GRAIN HANDLING COSTS IN WA*

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Abstract.

Pricing practice for grain handling, storage, and tran : is a major issue for the grains industry. The extent of price pooling and cost disaggregation has implications for least cost grain paths, for returns to farmers, and for overall efficiency of the system. The grain handling system in Western Australia is undergoing considerable change, and farmers face considerable uncertainty regarding the implications of ongoing change for their decisions, and ultimately for their returns.

The principal aim of this study was to improve farmers' knowledge about:

- the main issues relating to grain handling, including least cost grain paths,
- the likely impact on selected grain paths of changes to grain handling pricing,
- the overall efficiency of the West Australian grain handling system, including:
  the implications for investment in grain handling capacity.

The impact of further disaggregation of charges for grain handling was estimated by comparing predicted grain paths under a pricing scenario reflecting existing pricing arrangements with those predicted to evolve if prices were disaggregated to reflect true resource costs for grain handling, storage and transport. The potential benefits of price disaggregation estimated in this study are likely to be upper bounds on achievable levels because realised benefits initially will be a small fraction of potential long run benefits, and because systems in the real world often fall short of potential outcomes for a variety of technical, practical, institutional and political reasons.

Depending on levels of availability of key resources, moving to a system of price disaggregation for grain handling is estimated to ultimately generate potential savings in annual net resource costs of between $12.5 million and $23 million. For all core cases, a change from current pricing practice to one based on resource costs pricing alters least cost grain paths as follows:

- much greater use is made of rail than road to move grain to port,
- more grain is channelled through Kwinana, with a compensating lower
  proportion of grain shipped from the other ports.

and for all cases involving road deliveries to either North Fremantle or Forrestfield

- more grain is moved to port during the harvest period

Least cost grain paths are virtually unaffected by location of the road receival facility for grain shipped out of Kwinana, and quite insensitive to mobility of temporary storage at country receival points. Under the current pricing scenario, road haulage is used at the expense of rail haulage during the clearance period. This is inefficient in terms of minimising aggregate net resource costs, and under the costs pricing scenario, much greater use is made of the relatively less expensive standard gauge rail during the clearance period.

Under the charges pricing scenario, no part of the grain storage system is fully utilised except for port storage capacity at Esperance. Storage capacity at transfer bins is either left totally empty or is barely used. Instead, grain is held in more costly temporary storage facilities at country receival points. Under the resource costs pricing scenario, this inefficient use of storage capacity is largely remedied, with less grain being stored in country temporary storage facilities.

Introduction.

Since the Royal Commission into Grain Storage and Handling recommended an end to cost pooling in the grain industry, disaggregation of costs has been a major issue for those involved in the industry. In Western Australia, pricing practice for grain handling, storage, and transport continue to be of concern to many in the industry. The extent of price pooling and of cost disaggregation has implications for least cost grain paths, for returns to farmers, and for overall efficiency of the system. The grain handling system in Western Australia is in a dynamic phase, and farmers face considerable uncertainty regarding the implications of ongoing change for their decisions, and ultimately for their returns.

The prime objective of the study was to estimate the effect on least cost grain paths of further deregulation of the grain handling system, and in particular of the disaggregation of prices and costs in the charges levied on growers for handling, transport, and storage of grain. Specific aims were to improve farmers' knowledge about:

- the main issues relating to grain handling, including least cost grain paths,
- the likely impact on selected grain paths of changes to grain handling pricing,
- the overall efficiency of the West Australian grain handling system, including:
  - the implications for investment in grain handling capacity, and
  - the impact of number of grain segregations on grain handling efficiency.

Modelling Grain Paths in the West Australian Grain Handling System

Results were derived using a mathematical programming model developed by the Centre for Modelling Management Systems (CMMS) to represent the Western Australian grain handling system. Model structure followed previous classical "transport" models, and was specified to identify the arrangements for system-wide storage, handling, and transport of grain which minimises either system-wide aggregate net charges, or system-wide aggregate net resource costs for carrying out these tasks. Assumptions embodied in the model included estimates of costs and prices of the grain handling system, resource requirements for the various grain handling tasks, and aggregate availability of capacity for grain transfer, storage, and transport.

