CONVERSION FROM CONVENTIONAL TO ORGANIC AGRICULTURE

by

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1. Introduction

Before the advance of synthetic fertilisers and pesticides all farming was 'organic'[3]. That is, soil fertility and pest problems (here taken to include weeds, insects, and diseases) were dealt with through crop rotations, retention of organic matter on the farm, cultivation, manipulation of the planting date, and other techniques. Over the years the inclusion of synthetic fertilisers (since the late 19th century) and pesticides (since World War II) has changed the agricultural management system such that the farmer can cope with soil fertility and pest problem while the previous techniques decreased in importance. These developments increased the productivity of, for example, land and labour considerably.

Although most farmers changed to this technology (and are called 'conventional farmers' in this paper) some did not, and yet others changed back to the earlier technology at a later stage. For a while these farmers were considered by many as having little to contribute to 'real farming'.

However, in recent years it has become clearer, possibly even more overseas than in Australia, that organic farming has something to offer the farming community and also the society as

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2 The author thanks the farmers who provided most of the data, Mark Stanley from the South Australian Department of Agriculture in Keith for the data on conventional farming, David Vanzetti for comments on the paper, and the Rural Industries Research and Development Corporation for funding.

3 For a definition of organic agriculture, which is also referred to under different names such as sustainable, biological and ecological agriculture see Wynen and Fritz (1987, p.2).

a whole. The possibility of similar net private returns to organic farming as to conventional farming, together with less negative externalities from organic farming have made the community aware that organic agriculture is at least worthy of consideration.

Net private returns to conventional and organic farming have been the subject of a number of studies in the past, with Klepper et al. (1977) being one of the first and most well-known. Some of these studies show that the net returns are higher, some similar and some lower in conventional agriculture (for a review of studies see Lampkin 1984, and Wynen and Fritz 1987, pp.106-131). It seems fair to say that the private returns of conventional and organic farming could well be similar.

Negative externalities associated with conventional farming are in the form of soil erosion, deterioration in water quality and in human health. Organic farming is likely to ameliorate these effects (see Wynen and Edwards (1990)).

If net private returns to farming (a main measure on which many farmers base their decision) can indeed be similar between the two systems the question arises why it is that so few farmers have taken up this option (less than one per cent in most countries in 1989, although the figures have risen considerably over the last few years, see Wynen 1991). There might be a number of reasons for this lack of adoption of organic farming, of which problems in the transition period from conventional to organic farming might be a main one.

The objective of this paper is to assess likely effects of a transition from conventional to organic farming on net returns. The reasons for such a study is that the identification of barriers to entry into this form of agricultural production may facilitate the quest for solutions. If, as is often claimed, a movement of producers into organic agriculture is one way of reducing some of the negative externalities which are a feature of conventional agriculture, then identifying the problems may well be a first step on the road to a socially more efficient form of agriculture.

Apart from problems in the transition period, other reasons for farmers' apparent reluctance to move towards organic farming include the lack of information about how to adopt and manage an organic farming system; the negative image of organic farming and the social stigma attached to it, which can lead to social isolation; and existing misconceptions amongst conventional farmers about organic agriculture (for more details about these issues amongst cereal\livestock farmers in Australia, see Wynen 1989a, pp.73-75 and pp.59-65). A move towards organic farming would therefore cause the non-pecuniary benefits and the expected pecuniary benefits to drop, while benefits of being organic accrue mainly to the society as a whole (see Wynen and Edwards (1990)). Apart from information, these issues are not discussed further in this paper.

It has been reported overseas (see, for example Lampkin 1990) that the transition period from conventional to organic agriculture presents problems for farmers in so far that returns to farming can be low during this period, both relative to conventional and to an established organic system. This drop is usually attributed to three factors. One, it can take some time for the soil microbiological organisms (which, for example, helps in the breakdown of straw, and predates on pests) to establish an equilibrium, so that the system works effectively. Two, the farm manager needs time to learn about the practicalities of the new system, especially in a time when little information is available from official sources. And three, while production is likely to drop for these two reasons, price premiums during this time are unlikely, due to the certification system which prohibits the label 'organic' for products grown under organic management for less than (usually at least) two years.

In addition, transition to organic farming requires a change in input use. Apart from the more obvious such as fertilisers and pesticides (which are replaced by a change in technologies involving changes in rotations and livestock use), additional capital inputs (such as fencing, machinery and storage space) might be required.

The format of the paper is as follows. The methodology is described in Section 2, and the data sources in Section 3. The data provide a picture of input use (Section 4.2) and output (Section 4.3) during the transition period. These data are then used in Section 5 to simulate a representative farm to demonstrate the potential costs of a transition from conventional to organic farming. A summary and concluding comments, including policy implications, complete the paper (Section 6).

2. Methodology

To assess the likely impact of changes in farming system on farm returns during the transition from conventional to organic farming a simulation model was developed. A number of variables such as cash costs, cash receipts, farm cash operating surplus and returns to capital and management for the first years of transition are examined, and compared with figures for a conventional farm and an established organic farm. A sensitivity analysis is carried out for changes in output prices (for both organic and conventional products), and for yield.

In the model estimates of different variables are used which reflect conditions of a conventional farm, an established organic system, and a farm in transition from the conventional to the organic system. The figures for the transition period are estimates of the effect of the new management system on the input costs, yield and total output. The basis of these estimates is explained in general terms in Section 4 and in detail in Section 5.1. The results are discussed in Section 5.2.

3. Sources of data

Data for the conventional cereal\livestock sector were supplied by the Department of Agriculture of South Australia.

Information about organic farming was gathered in two research project, both about the cereal\livestock industry in Australia.

