THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

BRUCELLOSIS

AN INVESTIGATION ON DAIRY FARMS IN THE WEST OF SCOTLAND

Agricultural Economics and
Veterinary Medicine Divisions
Auchincruive

Report No. 141
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AN INVESTIGATION ON DAIRY FARMS IN THE WEST OF SCOTLAND

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ACKNOWLEDGMENT

The authors are very grateful to all the farmers who co-operated so freely in the investigation. Many colleagues made helpful suggestions in the design of a suitable questionnaire and thanks are due to colleagues in the Agricultural Economics Division who carried out the field survey and assisted in the analyses of data. Acknowledgment is also made of the assistance of J. P. Orr,* formerly of the Veterinary Medicine Division, in the early stages of the investigation.

The authors are also indebted to Mr. J. Clark, Head of the Agricultural Economics Division, who suggested the investigation and provided sustained guidance and encouragement.

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CONTENTS

TABLES

FOREWORD

Progress since the inception of the Brucellosis (Accredited Herds) Schemes in the eradication areas has been excellent. The number of accredited dairy herds in the West of Scotland Agricultural College area has tripled during the past two-and-a-half years—a fact usually overlooked in much of the emotive public debate about the disease. This rate of progress augurs well for the future and the industry can look forward to the successful eradication of the disease.

Meantime, the disease has posed certain problems, and this study sought to find the answer to some of these by studying the relationships between management practices and the incidence and severity of the disease on a sample of 125 farm representative of a wide spectrum of farming systems. The financial performance of these farms was also related to the impact of Brucellosis on them. Although the study reveals the dangers inherent in some modern intensive systems, these must be kept in perspective. For instance, a farm with only one reactor cow was regarded as an "infected" farm and because of the dangers of misinterpretation this report is being distributed on a confidential basis. The results underline the fact that modern systems of keeping dairy cows, although more vulnerable to infection and spread of the disease, are still more profitable than the traditional systems and enable farmers to overcome breakdowns without undue financial loss.

J. S. HALL,
Principal.

BRUCELLOSIS—A PRELIMINARY FIELD INVESTIGATION ON DAIRY FARMS IN THE WEST OF SCOTLAND

SUMMARY OF FINDINGS

The investigation has shown that the incidence of Brucellosis on the sample of farms in the West of Scotland Agricultural College province varied according to geographic location. The nothern counties were freer from the disease than the southern counties. The reason for this regional difference may have been due to the increase in the number of modern dairy farming systems on large farms in the southern counties.

There was strong evidence that large herds were more susceptible to Brucellosis than small herds. This susceptibility may have been due in part to the greater probability of the spread of infection on account of close proximity of animals but was more likely to have been the result of the introduction of the disease by stock bought in either during expansion of the herd or in changing from one breed to another.

The disease was more common in herds with loose-housing systems, where silage was fed to cows in the winter than herds housed in byres and fed on hay.

In the northern counties, infection appears to have been associated equally with byres and loose-housing whereas in the south loose-housing was more highly associated with Brucellosis than byre systems. In loose-housing systems, cows mingle freely and although slurry may be scraped away daily, the overall standard of hygiene is usually not as high as in byre systems. There is obviously a much greater opportunity in loose housing systems for cows to pick up infective material. In loose-housing conditions cows should be put into isolation boxes to calve and, where abortion does occur, feotus and afterbirth should be removed and destroyed, the affected area being thoroughly disinfected.

The findings should not be interpreted as a condemnation of loose-housing systems but they stress the need for adequate hygienic precautions to be taken.

The investigation showed that the incidence of Brucellosis was greater on farms feeding mainly silage in winter than on hay feeding farms. Predominantly 'silage feeding' farms associated with byres had as much infection as 'silage feeding' farms associated with loose-housing systems. 'Silage' farms in the southern counties reported more infection than 'silage' farms in the northern counties.

