

# On-farm grain storage in Australia

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*Centralised grain storage is an integral part of the overall grain marketing system in Australia. Historically it was associated with grain pooling which guaranteed farmers a partial payment for their grain on delivery to the pool with further payments once the pool had been finalised.*

*The grain distribution system was characterised by statutory monopolies established and protected from competition by Commonwealth and state legislation. A common feature of marketing the major grains was a single marketing body, such as the former Australian Wheat Board and the former Australian Barley Board, for both export and domestic markets. Grain transport was also regulated in all mainland states except for Victoria. In the regulated states, a formal agreement between the rail authority and the bulk handling authority directed grain traffic to rail instead of road.*

*Over the past decade there has been considerable easing of the regulations affecting the grain marketing and distribution system. The result has been a gradual deregulation, corporatisation and privatisation of the domestic marketing and handling arrangements, allowing farmers to sell directly to marketing agents and end users of grains. With the changes in the marketing system, a wider variety of grain payment and delivery options for farmers have been introduced. These new arrangements allow farmers more flexibility in how they dispose of their grain.*

*For many farmers, on-farm grain storage is likely to be an important contributor to greater marketing flexibility. The extent to which on-farm grain storage capacity changed during the 1990s can be seen from ABARE farm survey data.*

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## Australian grain storage, handling and marketing system

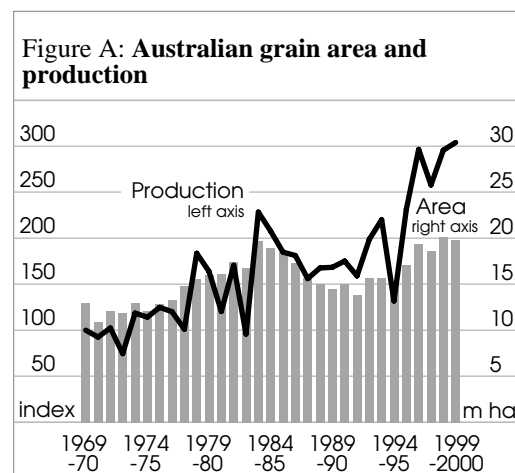
Historically the Australian grain storage, handling and marketing sectors comprised a state based system in which each link in the marketing chain was dominated by one operator. Commonwealth and state marketing and bulk handling legislation guaranteed the exclusive operation of a single bulk handling and storage company in each state. In addition vesting powers were granted to the former Australian Wheat Board, the former Australian Barley Board, the New South Wales Grains Board, the Queensland Barley Board, the Central Queensland Grain Sorghum Marketing Board, and the Grains Pool of Western Australia. Over the past decade, many state marketing boards have either merged to form new bodies, or have been disbanded.

Grain transport was dominated by rail authorities, reflecting legislative restrictions, while each port was controlled by a statutory public authority. Transport and port arrangements have also been largely deregulated in recent years.

### The current system

Bulk handling authorities have progressed from being either farmer or state owned cooperatives to farmer controlled public companies that are now able to trade in grains. This in turn has encouraged these entities to become vertically integrated in their operations. Grain handlers have introduced marketing options in their own right and have also formed strategic alliances with other handling and marketing organisations.

The large increase in grain production (figure A), combined with increased competition in grain handling and storage, has resulted in grain handlers providing larger and more technologically advanced storage facilities. Grain handlers have built new storage facilities, increased the size of others in strategic areas, relocated facilities from areas that were considered to be underutilised or inefficient, and sold others. These changes are aimed at reducing delivery and receival times, improving grain quality, reducing cost and increasing segregations and therefore boosting marketing options.



### Effect of deregulation of domestic grain markets

Deregulation of the domestic market has had different effects on grain farmers according to location. In the eastern states where intensive livestock industries are concentrated, grain farmers now market more grain direct to the end user. It is estimated that around

40–50 per cent of grain in New South Wales is consumed domestically and therefore producers are able to bypass grain pools.

The dramatic changes in the landscape of domestic grain marketing that followed deregulation have resulted in a broad range of options for farmers to market their grain within Australia. These include:

- cash sales;
- fixed or multigrade futures contracts;
- participation in a number of pools; and/or
- contracts with end users including millers, malsters, feed manufacturers and livestock feeders.

In mid-2000 AWB Ltd announced a new pricing/payment scheme that further expands the options available to wheat farmers. The new scheme avoids the large penalties that applied when wheat fell marginally short of predetermined quality standards. The new system phases in the grade standards for protein and screenings.

## Farm survey results

The result of the changes outlined above is a more efficient and cost effective system that provides farmers with greater marketing opportunities. Changes such as these were expected to result in farmers increasing on-farm storage capacity to take maximum advantage of the new options to manage their risk. However, to date, it appears that increases in on-farm storage capacity have been limited.