The first project involved interviews with organic cereal\livestock farmers in South-eastern Australia in 1986 and 1987 for the cropping season 1985-86, the analysis of which was published in Wynen (1989a). The survey was carried out on eight organic cereal\livestock farms and five semi-organic (farms which were run as an organic system, but would not have qualified fully under most organic standards). Figures used in this paper pertain mainly to the eight fully-organic farmers.

The second project is research into the conversion process itself[4]. For this research seven organic cereal\livestock farmers were interviewed in 1991 about their present practices and about the conversion period. The different years of conversion were: 1963, 1970, 1973, 1985, 1987, and two in 1990. All but one were dryland farmers, with one from Western Australia and the rest from NSW, Victoria and South Australia. The data from this survey will be published in Wynen (1992).

The data which were used most extensively pertained to three farmers in the Tatiara district in South Australia. One of those three, a conventional farmer, was interviewed for the years 1985-86 and 1986-87. The organic farmer was interviewed for the same years and for 1990-91. The third farmer, interviewed for 1990-91, is in the process of transition from conventional to 'low-input' farming (he stopped using synthetic fertilisers and pesticides on part of his land for the first time in 1990-91, with a number of other changes in the management practice). The figures

[4] This research is carried out with funding from the Rural Industries Research and Development Corporation.

collected from these farmers were then compared with the figures from the Department of Agriculture, and with the averages from the 1986 survey. Where there is a good (local) reason to diverge from the picture sketched by those figures, they are adjusted for the purpose of this model (for example, the farmers and the Department of Agriculture officer agreed that the yields for the area in which the farms are located are higher than the average for the area for which the gross margin data were compiled). Otherwise, the general picture has been adhered to.

4. Moving towards organic farming

4.1 Introduction

Moving towards organic agriculture from a conventional system means moving away from the inputs and techniques used in conventional and towards those used in organic agriculture. Where the conventional farmer uses synthetic fertilisers and pesticides to cope with soil fertility and pests, organic farmers use a combination of other inputs and techniques. These can include the use of mineral fertilisers (which can be in dust instead of in granular form, with consequences for the method of application and consequently the machinery required), manipulation of rotations and crops, and the use of livestock. It also often implies a change in seed-bed preparation, a change in rotations (with less cash crops and more green manure and/or leguminous crops), and smaller paddocks (to facilitate weed control by grazing). These differences have consequences for input use and output levels (Sections 4.2 and 4.3).

4.2 Inputs

Input costs per hectare cropped and operated on organic and conventional farms for some inputs are recorded in Table 1.

Table 1: Expenditure on main inputs on organic and conventional farms in South-eastern Australia (1985-86) ($ per hectare)

Input	Type of farmer		Difference	
	Org.	Conv.	Org.-Conv.	p-value
Per hectare cropped:				
Fertilisers	8.8	26.9	-18.1	0.038 **
Pesticides	1.1	18.1	-17.0	0.007 ***
Fuel	35.4	33.1	2.3	0.800
Mach. & Eq.	89.0	100.7	-11.7	0.624
Per hectare operated:				
Fertilisers	3.0	19.1	-16.1	0.018 **
Pesticides	0.4	14.1	-13.7	0.007 ***
Fuel	11.5	21.4	-9.9	0.030 **
Mach. & Eq.	31.3	73.8	-42.5	0.080 *
Labour	34.9	40.9	-6.0	0.363

Levels of significance of paired Wilcoxon tests
* = 90 per cent confidence level
** = 95 per cent confidence level
*** = 99 per cent confidence level
Figures, apart from the p-values, are group means for the eight organic farmers and their conventional farmer neighbours.

Not surprisingly, fertilisers and pesticides per hectare cropped were used less on organic than on conventional farms. More surprising is that the depreciation of machinery and equipment per hectare cropped was not lower on conventional farms. As organic farmers crop a lower percentage of the arable land than conventional farmers (47 per cent as compared to 77 per cent), a lower depreciation cost per hectare cropped on conventional farms could have been expected due to economies of scale. In addition, timely seed bed preparations are more important on organic than conventional farms, because on conventional farms weedicides can be used, which could well lead to higher capital expenditure and consequently higher depreciation costs on organic farms. However, an increased risk factor concerning timely planting and harvesting of the bigger areas on conventional farms might explain a major part of the large depreciation costs on conventional farms as compared to the organic farms.

On a per hectare operated basis, all inputs used mainly or solely for cropping were, of course, used less on organic than on conventional farms. Labour, consisting of both hired and family labour, and included only on a per hectare operated basis, was used to a similar extent on both types of farms.

The picture described in Table 1 is representative of eight farmers who had been farming organically for 20 years on average, and who were long past the period of transition. However, machinery needed in the transition period might well be different. When moving towards organic agriculture, a first step is often to stop burning the stubble, in order to retain the organic matter. This can cause major problems with crop planting the following year. Some farmers interviewed in 1986 mentioned that, in the first seasons after transition, the build-up of trash (organic matter) in cultivation equipment was a real problem, causing blockages of machinery and bad germination rates of seed. Some reported home-devised adjustments of machinery to cope with this problem (machinery suitable for the purpose was less easy to buy in the past than it is at present). The disappearance of the problem after a few seasons, presumably due to the build-up of organisms in the soil which break down organic material, was also commented upon.

In order to assess this need in the transition period, in the 1986 survey the question was asked: 'Was any special machinery or equipment needed after the change from conventional to sustainable [organic] farming?' Six of the 11 farmers who had made the change were of the opinion that special machinery was needed (mainly tillage equipment (which included equipment which could cope with trash), and equipment used for seedbed preparation). The answers did not necessarily imply that it was also acquired. All organic farmers interviewed in 1991 mentioned that a trash seeder, which they did not previously have, became essential or desirable at the time of transition. A different plough, like the 'agrowplow' (a tined implement which aerates the soil), was also mentioned several times as desirable for seedbed preparation.

