AN ECONOMIC EVALUATION OF COTTON AND ALTERNATIVE FARM ENTERPRISES UNDER IRRIGATION IN THE NAMOI REGION

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1. INTRODUCTION

In recent years development of intensive irrigated farming in the North West has been rapid and the number of possible farm enterprises based on irrigation is increasing. There is held to be a large potential for irrigation development in the Namoi, Gwydir, MacIntyre, and other valleys, based on proposed surface water development schemes and on the exploitation of sub-surface supplies similar to that which has occurred in the Breeza-Quirindi area.

Cotton is the dominant row crop in the Namoi Valley. The basis of present cotton price structure has been described by Kerridge,[1] and Gallagher and Musgrave[2] have discussed the relative economic advantage of North West cotton under this structure. Besides the Namoi, 1966-67 cotton crops have been planted at Quipolly, Yetman, Bourke, and Nevertire. As production increases, expectations are that grower prices will be reduced. However the high per acre capital investment in land-levelling, channel construction and water distribution systems and the introduction, largely through cotton, of sophisticated cropping technology, will probably encourage close future examination of alternative cash crops and intensive livestock enterprises, possibly in combination with reduced cotton acreages. Even if cotton prices continue unchanged it will be desirable to develop maximum profit farming systems rather than monocultures because of crop hygiene and soil structural factors.

This article presents the results of a linear programming analysis of farm production plans for a representative irrigated-dryland property in the Wee Waa-Merrah North area. The primary objective is to explore the economic possibilities of integrating dryland and irrigated enterprises in a whole-farm situation. Resulting farm plans are then examined parametrically to ascertain the degree of sensitivity of the plans to changes in commodity prices (cotton, wool, corn, lambs) and technical efficiency levels in the sheep enterprises.

2. PROPERTY RESOURCE SITUATION AND POSSIBLE ENTERPRISES

In this rapidly developing area it does not appear that either developmental capital (for irrigation, machinery, etc.) or production credit would be limiting factors, thus external constraints in the

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[1] W. J. Kerridge, "Cotton: The Effect of Current Trends on Producer Prices", *Quarterly Review of Agricultural Economics*, Vol. XIX, No. 2, (April 1966), pp. 57-72.

[2] D. R. Gallagher and W. F. Musgrave, *Location of the Australian Cotton Industry*, (Faculty of Agricultural Economics, University of New England), March 1966.

programme matrix are minimal. The resource situation and production possibilities have been described in detail elsewhere and will only be summarized here.[3]

The property is 1,600 acres of lower Namoi grey self-mulching clay; maximum irrigable area is set at 600 acres and 1,000 acres can be devoted to dryland grazing (native pasture), or wheat production to a limit of 500 acres.[4] A cropping intensity limit operates in most of the plans through the requirement that lucerne makes up to one third of the irrigation crop programme. This is based on unknown but expected soil structure deterioration that could occur under continual and intensive cropping, especially cotton and corn. Two double-cropping activities are permitted, barley-corn and barley-sudax but these are limited to a total of 100 acres. The limitation of 500 acres placed on dryland wheat is a subjective constraint based on the high (but here unquantified) level of risk associated with this crop in the Wee Waa-Merrah North area.

In full operation this type of property would probably require a permanent work force of five men including the owner-manager. In addition it is assumed up to ten casual workers can be employed at peak periods at a skilled equipment operator's rate of $1.50 per hour. (Typically—mainly because of problems of supervising the operation by casual labour of expensive equipment—this extra labour would be supplied by the permanent hands working at overtime rates or under a give-and-take arrangement.)

All necessary plant and field machinery is assumed available on the property: machinery owning and operating costs have been determined in the detailed enterprise budgets on which programme activities are based.[5]

Four types of enterprises are considered:

Fodder Production:

- Grazing lucerne
- Oats
- Sudax

Livestock:

- Crossbred ewes and fat lambs
- Merino ewes and first-cross lamb raising
- Merino wethers
- Steers on sudax, finished on dry-lot

[3] N. J. Dudley and D. J. McConnell, *Budgets and Gross Margins for Irrigation-based Farm Enterprises in the North West*, (Farm Management Report No. 10, Department of Farm Management, University of New England), 1967. Enterprise budgets and production possibilities were initially based on an actual property but to make the present results more widely applicable details relating to land tenure and equity position, irrigation development cost, special family management objectives, etc., are ignored.

[4] No comprehensive description of these soils is available but their main characteristics and locations are summarized by K. H. Northcote in *Atlas of Australian Soils, Explanatory Data for Sheet* 3, (CSIRO, Melbourne University Press), 1966.

[5] Dudley and McConnell, *op. cit.*

Irrigated cash crops:

- Lucerne hay (specialized and surplus to ewe needs)
- Corn
- Sorghum
- Wheat
- Soybeans and linseed
- Cotton
- Barley-corn and barley-sudax double crop

Dryland:

- Wheat
- Wethers on native pasture

In determining yields and physical farm efficiency a good but not outstandingly high level of management is assumed. With the exception of cotton and lucerne, experience with large-scale irrigated cropping in the area is too limited to provide firm yield estimates. Thus actual experimental results form the basis of most yield estimates used here, and these are discounted for commercial conditions to approximately two-thirds of experimental levels. The dryland wheat yield is based on the Namoi Shire mean yield of 17.7 bushels over 1964-65. All assumptions relating to production and efficiency levels, farm practices and levels of technology for the respective enterprises were checked where possible with progressive farmers and research workers in the area.

Activity prices are based on four- or five-year average commodity prices where appropriate (all livestock and wool, corn, sorghum, barley), or expected medium term local contract prices if the major outlet for the commodity is through contract (Tamworth prices for lucerne hay, Moree price for oilseeds). For cotton an initial price of $200 per bale is used. This is lowered parametrically in the programming. With increased production a future export market could develop for corn and sorghum: a second price situation specified for these commodities is based on limited f.o.b. shipments in 1964 and 1965.

Activities are summarized in Table 1. Structural coefficients and prices for all cash crops and livestock enterprises are taken from the budgets. Those activities generating sheep-feed directly or indirectly do so through two feed pools. A wet ewe pool is used by ewes in the last 6 weeks of pregnancy and lactation, and a dry sheep pool is set up for wethers and dry ewes. The basic wet ewe pool consists of grazing lucerne (when this is grown). Hay may also contribute to the wet ewe pool before but not after lambing, i.e. in August and September. Weaned lambs may use only grazing lucerne.