In constructing this model, a conscious decision was taken to focus on the movement of grain from country receival point to port terminal for shipment to export markets, although some grain is consumed by the domestic market, and follows somewhat different grain paths. In principle, additional grain paths to service the domestic market could have been incorporated into the models, but to do so would have made it even more complex. Given the relatively small size of the domestic market relative to the export market, the judgement was made that the greater complexity required to include the domestic market was not warranted in terms of somewhat more realistic results.

The estimated benefits of deregulation and price disaggregation are likely to be upper bounds on achievable levels of benefit. In the early years of implementation, realised benefits will almost certainly be some small fraction of potential long run benefits. However, even in the long run, actual realised benefits may be less than those estimated in this study, because systems in the real world often are unable to achieve theoretically specified outcomes for a variety of technical, practical, institutional and political reasons. Moreover, because circumstances differ from year to year, and because it is infeasible to change all aspects of grain handling arrangements from year to year, it is impossible to have absolutely the best arrangement in each and every year, No single set of assumptions about the characteristics of the grain handling system will accurately define a benchmark case of grain paths for future years under current pricing arrangements with which to compare predicted least cost grain paths under further price disaggregation. Consequently, a number of "core cases" were constructed. These cases differed with respect to the assumptions made about the following characteristics of the grain handling system:-

- road haulage of grain for shipment out of Kwinana received either at:
  - the existing facility at North Fremantle,
  - the proposed facility at Forrestfield, or
  - a hypothetical new facility at Kwinana.
- total grain receivals of either 9.35 million tonnes or 12.16 million tonnes.
- harvest period road haulage capacity of either 0.9 million tonnes or unlimited.
- available narrow gauge rail capacity either at current levels or larger.
- temporary storage capacity at country receival points either fixed or infinitely flexible .

The impact of further disaggregation of charges for grain handling was estimated by comparing predicted grain paths under a pricing scenario reflecting existing pricing arrangements with those predicted to evolve if prices were disaggregated to reflect true resource costs for grain handling, storage and transport. Current charging practices were characterised by price pooling for all grain storage, by rail charges which cover all avoidable costs, and by charges for road haulage which fully cover all costs of road haulage operators. Alternatively, under the resource costs pricing scenario, it was assumed that pricing would be characterised by charges for grain storage based on estimated actual storage costs, by rail charges which cover all avoidable costs, and by charges for road haulage which reflect all resource costs to the community.

The difference between the results from the so called costs models in comparison with the direct counterpart charges model for the same core case provides the best indication of the likely impact on least cost grain paths of a further move to deregulation and disaggregation of prices.

Least Cost Grain Paths Principal Findings

Table 1 below sets out the findings for the key core cases concerning potential system-wide cost savings which might be realised by changing pricing practices for grain handling. Depending on actual levels of availability of key grain handling resources, moving to a system of cost and price disaggregation for grain handling is estimated to ultimately generate potential savings in annual net resource costs of at least $12.9 million, and possibly up to $23 million.

Table 1:- Aggregate Level of Net Grain Handling Resource Costs.

Core Case No.	Case Code	Metro Road Deliv-eries*.	Crop Size (m. t.)	Road Haulage Capacity (m. t.)	NG Rail Capa-city	**Scenario 1:-** Grain Paths to Minimise Net Charges	**Scenario 2:-** Grain Paths to Minimise Net Costs	**Difference** in Net Resource Costs
II	**6-7	NF	9. 35	0. 9	100%	$139,796,604	$126,405,786	$13,390,818
III	**9-7	Ff	9. 35	0. 9	100%	$138,931,699	$125,780,062	$13,151,637
IV	**9-7a	Ff	9. 35	0. 9	100%	$139,068,411	$126,147,627	$12,920,784
V	**9-8	Ff	9. 35	Inf.	100%	$143,305,411	$119,680,340	$23,625,072
VI	**9-9	Ff	12. 16	Inf.	100%	$196,685,604	$175,437,512	$21,248,091

* NF = road receivals at North Fremantle; Ff = road receivals at Forrestfield.

