The economic cost of weeds in dryland cotton production systems of Australia

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Abstract:

Economic losses and costs associated with weeds in dryland cotton production are important, both for growers and for industry bodies when making decisions about research priorities and research and development funding. A survey was conducted to provide information on weed types, control strategies and estimated costs to growers. We used information from the survey to estimate conventional financial losses due to weeds, and as a basis for evaluating aggregate economic (society) impacts. An economic surplus model was used to estimate the aggregate societal impact of weeds for three production regions in north-eastern Australia. The annual economic costs associated with weeds were estimated to be $41 million, and the on-farm financial costs were $25 million. While these are past (sunk) costs, and based on a total removal of weeds, the approach outlined here can be used to begin evaluating likely future returns from technologies or management improvements for different agricultural problems.

Key Words: Weeds, Dryland Cotton, and Economics

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1. Introduction

The focus of agricultural research and development (R&D) by public sector agencies and industry bodies continues to be important. Priority setting for R&D issues provides an objective basis for funding decisions, which is especially important when budgets are limited. In determining priorities the 'economic cost' of particular problems is often mentioned. Properly measured, the current economic cost of a problem provides one indication of the relative importance of different issues. A more valuable measurement is to estimate potential payoffs (net benefits) from alternative R&D investments.

The on-farm (or financial) costs of weeds arise from application of direct control measures, and from yield losses (i.e. opportunity costs). The effects of weeds may also be felt beyond the farm gate by crop processors, manufacturers and consumers. Jones *et al*. (2001) estimated the costs of different weeds for Australian annual winter cropping systems including these extra impacts. A scoping study similar to that of Jones *et al*. (2001) was initiated for summer dryland farming systems involving cotton. This study examined weed issues and their economic impact to better understand weed management in regions growing dryland cotton. The economic analysis included measures of production, exports and price, demand and supply characteristics.

In terms of priority setting for cotton weeds R&D, this scoping study is only a first step. Dryland cotton is a very small proportion of total cotton production in Australia therefore; any priority setting for cotton weeds R&D would require a similar study for irrigated cotton. This is yet to be conducted. Even then, the point mentioned above must be borne in mind – the estimated economic costs measured in the past cannot be avoided. A forward-looking analysis of potential R&D projects could use the same framework based on specified inputs, likely outcomes and industry effects (adoption). In considering these scenarios, an industry R&D corporation would need similar evaluations for other areas besides weeds. The value of the approach used here lies in clear thinking about the relevant types of costs and consistent measurement of their relative importance. The framework can, in principle, be used for both *ex post* and *ex ante* analyses.

The project was funded by the Cotton Research and Development Corporation (CRDC), the Australian Cotton Cooperative Research Centre (CRC), the Grains Research and Development Corporation (GRDC), and the CRC for Australian Weed Management. The economic costs of all weeds in dryland cotton production in north-eastern Australia were estimated to be $19, $14 and $8 million in 2000-01 for the northern NSW, southern Queensland and central Queensland regions, respectively. This total economic cost of $41 million can be compared with an estimate of $25 million on-farm financial costs. The total economic cost is estimated on the basis that weed costs impact the supply of the product, and reflects the extent that supply could increase for export markets.

2. Approach used for the study

The dryland farming areas of north-eastern Australia are situated on fertile clay soils with substantial water holding capacity. They are distinguished climatically by average annual and monthly precipitation being less than evaporation, but with infrequent and often large rainfall events which allow episodic soil moisture accumulation. The farming systems that have evolved consist of soil and vegetation management to periodically store water in the soil profile, then planting a crop at the next available sowing window, and relying on in-crop rainfall to finish the crop.

These flexible management practices allowed both summer and winter crops to be grown, often in irregular rotations. Issues of pest, weed and disease management also complicate the crop choice decision. Farmers make crop planting decisions primarily on the basis of soil moisture and comparative crop price prospects. However, other factors such as weed and disease status may operate to override price considerations.

