

2. METHOD OF ALLOCATION OF NUTRIENTS TO BASINS

The only published information on fertilizer usage is that tabulated by the Bureau of Census and Statistics (to 1972) and the Australian Bureau of Statistics (ABS) since, based on the returns of primary producers.

Under 'The Statistical Returns Acts, 1896 to 1935' farmers and graziers were required to complete Form AP23 entitled 'Agricultural, Dairying, and Pastoral Statistics'. This covered information on land utilisation, employment, area and production of crops, fruit and vegetables, machinery, livestock numbers and production, areas irrigated and areas fertilized and how much fertilizer was applied, for the period ending 31 March each year.

2.1 Queensland Data

A tabulation in the author's possession, for the period 1915-16 to 1950-51, shows total crop area grown, crop area fertilized, tons of artificial fertilizer and loads of natural fertilizer used in Queensland in each year. The origin is unknown and the Bureau is unable to provide any indication where the original data are held. An archival search was not considered by the Australian Bureau of Statistics to be warranted.

2.2 Statistical Divisions

The Australian Bureau of Statistics has records of census data collected at the Shire level from 1938-39. In that year, a change was made from Petty Sessions Districts and Pastoral Districts to Local Authority areas and Statistical Divisions based on them, for all production statistics except Primary Production. The Australian Bureau of Statistics collected figures on fertilizer usage from this period at local authority area level, but these were not published prior to 1970-71 and are not available for inspection. Data at the divisional level have been published since 1951-52 as follows:

- (i) 1951-52 to 1955-56: Statistics of the State of Queensland for the year..... Compiled from official records. S. E. Solomon, Government Statistician. Part B - Production Section (i) - Rural Production. Table 36. Fertilization and Irrigation of crops and pastures 19..... The data cover 13 statistical divisions, with areas fertilized and total quantity of artificial fertilizer used on sugarcane, vegetables, fruit, fodder, other crops and pastures.
- (ii) 1956-57 to 1960-61: Statistics of the State of Queensland for the year..... Part B - Production. Section (i) - Rural Production. Issued by S. R. Carver, Commonwealth Statistician, compiled by S. E. Solomon, Deputy Commonwealth Statistician and Government Statistician. Table 34/35/36 contained statistics similar to the earlier period, except for 'wheat' being added to the list of crops in 1956-57 and 'other cereals' in 1958-59. K. M. Archer replaced S. R. Carver as Commonwealth Statistician in 1959-60.
- (iii) 1961-62 to 1963-64: Statistics of the State of Queensland for the year..... Part B - Production. Section (i) - Rural Production. Archer/Solomon. Table 34. The 1961-62 data included the first published figures for superphosphate usage (21 345 tons), with 'other or mixed fertilizer used' (104 956 tons) shown separately, although this information had been collected on earlier Agricultural, Dairying and Pastoral Statistics forms completed by primary producers.
- (iv) 1964-65: As above. Table 39. For the first time, a category 'Straight Nitrogenous Fertilizer Used' was included (50 869 tons).

- (v) 1965-66 to 1968-69: As above. Table 39 was headed 'Fertilization of Crops and Pastures, in Statistical Divisions'. The statistical bulletin for 1965-66 refers, for the first time, to the Bureau of Census and Statistics, Queensland office, and introduces decimal currency. The Government Statisticians were S. E. Solomon in 1966 and A. W. Mumme from 1967 to 1969, while J. P. O'Neill, as Acting Commonwealth Statistician, replaced K. M. Archer in 1967-68.
- (vi) 1969-70 and 1970-71: As above. Table 39/40 was headed 'Fertilizer used on Crops and Pastures in Statistical Divisions'. F. W. Sayer was Deputy Commonwealth Statistician and Government Statistician.
- (vii) 1971-72: As above. Table 41. The Bureau became the Australian Bureau of Statistics, Queensland office. Lucerne was introduced as an additional crop and 'Other Pastures' replaced 'Pastures'. Fodder (not included elsewhere) was excluded.
- (viii) 1972-73 and 1973-74: As above. Table 41. In the crop categories, '(including grapes)' was added after 'Fruit' and 'Pasture: Lucerne: Other' was used to subdivide the pasture section. 'Other Crops' was added at the end of the list, having previously been included before pastures. For the first time metric units were used, hectares and tonnes. O. M. May was Acting Government Statistician in 1972-73 and Government Statistician for Queensland in 1973-74. No further publications in this format were issued.