The following may contribute to the dry sheep pool: grazing lucerne, hay and after-cut lucerne stubble, all grain stubbles, grazing oats and dryland native pasture. Sudax is used only for cattle due to the abundance of other feeds in the dry sheep pool when sudax is producing. Within the dry sheep pool dryland pasture transfer is possible from April-May-June to July-August-September at a 50 per cent loss in feed value. Unused irrigable land can also contribute to the dry sheep pool as native pasture. Carrying capacity of dryland native pasture is estimated on a quarterly basis, being 1.65 DSE per acre for 100 pounds

wethers in the first quarter and 1.00, 0.50 and 1.85 DSE in the second, third, and fourth quarters respectively. It is practicable to save only second quarter dryland pasture.

The steers activity consists of growing steers from backward store condition to 900 pounds liveweight on sudax over a five months period before finishing to 1,000 pounds in a farm dry-lot. The sudax used may be a 'straight' fodder crop or the sudax portion of the barley-sudax double cropping activity. In dry-lot steers are fed lucerne hay and any of four grains—corn, barley, wheat, sorghum—selected by the programme. All dry-lot feed requirements are produced on the farm and their opportunity cash-sale costs are charged against the steers enterprise.

A total of 51 constraints are used: apart from those described above these are structural, being necessary to ensure flexibility in transferring feed (fodder crops, hay, grain, stubble, and native pasture) between seasons and classes of livestock according to cyclical nutrient requirements. The basic matrix is shown in the Appendix (Table 7). This was modified during the programming, as described below.

3. RESULTS

As the programming follows routine procedures, only the results will be discussed. Five groups of farm plans are generated. The main interest is in the structure and sensitivity of the plans rather than income levels actually achieved, so farm fixed costs, interest on property investment, management charges, etc. are not considered. The results of each plan are presented in terms of 'plan total gross margins' rather than net farm income.[6]

Group A Farm Plans: Variable Cotton Price

In this group of plans up to 600 acres of irrigated cash or fodder crops may be grown; no soil structure limitation is imposed by forcing lucerne into the plans. The cotton gross margin is progressively lowered from the initial level of $235.13 per acre and the corresponding combinations of activities or plans are obtained. Group A farm plans for different cotton prices are summarized in Table 2. The budgeted per acre cotton gross margin of $235.13 is based on a yield of 1.82 bales and net farm price of $200 per bale. At this level and down to a cotton gross margin of $116.76 all irrigated land would be devoted to cotton. The corresponding cotton price range is from the present $200 to a lower limit of $134.96 per bale. Between the cotton gross margin range of $116.76 and $106.99, which corresponds to a price range of $134.96 to $129.59 per bale, corn replaces increasing amounts of cotton in the plan until at a cotton gross margin of $106.98 (cotton price of $129.58) cotton is completely displaced by corn. Without any rotational requirements and with the corn enterprise as budgeted (110 bushels at $1.64), the farm plan would change from a cotton monoculture system to a corn one, over a narrow cotton price range.[7] At the above

[6] Farm capital inventory data contained in the initial budgets would permit determination of net farm income, rate of return on capital etc. for each of the programmed plans discussed below.

[7] Cotton displacement by corn is not immediately complete at a cotton price of $134.95 because these enterprises have different seasonal labour requirements.

TABLE 1

Summary of Activities for Linear Programming

Activity	Identification	Unit	Gross Margin or Activity Price
			$
Irrigated cash crops—			
Cotton	X_1	1 acre	60.00 to 235.13[1]
Corn	X_2	1 acre	60.00 to 107.30
Grain sorghum	X_3	1 acre	61.73
Soybeans	X_4	1 acre	36.77
Barley	X_5	1 acre	24.24
Wheat	X_6	1 acre	42.23
Linseed	X_7	1 acre	50.60
Sell lucerne hay	X_{27}	1 ton	10.00 to 15.36
Irrigated crop combinations—			
Barley-corn	X_8	1 acre	79.19
Barley-sudax	X_9	1 acre	−6.51[2]
Irrigated fodder crops—			
Lucerne	X_{16}	1 acre	−12.75[3]
Sudax	X_{10}	1 acre	−18.55
Grazing oats	X_{11}	1 acre	−19.55
Dryland crops—			
Wheat	X_{12}	1 acre	15.14
Livestock—			
Crossbred ewes	X_{13}	5 ewes	36.65
Merino ewes	X_{14}	5 ewes	32.75
Wethers	X_{15}	5 head	17.35
Steers on sudax and grain	X_{34}	1 acre (3·3 head)	84.70
Feed transfer activities—			
Use barley for steers	X_{35}	100 pounds	−1.36[4]
Use sorghum for steers	X_{36}	100 pounds	−1.56
Use wheat for steers	X_{37}	100 pounds	−1.90
Use corn for steers	X_{38}	100 pounds	−2.37
Graze lucerne with ewes	X_{17}-X_{18}	1 acre	....
Graze lucerne with dry sheep	X_{19}-X_{22}	1 acre	....
Feed hay to wet ewe feed pool	X_{28}-X_{29}	1 ton	....
Feed hay to dry ewe-wether pool	X_{30}-X_{33}	1 ton	....
Autumn-save dryland pasture	X_{39}	1 acre	....
Land transfer activities—			
Dryland to dry sheep feed pool and dryland wheat limit release	X_{52}	1 acre	....
Irrigable land for dryland use	X_{53}	1 acre	....
Hay making—			
January-March	X_{24}	1 acre	−9.41[3]
April-June	X_{25}	1 acre	−3.66
July-September	X_{26}	1 acre	−3.40
October-December	X_{23}	1 acre	−11.80
Labour hiring activities—			
Summer labour	X_{40}-X_{45}	1 month	−300.00[5]
Winter labour	X_{46}-X_{51}	1 month	−240.00[5]

[1] The price ranges shown are those over which plans are computed. Positive entries in this column indicate profits, negative entries indicate costs.

[2] Cost of growing both barley and sudax in a double-crop system less returns from farm-gate sale of barley.

[3] Annual direct costs of production.

[4] Opportunity costs of using farm-grown grains.

[5] 8 and 10 hours per day for winter and summer labour respectively.

TABLE 2

Group A Farm Plans: Activities and Plan Total Gross Margins for a Range of Cotton Prices

Plan Number:		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cotton Price per Bale:	$	134.96 to 200.00	134.34 to 134.95	133.97 to 134.34	131.18 to 133.97	130.80 to 131.60	129.59 to 129.90	Below 129.59
Cotton Gross Margin per Acre*:	$	235.13	116.00	115.00	113.00	110.00	107.00	106.00
Plan Total Gross Margins*:	$	147,265.00	75,855.00	75,351.00	74,442.00	73,458.00	72,686.00	72,525.00
Activity and Unit		Activity Level	Activity Level	Activity Level	Activity Level	Activity Level	Activity Level	Activity Level
Cotton, acres		600	513	496	377	266	181	0
Wethers, head		352	455	476	617	750	750	750
Dryland wheat, acres		500	500	500	500	500	500	500
Corn, acres		0	87	104	223	334	419	600
Save dryland pasture		168	168	168	168	168	0	0

* Measured at the upper limit of each range.

corn price and yield the critical cotton price is about $132 per bale—considerably below the present net farm price level.