At present, many conventional farmers are also moving away from burning their stubble, and retaining the straw. Those farmers will also need more suitable equipment. However, for the purpose of this paper it has been assumed that adjustments to the combine seeder were only required on the organic farm.

Weed problems are handled mainly by mechanical cultivation, and by strategic use of livestock. The difference in plough was mentioned above. The different use in livestock led several farmers remark on the need for smaller paddocks. Fencing would mean an extra cost in the transition period.

There is another input which is less tangible than those mentioned above: information. Lack of this input, about which most organic farmers complain, can result in costs in different ways. One of those ways is in errors in the management of the farm, which cause foregone income (see Section 4.3). Another way is in having to spend time in collecting data.

In the 1986 survey, farmers answered the question concerning from where they received information on the organic farming system as indicated in Table 2.

Nine of the 11 farmers in the 1986 survey indicated that, in the initial stage of transition, most of the information was gained from books. Four indicated that they found their way by trial and error, which sometimes involved having small experimental plots of different crops or different treatments on their farm. Farm newspapers were generally of overseas origin, as local newspapers were not specifically directed towards organic agriculture. 'Other farmers' and consultants (of importance only in one State) were relatively unimportant as a source of information in the initial stages. Their degree of importance, however, changes over time. 'Other farmers' become more important as a source of information over the years, while consultants become less so.

Table 2: Information sources for organic agriculture at conversion stage and at time of interview

	Conversion		At interview	
	A %	B %	A %	B %
Books	33	34	26	29
Trial and error (self)	15	18	23	24
Farm newspapers	11	9	14	12
Other farmers	7	7	17	15
Consultants	7	8	3	3
Depart. of Agric.	4	3	3	3
Conferences/ seminars / field days	4	1	6	4
Other	19	19	11	11
	Number of answers			
TOTAL	27	108	35	136

A = Number of answers for a particular reason divided by total number of answers
B = Total of answers times values as indicated by farmers divided by the sum of all values

The Department of Agriculture, conferences, seminars and field days, although mentioned, were not prominent on the list either for number of times consulted, or for the importance attached to the contact.

'Other' included religious literature, and in one case the farmer's father, who could be considered the developer of bio-dynamic agriculture in Australia.

The conventional farmer neighbours of the organic farmers were also asked where they acquired their information about farming. All but one mentioned the Department of Agriculture as a source, 12 mentioned rural papers and magazines, nine mentioned conversations with 'other farmers', and eight attending field days. Stock agents and input representatives were mentioned by eight, and farm consultants by two. Only one farmer mentioned that he did some trials himself. No conventional farmer mentioned books as a source of information, a source of considerable importance to organic farmers.

This indicates that for conventional farmers information on farming was much easier to obtain than for organic farmers.

In summary, the cost of lack of information for organic farmers, as compared to conventional farmers, is likely to be mainly in foregone output due to a lack of local sources of information. This means that the farmer will have to learn about organic farming while practising it. If that assumption is correct a large part of the costs are captured in variables which influence the farm returns, such as yield and rotation practices. In that way much of the cost of lack of information is captured in this model indirectly.

4.3 Output

4.3.1 Yield

As far as reductions in yield are concerned, it is not clear if and by how much this occurs in Australia. It seems clear that the biggest drops occur in intensive production systems, where the change to the new system is a greater upheaval than in extensive systems. Compared to Europe (where many studies have been carried out), most Australian production systems are extensive enterprises. The question therefore arises whether Australian farmers would also experience this drop, and if so to what degree this is the case.

Another question is for how many years the effect is likely to last. Indeed, it is possible that the time period in which this effect manifests itself is dependent on a combination of factors such as (apart from the degree of intensity which is reflected in past fertiliser and pesticide applications and crop rotations) type of enterprise and climatic conditions. Of course, these factors might be more or less interrelated.

In Australia not much data are available on this topic. The 1986-87 survey revealed that most farmers did not have sufficient historical data on which to base a thorough analysis. A question was therefore included which asked the farmers' opinion about yield behaviour in the transition phase. It was hoped that answers to this question would clarify the situation somewhat for Australian conditions on cereal\livestock farms.

Of the ten producers who had changed from conventional to organic agriculture, four did not think the change made any difference to their yields in the initial years of transition, three thought yields had decreased, and three that they had increased. The three who had observed decreases were organic farmers, while two of the three farmers who reported increases in yields in the initial stages were semi-organic farmers. One of these reported a heavy past fertiliser use, and beneficial effects of decreasing the application rate, which lasted approximately five years. The other reported immediate beneficial effect of the use of different machinery, while yields dropped in subsequent years. The third (organic) farmer who reported increased yields in the initial stages mentioned that there had been a decrease before the transition. It took 14 years for the yields to arrive at level which the farmer considered the true potential of the system.

Of the three who reported decreases, one said that his yields had not reached its potential at the time of the interview, some 16 years later, while the other two mentioned an average of 12 years (10 and 14 years) for the yields to reach that stage.

4.3.2 Rotations

Differences in rotations between the two management systems can be captured by a number of variables, such as the proportion of arable area which is cropped and the numbers of crops included in the rotation.

In the 1986 survey the difference in area cropped between organic and conventional farming showed to be highly significant (99.3 per cent level of confidence), with the eight organic farmers cropping 47 per cent of their arable area, and their conventional neighbour counterparts on average 77 per cent.

