FARMING IN SUB-HUMID AREAS.

A STUDY OF AGRICULTURAL AND CLIMATIC CONDITIONS ON THE LOWER NAMBUCCA RIVER, MID-NORTH COAST, NEW SOUTH WALES.—I.

By

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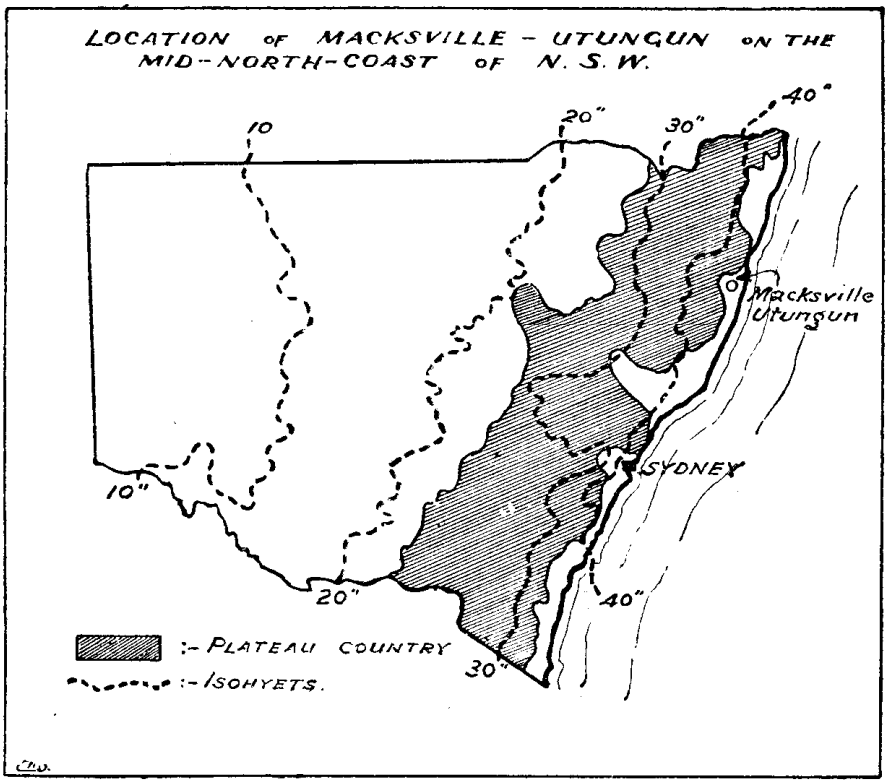
Introduction.

During recent months an investigation of agricultural conditions on the Lower Nambucca River was carried out with a view to examining the effects of rainfall on agricultural production and land-use. The uncertainty of coastal climates in New South Wales has been receiving more and more attention in recent years. Once regarded as a "safe" area it is now realised that the coast is by no means immune from periodical drought; agricultural production suffers grievously every few years with the failure of seasonal rains and the consequent drying-off of natural and improved pastures. Drought is more keenly felt on the coast because of its effects on the dominant type of activity—dairy-grazing. Dairying has developed mainly on natural pastures and demands a steady month by month rainfall to maintain pastures in a satisfactory condition. But experience over the last thirty years has disproved the reliability of high coastal rainfalls. Dairy farmers now know that they cannot rely upon an even distribution throughout the year. Rather must they reconcile themselves to the probability of a below-normal season a least once every three years. Naturally a growing consciousness of climatic uncertainty has had its effect on dairy farming along the coast; more noticeable however has been its effect on production. Each year finds some district well below its normal output of milk and butter because of local drought.

This investigation, carried out by the Division of Marketing and Agricultural Economics, has been designed to measure more precisely the effects of rainfall unreliability on production. Some quantitative measure of uncertainty has been sought which may serve as an indication of drought losses in the dairy industry. Other aspects of the problem have been touched upon in passing but on the whole the emphasis throughout has been on dairying and, in particular, butter.

A small area (8,541 acres) on the Lower Nambucca River (Taylor's Arm), between Utungun and Macksville, was chosen for investigation. It is fairly typical of districts on the mid-North Coast of New South Wales and the findings of this investigation can no doubt be applied, *mutatis mutandis,* to similar areas north and south of Macksville. Field surveys contributed a good deal to the investigation, although they were supplemented by a questionnaire survey of farmers in the district and an examination of official statistics in Sydney.