The attributes of current on-farm storage facilities and the changes that have occurred over the past decade were the focus of recent analysis of ABARE farm survey data. To facilitate the analysis, grain growers were asked a range of storage related questions as part of ABARE's 1998-99 Australian agricultural and grazing industries survey. These included:

- capacity and type of permanent on-farm storage;
- age and construction of storages;
- whether storages are gastight for fumigation;
- whether storages are fitted for fan aeration and reasons for aeration;
- why permanent grain storage is used;
- whether crops have been stored in permanent on-farm storage for at least a month;

- what insect control measures were used to treat stored grain;
- what treatment/retreatment measures were used on grain subsequently found to be infested by insects; and
- whether the farmer had plans to alter permanent on-farm grain storage capacity, the type of storage likely to be installed and the reasons why capacity would be altered.

## Extent of on-farm grain storage

On the basis of the survey, Australia's permanent on-farm grain storage on broadacre farms in 1998-99 was estimated to have been almost 13.4 million tonnes (table 1). This was equivalent to around 38 per cent of Australia's average annual grains production (excluding rice and cottonseed) of 35.5 million tonnes over the three years to 1998-99.

Based on the survey, it is estimated that around 64 per cent of broadacre farms in Australia had some form of permanent on-farm grain storage facilities in 1998-99, with an average storage capacity on these farms of 296 tonnes per farm. Approximately half of this storage capacity was on farms in New South Wales, 18 per cent on Victorian farms and 13 per cent on farms in Western Australia. Average storage capacity on farms is highest (394 tonnes) in New South Wales, the state with the largest domestic use of grain (table 1).

In regions where farmers can grow both winter and summer crops, storages can be used more than once within a given year provided storage for the first crop is not prolonged. As shown in map 1, farms with the largest storage capacity are in the grains belt in northern New South Wales and Queensland, regions where both winter and summer crops are grown.

Another concentration of farms with quite large storage capacity per farm is on the eastern fringes of the grain belt in Western Australia, where farm size is quite large and farms can be some distance away from centralised bulk handling facilities.

Table 1: Permanent on-farm grain storage capacity, 1998-99

|                   | Farms with permanent storage |                 |                         |                  | Proportion gas sealable | Proportion with aeration facilities |
|-------------------|------------------------------|-----------------|-------------------------|------------------|-------------------------|-------------------------------------|
|                   | Permanent capacity           | Population size | Proportion of all farms | Average capacity |                         |                                     |
|                   | kt                           | no.             | %                       | t/farm           | %                       | %                                   |
| Australia         | 13 376 (11)                  | 45 236          | 64                      | 296              | 17 (21)                 | 11 (41)                             |
| New South Wales   | 6 809 (21)                   | 17 289          | 71                      | 394              | 18 (38)                 | 12 (57)                             |
| Victoria          | 2 357 (8)                    | 10 343          | 67                      | 228              | 9 (29)                  | 5 (49)                              |
| Queensland        | 1 376 (22)                   | 4 888           | 41                      | 282              | 5 (44)                  | 40 (51)                             |
| Western Australia | 1 791 (9)                    | 6 955           | 74                      | 258              | 38 (11)                 | 1 (65)                              |
| South Australia   | 1 010 (11)                   | 5 456           | 62                      | 185              | 11 (28)                 | 0 (0)                               |

Note: Figures in parentheses are relative standard errors, expressed as percentages of the estimates.

## Age and type of storage facilities

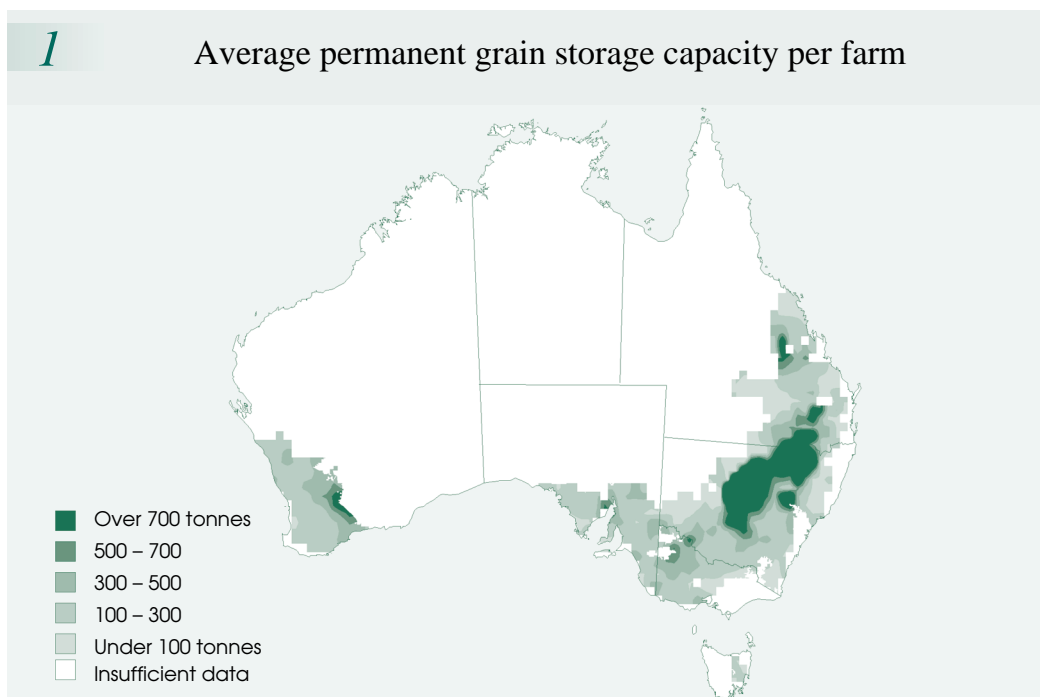
Farmers were asked about the age and construction materials used in their grain storage facilities. These data were then compared with 1990-91 data to see what changes may have taken place as the regulation of domestic grain markets eased during the 1990s.