No difference in number of crops could be established in the 1986 survey between the two farming systems.

Although the rotation system is a major tool for organic farmers in their struggle against weeds, pests and diseases, the system is not a static one. That is, in the early years of transition the rotation system might well be different from the system in later years. This is because the nature of the problems change over time. While in the first years the farmer might have difficulties coming to grips with how to manage the weeds, in later years the optimal sequence of cropping and stocking might be much clearer from that point of view. In the design of the rotation systems this needs to be taken into account. For example, if some crops (such as barley) are considered to be able to cope well with weeds (due to the fact that they grow fast in the initial stages, and that they can be sown late, which allows most weeds to germinate before planting) they might be used extensively in the rotation in the early transition stage. Over time, the problem area becomes clearer, and therefore the management easier, and a different rotation system can be practised.

4.4 Marketing arrangements

4.4.1 Licensing

In order to be able to sell the produce as organic a farm needs to be certified by one of the three Australian certification organisations. Fees depend on the organisation, and range from approximately $400 to $700 for the initial inspection, and 0.5 to 1 per cent of the gross returns of the area certified, whether the produce is sold as organic or not. This last amount is called the 'licensing fee'.

In general, a farm can not be certified until it has been under organic management for at least two years. Individual paddocks can be certified at present, although this is a practice which is preferred to be phased out by the international body which evaluates organic licensing organisations (the International Federation for Organic Agricultural Movements). This means that, if a farmer can show competence in organic farming, a paddock can be certified as organic after a pasture phase, if this has occurred for at least two years. This has implications for the availability of price premiums for such a crop (see below).

4.4.2 Market

The market for organic produce is not well-established at present. Having special quality products with no established markets might mean that, in order to be able to take advantage of existing premiums, the product might need to be stored on the farm for some time. On-farm storage facilities (which allows pest management without the use of synthetic pesticides) might than be essential. This may involve a significant capital cost.

4.5 Summary

Farmers stress the need for some machinery and equipment in the transition period, in particular a trash-seeder, possibly tined seed-bed preparation equipment, fencing and on-farm storage.

Most of the organic farmers (seven out of ten) did not report a decrease in yields at the time of conversion. Two of the five farms for which several years of yield data are available reported a decrease, a picture which tends to be confirmed by the data gathered from those farms (see Wynen 1989b). Although the answers were too diverse to enable firm conclusions, it would probably be wise for potential organic cereal farmers in South-eastern Australia to take into account some decrease in yields when planning to convert towards organic agriculture. This has been incorporated in the simulation model.

Rotations in general on organic farms include less cash crops than on conventional farms. This is taken into account in the simulation in the next Section.

5. A simulation

5.1 Assumptions

The model assumptions are as follows:

- Land:
  The conventional and organic farm are each 400 hectares of all arable land.

- Capital:
  The land is valued at $350,000 and a total capital of $480,000 (machinery $110,000 and livestock $20,000).
  In the 1986 survey Wynen found that the machinery value of organic farmers was, on average, considerably lower than for conventional farmers ($31 and $74 for depreciation per hectare operated on organic and conventional farms, respectively), which was partly caused by smaller-sized machinery. Reasons given for this difference included a smaller penalty (risk) for organic farmers if the crop could not be sown or harvested in time, as less land was in certain crops. However, on average these farmers had been farming organically for 20 years, and their machinery can have been expected to have reflected their management system. Machinery of farmers who will convert to organic agriculture in the future is more likely to be similar to that of their conventional farmer neighbours. For this reason similar values have been assumed both for the conventional and the organic farmers in the model.
  The value for livestock was increased with $2000 for each additional 33 hectare under grazing.

- Fertiliser and pesticides:
  Rates of fertilisers and pesticides are included as reported by the Department of Agriculture, and by the three farmers in Tatiara. For details of type and rate of fertilisers used see Table 3.

Table 3: Fertiliser types and rates used in the different agricultural production systems (kgs per ha) and prices paid ($/tonne)

Crop	Conventional			Organic
	Super	Urea	DAP	Mineral fert.
Wheat	110	50		100
Barley	90			100
Oats:				
- grain	-			100
- hay				100
Beans	180			-
Peas	100			-
Canola		40	100	-
Chickpeas				100
Price	195	322	415	210

Cost of fertiliser and pesticides per hectare are shown in Table 4.

- Cost of fuel:
  Fuel on the conventional farm are estimated as reported by the Department of Agriculture. Similar costs are included for both systems based on Wynen (1989a, pp.24-25). Costs are approximately $22 per hectare cropped, which includes repairs.

- Machinery and equipment:
  The total value of machinery and equipment, with the associated depreciation cost, is estimated to be similar for conventional and organic farming (see above). However, in the transition years organic farmers need some special

Table 4: Cost of fertilisers and pesticides in different farming systems ($/ha)

Crop	Fertiliser		Pesticide
	Conv.	Org.	Conv.
Wheat	38	21	18
Barley	18	21	20
Oats:			
- grain		21	
- hay		21	
Beans	35		42
Peas	20		47
Canola	54		53
Chickpeas		21	

equipment. For the purpose of this model it is assumed that:

- in the first year of transition the farmer stops burning straw, and adapts the combine seeder to be able to cope with the trash ($[illegible] 000). The depreciation rate is 15 per cent.
- the fertiliser is bought in granulated form, which increases the price by $20 per tonne, but does not require different equipment

- Storage:
  After 3 years the farmer builds storage capacity of 100 tonnes in 50 tonne lots. At a value of $3000 each, this amounts to $6,000. In the sixth year of transition another 100 tonne storage is built for $6000. The depriciation rate is taken as 3.75 per cent.