There are a number of weeds issues for growers and researchers resulting from the dryland farming system and constraints within the region. Residual herbicides used in rotational crops may damage cotton, in particular the sulfonylurea and triazine herbicides. Equally, a number of the common cotton herbicides have long plant-back withholding periods to either winter cereals or other summer cereals used in rotation with dryland cotton. To preserve soil moisture many dryland growers have adopted minimum or zero tillage systems that are almost solely reliant on herbicides for weed control. Control measures therefore must be flexible to allow last minute changes in the crops grown due to soil moisture limitations or price fluctuations, and need to provide adequate levels of protection against weeds in the chosen crop. This has led to a greater reliance on glyphosate for widespread weed control in minimum or zero till systems. This increased use has recently led to concerns over the development of resistance within some weed species.

The aims of the scoping study were to determine:

- Dominant and difficult-to-control weed species in each crop and fallow component of the different crop rotations used for dryland cotton production in the region;
- Weed management practices, both non-chemical and chemical, being used for weed control in these systems;
- Economic impact of these weeds; and
- Current practices exacerbating the weed problems.

The ‘economic’ analysis was conducted in two parts. The financial (on-farm) costs of weeds were estimated on an average-per-farm basis for each crop type. But because the aggregate effects of weeds are likely to have effects beyond the farm gate, an economic analysis was conducted to estimate likely effects on other industry players (eg processors, manufacturers) and consumers. The justification for the latter approach (apart from being a more complete view of cause and effect) is that agricultural R&D is partly funded by R&D Corporations which use taxpayer funds (from Federal and State Governments) based on a public benefit justification.

Three regions (Table 1) were identified to be of interest, based on dryland cotton production patterns. These were Northern NSW (comprising the Macquarie, Namoi and Gwydir river valleys), Southern Queensland (centred on the Darling Downs), and Central Queensland (based on Emerald and the Fitzroy area). These are shown in Figure 1.

3. Methods

Due to different cropping rotations in dryland cropping systems, the assessment of weed problems was studied in the context crop sequences types. Technical details of weed types and densities were collected within the particular management context. The scoping study consisted of four components, starting with a postal survey of dryland cotton growers. This was followed by detailed grower interviews and extensive field surveys of a select number of growers who responded to the mail survey. Finally, financial and economic analyses were conducted from the survey data and other sources.

3.1 Postal survey

A postal survey was sent to 342 dryland growers in the 3 regions. The list of growers was derived from industry sources, and represented all known dryland cotton producers at that time. In the survey growers were asked to provide information on their crop rotations, farming practices used in each component of the rotation for weed control, specific information on herbicides used for the main weeds of each crop and fallow, costs incurred and estimates of the impact of weeds on crop production, as well as specifics on troublesome weeds within the cropping systems. The overall survey response rate was 16%, with 53 useable survey forms being returned.

The survey was conducted to find information about the whole group (or population) of farmers with cropping systems that included dryland cotton. An effort was made to consider the errors associated with using a survey estimate to represent a true population parameter. There are two types of errors associated with using sample surveys to develop estimates of underlying population parameters – non-sampling and sampling errors. The former can be minimised by careful questionnaire design and testing to avoid ambiguous or misleading questions, minimising the possibility of transcription or other processing errors, and preliminary data analysis to ensure the required information is derivable. Sampling errors arise because estimates of a parameter of interest will vary with repeated sampling, even if the sample proportion of the population is ‘large’. If a sample survey is used to generate information about a population of interest to a researcher, any estimate derived from the sample should have an associated standard error to indicate the degree of confidence in that estimate. Sampling errors for some key variables are presented.

It is also possible for weed contamination to impact the price received for a crop. A question about weed contamination was contained in the postal survey. However, few problems of weed contamination in grain or cotton sold were reported.

3.2 Grower interviews

The scoping study was a collaborative effort involving staff from the Queensland Department of Primary Industries and NSW Agriculture. An external agronomist with extensive experience in dryland cotton production was appointed to interview 10 dryland cotton growers to validate responses given in the postal survey and provide any additional information relevant to weed management. He used a questionnaire similar to the postal survey, but with additional questions to provide information on land preparation prior to crop sowing, crop agronomy, water volume when spraying weeds and frequency of spray rig calibration, and reasons for choosing their crop and weed management options.

3.3 Field surveys

Thirty-four fields with summer crops and fallows in the different rotations on the 10 farms were surveyed to determine the diversity and density of weeds present. Monitoring was performed at the early stages of crop growth and fallow to determine the weeds being treated, and again later in the season prior to harvest or re-cropping to give an indication of the survivors with potential to replenish the seed bank. Weed counts were performed along 20 transects in each field.