The average age of storage facilities in 1998-99 was estimated to be seventeen years, with nearly 40 per cent of the total capacity up to ten years old (table 2). Around 30 per cent of total storage capacity was estimated to be over twenty years old.

Metal silos are the most common type of storage, with bolted metal silos comprising 50 per cent of current storage capacity and welded steel silos adding a further 13 per cent of storage capacity (table 2). Half of the storages erected in the past ten years were metal silos.

Long term grain storage requires effective protection from insect infestation if stored grains are to retain their quality and value. Fumigation of grain is generally regarded as the cheapest and most effective method of insect control. This method of control requires that the storage facility be made air tight, or gas sealable. However, of the 13.4 million tonnes of storage capacity in 1998-99, only 2.3 million tonnes or 17 per cent was estimated to be sealable (table 1).

The quality of grain stored over an extended period is likely to be maintained if the grain is stored at a relatively cool temperature and low moisture content. Typically grains in Australia are harvested under hot conditions and the moisture content of grain just harvested



**Table 2: Permanent on-farm grain storage capacity, by age of facility, 1998-99**

|                            | Less than five<br>years old | Five to ten<br>years old | Ten to<br>twenty<br>years old | More than<br>twenty<br>years old | Average age | Total storage<br>capacity |
|----------------------------|-----------------------------|--------------------------|-------------------------------|----------------------------------|-------------|---------------------------|
|                            | kt                          | kt                       | kt                            | kt                               | yr          | kt                        |
| Australia                  | 3 664 (34)                  | 1 439 (18)               | 4 157 (8)                     | 4 116 (13)                       | 17 (3)      | 13 376 (11)               |
| New South Wales            | 2 431 (50)                  | 441 (39)                 | 1 691 (16)                    | 2 244 (23)                       | 19 (5)      | 6 809 (21)                |
| Victoria                   | 413 (26)                    | 328 (21)                 | 963 (14)                      | 654 (13)                         | 16 (9)      | 2 357 (8)                 |
| Queensland                 | 203 (40)                    | 139 (122)                | 506 (23)                      | 527 (30)                         | 17 (5)      | 1 376 (22)                |
| Western Australia          | 372 (30)                    | 419 (18)                 | 595 (14)                      | 405 (20)                         | 15 (7)      | 1 791 (9)                 |
| South Australia            | 236 (35)                    | 103 (35)                 | 393 (15)                      | 277 (14)                         | 17 (5)      | 1 010 (11)                |
| <b>Type of storage</b>     |                             |                          |                               |                                  |             |                           |
| Metal silo – welded        | 466 (23)                    | 294 (24)                 | 629 (25)                      | 321 (18)                         | 14 (6)      | 1 710 (14)                |
| Metal silo – bolted        | 846 (19)                    | 850 (20)                 | 2 470 (10)                    | 2 506 (17)                       | 18 (4)      | 6 672 (8)                 |
| Concrete                   | 0 (150)                     | 0 (63)                   | 41 (57)                       | 41 (99)                          | 15 (14)     | 86 (55)                   |
| Grain shed                 | 588 (64)                    | 149 (58)                 | 624 (31)                      | 837 (29)                         | 18 (11)     | 2 203 (25)                |
| Dual purpose<br>grain shed | 122 (61)                    | 90 (120)                 | 240 (31)                      | 326 (31)                         | 21 (13)     | 783 (24)                  |
| Other                      | 1 642 (70)                  | 54 (60)                  | 149 (26)                      | 81 (27)                          | 15 (13)     | 1 923 (60)                |

*Note:* Figures in parentheses are relative standard errors, expressed as percentages of the estimates.

can be quite uneven. Such conditions can be conducive to insect growth unless grain is treated prior to storage.

Aerating and cooling of grain can be quite effective in keeping grain in good condition while in storage. The cooler conditions in storage enhance insecticide life and reduce any insect activity and mould growth in grain. Aeration can even out temperature and moisture levels of grain in storage (Fusae 1999).

Approximately 11 per cent, or 1.5 million tonnes, of total on-farm storage capacity in 1998-99 was equipped with aeration facilities. In Queensland, 40 per cent of permanent storage is equipped with aeration facilities, reflecting the high humidity in that state (table 1).