The maximum of 500 acres of dryland wheat is grown in all the plans: in the absence of lucerne no breeding ewes can be carried, thus dryland will be devoted to as much wheat as is permitted and the balance used as unimproved dryland pasture supporting wethers. Wethers are complementary with corn growing through their use of stubble. However the maximum number of wethers carried, 750 head, is stable over a wide range of corn acreages grown (334 to 600 acres) because of limiting summer dryland feed. As corn declines below 334 acres, being replaced by cotton, winter corn stubble feed for wethers becomes directly limiting to the wether enterprise. Dryland pasture is not autumn-saved (transferred from April-June to July-September) until less than 334 acres of corn are grown, then a constant amount of 168 acres is so transferred.

The main features of Group A farm plans are summarized graphically in Figure 1.

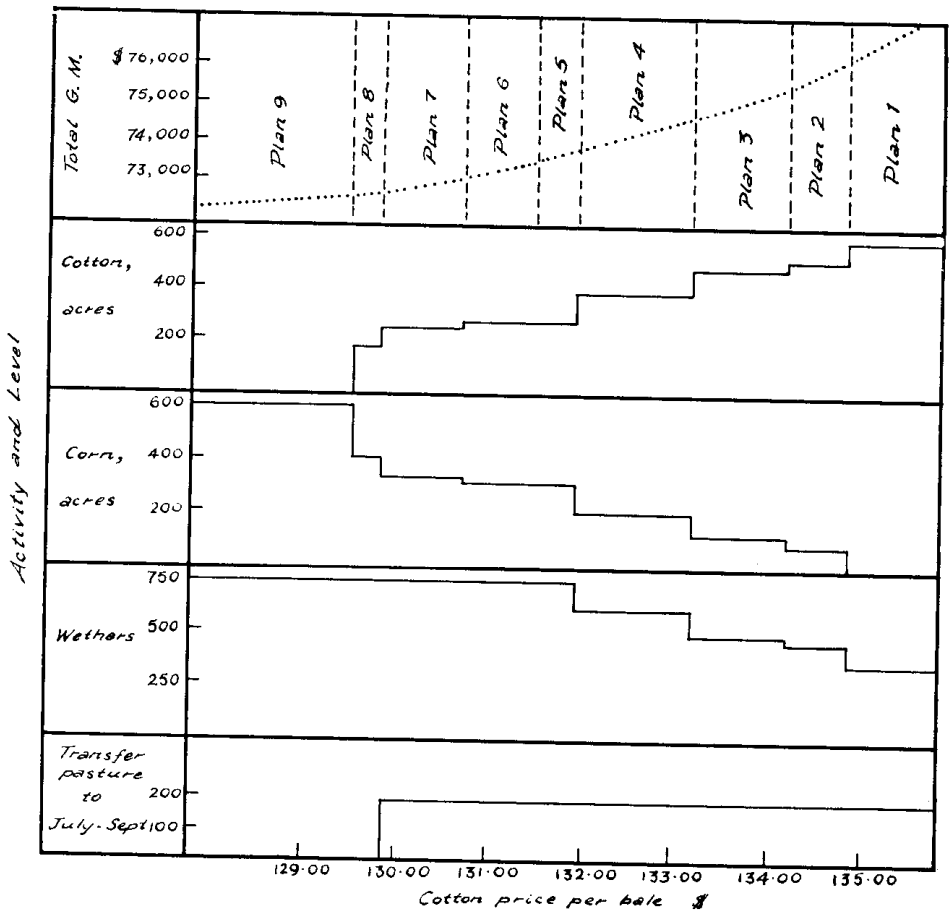

FIGURE 1: *Programmed Group A Farm Plans with Variable Cotton Prices and Current Corn and Sorghum Prices*

Group B Farm Plans: Variable Cotton Price with Cropping Intensity Restricted

While the effect of continuous irrigated cropping on soil structure is unknown, it seems reasonable to assume that some pasture phase will be necessary in the long run. Thus this group of plans shows the optimum combination and levels of enterprises over a range of cotton prices when one third of all irrigation land is forced into lucerne. Results are summarized in Table 3.

The critical cotton price range over which corn replaces cotton is less than $2 per bale: i.e. a drop in cotton price from $131.56 to $129.80 results in all available land going from cotton to corn. Above a cotton price of $131.56 per bale all land except that required for the lucerne rotation phase would be under cotton.

In these plans the price range over which hay is sold as a cash crop rather than through livestock is very narrow, indicating that selling lucerne hay would be quite sensitive to price changes. This instability is examined more closely below.

The main elements of Group B plans are shown in Figure 2.

Group C Farm Plans: Variable Cotton Prices and Lower Corn and Sorghum Prices

The critical cotton price range determined for plans in Groups A and B is based on an analysis using the 1960-64 mean corn price. However corn production is now rapidly expanding in the North West. More significant than acreage is the higher technology and greater specialization now evident in the industry. Expected future corn production increases due to these factors, and the possibility—at this time admittedly remote—of cotton prices falling below the critical levels determined in farm plan groups A and B warrant examination of the farm plans using lower corn prices. It is reasonable to expect the farm price of corn to fall as production increases, and grain sorghum is unlikely to be more profitable than corn, since with current technology yields are lower, prices generally lower, and costs of production under irrigation are similar.

The shape of the future demand schedule for corn is difficult to predict. With even a moderate price decline much larger quantities may be consumed within Australia by the broiler and pig-meat industries. Such non-economic factors as fear of yellow pigmentation in corn-fed broilers have to date prevented wider use of this grain. However regardless of future domestic demand the export parity price of corn would provide a final price floor. With lamb and wool prices held constant—they are later varied—the export price of corn could determine the new critical price level for cotton in these plans. This situation is examined in the Group C plans by generating solutions under the following assumptions: again for soil structural reasons 200 acres of lucerne are forced into the plans thus restricting irrigated cash crops to a maximum of 400 acres, and corn and sorghum prices are set at current export parity. Under these conditions the supply schedule for cotton at different cotton prices over the critical range is again constructed.