- **Labour:**
  Similar costs for both systems are assumed (see Wynen 1989a, pp.29-30). All labour, apart from shearing, has been estimated as family labour at 70 weeks work per year.

- **Fencing**
  In the first four years the farmer fenced one kilometer per year to decrease the size of the paddocks. The cost is estimated at $2,000 per kilometer. The depreciation rate is 4.5 per cent.

- **Interest:**
  None, apart from an estimate of interest on extra investments made by organic farmers in transition. This includes:
  - Year 1:
    - $ 4,000: adjustment on seed co[illegible]e
    - $ 2,000: fencing costs (incurred for four years)
  - Year 4:
    - $6,000: increased crop storage (100 tonnes)
  - Year 6:
    - $6,000: increased crop storage (100 tonnes)

  The interest rate employed is 10 per cent.

- **Yield:**
  For wheat yields Wynen(1989a, p.44) could not establish a statistical difference between conventional and organic farming. However, for other crops no data were analysed. Yields used in the model are based on figures from the Department of Agriculture, on the actual yield figures of the farmers involved, and on the farmers' estimates of the effect of conversion on yields. They are shown in Table 5.

Table 5: Yields (kgs/ha) and output prices ($/tonne) in the different farming systems (1990-91)

Crop	Yield			Output price	
	Conv.	Organic		Conv.	Org.
		Static	Trans.		
Wheat	3.0	3.0	2.5	84.0	121.0
Barley	3.5	3.0	2.5	85.0	125.0
Oats:grain	3.0	2.5	2.2	80.0	125.0
Oats: hay	4.0	3.5	3.5	85.0	
Peas	2.0			195.0	
Beans	2.5			190.0	
Canola	1.4			280.0	
Chickpeas	2.1	1.8	1.5	280.0	

- Rotation:

  The rotation on the conventional farm was chosen on the basis of conversations with the farmer in transition, and with the Department of Agriculture and is as follows:

  peas - canola - wheat - beans - wheat - barley - peas - wheat - barley - pasture - pasture - pasture

  The final rotation on the organic farm after transition is:

  oats (hay) - barley - chickpeas - oats(hay) - wheat - oats(grain) - pasture - pasture - pasture

  The rotation in the transition period is such that several conditions are met. They include:

  - only part of the farm is converted each year. The organic system is started after the pasture phase. This means that crops are rotated as under the conventional system until after three years of

TABLE 6:
ROTATIONS ON A FARM UNDER TRANSITION

Year 1		2		3		4		5		6		7		8		9		10		11		1
Crop	Ha	Crop	Ha	Crop	Ha	Crop	Ha	Crop	Ha	Crop	Ha	Crop	Ha	Crop	Ha	Crop	Ha	Crop	Ha			
oo(hay	33	obarley	33	ochick	33	oo(hay)	33	owheat	33	o(grain	33	opast	33	opast	33	opast	33	ooo(hay	44	oobarle	44	oochi
canola	33	wheat	33	beans	33	wheat	33	barley	33	past	33	past	33	past	33	oo(hay)	33	obarley	22	ochick	22	oo(ha
wheat	33	beans	[illegible]	wheat	33	barley	33	past	33	past	33	past	33	oo(hay)	33	obarley	33	ochick	44	oo(hay)	44	owhea
beans	33	wheat	[illegible]	barley	33	past	33	past	33	past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	22	owheat	22	oo(gr
wheat	33	past	33	past	33	past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	33	owheat	33	oo(grai	22	opast	22	opast
barley	33	past	33	past	33	past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	33	owheat	33	oo(grai	22	oopast	22	oopas
peas	33	wheat	33	barley	33	past	33	past	33	past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	22	owheat	22	o(gra
wheat	33	barley	33	past	33	past	33	past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	33	owheat	44	o(grain	44	opast
past	33	past	33	past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	33	owheat	33	opast	33	opast	44	opast	44	ooo(h
past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	33	owheat	33	opast	33	opast	33	ooo(hay	33	oobarle	22	oochick	22	ooo(h
past	33	past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	33	owheat	33	opast	33	opast	33	opast	44	ooo(hay	44	oobar
past	33	past	33	past	33	oo(hay)	33	obarley	33	ochick	33	oo(hay)	33	owheat	33	opast	33	opast	44	opast	44	opast
TotCro	267		234		234		233		267		267		267		267		267		265		265	2
TotPas	132		166		167		167		134		134		134		134		133		132		133	1
TOTAL	400	TOTAL	400		400		400		400		400		400		400		400		398			
Org.Cr	33		67		100		167		233		267		267		267		267		265		265	2
Conv.C	234		167		134		67		33		0											
CONVENTIONAL CROP																		2nd org. rotation				
canola	33									canola								ooo(hay	44		44	
beans	33		33		33					beans								ooo(gr)				
peas	33								0	peas								oochick			22	
barley	33		33		67		33		33	barley								oowheat				
wheat	100		100		33		33		0	wheat								oobarle	22		44	
TotCon	234		167		134		67		33	TotCon	0		0		0		0	TotOrg	66		110	
ORGANIC CROP																		1st org. rotation				
oo(hay	33		33		33		100		100	oo(hay)	100		133		100		100	oo(hay)	44		44	
oo(gr)					0		0		0	oo(gr)	33		0					oo(gr)	44		44	
ochick			0		33		33		33	ochick	33		67		33		67	ochick	44		22	
owheat							0		33	owheat	33		33		66		67	owheat	44		44	
obarley			33		33		33		66	obarley	67		33		67		33	obarley	22			
TotOrg	33		67		100		167		233	TotOrg	267		267		267		267	TotOrg	199		155	
TOTCROP	267		234		234		233		267	TOTCROP	267		267		267		267	TOTCROP	266		265	

oo(hay) = organic oats (hay)
owheat = organic wheat
obarley = organic barley
ochick = organic chickpeas
oo(grain) = organic oats (grain)
opast = organic pasture

