and a growth rate of 3 percent per year.

The major external freight movements are between western areas of the state and Sydney, and the significant movement between Victoria and Queensland along the Newell Highway. The north-south movements on the Newell Highway outweigh the freight generated by the study area itself. The inability of existing datasets to support economically based growth estimates on these external movements remains a major impediment to the use of I/O techniques within regions.

Infrastructure Options

A range of possible regional strategies was developed, taking into account community issues as well as identified network deficiencies. Strategies included both infrastructure and operational options, including options which involved significant modal shift from road to rail.

The two development scenarios were translated into origin-destination matrices for standard traffic assignment. Using TransCAD, which has GIS capabilities as well as standard transport planning routines, estimates were made of future traffic volumes on the transport network. The viability of each strategy option was thus able to be tested.

Conclusions

The authors' experience is that in a changing economic structure in rural areas, it is no longer reasonable to rely on growth factors or simple traffic generation models to evaluate strategic infrastructure proposals. These models do not provide sufficient sensitivity to accommodate changes in production activities which are causing significant shifts in the nature and quantity of demand for transport of goods and materials.

Using a GIS-based transport planning model provides significant efficiencies over traditional model structures. The use of a database rather than flat files increases the usefulness of the data and reduces the incidence of errors. The map-like description of transport links improves the presentability of the outputs and also reduces the level of data entry and manual intervention (such as in calculation of link distances).

Recommendations

The marriage of Input-Output analysis and GIS-based transportation models provides a significant opportunity to improve the quality and reliability of rural transport system modelling. The openness of the process provides considerable reassurance to clients by avoiding the (often correct) suspicion of a "black box" approach to travel demand projection. It also provides opportunities for calibration of parameters at several different stages of the process, increasing its robustness.

The process can be further improved by:

- Developing a better understanding of the mechanism of mode choices made by those responsible for the movement of freight, when the nature or location of freight permits that discretion. The reluctance of freight organisations to release operating cost data is a major hindrance to this understanding.

- Improving the understanding of route selection by road freight operators, particularly when part of a route passes through urban areas with significant congestion. The trade-offs between longer distances on rural roads versus travel on suburban arterial roads are not well reflected in current vehicle operating cost and value of time data provided by state road authorities. There are obvious behavioural factors which affect drivers' perceptions of the attractiveness of routes.

- Improving the understanding of the impacts of the time of day on freight activities, particularly where the time of arrival or departure is controlled by regulation or the type of activity. This may be important when substitution of economic activities is under consideration and road or rail links are approaching capacity during some periods of the day.

- Broadening the coverage of I/O tables, especially with the inclusion of data on commodity mass, the location of origins and destinations and the mode used.

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