## Changes in storage capacity over time

ABARE has conducted previous surveys of on-farm grain storage capacity in Australia, the most recent being in 1990-91 (Hunter and Hooper 1992). It is estimated that total permanent storage capacity in Australia increased by 6 per cent between 1990-91 and 1998-99 (table 3). At the same time, grain production increased by over 50 per cent. On-farm storage availability represented about 55 per cent of Australia's annual average grain production (of 22.9 million

**Table 3: Capacity of permanent grain storage facilities on broadacre farms**

|   |     | 1990-91 | 1998-99 |
|---|-----|---------|---------|
| Total capacity of permanent storages                | kt  | 12 630  | 13 376  |
| Number of farms with permanent storage facilities   | no. | 58 897  | 45 236  |
| Storage capacity per farm                           | t   | 216     | 296     |
| Proportion of broadacre farms with storage capacity | %   | 73      | 64      |
| <b>Storage capacity</b>                             |     |         |         |
| New South Wales                                     | kt  | 6 298   | 6 809   |
| Victoria  | kt  | 1 932   | 2 357   |
| Queensland  | kt  | 1 207   | 1 376   |
| Western Australia                                   | kt  | 2 013   | 1 791   |
| South Australia                                     | kt  | 1 180   | 1 010   |

tonnes) in the three years to 1990-91, compared with 38 per cent of the much larger crop in 1998-99. This means that although grain production has increased dramatically over the decade, changes to the handling and marketing system have encouraged farmers to continue to support the bulk handling system in preference to increasing on-farm storage capacity.

The number of farms with permanent on-farm storage facilities declined by 23 per cent between 1990-91 and 1998-99. In this period, total farm numbers in the wheat-sheep zone and the high rainfall zone declined by 16 per cent and 20 per cent respectively. The decline in the number of farms can partially be explained by continued farm amalgamations.

### Future storage capacity

Approximately 16 per cent of farms indicated that they planned to expand their storage facilities over the next two years (table 4). Regions where significant expansion was planned are central Queensland, around the border of Queensland and New South Wales and the western grain growing areas of New South Wales (map 2).

If these intentions are realised and existing storage capacity maintained, total permanent on-farm storage capacity would increase by around 1.6 million tonnes, or 12 per cent. It is planned that 61 per cent of the new capacity would be gas sealable, with 34 per cent being equipped with aeration facilities.

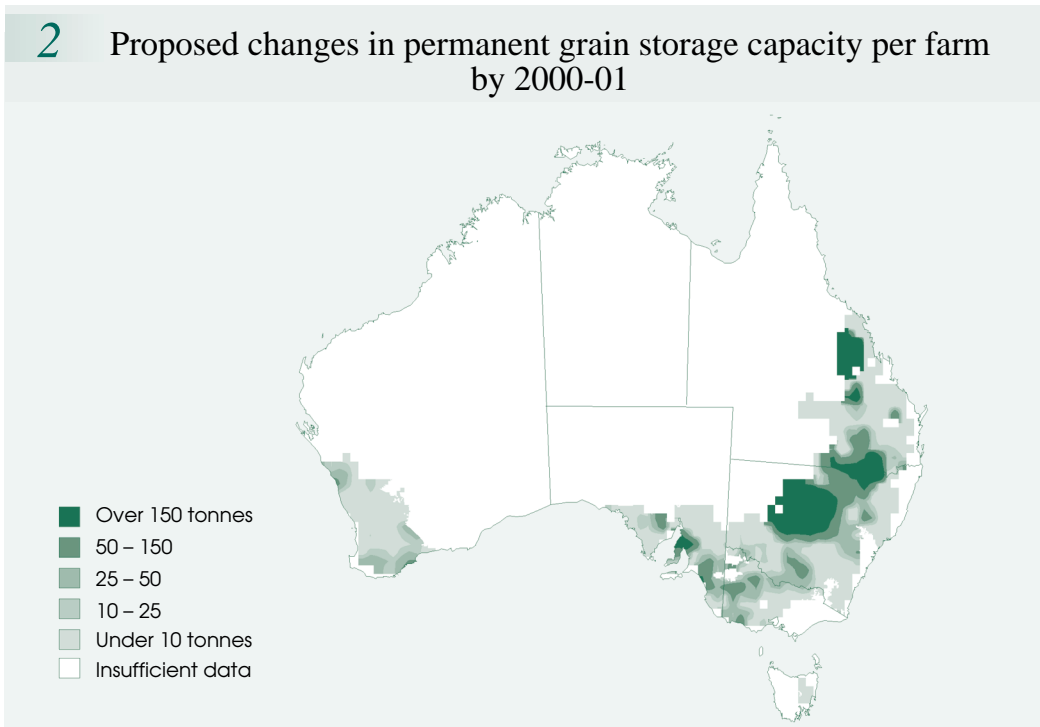


Table 4: **Planned changes in on-farm grain storage capacity over the two years from 1998-99**

|                   | Increased capacity | Percentage increase in capacity a | Farms increasing capacity b |    | Increased capacity per farm c | Gas sealable capacity | Capacity with aeration facilities |
|-------------------|--------------------|-----------------------------------|-----------------------------|----|-------------------------------|-----------------------|-----------------------------------|
|                   | kt                 | %                                 | no.                         | %  | t/farm                        | t/farm                | t/farm                            |
| Australia         | 1 612              | 12                                | 7 261                       | 16 | 222 (17)                      | 136 (28)              | 76 (22)                           |
| New South Wales   | 752                | 11                                | 3 151                       | 18 | 239 (27)                      | 152 (40)              | 83 (27)                           |
| Victoria          | 243                | 10                                | 1 781                       | 17 | 136 (19)                      | 71 (41)               | 50 (55)                           |
| Queensland        | 323                | 23                                | 728                         | 15 | 444 (49)                      | 312 (67)              | 241 (45)                          |
| Western Australia | 78                 | 4                                 | 630                         | 9  | 124 (46)                      | 19 (48)               | 3 (83)                            |
| South Australia   | 216                | 21                                | 970                         | 18 | 223 (43)                      | 151 (78)              | 50 (57)                           |

a Percentage increase based on estimated 1998-99 storage level. b Based on all broadacre farms. c For farms increasing storage capacity.