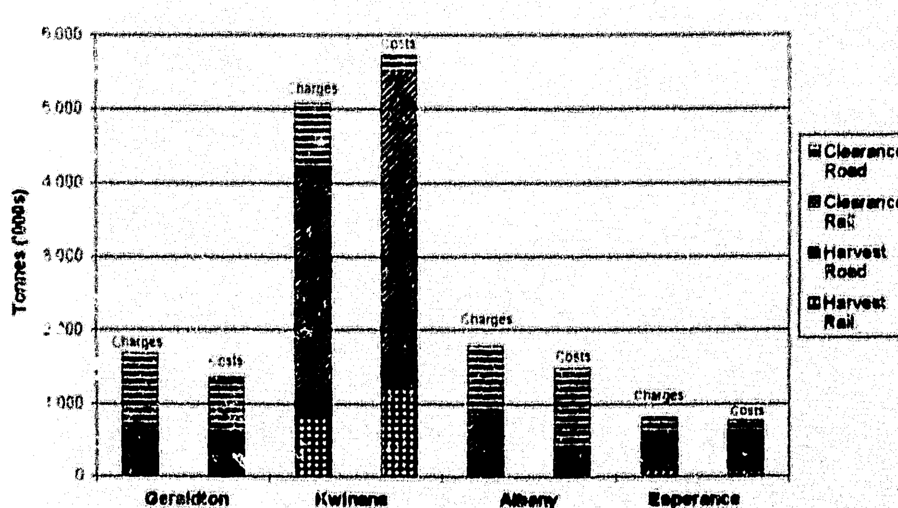
Least cost grain paths for core case III are illustrated in Figure 1 below. For all core cases, a change from the charges pricing scenario representing current pricing practices to one based on resource costs pricing alters least cost grain paths as follows:

- much greater use is made of rail than road to move grain to port,
- more grain is channelled through Kwinana, with a compensating lower proportion of grain shipped from the other ports.

and for all cases involving road deliveries to either North Fremantle or Forrestfield

- more grain is moved to port during the harvest period.

Figure 1: Least Cost Grain Paths - Charges versus Resource Cost Scenarios; Core Case III: Forrestfield Road Deliveries; "Small" Crop.



Arguably core case III is the single most representative model. For this case, all available transport capacity, both standard gauge and narrow gauge rail as well as road, are fully utilised under both pricing scenarios during the harvest period, but under the charges pricing scenario, road haulage is used at the expense of rail haulage during the clearance period. This is inefficient in terms of minimising aggregate net resource costs, and under the costs pricing scenario, much greater use is made of the relatively less expensive standard gauge rail during the clearance period.

Under the charges pricing scenario, no part of the grain storage system is fully utilised except for the Co-operative Bulk Handling port storage capacity at Esperance. Storage capacity at transfer bins is either left totally empty (Avon and Forrestfield), or is barely used (Merredin). Instead, grain is held in the much more costly temporary storage facilities at country receival points. The inefficient use of storage capacity under this pricing scenario is largely remedied under the resource costs pricing scenario, with less grain being stored in temporary storage facilities in the country, and the relatively cheaper permanent storage capacity at the transfer points and at country receival points being more fully utilised. However, the findings indicate that there would be no value in building extra storage capacity at any of the ports under either pricing scenario.

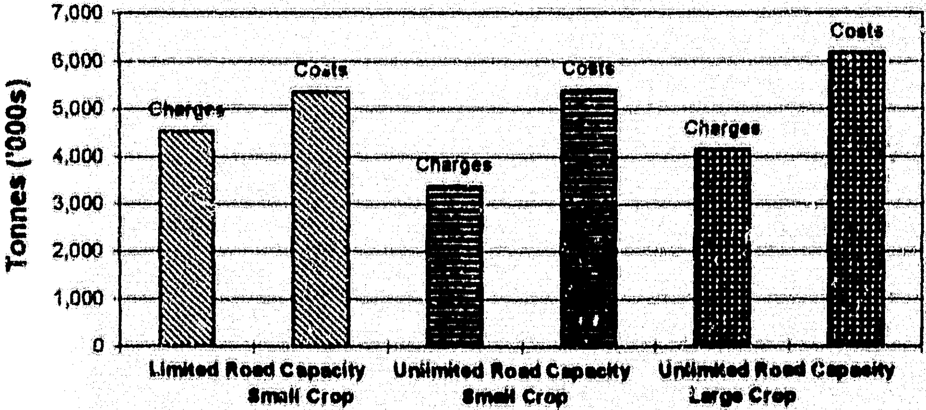
A striking feature of the results is the complete utilisation of road receival capacity in all four port zones under both pricing scenarios due to the dominance of direct road haulage from farm to the regional ports during the harvest period. By contrast, rail receival facilities are not fully utilised in any port, and only come close to full utilisation at Kwinana and Esperance.