TABLE 3

Group B Farm Plans: Activities and Plan Total Gross Margins for Cotton Price Range and Restricted Cropping Intensity

Plan Number:		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cotton Price per Bale:	$	131.56 to 200.00	131.34 to 131.56	130.57 to 131.34	130.35 to 130.57	130.01 to 130.35	129.80 to 130.01	Below 129.80
Cotton Gross Margin per Acre*:	$	235.13	110.50	110.00	108.70	108.30	107.60	107.30
Plan Total Gross Margins*:	$	113,350.00	63,671.00	63,563.00	63,288.00	63,222.00	63,125.00	63,093.00
Activity and Unit		Activity Level	Activity Level	Activity Level	Activity Level	Activity Level	Activity Level	Activity Level
Cotton, acres		400	219	214	168	141	132	0
Corn, acres		0	181	186	232	259	268	400
Lucerne, acres		200	200	200	200	200	200	200
Make hay, acres:								
January-March		200	200	198	148	198	200	200
April-June		200	200	200	200	200	200	200
July-September		0	0	195	157	195	200	200
October-December		197	197	191	129	191	197	197
Sell hay, tons		16	1,311	1,286	964	1,286	1,311	1,311
Merino ewes, head		0	0	74	587	73	0	0
Wethers, head		873	873	806	769	808	873	873
Hire labour, man months:								
January		2·82	2·50	2·50	2·57	2·37	2·35	2·11
February		3·37	3·70	3·69	3·31	3·82	3·85	4·09
March		0·27	0·96	0·98	0·99	1·25	1·29	1·97
May		1·51	0	0	0	0	0	0
September		1·41	0·45	0·38	0·90	0	0	0
November		0·12	0·84	0·80	0·31	1·09	1·18	1·70
December		3·66	2·22	2·13	1·19	1·56	1·53	0·48

* Measured at the upper limit of each range.

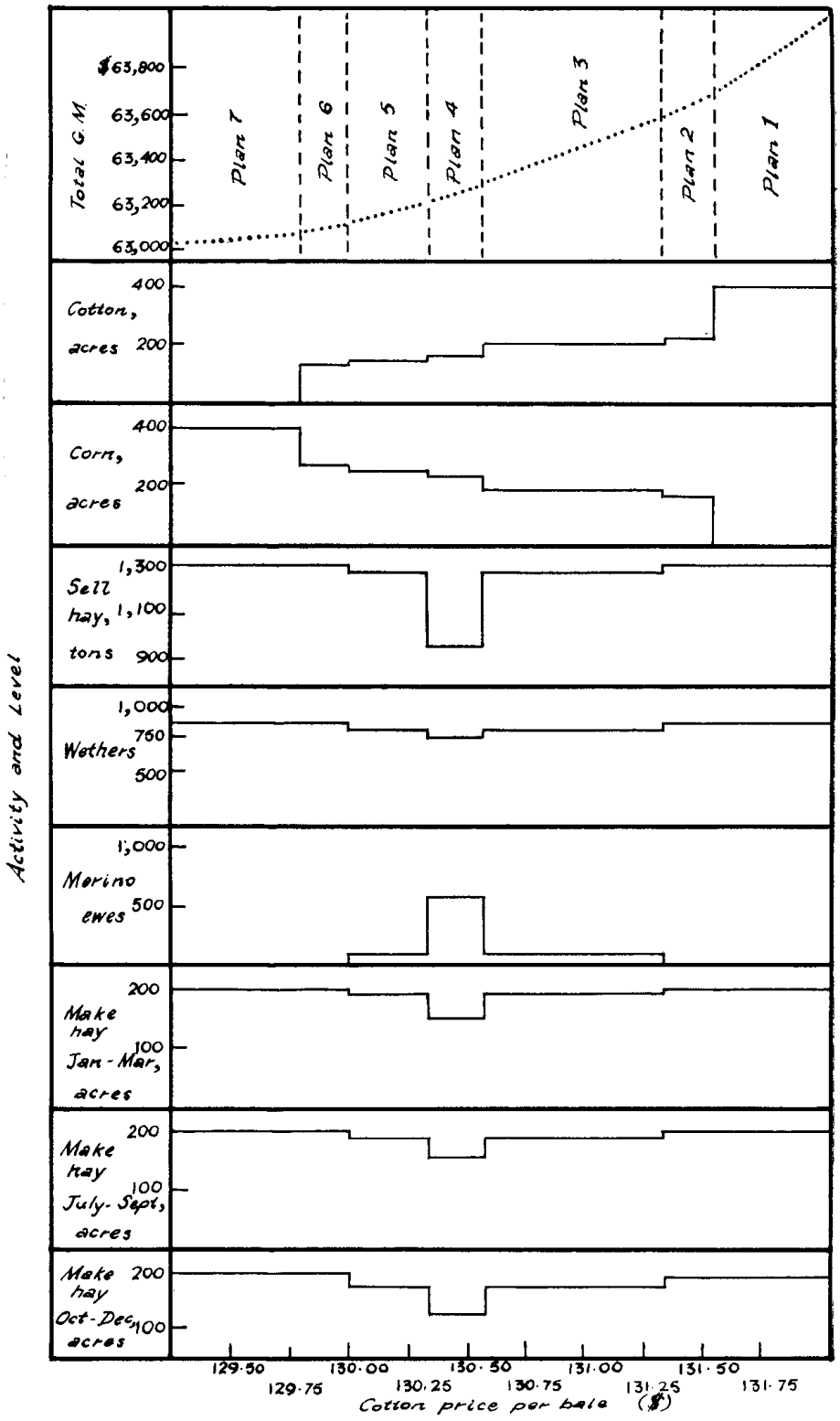

FIGURE 2: *Programmed Group B Farm Plans, with Variable Cotton Prices,* 200 *Acres of Lucerne forced in, and Budgeted Corn and Sorghum Prices*

The corn export parity price is based on sales to Japan, where imports of feed grain have risen sharply in recent years to produce lot-fed red meat and poultry products. Only limited quantities of feed grains have been exported from Australia recently because of the drought. The export parity price assumed here is based on the mean f.o.b. price of three shipments from Brisbane in 1964 and 1965.[8] Narrabri-Newcastle rail freight for bulk grain is subtracted, together with a wharfage charge of $4.50 per ton for bulk grain. In this situation the critical cotton price range is $104.22 to $105.59 above which all irrigation land is devoted to cotton and below which corn is the only irrigated cash crop, apart from lucerne hay. Little change in other activities takes place over the critical cotton price range: a small number of merino ewes replaces some wethers and reduces slightly the amount of hay made and sold. This again illustrates the instability of those activities in the plans, and this is examined in the Group D plans.

Group C plans are summarized in Table 4 and Figure 3.