Note: Figures in parentheses are relative standard errors, expressed as percentages of the estimates.

## Purpose of on-farm grain storage facilities

Farmers with permanent on-farm grain storage facilities were asked to rank in order of importance the following five reasons for having on-farm grain storage:

- storage buffer in harvest time
- store seed
- store feed
- increase grain marketing opportunities
- other.

The following discussion is limited to the key reason stated by farmers.

### Current purpose

Storing grain for feed was given as the main reason for having storage by 47 per cent of farmers with on-farm grain storage facilities, followed by storage for seed (25 per cent) and as a storage buffer at harvest time (16 per cent) (table 5). Only 11 per cent of farmers gave increased marketing opportunities as the primary purpose for having storage facilities.

Farms with on-farm storage were stratified by their storage capacity into five groups and the major reason why they had on-farm storage was examined. It was found that as storage capacity on-farm decreased, the need for storage as a harvest buffer and for marketing opportunities decreased and the need for storage for feed increased (figure B).

This relationship can be explained largely by the changes in enterprise mix on farms. Farms with the largest area under crop had the most on-farm storage capacity. As the area under

**Table 5: Major reasons for having on-farm storage**

|                                       | Storage buffer<br>at harvest | Feed | Marketing<br>opportunities | Seed | Other |
|---------------------------------------|------------------------------|------|----------------------------|------|-------|
|                                       | %                            | %    | %                          | %    | %     |
| <b>1990-91 a</b>                      |                              |      |                            |      |       |
| Australia                             | 8                            | 59   | 9                          | 19   | 5     |
| New South Wales                       | 8                            | 69   | 11                         | 8    | 4     |
| Victoria                              | 8                            | 64   | 11                         | 12   | 5     |
| Queensland                            | 16                           | 35   | 7                          | 20   | 22    |
| Western Australia                     | 4                            | 53   | 5                          | 35   | 3     |
| South Australia                       | 4                            | 48   | 2                          | 46   | 0     |
| <b>1998-99 a</b>                      |                              |      |                            |      |       |
| Australia                             | 16                           | 47   | 11                         | 25   | 1     |
| New South Wales                       | 13                           | 60   | 15                         | 10   | 1     |
| Victoria                              | 14                           | 53   | 16                         | 16   | 0     |
| Queensland                            | 31                           | 38   | 11                         | 17   | 4     |
| Western Australia                     | 18                           | 32   | 2                          | 48   | 0     |
| South Australia                       | 14                           | 16   | 3                          | 66   | 0     |
| <b>Planned expansion by 2000-01 b</b> |                              |      |                            |      |       |
| Australia                             | 21                           | 27   | 44                         | 8    | 1     |
| New South Wales                       | 9                            | 24   | 65                         | 2    | 0     |
| Victoria                              | 12                           | 38   | 40                         | 10   | 0     |
| Queensland                            | 67                           | 0    | 26                         | 0    | 7     |
| Western Australia                     | 5                            | 41   | 5                          | 49   | 0     |
| South Australia                       | 49                           | 24   | 21                         | 5    | 1     |

a Most important reason given by farmers as to why they had permanent on farm grain storage facilities. b Most important reason given by farmers to expand storage capacity.

crops declined and livestock enterprises became a more important part of farm businesses storage capacity fell.