2.3 Local Authority Areas

The first available fertilizer usage statistics in local authority areas were published in January 1972, for the 1970-71 season. Issued by the Bureau of Census and Statistics, Brisbane, as publication Q7/72 and headed 'Artificial Fertilizer used on Rural Holdings, 1970-71 season, Queensland', the bulletin provided the areas fertilized, the total tons of straight nitrogenous, single strength superphosphate, double/triple strength superphosphate and other and mixed fertilizer for each Shire, but not for each crop category (although total tons of fertilizer are shown for each crop group). The superphosphate figure in (vi) above is the sum of the different strength products, with no allowance for the different phosphorus contents in them.

Bulletin Q31/73 for the 1971-72 season provided similar information to the year before, except that the types of fertilizer included superphosphate, urea, sulphate of ammonia, other nitrogenous and other and mixtures. Again, only total tonnage figures were provided for crop groups.

Q62/74 from the Australian Bureau of Statistics issued in May 1974 for the 1972-73 season provided the same kinds of data as for the previous year, using metric units. Statistics for 1973-74 were similarly presented.

From 1974-75 to 1978-79, fertilizer use statistics (areas fertilized and tonnes used) for each local authority were provided for the following crop groupings: wheat, grain sorghum, other cereals, sugarcane, fruit, vegetables, other crops, pasture-lucerne and pasture, other than lucerne, with the fertilizer headings being superphosphate, urea, sulphate of ammonia, other straight nitrogenous and other artificial including mixtures.

In 1979-80 and 1980-81, the Australian Bureau of Statistics collected fertilizer use information only on sugarcane, wheat and pasture (native or sown), without total figures, and only for superphosphate, straight nitrogenous and other artificial including mixtures.

In 1981-82, 1984-85 and 1987-88 the more detailed crop and product statistics as for 1978-79 were again collected, but only for sugarcane, wheat and pasture (as for 1980-81) in 1982-83, 1983-84, 1985-86, 1986-87 and 1988-89. Total areas fertilized and the tonnes of products applied were provided in 1986-87 and 1988-89.

2.4 Using Australian Bureau of Statistics Data to Obtain Nutrient Usages

Assuming no major changes in agricultural practices, it is possible to make estimates of fertilizer usage for 10-20 year periods prior to the publication of more detailed statistics, with a reasonable degree of accuracy. These estimates require consideration of crop areas grown, and the changing proportions of fertilizer on each crop and in each district.

Such estimates have limited value unless information is also available on changes in composition of the various fertilizer groups, i.e. the proportions of the products making up each group. For example, it is necessary to be able to estimate for say, 7-10 years prior to 1971-72 (when the first statistics on forms of nitrogen fertilizers were published/collected), what the proportions of such fertilizers were in the category 'straight nitrogenous fertilizer' which appeared first in the 1964-65 census. Similarly the usage of superphosphate in divisions in the 10 years prior to 1961-62 might be estimated from the figures for that year.

These estimates of the fertilizer products or groups of products might be extended from divisions to local authority areas, using the earliest such data from 1971-72, in the same way.

The value of the results of such estimates and the calculations applied to them depends on the accuracy of the original data. It is highly likely that census figures, in terms of areas fertilized and tonnages used, became less accurate as the complexity of the tables on the form increased.

In more recent times, when direct comparisons can be made with fertilizer industry sales data for the same geographic area, considerable differences are apparent.