The broad pattern of least cost grain paths was virtually unaffected by changing the site for road receivals of grain to be shipped out of Kwinana, and was almost completely insensitive to the degree of mobility of temporary storage facilities at country receival points. Therefore the following three core cases suffice to convey the essence of the findings concerning sensitivity of least cost grain paths to the key assumptions:

Core Case III = Small Crop & Limited Road Haulage Capacity
Core Case V = Small Crop & Unlimited Road Haulage Capacity
Core Case VI = Large Crop & Unlimited Road Haulage Capacity

The impact of these assumptions on the total amount of grain hauled by rail for the two pricing scenarios is depicted in Figure 2 below.

Figure 2: Impact of Key Assumptions on the Total Amount of Grain Hauled by Rail for Charges and Resource Cost Scenarios.



Under the current charges pricing scenario where decision makers do not perceive any difference in the cost of different types of storage because of price pooling, a minimal amount of grain is moved by rail, and very little substitution of expensive temporary storage by less costly permanent storage takes place even when road haulage capacity is freely available. Moreover, note that if current pricing practices for grain handling are maintained, then the amount of grain moved by rail is likely to reduce by about 25% if there is unlimited availability of road haulage capacity.

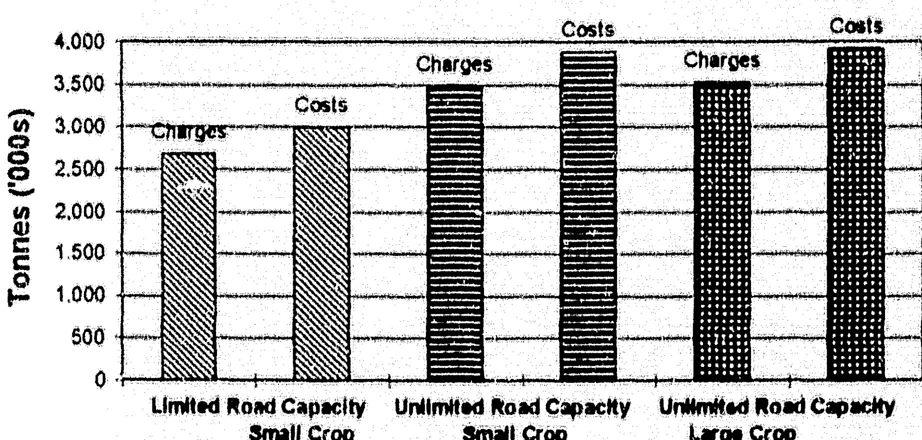
Where grain handling pricing is based on resource costs, more grain is moved during the harvest period relative to current pricing arrangements, and storage at both Avon and at Merredin are fully utilised because use of expensive temporary storage capacity at country receival points is minimised.

Note that the proportion of grain moved by rail is relatively insensitive to the availability of road haulage capacity. As a result, the difference between the two pricing scenarios is much larger for the "unlimited road capacity" case than it is for the "limited road capacity" case. In relative terms, this difference between the two pricing scenarios is approximately maintained for the large crop case with "unlimited road capacity".

Least cost grain paths involving road transport increase both absolutely and relatively when crop size is larger, although the absolute amount moved by rail increases under the costs pricing scenario.

Also of interest is the impact of the same set of assumptions on the total amount of grain moved during the harvest period under the two pricing scenarios. This is depicted in Figure 3 below.

Figure 3: Impact of Key Assumptions on the Total Amount of Grain Moved During the Harvest Period for Charges and Resource Cost Scenarios.