Group D Farm Plans: Variable Lucerne Hay Price

Because of the high level at which the hay selling activity entered most plans in which lucerne had to be grown—Groups B and C—and the instability of this activity, the farm-gate hay price is progressively lowered in the Group D plans from the initial $15.85 per ton to $10.00. Here cotton price is set and maintained at $129.59 per bale to give a gross margin of $107.00. This was the lower critical cotton price in the initial Group A farm plans below which cotton did not enter those plans. Here also the initial domestic corn price is used, giving a corn gross margin of $107.30. Hay price is lowered in dollar units to avoid calculating plans which are stable only over very narrow price ranges. Group D plans are summarized in Table 5. At the initial budgeted hay price of $15.85 virtually all of the 200 acres grown is sold as hay. All irrigated land not under lucerne is devoted to corn and the maximum of 500 acres of dryland wheat is produced. While the 500 acres of dryland not under wheat carried only 352 wethers when 600 acres of cotton were grown (Table 2), the 500 acres of dryland plus 200 acres of winter lucerne now carry 873 wethers in the first plan of Group D. At a lucerne hay price between $14.00 and $15.83 it is most profitable to sell about 860 tons of hay and use the lucerne for running merino ewes, with a reduction in the number of wethers (Figure 4). Grazing merino ewes continues to replace hay making as the hay price falls further, and wether numbers show little change until the hay price drops below $13.00. Wether numbers are then restricted to provide feed in the third quarter for ewes until hay price falls to $10.00 per ton. At this price it becomes profitable to feed hay to wethers as well as ewes in the feed-critical July-September quarter.

Thus the critical farm-gate hay prices are $15.85 per ton, above which virtually all lucerne grown is sold as hay, and $10.00 per ton, below which hay selling ceases and it becomes profitable to conserve hay for supplementary winter feeding in the July-September quarter.

[8] *Grain Abstracts*, (Division of Marketing, Queensland Department of Primary Industries), 1964-1965.

TABLE 4

Group C Farm Plans: Activities and Plan Total Gross Margins for a Range of Cotton Prices with Export Corn Prices

Plan Number:		(1)	(2)	(3)	(4)	(5)
Cotton Price per Bale:	$	105.59 to 200.00	105.34 to 105.59	104.58 to 105.34	104.22 to 104.58	Below 104.22
Cotton Gross Margin per Acre*:	$	235.13	63.00	62.00	61.00	60.00
Plan Total Gross Margins*:	$	13,503.00	44,707.00	44,493.00	44,302.00	44,173.00
Activity and Unit		Activity Level	Activity Level	Activity Level	Activity Level	Activity Level
Cotton, acres		400	219	214	141	0
Corn, acres		0	181	186	259	400
Lucerne, acres		200	200	200	200	200
Make hay, acres:						
January-March		200	200	198	198	200
April-June		200	200	200	200	200
July-September		200	200	195	195	200
October-December		197	197	191	191	197
Sell hay, tons		1,311	1,311	1,286	1,286	1,311
Merino ewes, head		0	0	74	74	0
Wethers, head		873	873	808	813	873
Hire labour, man-months:						
January		2·83	2·50	2·50	2·37	2·11
February		3·37	3·70	3·69	3·82	4·09
March		0·27	0·96	0·98	1·25	1·79
May		1·51	0	0	0	0
September		1·40	0·45	0·38	0	0
November		0·12	0·84	0·80	1·09	1·70
December		3·66	2·22	2·13	1·56	0·48

* Measured at the upper limit of each range.

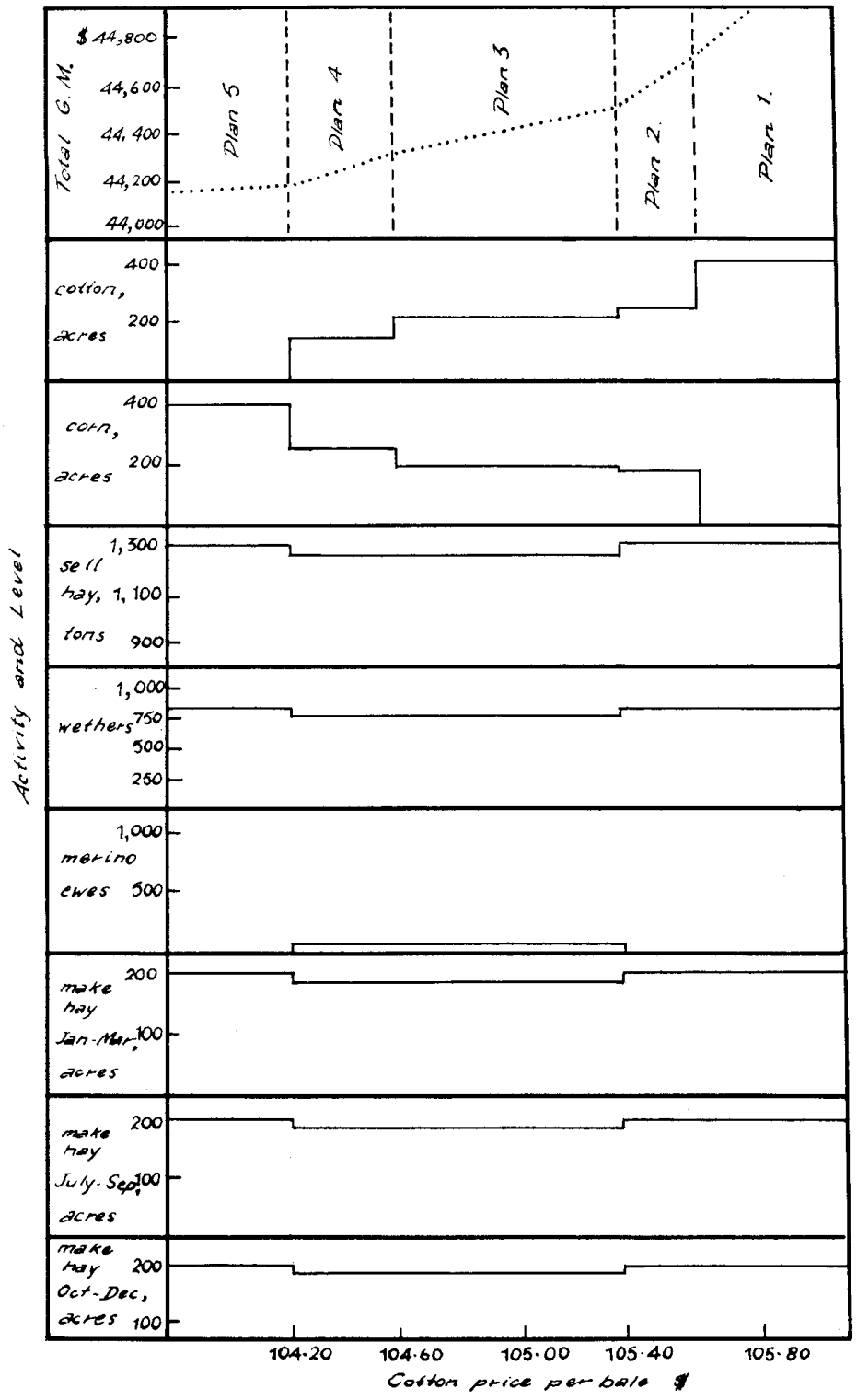

FIGURE 3: *Programmed Group C Farm Plans, 200 Acres of Lucerne forced in and Export Parity Prices for Corn and Sorghum*