Follow-up grower interviews and field surveys were not conducted in central Queensland. It is uncertain whether this had any effect on the results presented for this region.

3.4 Financial and economic analysis

The financial analysis of weed costs on farm was determined according to the expenditure on direct control costs and the yield loss due to weeds for each of the crops. The results of this analysis are presented in Section 5.3.

The economic evaluation is distinguished from the on-farm financial analysis by estimating likely changes in industry prices and quantities based on potential changes in production due to removal of the effects of weeds. From the survey, respondents were asked to estimate direct control costs and yield losses associated with different weeds and crop types. This combined dollar cost was expressed as a percentage of variable costs, and then treated as the amount by which the industry supply schedule would be changed *if the weed constraint was removed by R&D.*

3.4.1 Economic surplus modelling

The economic cost of weeds was evaluated with the standard industry supply and demand representation shown in Figure 2. The cost of weeds was evaluated as a downward shift in the industry supply curve which is taken to represent the case of a weed-free environment for dryland cotton production. Changes in consumer and producer surplus were evaluated with this model.

The survey results included estimates of crop yields if there were no weeds present, for comparison with the control costs and yield loss associated with the existing level of weeds. This is modelled as the difference between the current situation (S_0, with weeds) and the alternative weed-free case (S_1).

Jones *et al.* (2001) adapted McInerney's (1996) representation of the trade-off between crop losses (due to weeds) and control expenditure to conceptualise the economic cost. A comparison of the current situation with a weed-free yield (presumably with zero control costs) fits within the framework, although it is unrealistic in terms of achievable outcomes. However, the framework is valuable in that it can be used to assess other scenarios where potential outcomes from R&D (in terms of a reduction in yield losses, with an associated change in control costs) could be evaluated in a priority-setting process.

The change in supply is represented by a percentage change in the minimum average variable costs of production per unit of output. This is in accordance with economic theory of supply representing marginal costs of production. The change in total economic surplus (TS) can be expressed as a change in consumer surplus (CS) and producer surplus (PS) as follows:

$$\Delta CS = P_0 Q_0 Z(1 + 0.5Z\eta)$$

$$\Delta PS = P_0 Q_0 (K - Z)(1 + 0.5Z\eta) \text{, so that}$$

$$\Delta TS = P_0 Q_0 K(1 + 0.5Z\eta) \text{, where}$$

P_0 and Q_0 are initial prices and quantities, Z is the percentage reduction in price from the supply shift ($Z = K\varepsilon/(\varepsilon + \eta)$), K is the initial vertical supply shift expressed as the percentage reduction in production costs, and ε and η are the price elasticity of supply and absolute price elasticity of demand, respectively.

3.4.2 Demand and supply elasticities

Estimates of demand and supply elasticities were collected for the analysis. Hill *et al.* (1996) reviewed Marshallian demand elasticities from previous studies and used their own judgement to develop an own-price domestic cotton demand elasticity of -0.2 and a cotton supply elasticity of 1.5. Clements and Lan (2001) quoted an own-price cotton demand elasticity of -0.14.

These numbers were considered in the context of dryland cotton production in Australia. Over 90% of Australian cotton is exported for processing. It is also important to consider the size of the industry being considered. Because dryland cotton is such a small proportion of the industry, and because of the strong export orientation it was considered that dryland cotton producers are price takers and that changes in production would have no effect on price. Therefore we assumed demand to be perfectly elastic. This has implications for economic surplus gains from potential improvements in weed management.

4. Physical and economic characteristics of the industry

Information on irrigated and dryland cotton production by state for 2000-01 is shown in Table 2. The dryland proportion of the cotton crop (both area and production) is higher in Queensland than in NSW, but overall only 7% of production is from dryland sources.

Crop prices and variable costs for the 2000-01 year are shown in Table 3. These were taken from published gross margin budgets. While these figures are from synthetic budgets based on 'best management practice', they are considered useful as a guide for the analysis. The farm-gate prices are considered the most relevant measures to which farmers throughout the industry would be likely to respond. Estimates of average variable costs from farm budgets (Scott 2001, Lucy 2002, Lucy *et al*. 2002) are also presented in the table. These budgets are derived according to 'best practice' and may differ from actual on-farm figures. However, the postal survey did not ask for all costs on an enterprise basis. This would be almost impossible to accurately measure from a self-administered postal survey.