Considerable space has been given to an examination of rainfall because it is felt that therein lies one of the main problems of the entire coastal dairy belt. As a background for the rather detailed analysis of rainfall and production, a geographical description of the Lower Nambucca River has been included. Some of the district's more pressing problems have also been touched upon in the introduction. Answers to questions were sought from some forty-five farmers in the district between Macksville and Utungun. Not all replied to every question asked but most replied to some. For convenience the area canvassed between Macksville and Utungun has been referred to as the "Questionnaire District."

The Area.

Macksville and Utungun on the mid-North Coast of New South Wales are located at the coastal end of the Nambucca River. The Nambucca is one of the smaller river systems draining the narrow mid-coastal belt; two main streams ultimately unite near the coast to form the Nambucca estuary. Both of them rise on the north-eastern slopes of the Macleay-Bellinger watershed about thirty miles from the coast, and flow through narrow valleys in a dissected plateau before entering the less elevated coastal hill-and-spur zone. Both the Bowra River, on which Bowraville is located, and Taylor's Arm are subject to tidal influence before they unite at Macksville to form the Nambucca estuary. The estuary enters the sea across a sandy bar at Nambucca Heads about eight miles below Macksville.

(a) Topography.

Above the village of Taylor's Arm the stream is small and confined to a narrow valley with only tiny patches of alluvium usually on the convex bank. The average height of plateau spurs in the vicinity of the river is round about 2,000 feet, although the stream itself at Burrapine for instance is only about 280 feet above sea level. Above Muirbank the topography on the whole is too rugged for grazing and only the more accessible slopes close to the river have been cleared.

In the vicinity of Taylor's Arm the average height of the surrounding plateau spurs decreases and the topography is less rugged. Flats along the river become more frequent and the character of the topography changes from rugged to hilly. Clearing has been much more extensive and grazing is important on the hills each side of the river.

Between Utungun and Macksville the topography is hilly with relatively steep slopes. Ridges on the western side have an average altitude of about 300 to 400 feet dropping away to about 100 feet near Macksville. Below Utungun, Taylor's Arm is at sea level, although relative relief is about 250 feet throughout the greater part of the district. Hills tend to be steep and flat land is at a minimum. Average degree of slope is high at about 6 degrees; level areas are restricted to enclaves of flat land between spurs, reaching to the river.

From the standpoint of land-use farmers in the district have been at a disadvantage because of the unfavourable nature of the water supply. In recent geological times earth movements along the coast of New South Wales resulted in the flooding or "drowning" of many coastal valleys. Salt water invaded the lower portions of most streams, turning them into estuaries. Extensive areas of alluvial flats built up before the subsidence were turned into salt-water swamps, many of which still remain. The Nambucca was but one of many east coast valleys which were "drowned" by the sea. To-day the lower reaches of the river are estuarine and tidal influence extends inland for about ten miles or so. On Taylor's Arm its influence is felt as far up as Utungun. Below Utungun the river drops a few feet to base level and the water changes from fresh to brackish. At Macksville it is salt.

The salinity of Lower Taylor's Arm and the Nambucca River has been a great handicap to farmers in the eastern end of the valley and on the flats near Macksville. Taylor's Arm is a perennial stream with a considerable flow of fresh water; but for its brackish nature farmers below Utungun might have been able to develop their own irrigation schemes by pumping water direct from the river. A number of dairies above Utungun are already using river water in this way. At present, however, pastures and fodder crops between Utungun and the sea must depend entirely on rainfall for their growth. Stock are little better off, since sub-surface water obtained from wells on the river flats is mineralised. In the not-distant past some of the existing flats adjacent to the river were probably salt-water swamps, and some low-lying areas are still in this state. The water table on the lower flats is

at about 10 feet and on higher alluvial terraces about 20 feet. Farmers must rely where they can on hillside tanks to conserve stock drinking water. As with crops and domestic supplies, stock water has thus to contend with the vagaries of the local rainfall.

(*b*) *Rainfall Characteristics of the Macksville-Utungun District.*

The average annual rainfall of Macksville (records not kept at Utungun) over a forty-year period has been 52.7 inches. The mid-North Coast of New South Wales is on the southern fringe of the summer rainfall zone of Australia. This zone includes all the tropical and sub-tropical parts of the continent and falls into—

(i) A summer monsoon region (northern Western Australia and Northern Australia)

(ii) A transitional region (interior Queensland and the northern parts of interior New South Wales).