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TABLE 5

Group D Farm Plans: Activities and Plan Total Gross Margins for a Range of Hay Prices

Plan Number:		(1)	(2)	(3)	(4)	(5)	(6)
Hay Price per Ton:	$	15.85	14.00	13.00	12.00	11.00	10.00
Plan Total Gross Margins:	$	63,093.00	61,605.00	60,841.00	60,222.00	59,643.00	59,521.00
Activity and Unit		Activity Level	Activity Level	Activity Level	Activity Level	Activity Level	Activity Level
Lucerne, acres		200	200	200	200	200	200
Make hay, acres:							
January-March		200	118	108	94	48	26
April-June		200	200	200	200	81	0
July-August		200	135	128	91	0	0
September-December		196	99	79	39	0	0
Sell hay, tons		1,311	864	708	535	168	20
Merino ewes, head		0	927	996	1,320	1,641	1,641
Wethers, head		873	716	739	498	537	809
Save pasture, acres		0	91	79	0	0	28
Feed hay to dry sheep, tons: July-September		0	0	0	0	0	0
Dry sheep on lucerne, acres:							
January-March		0	48	60	64	102	124
April-June		0	0	0	0	119	200
July-September		0	0	0	13	91	104
October-December		0	0	0	0	0	0
Feed hay to ewes, tons: September		0	0	0	0	0	11
Dryland wheat, acres		500	500	500	500	500	500
Corn, acres		400	334	400	400	400	400
Hire labour, man-months:							
January		2·11	2·48	2·39	2·45	2·57	2·62
February		4·09	3·21	3·26	3·14	2·77	2·65
March		1·79	1·30	1·49	1·48	1·34	1·25
November		1·70	0·39	0·44	0	0	0
December		0·48	0	0	0	0	0

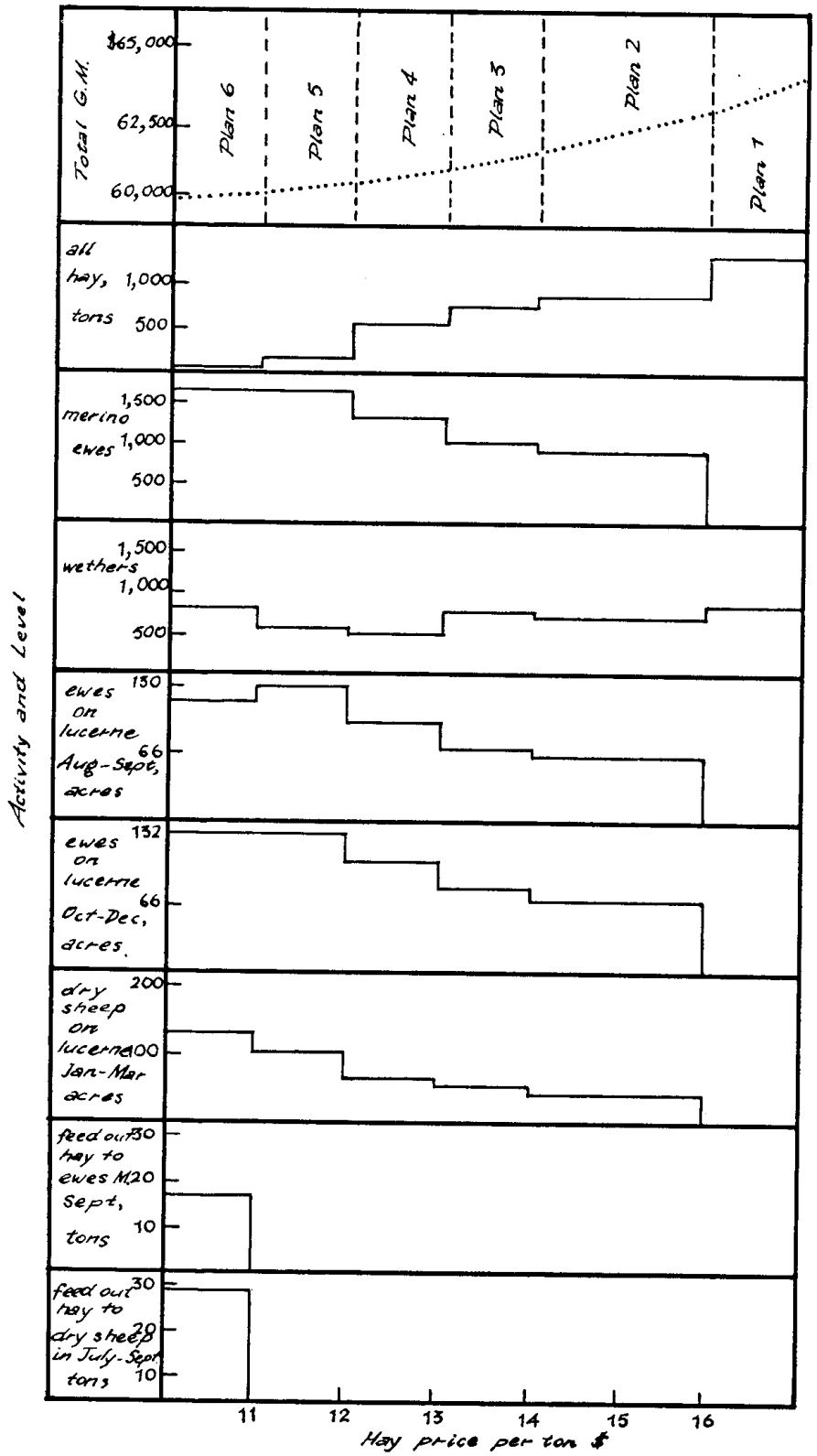

FIGURE 4: *Programmed Group D Farm Plans with Variable Hay Price*

Group E Farm Plans: Varied Wool and Lamb Prices and Lambing Percentages

Because of the highly unstable nature of the merino ewes activity and the complete absence of crossbred ewes in previous plans, Group E plans were developed to explore the situation when the basic matrix is taken and major sheep enterprise coefficients are independently varied. These are as follows:

Plan 1. Cotton price of $129.59 per bale with other parameters as budgeted.

Plan 2. Wool prices increased 20 per cent with other parameters as budgeted.

Plan 3. Wool prices decreased 20 per cent with other parameters as budgeted.

Plan 4. Lamb prices increased 20 per cent with other parameters as budgeted.

Plan 5. Lamb prices decreased 20 per cent with other parameters as budgeted.

Plan 6. Merino and crossbred lambing percentages of 95 per cent and 105 per cent respectively, other parameters as budgeted.