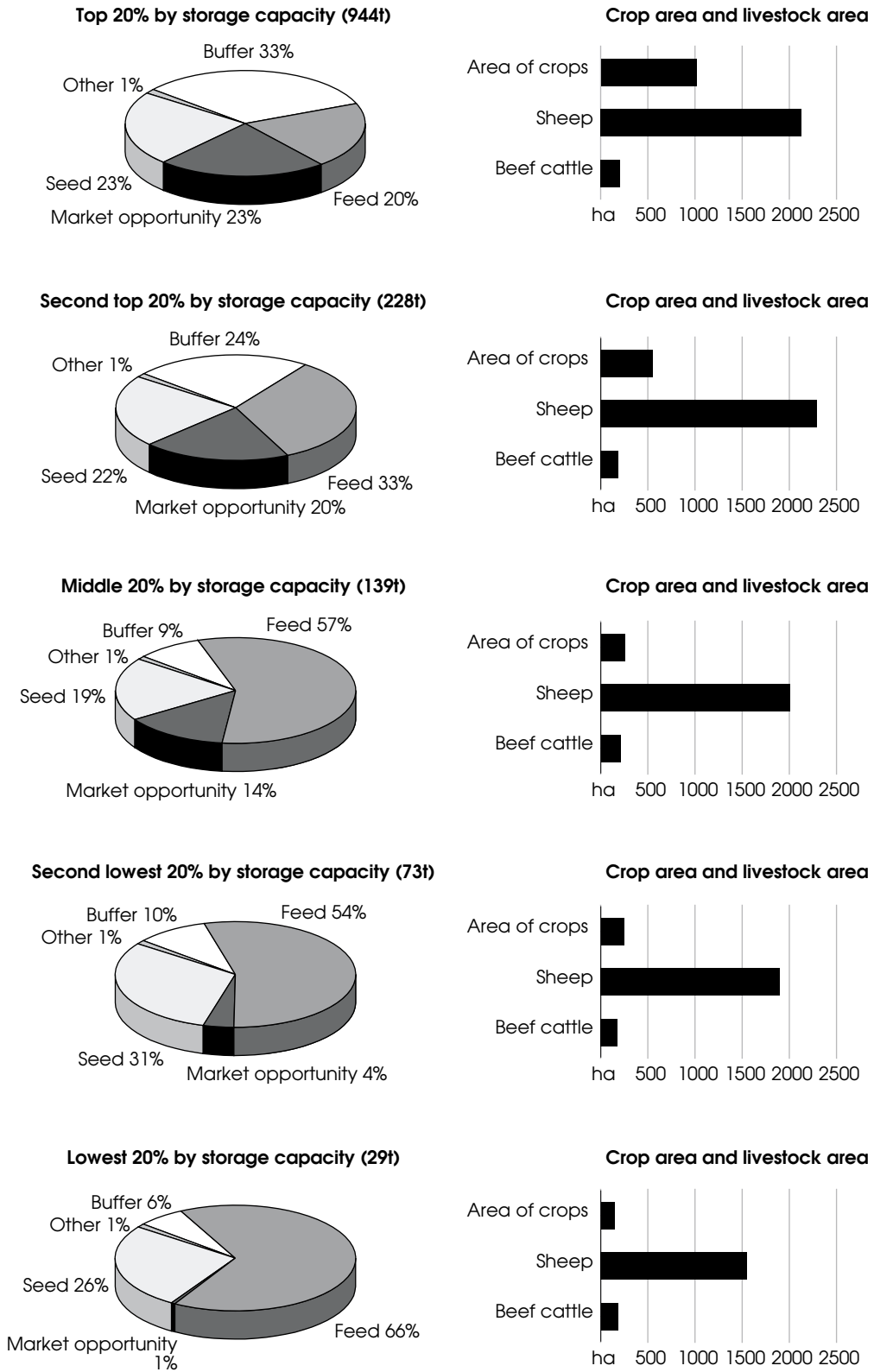
### **Comparison with 1990-91**

In 1990-91, 59 per cent of farmers gave storing grain for feed as the main reason for having storage (compared with 47 per cent in 1998-99), 19 per cent said seed (25 per cent in 1998-99), 8 per cent said for buffer storage (16 per cent in 1998-99) and 9 per cent said for marketing opportunities (11 per cent in 1998-99).

The changes in the primary reasons why farmers had on-farm storage between 1990-91 and 1998-99 may reflect the changes in relative profitability between cropping and livestock industries and the decline in livestock numbers and increase in crop areas over this period.

Sheep numbers declined from 167 million in 1990-91 to 116 million in 1998-99 (ABARE 1999), thus potentially reducing the need for storage for feed. Over the same period, the area sown to crops increased from 17.4 million hectares to 21.9 million hectares, which is likely to have increased the need for storage for seed for the subsequent season's crops, as a storage buffer at harvest time, and to provide increased marketing opportunities.

Figure B: Use of storages by storage capacity



## Reasons for expanding on-farm storage facilities

When farmers were asked whether they were going to increase their on-farm storage capacity over the next two years, they were also asked what reasons were important in their decision to increase capacity. Increased marketing opportunities was given as the primary reason by 44 per cent of farmers expanding storage (table 5), followed by storage for feed (27 per cent) and as a storage buffer at harvest time (21 per cent).

## Use of storage facilities in 1998-99

Farmers were asked for details of any grain they stored on farm in temporary or permanent storage for more than a month during 1998-99, and for details of any insect control measures they undertook. Approximately 65 per cent of farmers stored some grain on farm for over a month. Seventy per cent of these farmers were in the grains industry (table 6).