(iii) The east coast (tropical and sub-tropical anti-cyclone zone).

The third is distinguished from the monsoon regions by its not inconsiderable rainfall during the cooler months of the year. While the highest falls are usually recorded in the hot months (December, January, February and March) winter registrations on the average seldom fall below two inches in the driest month (usually August). The tropical and sub-tropical east coast in fact comes partly under the influence of winter rain-producing systems and in a normal year escapes the true winter drought of the monsoon areas.

But in speaking of climate, one is concerned with average conditions; what of actual rainfall behaviour? Actual performance is of critical significance for the primary producer whose expectations are vitally affected by the deviation of actual rainfall from the average. Yearly figures have only a very general meaning for agriculture and grazing and at best they establish only broad zones of possibility. Weather rather than climate is of greatest concern to primary producers; crops react to weekly and sometimes daily changes in weather conditions. In the case of rainfall what the farmer wants to know is the number of times the weekly or monthly rainfall of his locality is likely to fall below what might be called the drought point for his particular land-use. Without this knowledge the average annual rainfall data is of little use. We need to know the extent of monthly, or better still, weekly deviations from the drought point before we can safely describe a locality's weather.

Remembering that the Macksville-Utungun district is primarily a dairy-grazing area, what of its monthly rainfall requirements? How much rain is needed each month to maintain normal production? Butter is the main product of the district. We shall assume "normal production" to mean butter obtained during a year in which monthly rainfall in no month falls below the drought point (i.e., the drought point for natural and improved dairy pastures and fodder crops).

Table I sets out the monthly rainfall needs of the locality and compares them with the number of times that amount of rain per month has been recorded during the past thirty-one years.

TABLE I.

Macksville—Monthly Rainfall Statistics.

Month.	Rain needed to maintain monthly production capacity of herd.*	No. of times in last 31 years in which rainfall has reached or exceeded the monthly requirement.†		Average monthly rainfall (47 years).
	Ins.	No. of times.	Per cent.	Ins.
January	6	10	31	5.6
February ...	5.5	11	35	5.9
March	5	15	48	7.1
April	3.5	21	68	5.1
May	2.75	20	65	4.0
June	2.5	13	42	3.8
July	2.5	14	45	3.2
August	3	5	16	2.5
September ...	4.5	8	26	3.0
October	5	7	23	3.5
November ...	6	5	16	3.3
December ...	6.5	8	26	4.7

* Farmers' estimates.

† In estimating this figure account was taken of the amount of rainfall received in the preceding month.

Monthly rainfall needs are based on farmers' estimates of the amount of rain required each month to maintain the average milking herd at maximum production, allowing, of course, for seasonal variations in output per cow. Without this amount of rainfall per month output per cow will decline because of pasture deterioration and inadequate drinking supplies; natural decline in production arising from the lactation cycle will be greatly accentuated.

Table I indicates that for six months (February to July) average monthly rainfall exceeds the amount dairy farmers need, but actual monthly performance over the past thirty-one years shows that a large proportion of these months did not in fact receive either the necessary or the average rainfall. Thus only 35 per cent. of Februarys were satisfactory, 48 per cent. of Marchs, 68 per cent. of Aprils, 65 per cent. of Mays, 42 per cent. Marchs, 68 per cent. of Aprils, 65 per cent. of Mays, 42 per cent. of Junes, and 45 per cent. of Julys. The rest were dry months with rainfall below the required amount. Allowing for the limited nature of our rainfall statistics we can say, broadly speaking, that during the last thirty-one years, 65 per cent. of Februarys have probably had a below-normal milk production, 52 per cent. of Marchs and so on. April, with only 32 per cent. of its years below normal, is probably the most reliable month. Coming as it does towards the end of the lactation period, however, it is not the peak producing month; but its more reliable rainfall is evidenced by a much steadier year to year production than in any other month.