Some of the differences can be attributed to the allocation of total fertilizer to the first column of the table (which is for superphosphate). While this may explain why official statistics for superphosphate applications greatly exceed sales in every year, it does not explain differences in total tonnages applied. Because of the inherent difficulties in trying to make sense of the Australian Bureau of Statistics data, an alternative method was sought. This was aimed directly at river basins, rather than at local authorities, few of which have boundaries which contain single basins.

Australian Bureau of Statistics data were considered to be more accurate in relation to the areas fertilized, for each group of crops.

Primary producers have reliable estimates of the area of crops grown and, where these crops are always fertilized, it is simple to record accurately the area fertilized on the census form. Crop producers pay much attention to the calibration of fertilizer application machinery to obtain desired rates of usage, providing a further check on areas and tonnages, but not products.

Assuming that the errors made by farmers completing their census forms are reasonably consistent from year to year, changes in areas fertilized may reflect the major variations in total nutrient usage better than changes in the tonnages applied. If these area changes are combined with changes in the quantities in each of the product groups used, reasonable estimates of usage can be made for each local authority area.

To provide a historical sequence of data on nutrient usage, it is necessary to have several points of reference, over the period being considered, for which accurate information is available and for comparison with calculations made using the Australian Bureau of Statistics data. Such information can only come from within the fertilizer industry. None of this is published.

2.5 Fertilizer Industry Data

In compiling the tables of nitrogen and phosphorus usage in each basin, it was first necessary to calculate or to estimate usage at the regional level. This was done in relation to:

- (i) local government authorities and statistical divisions;
- (ii) sugar mill areas, which formed the original sales areas of the fertilizer companies; and
- (iii) sales districts of fertilizer companies, made up of sales by groups of individual dealers, some of whose sales territory overlapped that of other dealers.

The information utilised included:

- (i) 1949. Fertilizer materials required by North Queensland Fertilizers and Chemicals Ltd (NQFC) for the Townsville and Cairns blending plants. Forecast sales of products (superphosphate, ammonium sulphate and blended mixtures) for all suppliers for Mossman, Cairns, Innisfail, Tully, Ingham and Ayr sales districts. Actual deliveries of ammonium sulphate and mixtures to these districts for year ending February 1950.
- (ii) 1950-51 to 1958-59. Sales by NQFC and estimates for other suppliers, of ammonium sulphate, superphosphate, mixtures and other products for Mossman, Cairns (Hambledon-Mulgrave), Babinda (from 1954), Innisfail, Tully, Ingham, Burdekin, Townsville and Tablelands.
- (iii) 1959. District sales by NQFC of all products from March to September.
- (iv) 1959-60 to 1966-67. NQFC sales of urea, ammonium sulphate, aqua ammonia, superphosphate, potash and mixtures in the following districts; Atherton, Mareeba, Mossman-Hambledon-Mulgrave-Babinda-Innisfail, Tully, Ingham, Townsville and Burdekin. Estimates of NQFC market share.
- (v) Monthly sales by NQFC of mixtures and various straight products for Burdekin, Tablelands and Ingham to Mossman, from February 1948 to September 1959.
- (vi) 1968 to 1973. ACF & Shirleys sales of fertilizers for years ending September.
- (vii) Estimates of sales by Austral Pacific Fertilizers Ltd for 1968 to 1971, by sales area.
- (viii) October 1973 to June 1974. Nine months sales figures for ACF & Shirleys and ACF-Austral.
- (ix) 1969-70. Detailed market study of product and nutrient usage by crop segment in each sales district for Mackay zone and north Queensland zone. All suppliers included in this study.
- (x) 1971 to 1992. Monthly sales of products for the Ingham-Mossman and Tablelands area. All suppliers included in annual tabulations, based on imports and local production.
- (xi) 1972. Estimates of nitrogen, phosphorus and potassium usage by crop segment for each zone.

(xii) 1976 to 1991. Calendar year allocations of total sales of individual products, by all suppliers, to crop segments, for every sales district in Queensland. Referred to as 'Segmentation data'.