ABARE estimates for the Wheat and Other Crops Industry of the North West Slope and Plains region of NSW in 2000-01 showed total cash costs of $651,034 for an average farm size of 3,437 ha ($189/ha). However, this 'average' farm included livestock and pasture land, as well as crops, and the total cash costs are not apportioned to specific enterprises.

5. Results

5.1 Rotations including dryland cotton

Due to the nature of the cropping systems used in north-eastern Australia (Section 2), dryland cotton may be grown in combination with a number of other winter and summer crops, and fallows. From the postal survey results the main crops grown with cotton were winter cereal only (predominantly wheat but also some barley), summer and winter cereal (sorghum and wheat/barley), long fallow, and summer cereal only (sorghum). These results reflect soil types and management preferences of the graingrowers.

This information has implications for the financial and economic analyses carried out for this study. The financial costs can be apportioned for each crop, and these results are presented in the next section. The weed costs could also be added up to develop a total cost for any specified crop sequence, provided that double counting was avoided. Similarly the framework used for the economic analysis allows the industry impacts of weeds to be evaluated for each crop type. However, aggregation of financial or economic benefits over crop rotations has not been undertaken here because of the diversity and unpredictability of crop rotations.

5.2 Reliability of survey estimates

The standard errors for key estimates from the postal survey are presented in Table 4. Bruce McCorkell (NSW Agriculture) assisted with these calculations. The standard error can also be expressed as a percentage of the sample mean, called the relative standard error (RSE) (see ABARE 2001).

Some of the standard errors and RSEs are relatively large, meaning that care should be used when stating that one estimate is larger than another. Estimates with RSEs greater than 100% may not be statistically different from zero.

5.3 Financial analysis

The average financial cost of controlling weeds in each crop grown in rotation with dryland cotton is presented in Table 5. These amounts include the cost of herbicides, application costs, cultivation, and manual chipping where appropriate. The costs associated with weed control are very similar for northern NSW and southern Queensland. Cotton, sorghum, wheat and chickpea costs were very similar, which should not be surprising given the similarities in production environments for the two regions. In central Queensland the average per hectare costs were substantially lower for cotton, sorghum and wheat. The low wheat cost reflects the fact that there are few winter grass weeds; however, the sorghum and cotton costs are surprising.

In general the weed costs in Table 5 might be considered quite high, especially in comparison with the average variable costs in Table 3. Although the cost due to yield loss is not generally considered in financial budgets, even the direct control costs of $220/ha and $124/ha seem very high. It must be remembered that there is substantial variability associated with these estimates (see Table 4), and the wheat control cost estimates may not even be significantly different from zero.

Growers were also asked in the postal survey to provide details of the reduction in the yield due to weeds in their crops. The reported yield losses were averaged for each of the crops across the regions and are presented as the percentage yield loss due to weeds in Table 5. This percentage loss was converted into dollar equivalents using current prices for the crops and the average yield for each region for each crop. The total cost of weeds for each crop was calculated taking into account the impact of weeds on yield and the costs of weed control for each crop (Table 5).

The aggregated financial costs of weeds for dryland cotton producers is estimated to be (from Table 5 (total $/ha cost of weeds) and Table 3 (total area of dryland cotton production)) $14.8 million in northern NSW, $8.4 million in southern Queensland and $1.9 million in central Queensland.

Weed control in summer and winter fallows relies primarily on knockdown herbicides and some cultivation. As water conservation is of upmost importance to dryland growers, the use of cultivation for weed control is likely to be minimal. The transition of many growers to minimum or zero tillage for soil conservation thus places a great deal of reliance on knockdown herbicides as the primary means for weed management in summer and winter fallows. Average cost for weed management in summer and winter fallows is $34.40 per hectare, which varies from $9.83 to $54.33 per hectare (Table 6). This cost includes operational cost (cultivations), chemicals (herbicides) and spray application cost. The average cultivation cost is $5.98 per hectare. The major component is the chemical cost (herbicides) $24.51 per hectare. Spot spraying costs more than the usual spray. The average spray cost is $3.91 per hectare, which includes the spot spraying (Table 6).