Plan 7. Merino and crossbred lambing percentages of 115 per cent and 125 per cent respectively.

Plan 8. First cross ewe lamb price of $6.43 per head with lambing percentages as in Plan 6, other enterprises as budgeted.

The results are shown in Table 6 and Figure 5. The cotton price of $129.59 which is used in Group E prevents the cotton enterprise from appearing in 5 of the 8 plans and limits cotton to an impracticable 62 acres in the remaining three plans. Corn is the only cash crop grown —the maximum of 400 acres in each of the Group E plans at the original domestic price.

In Plan 1 making and selling hay[9] dominate the irrigated lucerne activity. Wethers are restricted to dryland pasture, light grazing after each hay cut, and grazing lucerne in June and July when no hay can be cut.

Plan 2 with a 20 per cent increase in wool prices shows a sharp increase in the number of wethers run at the expense of the hay selling activity, but still no ewes enter the plan. There is an accompanying increase in dry sheep lucerne grazing in the first and fourth quarters but no lucerne is grazed in April-June or July-September. However, as mentioned previously, the programme assumes that haymaking is impracticable in June and July, and thus supplies lucerne grazing to the dry sheep feed pool in these periods.

In Plan 3, wool prices are decreased 20 per cent from the levels so far used.[10] This results in a plan very similar to Plan 1: virtually all

[9] Note that in Group E the original lucerne hay price of $15.85 is used.

[10] Wool prices are based on 1960-61 to 1963-64 mean prices, and lamb prices on February 1962-64 Gunnedah prices. For details see Dudley and McConnell, *op. cit.*

TABLE 6

Group E Farm Plans: Activities and Farm Total Gross Margins for Varied Wool and Lamb Prices and Lambing Percentages

Plan Number:		(1)	(2)	(3)	(4)	(6)	(7)	(8)
Farm Total Gross Margins:	$	63,093.00	64,994.00	62,046.00	63,985.00	63,985.00	65,183.00	63,589.00
Lamb Price Level:		standard	standard	standard	20 per cent increase	standard	standard	ewe lambs $6.43
Wool Price Level:		standard	20 per cent increase	20 per cent decrease	standard	standard	standard	standard
Crossbred Lambing Percentage:		85	85	85	85	105	125	105
Merino Lambing Percentage:		75	75	75	75	95	115	95
Activity and Unit		Activity Level	Activity Level	Activity Level	Activity Level	Activity Level	Activity Level	Activity Level
Lucerne, acres		200	200	200	200	200	200	200
Make hay, acres:								
January-March		200	143	198	117	117	89	117
April-June		200	200	200	200	200	200	200
July-September		200	200	195	135	135	89	135
October-December		196	155	191	91	91	15	91
Sell hay, tons		1,311	1,062	1,286	769	769	451	769
Merino ewes, head		0	0	65	899	899	1,520	899
Wethers, head		873	1,575	808	746	746	0	746
Crossbred ewes, head		0	0	0	0	0	297	0
Save pasture, acres		0	229	0	94	94	0	94
Dry sheep on lucerne, acres:								
January-March		0	57	0	54	54	62	54
October-Dezember		0	45	0	0	0	0	0
Save pasture, acres		0	229	0	94	94	0	94
Dryland wheat, acres		500	500	500	500	500	500	500
Corn, acres		400	400	400	338	338	400	338
Hire labour, man-months:								
January		2·11	2·23	2·12	2·48	2·48	2·47	2·48
February		4·09	3·54	4·07	3·23	3·23	3·11	3·23
March		1·79	1·54	1·79	1·29	1·29	1·48	1·29
November		1·70	1·23	1·64	0·32	0·32	7·35	0·32
December		0·48	0·01	0·43	0	0	6·89	0
Opportunity costs: Crossbred ewes, $/head		1·18	1·35	0·97	1·15	0·63	0·73	0·09

lucerne is converted to hay and sold. Here, however, merino ewes enter the plan at a low level of 65 head and this slightly reduces wether numbers and hay selling.