TotCrop = Total Crop (ha)
TotPas = Total Pasture (ha)
Org.Cr = Organic Crop area (ha)
Conv.C = Conventional Crop area (ha)

An additional 'o' in front of crops indicates that the crop is in the 2nd organic rotation phase.

pasture. However, to speed up the transition (which, in some paddocks, would not take place until after 12 years), pasture is started at the point of, or after, the inclusion of the first year of barley in the conventional system (that is, in the fifth or sixth year of the conventional rotation)

- diversification of enterprises (for example, not less than 233 hectares is cropped annually)
- diversification of crops (for example, not all barley crops are planted in the same year)

The rotations for the first 12 years of transition are shown in Table 6.

- Livestock:

  It is assumed that returns from livestock per hectare grazed are similar for the two management systems, as described in Wynen (1989a, p.53). It is further assumed that, with a decrease in cropped area when moving towards organic agriculture, farmers have no problems in increasing their flock, thus maintaining their returns to the stocking enterprise per hectare grazed.

  The figures used are those for a self-replacement flock, and are $55.79 per hectare. They indicate returns minus costs and are included in the 'cash returns' of the results.

- Output prices are taken as for the year 1990-91 and are shown in Table 5.

  For the sensitivity analysis the following variations are modelled:

  - premium prices for organic cereals
  - increased returns for livestock ($100 per hectare)
  - increased prices for conventional crops (wheat, barley, oats
  - diminished decrease in yields in transition stage

5.2 Results

In Table 7 the results of the simulation of activities on a conventional and an organic farm, under assumptions as discussed in Section 5.1, are shown. The total cash receipts and the total cash costs are approximately $15,000 less on the organic farm, resulting in similar levels of farm cash operating surplus on the two different farms. As labour, depreciation and total capital employed on the farm were assumed to be alike, the returns to capital and management are also similar.

When a conventional farm like the one modelled here incorporates organic practices, resulting in a gradual moving toward an organic farming system, the private returns to farming are considerably decreased over the next years. The biggest decrease is in the second year of transition, shown in the bottom row of Table 7 ($15,658), when the total area under crop decreases to 233 hectare (as in the third and fourth year) before it gets back to 267 hectares, its final level. In later years the difference in returns as compared to the conventional system becomes less severe, but is still significant in year 12 ($6,321).

Up until year 10 the variation in farm returns is considerable. This can be explained partly by the fact that, when moving from a twelve-year (conventional) to a nine-year rotation (organic), while not varying the paddock size, each individual crop might be planted twice depending on the year (see Table 6). In years in which a high value crop such as chickpeas is included twice (for example in year 7), the returns will be higher than in a year when wheat or barley are included twice (for example in year 8). In practice, of course, as the farmer has already carried out fencing, smaller paddocks are available and the move towards one crop (or pasture) per 44 hectares (instead of per 33 or 66 hectares), would probably take place more gradually than in this model. It is therefore more realistic to take averages of two years in the model as an indicator of the trend of differences between the transition stage and conventional farming.

TABLE 7:
RETURNS TO FARMING UNDER CONVENTIONAL AND ORGANIC MANAGEMENT WITH CONVENTIONAL OUTPUT PRICES

	CONV.	ORGANIC FARMING Static	In transition Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year10	Year11	Year12
Total ha	400	400	400	400	400	400	400	400	400	400	400	400	400	400
Area cropped	300	266	267	233	233	233	267	267	267	267	267	265	265	265
Ha cropped (%	0.749	0.666	0.668	0.583	0.583	0.583	0.667	0.667	0.667	0.667	0.667	0.664	0.662	0.664
Capital value:														
Land (impr.)	350000	350000	352000	350000	350000	350000	350000	350000	350000	350000	350000	350000	350000	350000
Machinery	110000	110000	114000	114000	114000	120000	120000	126000	126000	126000	126000	126000	126000	126000
Livestock	20000	22000	22000	24000	24000	24000	22000	22000	22000	22000	22000	22000	22000	22000
Total capital	480000	482000	488000	488000	488000	494000	492000	498000	498000	498000	498000	498000	498000	498000
Receipts:														
Crop	99367	80186	86640	67943	75059	69143	74826	74859	81742	71909	78825	72329	74915	77024
Stock	5573	7431	7454	9317	9317	9317	7454	7454	7454	7454	7454	7387	7409	7387
TotCashRec.	104941	87618	94093	77260	84376	78460	82279	82313	89195	79363	86279	79715	82324	84411
Costs:														
Fertilisers	9228	5594	8719	5664	5691	5336	5484	5599	5599	5599	5599	5573	5557	5573
Pesticides	9445	0	7239	3920	3375	1289	678	0	0	0	0	0	0	0
Fuel	6635	5898	5988	5154	5125	5157	5888	5903	5903	5903	5903	5876	5858	5876
Interest			600	600	600	1200	1200	1800	1800	1800	1800	1800	1800	1800
Other	6572	3021	5150	3740	4001	2541	2807	3366	3348	2956	3521	3011	3001	3013
TotCashCosts	31880	14513	27697	19078	18792	15523	16057	16669	16651	16259	16824	16260	16216	16262
FCOS	73060	73105	66396	58182	65584	62937	66222	65644	72544	63104	69455	63456	66108	68149
Family labou	21910	21910	21910	21910	21910	21910	21910	21910	21910	21910	21910	21910	21910	21910
Depreciation	23622	23622	24312	24402	24717	24807	25032	25032	25032	25032	25032	25032	25032	25032
Ret.to cap.+m	27528	27573	20174	11870	18957	16220	19280	18702	25602	16162	22513	16514	19166	21207
RTCM/TotCap	0.057	0.057	0.041	0.024	0.039	0.033	0.039	0.038	0.051	0.032	0.045	0.033	0.038	0.043
Transit - conv.			-7354	-15658	-8572	-11308	-8248	-8826	-1926	-11366	-5015	-11015	-8362	-6321