5.4 Economic analysis

The economic analysis was conducted to evaluate the losses from weeds in each crop within each region. As noted previously, the analysis was based on farm survey estimates of yields with current weed control and weed-free crop yields.

Information available about regional crop production indicated that the regions differed in their production characteristics; at least as far as production costs and likely yields were concerned. For cotton, the total cost of weeds (Table 5) was expressed as a percentage of average variable costs (Table 3) to derive cost reduction proportions of 29% (northern NSW), 24% (southern Queensland), and 33% (central Queensland). These proportions were used to represent the restrictions to crop supply deriving from the effects of all weeds that influence the cotton yield. As stated above, some the author's industry experience suggested that the survey estimates of control costs appeared to be quite high.

For cotton, estimates of changes in producer and consumer surplus for each region were derived using the supply and demand elasticities (Section 3.4.2), a conversion of production and price from a bale to a tonne basis (227 kg bale weights standard in Australia), and equations involving initial prices and quantities, the percentage cost reductions above (K), and the percentage reduction in price from the supply shift (Z). The results are shown in Table 7. The loss in producer surplus associated with all weeds in cotton was estimated to be $19, $14 and $8 million in the three regions respectively. There are no changes in consumer surplus because of the price taking assumption for dryland cotton producers exporting most of their produce.

For other crops, analysis is dependent on obtaining the annual production levels for those crops when grown in rotation with dryland cotton. Presumably the weed costs are specific for the particular rotation(s). To take the cost estimates derived here and apply them to crops grown in other rotation (i.e. without dryland cotton) would not be proper. If such production estimates can be derived, then a similar analysis can be performed. But it is very difficult to do the production estimate for crops grown with in the dryland cotton as there are no secondary data sources available. Estimates of supply and demand elasticities, and initial prices, are also required.

6. Discussion

The focus of this paper has been the potential for using financial and economic analysis of crop survey data in an R&D priority-setting process. The underlying methodologies are well known to economic analysts, but the application to weeds in dryland cotton crop rotations is novel.

Several interesting points arise from the survey results. First, we have calculated the standard errors associated with some survey estimates and found them to be quite large. The use of surveys and interpretation of survey results seems relatively widespread, but seldom is there any acknowledgement of the possibility or implications of sampling (or non-sampling) errors associated with these types of analyses. The size of errors can be reduced by stratifying the population to increase sampling efficiency. There are also likely to be substantial non-sampling errors associated with the use of self-administered surveys and response bias.

The estimates of weed control costs presented in the paper appear to us to be relatively large. Whether they are realistic is hard to know. Considerable care should be used if drawing conclusions for R&D payoffs from weeds compared to other problems (eg fertiliser, insect pests).

The aggregated estimates of financial and economic costs associated with current weed infestations are broadly similar, although the economic estimates are larger. The figures are derived using different methodologies. The financial estimates are derived by applying an estimated cost ($/ha) against a fixed area of production. The economic analysis, characterising as it does the costs associated with weeds as impacting on aggregate supply, is a normative analysis which assumes a supply response to the additional costs. Intuitively, it does not seem impossible that the economic could outweigh the financial effects. Of course this depends on the supply and demand elasticity assumptions, but since cotton production has been relatively profitable and also uses higher levels of inputs any major cost reduction could generate a substantial cost reduction and relative supply response.

To fully utilise this methodology for priority setting, several potential R&D projects could be analysed in this framework to provide a ranking according to likely net benefits. The framework also allows an allocation of benefits between producers, processors and consumers (both domestic and export). Such analyses would need to consider assumptions about patterns and rates of technology adoption by industry. Software packages (eg DREAM, Wood *et al.* 2001) can be used for this purpose. These analyses can show the benefits from further uptake of existing technology versus development of completely new technologies, which may have uncertain adoption by industry.

7. Conclusions

The analysis of weed costs in crop rotations with dryland cotton has shown potential benefits from the removal or reduction of weeds. While this scenario of complete weed removal is somewhat unrealistic, the methodology can be used to evaluate the returns from future R&D on a more valid and consistent basis. Research workers need to be careful about the collection, analysis and interpretation of survey data when drawing implications for research priorities.