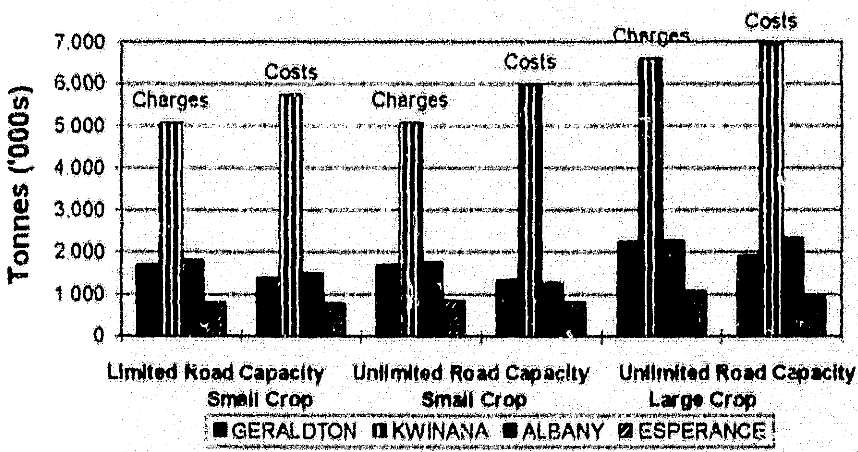


Clearly, if prices were based on resource costs rather than structured as at present, then more grain would be transported from country receival points during the harvest period. This is a robust result which holds for all plausible cases. Furthermore, unlimited road haulage capacity obviously permits more grain to be hauled to port during the harvest period under both pricing scenarios, and consequently both port terminal and Forrestfield storage capacity are more or less fully utilised. This result is independent not only of the assumed pricing scenario, but also of crop size. The finding that the aggregate level of least cost grain paths during the harvest period is independent of crop size no doubt reflects assumptions made about available levels of grain receival capacity at port terminals.

The potential benefit of extra road haulage capacity derives from the ability to move more grain away from country receival points where storage tends to be relatively costly. This benefit will only be realised if grain handling pricing reflects resource costs.

Another consideration, depicted in Figure 4 below, is the impact of selected assumptions on the level of shipments of grain from each port.

Figure 4: Impact of Key Assumptions on the Shipments of Grain from Each Port for Charges and Resource Cost Scenarios.



For all cases, more grain is shipped out of Kwinana under a resource costs pricing scenario than would be the case were current pricing practices maintained. Again, the difference between the two pricing scenarios is greater when road haulage capacity is unlimited than when it is constrained to current levels.

For the "monster" crop case, there is little change vis-a-vis alternative cases in the proportion of the total harvest shipped out of each port when current charges pricing is simulated, but Kwinana becomes relatively less important as the outlet for export grain under the costs pricing scenario because the capacity to move grain through Kwinana during the harvest period is fully utilised. If such large crops became common, it might well be profitable to invest in additional grain handling facilities at Kwinana.

Least cost grain paths involving road transport increase both absolutely and relatively when crop size is larger, although the absolute amount moved by rail increases under the costs pricing scenario. The proportion of the crop moved during the harvest period drops dramatically under both pricing scenarios because of constraints limiting the absolute amount which can be moved from country receival points during the harvest period. As would be expected for such a large crop, both standard gauge rail and narrow gauge rail are fully utilised during both the harvest and clearance period under the resource costs pricing scenario, but neither are fully utilised all year under the charges pricing scenario.

Investment Options for Grain Handling Infrastructure.

Given the decision to discontinue road deliveries to North Fremantle, an alternative to the proposed new facility at Forrestfield would be to build additional storage capacity plus road receival facilities as an integral part of the Kwinana grain handling complex. This choice of site involves a number of complex issues, many of which can not be analysed with a model of the type constructed for this study. Obvious advantages of the Kwinana option are the avoidance, or at least minimisation of double handling of grain, and the elimination of the need for rail transport from Forrestfield to Kwinana. Estimates of potential aggregate annual net resource cost savings from locating facilities for road receivals from the Fremantle port zone at Kwinana rather than at Forrestfield exceed $1 million per annum. It was not possible to attempt to quantify the magnitude of possible disadvantages to set against the estimated value of the advantages identified above.