From August to January average monthly rainfall is well below the amount farmers say they need to maintain the productive capacity of the herd. Only 16 per cent. of Augusts have reached or exceeded the required amount of rain; 26 per cent. of Septembers, 23 per cent. of Octobers, 16 per cent. of Novembers, 26 per cent. of Decembers, and 31 per cent. of Januarys. The lactation cycle of most herds, however, reaches its peak during November, December and January—given adequate rain it is also the season of maximum pasture growth. Production reaches its peak during early summer; it is thus the season of greatest production potentialities. However, if only 23 per cent. of Octobers, 16 per cent. of Novembers, 26 per cent. of Decembers, and 31 per cent. of Januarys have received a rainfall sufficient to maintain herds at maximum capacity, then the production potentialities of the district have been realised only in a minority of years. Because these are naturally the high producing months and at the same time least likely to receive "needed" rainfall, then the loss of possible production in a dry year must be very considerable. With 74 per cent. of Decembers for instance receiving less than the needed amount, actual production for December and perhaps January has probably reached its potential in only about 30 per cent. of seasons during the last thirty-one years.

Analysis of the monthly distribution of rainfall in the Macksville-Utungun district thus brings out the following points:—

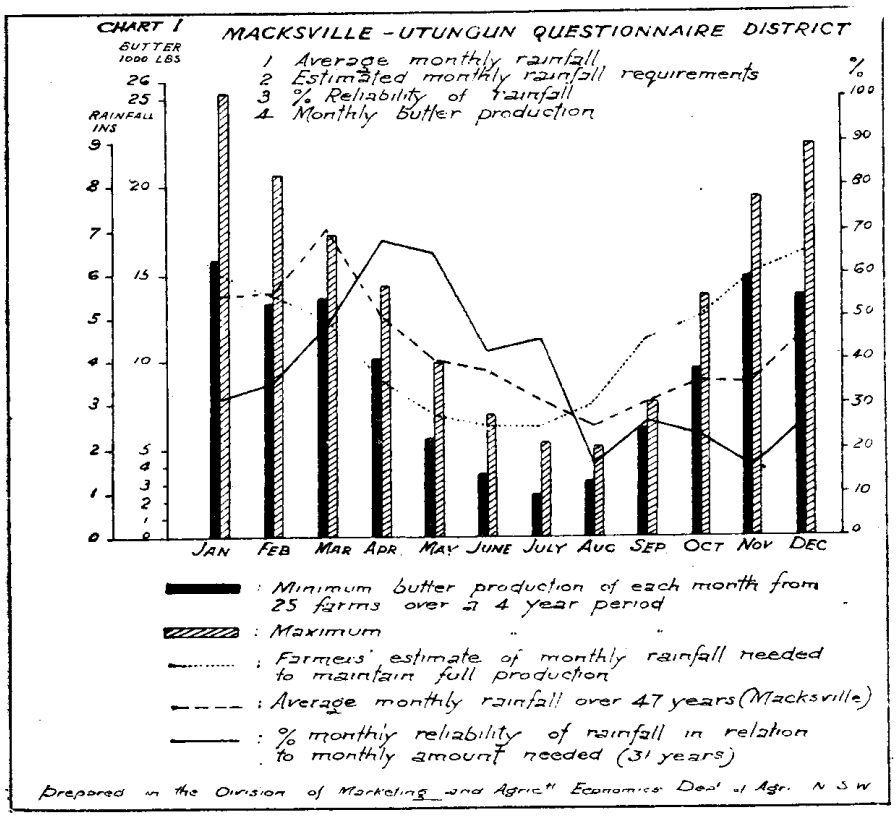
(1) For five months of the year (August to December) average monthly rainfall is well below estimated monthly requirements. August is the driest month and on the great majority of occasions (84 per cent.) its rainfall has been well below the amount required in August.

(2) August to December is the driest period of the year and spring drought seems to be normal for the district. Only occasionally is spring rainfall equal to the amount required; although spring is the season when rainfall is most needed.

(3) The wettest period of the year is from January to May with March the wettest month. From January to July the monthly average is either equal to or considerably in excess of the amount of rain needed. The period March to July is the most reliable rainfall season of the year, in so far as actual rainfall during the last thirty-one years has exceeded the monthly average on 54 per cent. of occasions.

(4) Unfortunately the period of greatest rainfall reliability (autumn and early winter) does not correspond with the season when rainfall is most needed. Spring and early summer is the critical time for building up summer pastures and hence production. Drought is thus most likely to occur at a time when production is most dependent upon adequate rainfall.

Chart I correlates average monthly rainfall, rainfall needed each month, and monthly percentage reliability for the district. Monthly butter production in a uniformly good rainfall year, and production in a uniformly bad



year have also been charted on the graph by means of bars. The probability of drought is thus seen to be greatest in August, September, October, November, and December.