Figure 1: Dryland cotton areas within the cotton growing regions.

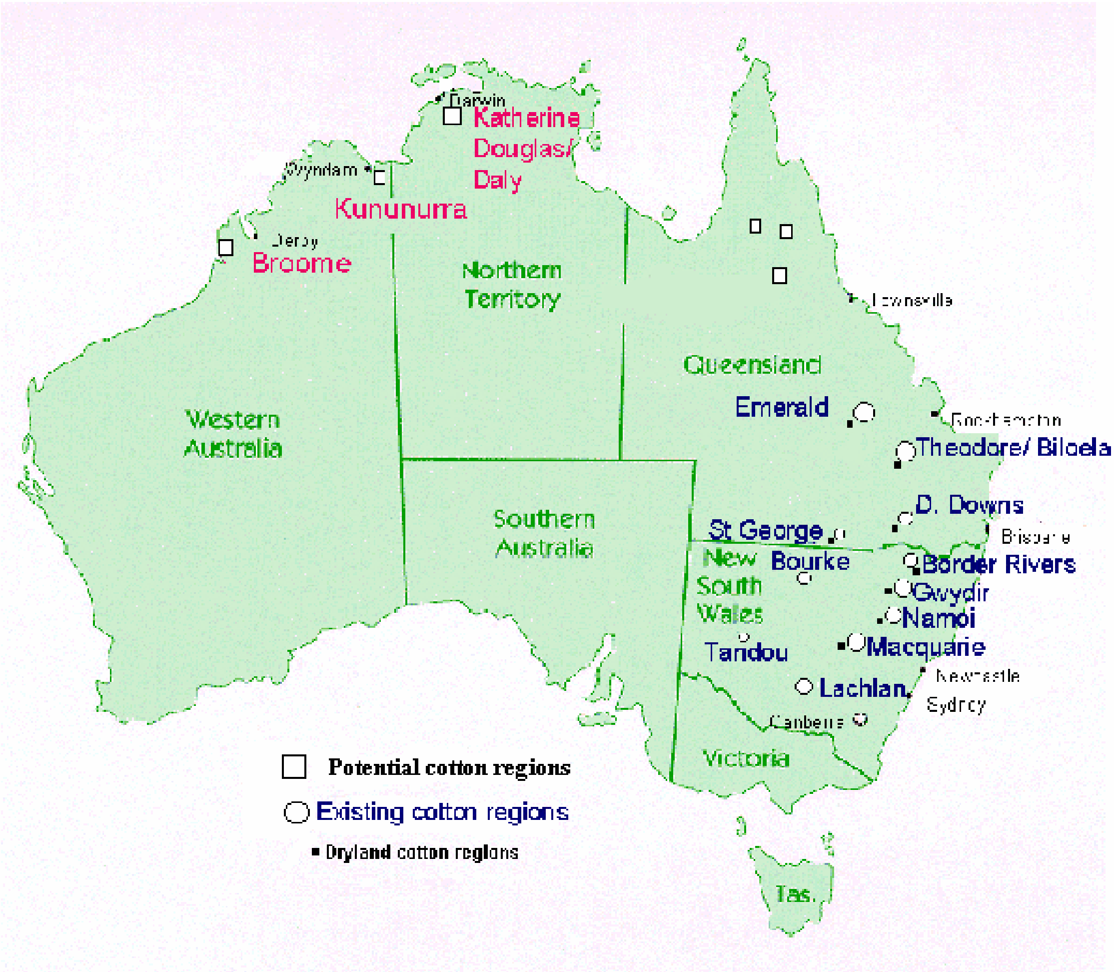

Figure 2: Supply and demand representation of a new technology

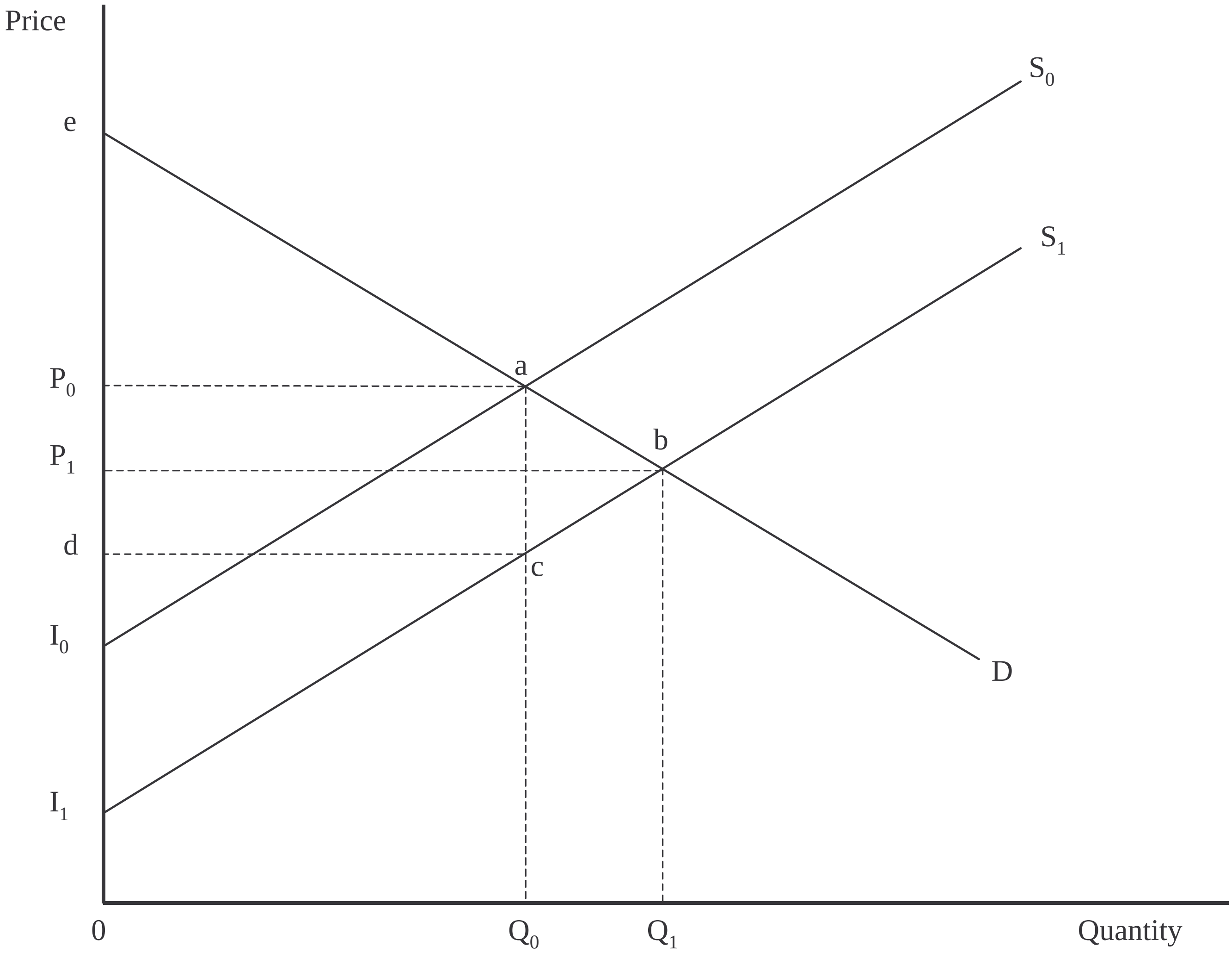

Table 1: Population and sample numbers, dryland cotton producers, by region

Farms	Northern NSW	Southern QLD	Central QLD	Total Industry
Population	89	215	38	342
Sample	14	33	6	53
Sampling %	16	15	16	16

Table 2: Cotton area and production, irrigated and dryland, by region, 2000-01

Region	Irrigated			Dryland			Total	
	Ha '000	**Yield** Bales/ha	**Bales** '000	**Ha** '000	**Yield** Bales/ha	**Bales** '000	**Ha** '000	**Bales** '000
Queensland								
Central	30.1	7.6	228.8	11.6	2.9	33.1	41.7	261.9
Southern	85.4	7.3	627.2	28.0	2.9	82.0	113.4	709.2
Other	0.4	4.4	1.8	-	-	-	0.4	1.8
Total	115.9	7.4	857.8	39.6	2.9	115.1	155.5	972.9
Percent	75		88	25		12	100	100
NSW								
NW NSW	221.9	7.5	1673.4	41.2	2.8	113.8	263.1	1787.3
Other	92.6	7.3	679.2	1.0	2.0	2.0	93.6	681.2
Total	314.5	7.5	2352.6	42.2	2.7	115.8	355.6	2468.4
Percent	88		95	12		5	100	100
Aust Total	430.4		3210.4	81.7	2.8	230.9	511.1	3441.3
Percent	84		93	16		7	100	100

(Source: Cotton Yearbook 2001).