(xiii) 1977 to 1990. Tabulation of quarterly and annual product and nutrient usage, areas fertilized and rates of application of each nutrient for each crop for each sales area.

2.6 Drainage Basins

The drainage divisions of Queensland are depicted in figure 1. Those in Division 1 are east of the Great Dividing Range. Mainland basins 108 to 138, from the Daintree (latitude 16°S) to the Mary River (latitude 27°S) have been investigated for this study of fertilizer usage in catchments adjacent to the Great Barrier Reef. Rainfall and run-off characteristics for each of the 28 basins are shown in table 1. In the northern area, from the Murray to the Daintree, more than half of the average rainfall runs off, as indicated by flow rates from stream gauging stations.

In the central and southern areas, rainfall, run-off and the proportion of rainfall which runs off, are much lower. In the main southern basins, the Burnett and Fitzroy, only 7% of the rainfall on average, runs off.

2.7 Allocation of Nutrients to Basins

While several other macro- and micro-nutrients which are necessary for plant growth are components of many fertilizer products, only nitrogen and phosphorus are considered in this report. The procedure used to allocate historical usage of nutrients varied from basin to basin, depending on the complexity of the agriculture in each, and on the availability of fertilizer use information for the area. For some areas, e.g. Mulgrave-Russell and Proserpine, the local authority area, sales district and river basins were similar. In others, particularly the smaller basins, it was necessary to allocate proportions of nutrients from two or more sales areas or shires to the basin. In most cases, allocation of nitrogen had to be treated differently to phosphorus and separate calculations and allocations were made.

Most of the allocations were done on a crop basis, and then amalgamated. Unless this procedure was adopted, nutrient figures did not reflect changes in crop area and rates of fertilizer usage adequately. However since sugarcane constituted the bulk of the fertilizer usage in most river basins (the exceptions being Barron, Waterpark, Fitzroy, Calliope, Boyne and Burnett), changes in nutrient usage are highly correlated with changes in sugarcane production methods.

Allocations of sales area data to catchments were confirmed in discussions with industry personnel and by visits to most of the areas.

While the 1990 figures are likely to be the most accurate, it is believed that the earlier years reflect the situation well enough.

The regional totals for nitrogen and phosphorus for the 1950 to 1990 period have high accuracy; in the 1910 to 1950 period there are no statistics available to check against individual areas of usage. The five-year intervals used to 1960 infer average data for the particular period, rather than for the particular year.