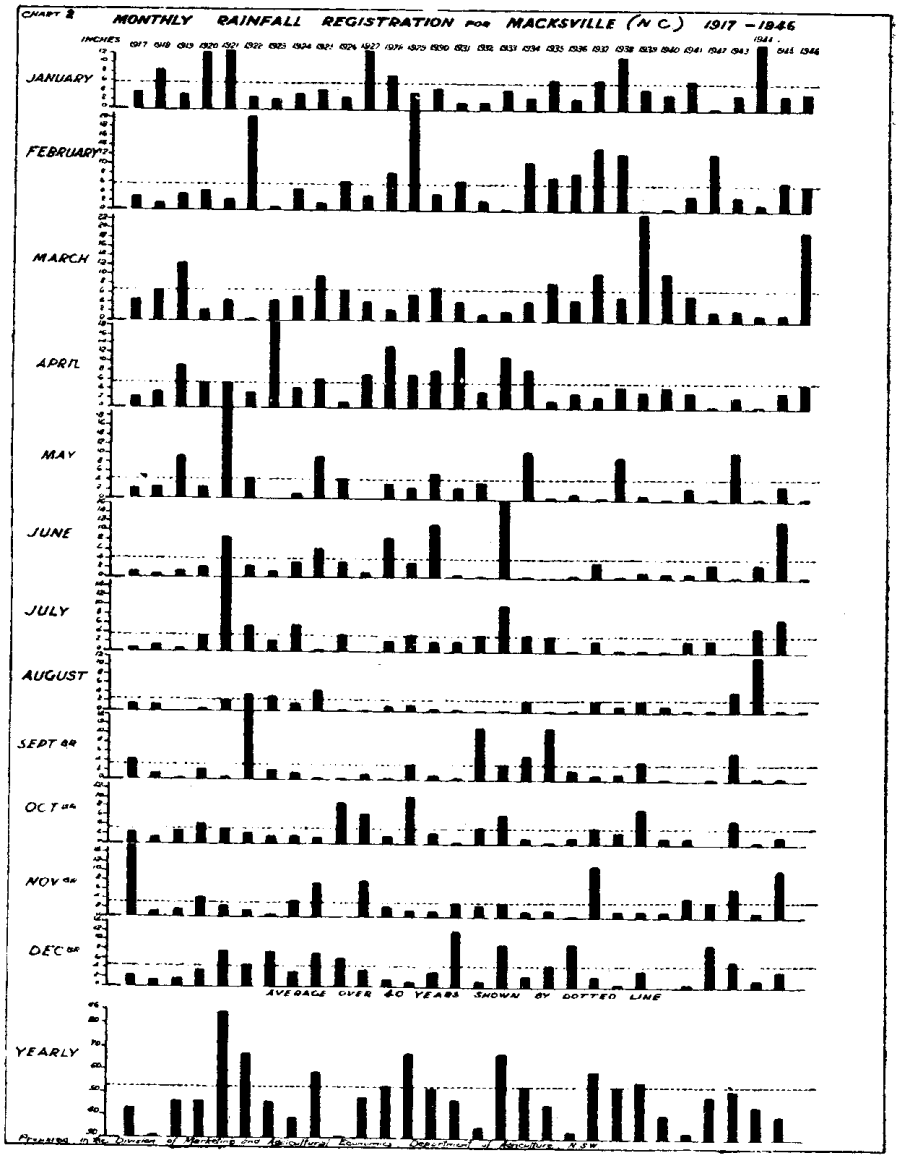
(5) Although average annual rainfall of the Macksville-Utungun district exceeds 50 inches, its significance is considerably reduced by the frequency of drought in the critical production months. From the standpoint of present land-use the climate should thus be described as sub-humid rather than humid. (See Chart 2.)

Land-use and Type of Farming.

(*a*) *Soils.*

Except for about 1,600 acres of alluvial flat the soils of the district are derived directly from early Paleozoic sediments; schistose slates, quarzites, phyllites and sandstones constitute the parent material of soils developed on the hills. Such soils tend to be shallow and have an immature structure; although podsoltic they are moderately fertile, and vegetables do well on the lighter areas.

The better soils, however, are found on the higher alluvial terraces near the river. They are well drained and not under salt influence. The lower flats are shallow with a gravelly subsoil. The soils on the higher terraces have the appearance and texture of light-grey sandy loams. These are most suitable for irrigation and have the highest agricultural potentiality.