Table 3: Prices and variable costs used for crop analysis

Crop	Farm-gate price $/bale (cotton), others $/tone			Average variable costs $/ha		
	Nort-hern NSW	**Sout-hern QLD**	**Central QLD**	**Norther-n NSW**	**Souther-n QLD**	**Central QLD**
Dryland cotton	480	430	593	1236	986	508
Wheat	170	170	140	210	140	134
Sorghum	115	115	133	305	208	184
Barley	165	200	--	209	141	--
Chickpeas	400	350	--	295	172	--
Maize	150	150	--	353	185	--
Sunflowers	320	300	209	219	145	165
Mung beans	420	450	--	284	132	--

Source: Scott (2001), Lucy (2002) and Lucy et.al (2002).

Table 4: Sampling errors associated with some survey estimates

Region	Crop	Average Weed Control Costs		
		Mean $/ha	**Standard Error** $/ha	**Relative SE (a)** %
Nthn NSW	Cotton	220	84	38
	Wheat	35	59	169
	Sorghum	59	34	57
Sthn QLD	Cotton	220	52	24
	Wheat	13	13	99
	Sorghum	58	26	46
Central QLD	Cotton	124	67	54
	Wheat	14	20	141
	Sorghum	33	5	16

(a) See ABARE (2001) pages 48-49 for an explanation and interpretation.

Table 5: Estimated weed control and yield loss costs by region, 2000-01

Region	**Crop**	**Control cost ($/ha)**	**Per cent yield loss due to weeds (%)**	**Dollar yield loss due to weeds (a) ($/ha)**	**Total cost of weeds ($/ha)**
Northern NSW	Cotton	220	8.3	139	359
	Sorghum	59	10.2	59	118
	Wheat	35	4.8	20	55
Southern QLD	Cotton	220	5.3	81	301
	Barley	7	1.0	4	11
	Chickpea	35	2.8	17	52
	Maize	15	2.3	12	27
	Mung bean	132	3.6	21	153
	Sorghum	58	4.3	17	74
	Sunflowers	53	4.8	25	78
	Wheat	13	2.4	10	23
Central QLD	Cotton	124	5.9	44	168
	Sorghum	33	6.4	20	53
	Sunflowers	15	10.5	26	41
	Wheat	14	6.9	19	33

(a) Accounting for expected prices and yields.

Table 6: The cost of different farming practices used for weed management in summer and winter fallows

Region	Farming Practices	Cultivation Cost (for fallow weed control) $/Ha	Chemical only (Herbicide) $/Ha	Av Spray Application Cost $/Ha	Total spray cost $/Ha (Chem+ Applica)	Total Fallow Weed control cost $/Ha
Nthn NSW	Average Summer Fallow	5.88	25.64	4.10	29.74	35.62
Sthn QLD	Average Summer Fallow	5.60	27.08	4.15	31.23	36.83
Central QLD	Average Summer Fallow	6.51	19.84	2.91	22.75	29.26
Nthn NSW	Average Winter Fallow	6.66	26.61	3.89	30.50	37.16
Sthn QLD	Average Winter Fallow	5.90	22.47	3.86	26.33	32.23
Central QLD	Average Winter Fallow	7.50	17.60	3.41	21.01	28.51
	Average	**5.98**	**24.51**	**3.91**	**28.42**	**34.40**

Table 7: Reduction in economic surplus due to weeds, by crop and Region

Crop	Region	Change in surplus		
		Consumer $ million	Producer $ million	Total $ million
Dryland cotton	Nthn NSW	0	-19.3	-19.3
	Sthn QLD	0	-13.5	-13.5
	Central QLD	0	-8.1	-8.1

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