In the model the change in paddock size (from 33 to 22 hectares) occurred in the tenth year, when the first paddock had completed one full rotation under organic management. This meant that two paddocks (44 hectares) represented each crop/pasture. The fact that the decrease is steady is due to equal acreages of the different crops in the different years. The relative increase in returns then is mainly due to the increase in yield, which happens progressively over the next years when more paddocks are in an organic crop for the second time, so that the yields of the steady-state ('static') of the organic system can be assumed (see Table 5).

The figures quoted above are estimates of returns to farming in a situation where no premiums are obtained for the organic produce, where relative output prices are as in 1990-91, and where yield reductions are as shown in Table 5. It is likely that one or a combination of these factors will be different in practice. Estimates of farm returns are made for situations where these variables are different from the assumptions in the first model (see Table 8).

If farmers receive a premium for their grains (wheat, barley, oats) the severity of the deficit as compared to the conventional farm is considerably less, especially in later years ($12,325 in year 2, the worst year). Also, decreased returns only occur in the first four years of transition, after which the organic farmer has higher returns than the conventional farmer. The deficits would be even more ameliorated if there is a market for organic chickpeas and hay, which is not incorporated in this model. In practice, farmers who just start out as organic farmers often do not have an established market for their (new) products and sell only part of their crops as organic. This would, of course, result in a picture somewhere between that calculated for premium prices and for conventional prices.

RETURNS TO CONVENTIONAL AND ORGANIC FARMING UNDER DIFFERENT ASSUMPTIONS

	CONV.	ORGANIC FARMING Static	In transition Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year10	Year11	Year12
CONVENTIONAL PRICES														
TotCashRec.	104941	87618	94093	77260	84376	78460	82279	82313	89195	79363	86279	79715	82324	84411
TotCashCosts	31880	14513	27697	19078	18792	15523	16057	16669	16651	16259	16824	16260	16216	16262
FCOS	73060	73105	66396	58182	65584	62937	66222	65644	72544	63104	69455	63456	66108	68149
Ret.to cap.+m	27528	27573	20174	11870	18957	16220	19280	18702	25602	16162	22513	16514	19166	21207
RTCM/TotCap	0.057	0.057	0.041	0.024	0.039	0.033	0.039	0.038	0.051	0.032	0.045	0.033	0.038	0.043
Transit - conv.			-7354	-15658	-8572	-11308	-8248	-8826	-1926	-11366	-5015	-11015	-8362	-6321
PREMIUM PRICES FOR ORGANIC GRAINS														
TotCashRec.	104941	102869	94093	80593	87709	81793	92028	95361	95611	92195	95778	93041	96030	98154
TotCashCosts	31880	14513	27697	19078	18792	15523	16057	16669	16651	16259	16824	16260	16216	16262
FCOS	73060	88356	66396	61515	68917	66270	75971	78693	78961	75936	78954	76781	79814	81892
Ret.to cap.+m	27528	42824	20174	15203	22290	19553	29029	31751	32019	28994	32012	29839	32872	34950
RTCM/TotCap	0.057	0.089	0.041	0.031	0.046	0.040	0.059	0.064	0.064	0.058	0.064	0.060	0.066	0.070
Transit - conv.			-7354	-12325	-5239	-7975	1501	4223	4490	1466	4484	2311	5344	7422
INCREASED LIVESTOCK PRICES														
TotCashRec.	109357	93506	100000	84643	91759	85843	88186	88219	95102	85269	92185	85569	88195	90264
TotCashCosts	31880	14513	27697	19078	18792	15523	16057	16669	16651	16259	16824	16260	16216	16262
FCOS	77477	78994	72303	65565	72967	70321	72128	71551	78451	69011	75362	69309	71979	74002
Ret.to cap.+m	31945	33462	26081	19253	26340	23604	25186	24609	31509	22069	28420	22367	25037	27060
RTCM/TotCap	0.067	0.069	0.053	0.039	0.054	0.048	0.051	0.049	0.063	0.044	0.057	0.045	0.050	0.054
Transit - conv.			-5864	-12691	-5605	-8341	-6758	-7336	-436	-9876	-3525	-9578	-6908	-4885
SIMILAR CEREAL YIELDS OF ORGANIC AND IN-TRANSITION FARM														
TotCashRec.	104941	87618	94093	78677	85793	79877	86512	87346	92012	84996	90495	83573	85228	87331
TotCashCosts	31880	14513	27697	19078	18792	15523	16057	16669	16651	16259	16824	16260	16216	16262
FCOS	73060	73105	66396	59599	67000	64354	70455	70677	75361	68737	73671	67313	69012	71070
Ret.to cap.+m	27528	27573	20174	13287	20373	17637	23513	23735	28419	21795	26729	20371	22070	24128
RTCM/TotCap	0.057	0.057	0.041	0.027	0.042	0.036	0.048	0.048	0.057	0.044	0.054	0.041	0.044	0.048
Transit - conv.			-7354	-14241	-7155	-9891	-4015	-3793	891	-5733	-799	-7158	-5458	-3401

Returns to livestock were low in 1990-91. For this reason a simulation was carried out with higher livestock prices ($100 per hectare grazed instead of $56). As can be expected, farmers in transition gain more than conventional farmers from such price changes, as they have more area in pasture. The result is a smaller difference between the two systems than under prices in 1990-91 ($12,325 at the peak in year 2, and generally approximately $1,500 less than under previously assumed prices).