Depending on whether road haulage capacity is limited or unlimited, additional narrow gauge rail capacity has an annual value of between $7.42 and $11 per tonne in the harvest period and between $2.84 and $6 per tonne in the clearance period. When limited to current levels, extra road haulage capacity during the harvest period is valued at $7.77 per tonne per annum. These findings suggest that it may be profitable to expand narrow gauge rail haulage capacity even if road haulage capacity expands beyond current levels.

At some country receival points, permanent storage is not fully utilised, and therefore valueless, but at other sites it is scarce and valuable and typically "worth" about $7.20 per annum for an extra tonne of capacity. On average, the annual value of extra permanent storage capacity at country receival points is about $4 per tonne. For a small crop of 9.35 million tonnes, the only other sites where extra storage capacity has some value are Merredin (about $2/tonne) and Forrestfield (less than $2/tonne) provided pricing is based on resource costs. Not surprisingly, for core case VI involving a "large" crop, scarcity of storage capacity is widespread throughout the system, and the value of extra capacity at most port terminals and transfer sites is about $6 to $8 per tonne per annum.

The current capacity for road receival facilities at Geraldton, Albany, and Esperance are limiting even for current crop sizes and levels of road haulage capacity. For Geraldton and Albany, the annual value of extra capacity is at least $4 per tonne. If crop sizes increase significantly without any increase in these receival capacities, then the value of an additional tonne of capacity would be appreciably greater. Given that it is likely to be less expensive to provide an extra tonne of grain receival capacity relative to extra storage or transport capacity, the returns to investment in increasing grain receival capacity at all ports warrants further examination.

The possibility of closing grain handling facilities at the regional ports was investigated as part of the analysis. Relative to the key core cases, all such port closure models resulted in significantly greater system-wide aggregate net resource costs due to longer transport hauls for grain produced in areas adjoining the closed port, and were judged to be uneconomic. The increase in aggregate net resource costs for closure of Esperance was much smaller than that for the other options by a considerable margin, but even so exceeded likely savings in avoidable fixed costs from port closure by a sizeable margin.

Grain Segregations

Historically, the infrastructure in the grain handling system has been developed to accommodate a marketing strategy based on bulk sales of a limited range of generic products. This traditional approach has been overtaken by moves to capture the price premiums paid in some markets for desired grain quality attributes by "niche marketing", which has necessitated greater numbers of grain segregations to keep different types, classifications and grades of grain separate in all stages of the grain handling system.

While extra segregations provide the potential for extra revenue, they also involve extra costs. The very skewed distribution of tonnages by segregation guarantees that the potential to increase aggregate revenue from a crop of fixed size by increasing the number of segregations is subject to diminishing returns, and will in fact asymptote to some maximum level. Similarly, there are grounds for expecting costs of grain handling to increase at an increasing rate as the number of grain segregations is increased. The optimal number of grain segregations is defined by the point where the addition to aggregate grain crop revenue is just sufficient to offset the extra on-farm costs of producing the new grain type or grade, plus the extra off-farm costs incurred from providing an extra segregation in the grain handling system.

The number of segregations can affect the total costs of grain handling directly via the impact on performance indicators such as potential rates of utilisation of storage and transport capacity, as well as inloading and outloading capacity at both country receival points and at port terminals. All three operations of transport, storage, and transferral are subject to economies of size and throughput, so effective capacity or realised throughput rate will be determined by the extent of utilisation of potential capacity or throughput rate. In general, the greater the number of segregations, the lower the rate of utilisation in one or more of the three basic grain handling operations. This constitutes the "first round" impact of extra grain segregations.

Depending on the existence of excess capacity, such potential "first round" effects may or may not translate into changes in system-wide grain handling costs. The actual impact on system-wide costs will depend on decisions made about the trade-off between investing in extra grain handling capacity to maintain prior performance levels, versus living with the costs of a shortage of grain handling capacity. In addition to the direct and indirect individual impact of number of grain segregations on costs of each of the three primary grain handling functions, the possibility also exists that extra grain segregations might create logistical difficulties in the grain handling system and so give rise to further incremental costs.

In conclusion, it is clear that the number of segregations can affect system-wide grain handling costs in a variety of different ways which *in toto* could be important, and particularly so for segregations involving small volumes. Determination of the optimal number of grain segregations for the West Australian grain industry was not an aim of this study, and could not be determined given the available data sources.

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