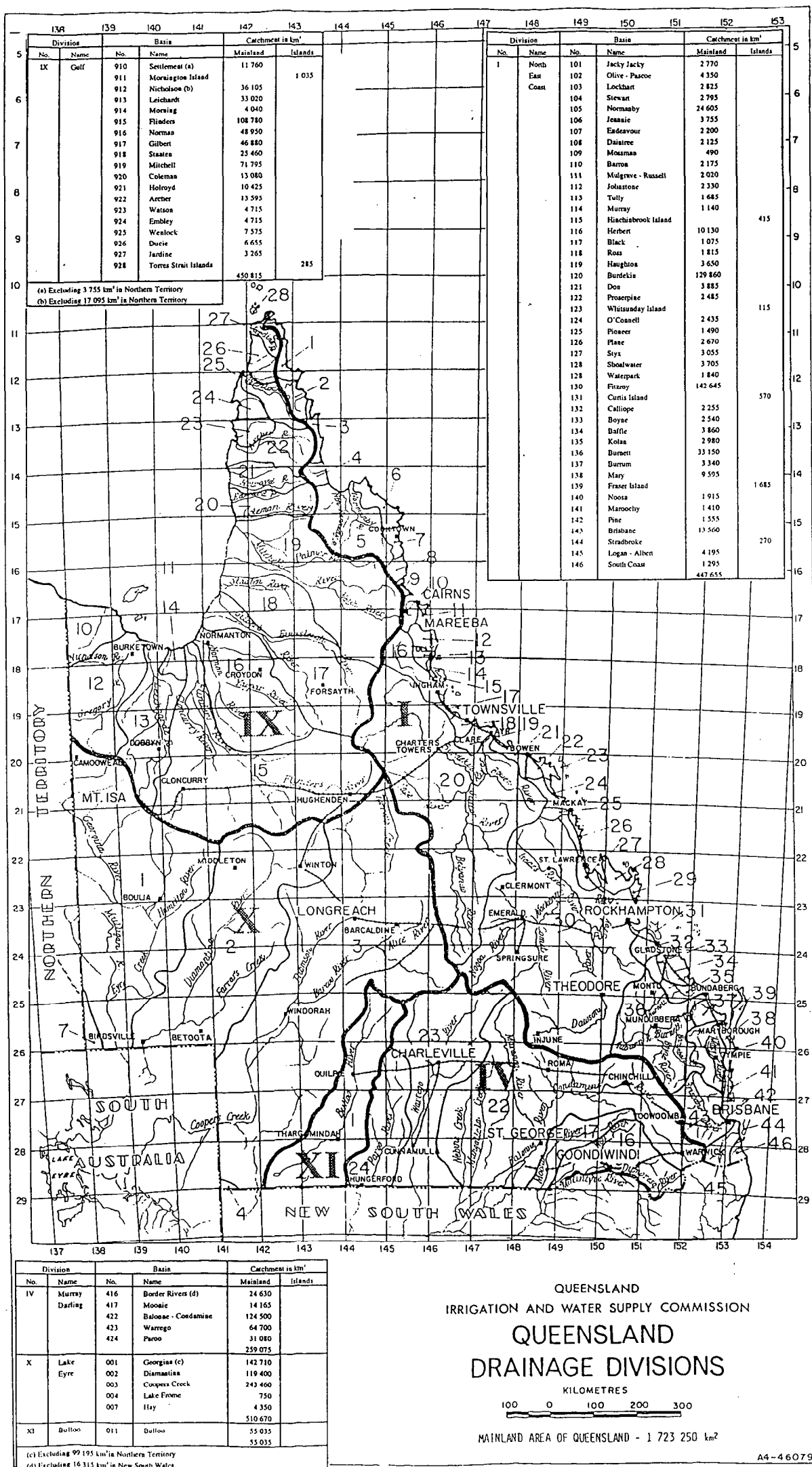


Table 1. Area, rainfall and run-off statistics of some eastern Queensland basins

Basin	Basins area (km ²)	Mean annual run-off (000 ML)	Mean annual rainfall (mm)	RO/RF (%)	% basin gauged (%)
108 Daintree	2125	3560	2576	65	55
109 Mossman	490	687	2459	57	0
110 Barron	2175	1153	1447	37	89
111 Mulgrave-Russell	2020	4193	3233	64	45
112 Johnstone	2330	4698	3405	59	57
113 Tully	1685	3683	2970	74	87
114 Murray	1140	1628	2485	57	14
116 Herbert	10131	4991	1331	37	87
117 Black	1075	509	1510	31	33
118 Ross	1815	372	1071	19	50
119 Haughton	3650	756	923	22	67
120 Burdekin	129860	10100	640	12	99
121 Don	3885	689	1022	17	33
122 Proserpine	2485	1431	1562	37	14
124 O'Connell	2435	1668	1705	40	30
125 Pioneer	1490	994	1418	47	93
126 Plane	2670	1370	1499	34	16
127 Styx	3055	825	1157	23	0
128 Shoalwater	3705	832	1102	20	0
129 Waterpark	1840	700	1317	29	7
130 Fitzroy	142645	7127	702	7	95
132 Calliope	2255	340	889	17	61
133 Boyne	2540	401	1031	15	99
134 Baffle	3860	750	1173	17	37
135 Kolan	2980	464	1162	13	80
136 Burnett	33150	1743	765	7	98
137 Burrum	3340	718	1104	20	52
138 Mary	9595	2309	1158	21	81