Changes in some conventional crop prices ($120 for wheat, and $100 for barley and oats (grain and hay)) increase the difference between the conventional farmer and the organic farmer in transition by roughly $2,000 per year (not shown in the table). An increase of both livestock and crop prices by the above mentioned amounts results in a higher deficit between the two systems in half of the years and lower in the other half of the years (not shown in the table).

The question of lower yields in the rotation period under Australian conditions is debatable, as mentioned in Section 4.3.1. If yields in the transition time are not lower than in the steady-state organic system, farm returns decrease to a less extent than if yields are lower (see Table 8). This is especially the case in the middle years ($14,241 in year 2), when the organically cropped area is increasing (up til year 6), while no paddock is yet in the steady-state stage (after year 9).

If all conditions are favourable for organic farms as compared to conventional farms (that is, if premiums are received for organically grown crops, if livestock prices are high, and if yields are relatively high) there is still a considerable deficit for the organic farmer in the first two years of conversion ($5,864 and $7,275; not shown in the table). But this becomes a surplus in year 3, and from year 5 onward the surplus is between $10,000 and $20,000 per year.

In summary, a transition from conventional to organic agriculture can be costly in terms of net financial returns to cereal\livestock farmers. This is especially the case if no premiums are obtained by farmers, while stock prices are low (as in 1990-91) and yields are relatively low during the transition stage.

6. Summary and conclusions

There is little doubt that, when cereal\livestock farmers in Australia move from conventional to organic farming, the returns possible under conventional management are reduced. The question is by how far this reduction is likely to be.

The answer depends considerably on the assumptions which are made in connection with a number of variables, the main ones of which are the availability of premium prices for organic products, changes in conventional output prices, the level of yield reductions, changes in rotations and new investments needed.

In this paper a model was set up to imitate as closely as possible a typical conventional farm, together with an organic farm, in the Tatiara district in South Australia. Conditions were then changed such that a conversion towards organics was approximated according to the data available at present.

Such a simulation shows that, without the aid of premium prices, farmers' decrease in returns can be considerable (reaching a maximum of $15,000 in year 2 and decreasing over the years to $6,000 in year 12). With premiums for organic products, these decreases are considerably less, although the first four years are still negative (at a maximum of $12,000 in year 2). Increased livestock prices and similar cereal yields in the transition and the steady-state organic period decrease losses in the transition period, but not to the extent that premium prices do. Increased conventional product prices widen the gap between in-transition and conventional farming.

In practice it is likely that all of these factors occur to some degree: most farmers will be able to sell some of their crop on the organic market and secure a premium, the livestock prices might well increase in the near future and not every farmer will have yield decreases as severe as those used in this paper.

We can therefore be reasonably sure that the picture painted of farm returns under conventional prices is pessimistic. The most optimistic picture, in which the organic cereal crops are sold for a premium, prices of livestock and livestock products have almost doubled, and without transitional yield decreases, the (considerable) decrease in farm returns occurs only in the first few (two) years of conversion, while there is a large surplus from year 5. It is also not likely that this picture is realistic.

What are the implications of the above findings, either for an individual farmer or for policy in general?

For individual farmers it seems important that, before moves are made towards organic agriculture, a careful plan is made to estimate the returns to farming in those transition years. Although there might not be a lot of scope for flexibility in the actual rotation used, there are likely to be differences in total farm returns over the years depending on when in the conventional rotation the organic system is started, how much of the land is converted each year, and how much variability in the return is acceptable to the farmer.

As far as general policy is concerned, if the objective is to increase the adoption of organic farming (as it is in a number of European countries), one way to reach this aim is to support farmers in the transition years. The reason is that the financial loss in the first years of conversion can be substantial. Not all potential organic farmers would be able to survive those first years without aid or would be willing to suffer the loss. In Europe, such aid is extensively provided (see Wynen, 1991).

Before detailed conclusions are drawn from this model a word of warning about the validity and applicability of the model.

The model was not optimised. Although improvement of the model might well be possible, the scope for altering activities is somewhat limited by the greater importance placed on particular rotations in organic agriculture. Since rotations are an important tool to combat fertility and pest problems in organic farming, changes in crop mixes and sequences can have more negative consequences (increased weed problems, with subsequent yield reductions) than under conventional management (where fertility and pests can be combatted with fertilisers and pesticides). The improvement to the model is therefore likely to be more in the area of decreasing the variability of returns in the different years of transition.

The particular yields and rotations are peculiar to the particular enterprise and area discussed. Although the general principles (decrease in yield and total area cropped, and a change in rotations), and trends (decreased income in the early years of transition, improving over time) are likely to apply anywhere else, absolute figures should be treated with care.

The results pertain to conditions in 1990-91, especially for output prices. With changes in those conditions, the results in absolute terms might well be completely different. For example, in 1990-91 prices for canola and chickpeas were close to $300, while in 1991-92 these had dropped to between $220-$230. Prices of wheat were at a low in 1990-91 ($120-130) as compared to expected prices for 1991-92 ($150-160). Changes in prices can not but have an effect on the relative values in this model.

In spite of these limitations, use of the model has shown the trend and magnitude of the costs of transfer from conventional to organic cereal\livestock farming, and idenfified how these costs vary as various output prives and yield change.

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