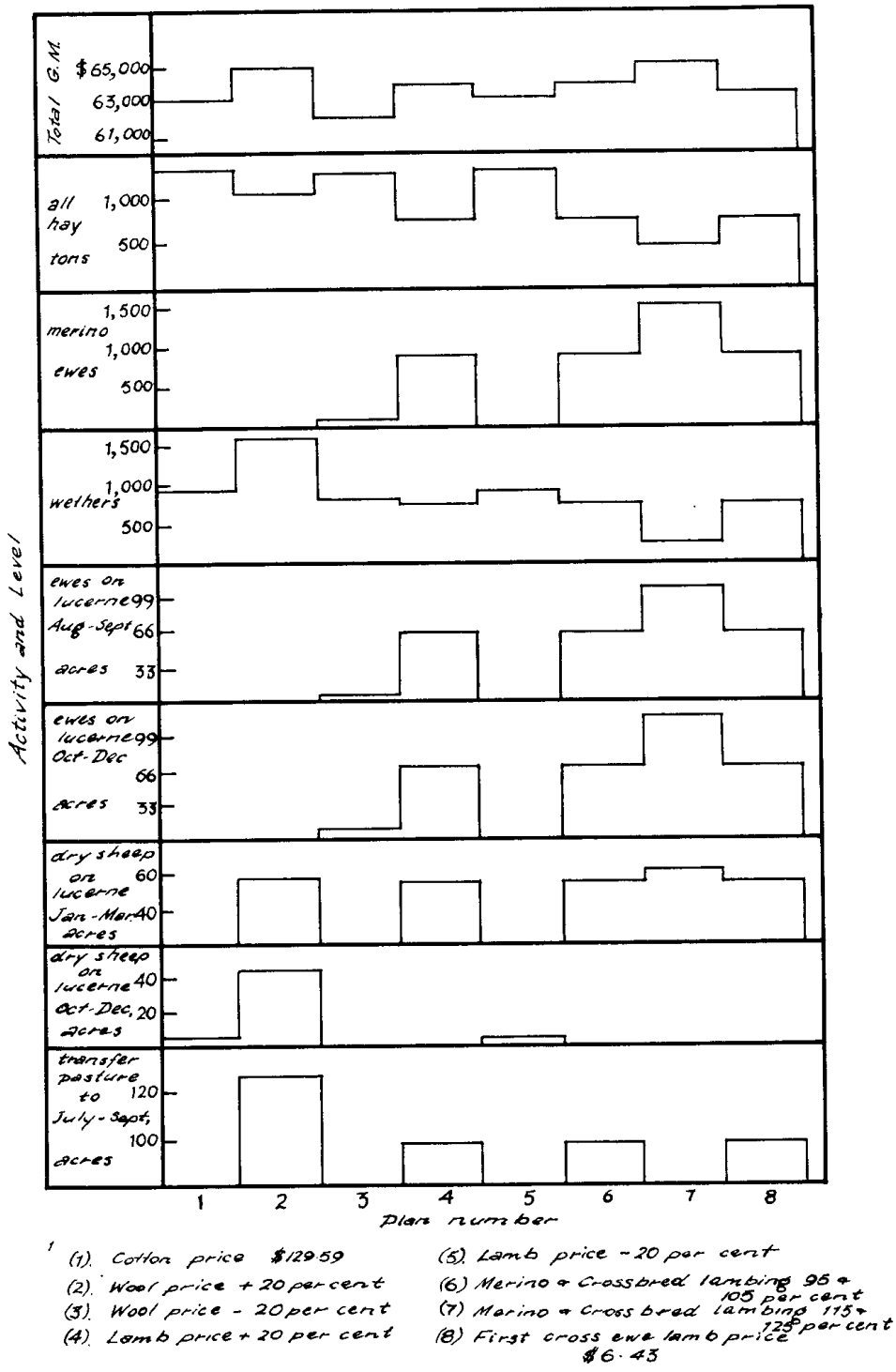

FIGURE 5: *Programmed Group E Farm Plans for Varying Sheep Enterprise Parameters*

When the market price of all lambs is increased by 20 per cent in Plan 4 from the levels budgeted, a large increase in merino ewe numbers results. Wether numbers decline slightly and about 500 tons less hay is sold. However hay production is still at more than half the level possible. No hay is fed to any of the sheep. Comparing total gross margins of Plans 1, 2, and 4 it will be seen that the 20 per cent increase in lamb prices in Plan 4 results in a much smaller profit increase than does the 20 per cent rise in wool prices in Plan 2.

As expected, the results of a 20 per cent reduction in lamb prices assumed in Plan 5 are identical with Plan 1, and are therefore omitted from Table 6. Here again hay selling dominates the irrigated lucerne activity, while wethers are restricted to the dryland with post-cut lucerne grazing only.

The lambing percentages assumed in the sheep budgets, 75 per cent and 85 per cent for merinos and crossbreds respectively, are lower than those obtained in the higher rainfall Tablelands adjoining the Namoi area. Plans 6 and 7 are derived to examine the effects of obtaining higher lambing percentages. It is assumed the extra lambs require no extra fodder. Plan 6, with lambing percentages of 95 per cent and 105 per cent for merinos and crossbreds respectively, is, with the exception of the opportunity costs of crossbreds, identical to Plan 4. This is because the merino ewe gross margin with 95 per cent lambing happens to be the same as the margin obtained when lamb prices are increased by 20 per cent, other coefficients unchanged.

The increase in lambing percentages to 115 per cent for merinos and 125 per cent for crossbreds in Plan 7 increases the merino ewe level to 1,520 head, reducing hay making and selling to about 30 per cent of maximum production. Feeding hay to sheep is still unprofitable, though less unprofitable than in any of the other plans which have a hay price of $15.85 per ton.

Plan 8 examines the situation where price of first-cross ewe lambs sold for breeding falls below their value as fat lambs. That is, the price of first cross ewe replacement lambs from the merinos is lowered from the $8.00 per head price if sold on the farm, to the price obtained for the wether and cull ewe portion of the merino ewe drop. (The merino ewe enterprise gross margin is adjusted for freight and commission costs.) Lambing percentages are again 105 per cent and 95 per cent as in Plan 6.

The resulting plan is similar to Plans 4 and 6. Thus even with the unrealistic assumption that the higher lambing percentages require no increase in feed, which favours crossbreds relative to merinos, and lower merino ewe lamb prices, crossbreds have not entered any of the plans. The opportunity costs of this crossbred ewe activity are shown in Table 6: the costs of forcing crossbreds into the programme range from $1.35 per head in Plan 2 to 9 cents when lower prices for the first cross merino lambs are assumed from Plan 8.

We may conclude that crossbreds are less profitable than merinos under any of the hay, lamb, or wool price structures considered, and it is very unlikely that conditions would exist which would cause crossbreds to be more profitable in this type of farming system unless their lambing percentage is considerably more than 10 per cent better than merinos.

4. SUMMARY AND CONCLUSION

Detailed enterprise budgets were prepared for the major irrigated farm enterprises in the North West: these were then integrated in a linear programming study to develop technically feasible maximum-profit farm plans for a representative 1,600-acre property on the lower Namoi. The stability of these plans is tested by varying the main parameters. Five groups of farm plans are developed, and individual plans within each group examine the effects of varying the commodity price, the production level or other critical parameters. Cotton, corn, grain sorghum, lucerne hay, wool, and lamb prices are varied, and also lambing percentages. Lucerne growing is forced into most of the plans to examine the economic effects of meeting possible future soil structure or crop hygiene problems under intensive land use.

The main conclusions are summarized below.

1. Cotton growing is so clearly the most profitable enterprise that the budgeted price of $200 per bale could decline to about $132 per bale (or $0.264 per pound) before the next most profitable enterprise, specialized corn growing, becomes dominant in these farm plans.

2. Corn was budgeted at a yield of 110 bushels and a price of $1.64 to give a gross margin of $107.30 per acre. Price is based on 1960-64 Sydney mean quotations. In early 1967 a Tamworth feed firm announced a buying price pegged to export wheat. It would be premature to predict success for this limited attempt at stabilization; by encouraging production in the North West it could have the opposite effect. The yield of 110 bushels is reasonably conservative: specialist growers are achieving yields of the order of 150-170 bushels. Certainly corn technology (partly as a spill-over effect from cotton) is developing rapidly. This could narrow the transition range from cotton monoculture to mixed row cropping compared with that obtained in the programming.

3. If corn and grain sorghum prices fall to export parity cotton could drop in price to about $104 per bale ($0.208 per pound) before it would cease to be more profitable than these grains.

4. As long as some part of the irrigated farm area must be under a pasture or lucerne rotation, there will be a place in the plans for the merino ewe enterprise regardless of whether the ewe lamb portion is sold as flock replacements or at slaughter prices.

5. If lucerne is grown it will be more profitable to bale for cash sale than to graze, as long as the farm-gate price is above $15.83 per ton.

6. On the type of property specified here it would not be profitable to hand-feed baled hay to sheep unless the price fell below about $10 per ton.

7. It is most unlikely that fat lamb raising will be as profitable as first-cross lamb breeding (both based largely on irrigated lucerne) unless the lambing percentage with the fat lamb enterprise is more than 10 per cent higher than that achieved with first-cross lamb raising.

APPENDIX

The basic linear programming matrix is shown in Table 7. In this table the abbreviation "DSEGD" is used to indicate "Dry-Sheep-Equivalent Grazing Days". For the names of activities in Table 7, refer back to Table 1.