Table 6: Grain stored for more than one month, 1998-99

Average per farm

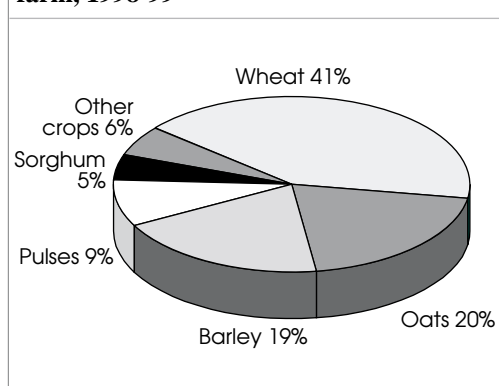
|  |     | New South<br>Wales | Victoria | Queens-<br>land | Western<br>Australia | South<br>Australia | Australia |
|--|-----|--------------------|----------|-----------------|----------------------|--------------------|-----------|
| Population a   | no. | 9 771              | 7 007    | 2 378           | 5 992                | 3 996              | 29 330    |
| <b>On-farm storage utilisation</b>   |     |                    |          |                 |                      |                    |           |
| Total grain production   | t   | 755 (9)            | 437 (9)  | 653 (14)        | 1 710 (10)           | 1 180 (8)          | 914 (5)   |
| Total quantity stored b  | t   | 237 (19)           | 128 (12) | 198 (43)        | 308 (29)             | 116 (17)           | 204 (12)  |
| Quantity untreated at time<br>of storage for insects   | t   | 88 (48)            | 21 (23)  | 62 (28)         | 162 (51)             | 36 (41)            | 77 (29)   |
| Quantity treated at time<br>of storage for insects   |     |                    |          |                 |                      |                    |           |
| – fumigated in gastight<br>storage   | t   | 9 (69)             | 12 (41)  | 5 (79)          | 78 (45)              | 4 (58)             | 23 (33)   |
| – fumigated in unsealed<br>storage   | t   | 44 (53)            | 12 (29)  | 51 (150)        | 24 (31)              | 37 (26)            | 31 (32)   |
| – chemical sprays/dusts  | t   | 95 (17)            | 80 (19)  | 80 (35)         | 30 (41)              | 37 (31)            | 68 (11)   |
| – other  | t   | 2 (65)             | 4 (76)   | 0               | 14 (84)              | 2 (85)             | 5 (53)    |
| – total  | t   | 149 (18)           | 107 (14) | 136 (61)        | 145 (25)             | 79 (19)            | 127 (11)  |
| <b>Quantity stored that was found to be infested<br/>with insects and subsequently treated</b> |     |                    |          |                 |                      |                    |           |
| – fumigated in gastight<br>storage   | t   | 47 (91)            | 0        | 1 (91)          | 4 (90)               | 0 (111)            | 17 (87)   |
| – fumigated in unsealed<br>storage   | t   | 15 (99)            | 7 (48)   | 25 (38)         | 7 (49)               | 9 (43)             | 11 (45)   |
| – chemical sprays/dusts  | t   | 3 (74)             | 14 (56)  | 1 (111)         | 0 (101)              | 3 (44)             | 5 (48)    |
| – other  | t   | 7 (94)             | 0 (121)  | 0               | 0                    | 0                  | 2 (93)    |
| – total  | t   | 72 (64)            | 21 (41)  | 27 (36)         | 11 (48)              | 12 (34)            | 35 (44)   |
| <b>Grain aeration</b>  |     |                    |          |                 |                      |                    |           |
| Quantity stored<br>that was aerated  | t   | 29                 | 0        | 54              | 0                    | 0                  | 14        |
| Quantity aerated for:  |     |                    |          |                 |                      |                    |           |
| – insect control   | t   | 3 (86)             | 0        | 35 (46)         | 0                    | 0                  | 4 (41)    |
| – high moisture  | t   | 19 (101)           | 0        | 13 (64)         | 0                    | 0                  | 8 (87)    |
| – grain quality<br>preservation  | t   | 5 (71)             | 0        | 4 (58)          | 0                    | 0                  | 2 (60)    |
| – other  | t   | 1 (71)             | 0        | 2 (102)         | 0                    | 0 (118)            | 1 (52)    |

a Population based on those farms with on-farm storage facilities who stored grain in storages for more than 1 month during 1998-99. b Not all grain stored on a farm may have been harvested on that farm or harvested in 1998-99.

Note: Figures in parentheses are relative standard errors, expressed as percentages of the estimates.

Grain held in storage in 1998-99 was not necessarily harvested in that year and may not necessarily have been harvested by the farmer. The grain stored could have been purchased through the year, or other farmers could have been using the available storage. However, grain stored on these farms accounted for 22 per cent of grain produced on these farms in 1998-99. Grains industry farmers stored nearly 90 per cent of this grain, storing on average 20 per cent of their production.

Figure C: Composition of grains stored on farm, 1998-99



On average, wheat comprised 41 per cent of grain stored, oats 20 per cent, barley 19 per cent and pulses 8 per cent (figure C). As a proportion of production in 1998-99, the quantity that was stored was equivalent to 76 per cent for oats, 33 per cent for sorghum, 25 per cent for pulses, 23 per cent for barley and 16 per cent for wheat (figure C).

About 62 per cent of grain going into storage was treated for protection against insects at the time of storage. The main form of treatment used was chemical sprays and dusts (54 per