(b) Land-use.

The district has been largely cleared and only about 1,000 acres are at present under standing timber or regrowth. The rest is under pasture of which the greater part is paspalum and white clover. In 1945-46 about 1,200 acres were under improved pasture, chiefly clovers and rye grasses. About 540 acres were cultivated—140 being under vegetables and fruit, 180 under grain crops—almost entirely maize—and 150 under green fodder crops. Only about 6 acres of lucerne were planted in the district.

The chief land-use is unquestionably dairy-grazing on natural and improved pastures. Fodder crops to supplement pastures account for three-quarters of the cultivated area. Cash crops like vegetables and bananas are of minor importance, although there has been some increase in vegetable acreages during the last five years.

(*c*) *Types of Farming.*

Of forty-five farms in the district, thirty-seven received more than 50 per cent. of their income from dairying, and twenty received more than 70 per cent. Seventeen are solely dairymen with a few pigs as a sideline. Seventeen obtained some of their income from the sale of cattle; nineteen farmers obtained some of their income from vegetables, but of these, fifteen are chiefly concerned with dairying. Only two farmers in the district are not engaged in dairying; one derives his income from the sale of vegetables and cattle and the other from the sale of vegetables, pigs, and cattle.

Table II below sets out the various combinations of activities:—

TABLE II.

Farm Types—Based on Sources of Income.

(Activities Listed in Order of Importance.)

Dairying Pigs.	Dairying, Cattle, Pigs.	Dairying, Cattle, Pigs, Vegetables.	Dairying, Pigs, Vegetables.	Dairying, Fruit, Vegetables, Cattle.	Vegetables, Dairying.	Vegetables, Cattle.	Vegetables, Pigs, Cattle.
No. of Farms.	No. of Farms.	No. of Farms.	No. of Farms.	No. of Farms.	No. of Farms.	No. of Farms.	No. of Farms.
17	9	6	9	1	1	1	1

There are forty-nine separate farms in the district at present being operated by forty-five farmers; thirty-five are owner-operators of their farms. Between seventy and eighty persons are permanently engaged in farm work in the district. Thirty owners have been working their farms for ten years or more; the remaining ten occupiers are either tenant-farmers or share-farmers.

(*d*) *Farm Areas.*

The average area of farms in the district is 173 acres; this is lower than the average area of a dairy farm in the coastal belt. The largest holding in the district is 479 acres; the smallest 48 acres. Table III classifies the forty-nine according to areas.

TABLE III.

Classification of Farms According to Areas.

Classification in Acres.	No. of Farms.	Classification in Acres.	No. of Farms.
Less than 50	1	250—299	4
50—99	12	300—349	2
100—149	13	350—399	1
150—199	8	400—449	1
200—249	5	450—499	2

Of the forty-nine holdings, twenty-six are less than 150 acres and twenty-five are between 50 and 150 acres. The 100-149 class includes the greatest number of farms (13). Thirty-nine farms are less than 250 acres and forty-three are less than 300 acres. Only two exceed 450 acres, and both of these are less than 500 acres. While the average farm area is 173 acres the modal or typical farm is only 120 acres. The district is thus characterised by the smallness of its holdings, and the possibilities of subdivision, having in mind a maximum area of, say, 200 acres, are not great. Only about five additional farms could be carved out of existing large holdings. If, however, a smaller farm area is to be aimed at, the possibilities of subdivision are greater but it must be kept in mind that at present the district is primarily a dairy-grazing area.

At present average carrying capacity throughout the district is a beast to about 3 acres; thus about 200 acres are necessary under existing conditions to carry approximately sixty-six cattle. The average size of a milking herd, however, is only about thirty cows so that a smaller area (say 150 acres) may possibly be a sufficient grazing area (i.e., an economic area). So far as individual holdings are concerned much depends upon the area of alluvial terrace available for more intensive grazing. At 150 acres about ten additional dairy farms might possibly be carved out of existing holdings by subdivision.

Current Production.

Table IV sets out the approximate numbers of the various types of stock at present carried in the district:—

TABLE IV.

Stock Numbers—Macksville-Utungun Questionnaire District.