Table 7: Chemical treatment of grain stored for more than one month, 1998-99  
Average per farm for all farms that stored grain

|  |     | New South<br>Wales | Victoria | Queens-<br>land | Western<br>Australia | South<br>Australia | Australia |
|--|-----|--------------------|----------|-----------------|----------------------|--------------------|-----------|
| Population   | no. | 9 771              | 7 007    | 2 388           | 5 992                | 3 996              | 29 330    |
| <b>Quantity treated at time of storage for insects</b>                                     |     |                    |          |                 |                      |                    |           |
| Treatment 1 a  | t   | 39 (30)            | 49 (22)  | 8 (72)          | 1 (95)               | 26 (46)            | 29 (17)   |
| Treatment 2 b  | t   | 6 (66)             | 4 (51)   | 26 (54)         | 0 (101)              | 2 (100)            | 6 (34)    |
| Treatment 3 c  | t   | 37 (30)            | 35 (31)  | 22 (358)        | 1 (69)               | 0 (154)            | 23 (35)   |
| Dryacide   | t   | 1 (106)            | 1 (106)  | 0               | 3 (56)               | 5 (64)             | 2 (37)    |
| Dichlorvos   | t   | 17 (45)            | 2 (66)   | 49 (51)         | 0                    | 0 (118)            | 10 (32)   |
| Phosphine  | t   | 47 (48)            | 16 (32)  | 31 (35)         | 133 (28)             | 41 (20)            | 55 (20)   |
| Carbon disulphide  | t   | 0 (112)            | 0        | 0               | 0                    | 0                  | 0 (112)   |
| Carbon dioxide or nitrogen   | t   | 0                  | 0        | 0               | 2 (108)              | 0                  | 0 (108)   |
| Other  | t   | 2 (87)             | 1 (94)   | 1 (114)         | 5 (76)               | 5 (38)             | 3 (39)    |
| Total  | t   | 149 (18)           | 107 (14) | 136 (61)        | 145 (25)             | 79 (19)            | 127 (11)  |
| <b>Quantity stored that was found to be infested with insects and subsequently treated</b> |     |                    |          |                 |                      |                    |           |
| Treatment 1 a  | t   | 0                  | 1 (90)   | 2 (80)          | 0 (25)               | 3 (69)             | 1 (47)    |
| Treatment 2 b  | t   | 0                  | 3 (54)   | 0               | 0                    | 0 (85)             | 1 (52)    |
| Treatment 3 c  | t   | 0                  | 1 (83)   | 0 (93)          | 0                    | 1 (105)            | 0 (63)    |
| Dryacide   | t   | 0                  | 0        | 0               | 0                    | 0                  | 0         |
| Dichlorvos   | t   | 3 (70)             | 12 (69)  | 4 (113)         | 0                    | 0                  | 4 (57)    |
| Phosphine  | t   | 68 (68)            | 5 (71)   | 22 (42)         | 9                    | 8 (42)             | 29 (54)   |
| Carbon disulphide  | t   | 0 (121)            | 0        | 0               | 0 (53)               | 0                  | 0 (121)   |
| Carbon dioxide or nitrogen   | t   | 0                  | 0        | 0               | 2                    | 0                  | 0 (108)   |
| Other  | t   | 1 (100)            | 0        | 0               | 0 (108)              | 1 (74)             | 0 (73)    |
| Total  | t   | 72 (64)            | 21 (41)  | 27 (36)         | 11                   | 13 (32)            | 35 (44)   |

a Treated with acetellic, fenitrothion, reldan or sumithion. b Treated with bioresmethrin, diacon, IGR, sumithrin, warden, carbaryl or pyrethrin. c Treated with a combination pack of chemicals in treatment 1 and 2.

Note: Figures in parentheses are relative standard errors, expressed as percentages of the estimates.

cent of treated grain), followed by fumigation. A wide range of chemical sprays were used, although the most common chemicals used were actellic, fenitrothion, reldan and sumithion. Phosphine was the major fumigant used (table 7).

Subsequently, around 17 per cent of grain in storage was found to be infested with insects and retreated. Fumigation was the preferred retreatment method, with phosphine being the main fumigant used.

## Conclusion

The Australian grains industry has changed significantly in the past decade. Total production of grain has risen by over 50 per cent to around 35 million tonnes. Although wheat remains the main crop, many farmers are diversifying their cropping enterprises, resulting in a large increase in crops such as canola. At the same time the handling and marketing of grain has been gradually deregulated. This has been accompanied by an increase in the marketing options available to farmers. There is also increased pressure on marketing bodies to segregate grain not only for type and grade, but also to be able to trace grain through the system. For example, with genetically modified crops or as markets become more demanding with specifications, more segregation is likely to be required.

It was expected that on-farm grain storage would increase dramatically as farmers began to take advantage of the new marketing arrangements. However, ABARE farm survey data reveal that there has only been a marginal increase in permanent on-farm grain storage capacity over the past decade. The reasons for this are not clear, but it is reasonable to assume that farmers have been more inclined to use the improved facilities and marketing options being provided by the grain handlers and marketers, thus avoiding the expense of increasing their on-farm grain storage capacity.

Despite dramatic change to the grain distribution and marketing system, around 16 per cent of farms plan to expand their storage capacity over the next two years. Survey data indicate that this could result in a further 12 per cent increase in total on-farm grain storage capacity, with significant increases planned in northern New South Wales and Queensland. Of these farms over 40 per cent planned the expansion to take advantage of increased marketing opportunities.

## References

- ABARE 1999, *Australian Commodity Statistics*, Canberra.
- Fusae, T. 1999, *Managing Aeration* (online: <http://www.arpl.com.au/manaer.htm>).
- Hunter, R. and Hooper, S. 1992, 'On-farm grain storage in Australia', *Agriculture and Resources Quarterly*, vol. 4, no. 2, pp. 242–56.