Total Horses.	Dairy Cattle.		Total Beef Cattle.	Total Cattle.	Total Pigs.	Total Poultry.
	Milkers.	Other.				
140	1,300	750	600	2,600	900	950

Dairy farming is by far the most important occupation. For the majority of farmers, the sources of income are as follow:—

Activity.	Per cent. of Income.
From production of cream	68-80%
From sale of pigs	15-20%
From sale of cattle	5-10%

About eight farmers received 10-25 per cent. of their income from the sale of vegetables.

During the year ended 31st March, 1946, the production of cream within the area was approximately 280,000 lb. As a matter of interest, portion of the Macksville town supply of milk is also produced in the area (4-5,000 gallons per annum). Fresh milk used on the farms amounts approximately to 8,000 gallons.

In a normal year rather more than 300 baconers and porkers are marketed.

(a) Vegetable and Fruit Production.

The area devoted to vegetables for human consumption averages about 100 acres. Commercial production is practised on six to eight farms, on which the main types grown over recent years have been (in order) peas, carrots, tomatoes and potatoes. The growing of tomatoes, approximately 10 acres, has been almost entirely limited to those few areas on which water is available for irrigation. Commercial fruit production is restricted to bananas; about 40 acres are within the area.

Cultivation is therefore concerned mainly with the production of feed stuffs for dairy cattle. The average total area under crop in recent years, excluding vegetables for human consumption and fruit, has amounted to almost 400 acres. The types of crops and approximate annual area of same are as follows:—

TABLE V.

Area and Crops Cultivated.

Grain Crops.		Green Fodder Crops.					Vegetables for Animal Fodder.
Maize.	Sorghum.	Wheat and Oats.	Maize.	Sorghum.	Lucerne.	Other.	
acres.	acres.	acres.	acres.	acres.	acres.	acres.	acres.
150—200	2	40—60	30	40—50	5—10	20—30	20

The main crop, therefore, is maize for grain, total production varying from 4,000 to 5,000 bushels. The majority of farmers grow from 4 to 10 acres of maize each year. Sorghum and oats are preferred as green fodder crops, 2 to 3 acres of sorghum or 4 to 5 acres of oats or wheat being the usual areas planted.

While there are several areas on which lucerne might be a sound proposition, the crop has not been important in the past. It has been suggested that there is difficulty in getting the crop established owing to prolonged dry spells during the winter and spring months.

Fodder conservation has not been practised in the past to any great extent. Conservation has been limited to pasture hay and is only carried out during very good years when pasture growth is greatly in excess of stock requirements.

(*b*) *Pasture.*

The predominant pastures within the area are paspalum and white clover and these, together with green fodder crops, make up the main spring and summer feed stuffs for the dairy cattle. Pasture improvement is carried out fairly consistently mainly with the object of providing winter feed. Rye grass (mainly perennial) and clover (both red and white) are most favoured, the majority of farms having from 10 to 40 acres of such pasture. Rhodes grass is also important on some farms. Winter pastures are usually supplemented to a small extent by oats or wheat as green fodder crops.

Note.—This article will be concluded in the March number of the review.

SNAP FREEZING OF FOODSTUFFS.

LOCAL AND OVERSEAS DEVELOPMENTS.

In view of the recent development in the United States in connection with quick or snap freezing it is interesting to note the proposals of the St. George County Council (the electricity supply authority for portion of the Sydney Metropolitan Area, viz., the Municipalities of Bexley, Hurstville, Kogarah and Rockdale) to enlighten residents of the district as to this method of preserving food and the possibilities in Australia.

The Council is not unmindful of the fact that the development of improved methods of food freezing in Australia is not so urgent or necessary as in the United States, for instance, where climatic conditions warrant, in some respects, the adoption of a different technique in the feeding of the populace. It feels that quick freezing methods in Australia may not be commonplace for some considerable time, and, in any case, the development of the low-temperature storage unit for use in the home and installation in stores would appear to be dependent on the prior establishment of plants for bulk food processing and snap freezing with provision for transport to centres of population.

The Council holds the view, however, that the consumer in Australia should be given the opportunity to examine at first hand the operation of storage units and assess their potential value in the food distribution set up in this country. For this purpose the Council has arranged to install, at an early date, in its auditorium at Kogarah, a locally manufactured home-freezer unit. If experience justifies the experiment an additional unit will be secured for display elsewhere.

In addition to the action indicated the Council has secured considerable data on the subject, included in which was a paper by P. D. Rodgers, of the United States Department of Commerce, on the "Present Status and Probable Development of the Frozen Food Industry." The following points are interesting as indicating the present position in that country.