There was apparently no significant difference in the association between self-feeding and other methods of silage feeding and the occurrence of Brucellosis. This matter needs further investigation.

The findings should not be used as an argument against silage feeding. Both silage-feeding and loose-housing are normally only a reflection of the intensification of systems often associated with expansion. The disease is a 'social' one and loose-housing and self-feeding silage systems allow greater contact between cows in the herd and this can predispose to

a spread of infection. The need is to reduce the risk of introducing infection and to take measures to prevent its spread.

The investigation demonstrated clearly the dangers inherent in buying untested stock, particularly where this is a regular policy. The same dangers are, of course, present when stock are bought only occasionally. Once the disease is introduced it will tend to spread more rapidly in large herds, particularly those practising intensive methods than in small herds where stock are less free to mix or methods are not so intensive.

Herds which are expanding tend to cross-breed but they also buy in animals and this latter factor could account for cross-bred herds showing a higher incidence of Brucellosis than pure bred herds.

There was also some evidence that herds with a high proportion of second-crosses had a higher degree of infection and this is a matter requiring further investigation.

In the purchase of stock and where arrangements are made to graze 'away' dry and young stock, contact with infected or suspect stock from other farms should be avoided.

The disease did not appear to be related to intensive *grazing* systems or to differences in the levels of stocking intensity practised in the West of Scotland. It did not appear to affect high-yielding herds (average of over 800 gallons per cow) more than low-yielding herds and there was no significant difference between seasonality of milk production and the incidence of Brucellosis.

The disease appeared to be more associated with the type of buildings and method of winter feeding than with the grazing arrangements. On farms with separate calving accommodation and cattle handling facilities the percentage of infected farms was markedly higher (and the severity of the disease was greater) in loose-housed herds than in byres.

For all the dangers and risks which are apparent in modern, intensive systems, the financial implications of the disease have not been unduly severe. Indeed, affected farms performed financially as well as 'clean' farms, the adoption of modern techniques enabling the affected farmers to 'ride out' Brucellosis, loss from the disease being compensated by the higher stocking density. The longer term financial implications of the disease will be studied in greater depth in the future.

1.0 INTRODUCTION

Area eradication of Brucellosis commenced in three areas of the United Kingdom on 1 November 1971, with a programme of compulsory blood testing of all herds not already in the Voluntary Schemes in these areas. From the initial areas, the eradication programme will extend to other adjoining zones until the whole of the country is Brucellosis free.

In the province covered by the West of Scotland Agricultural College, the initial areas chosen for eradication include the counties of Argyll and Bute. The extension zones, in which testing began in 1972/73, include the counties of Dunbarton, Renfrew and part of Stirlingshire, and will be extended in November 1973 to the county of Ayr.

This report begins with a summary of facts about Brucellosis. This is followed by a summary of the results of a field-investigation on dairy farms in the West of Scotland Province. Finally, prophylactic measures are discussed.

2.0 SOME FACTS ABOUT BRUCELLOSIS

2.1 What is Brucellosis?

Brucellosis is an infectious disease of animals and man and is caused by one of the members of the group of bacteria known as *Brucella.* There are, in fact, several strains of *Brucella* but only one of these, as far as is known—*Brucella abortus*—is found in British livestock. Cattle are the main hosts of *Brucella abortus* but it can also affect a wide range of other hosts such as human beings, horses, dogs, sheep, goats, pigs and various wild animals.

Abortion is the most obvious sign of the disease in cattle. However, cows can be infected and be capable of infecting others without themselves aborting.

2.2 The Course Taken by the Disease

When a cow becomes infected the bacteria enter the blood stream and multiply slowly for months in various cells of the body. From these cells they invade the pregnant uterus, the udder and other tissues. In the cow, *Brucella abortus* is attracted to the pregnant uterus and causes inflammation of the placenta. This inflammation causes a loss of attachment between the calf and its dam and results in premature expulsion of the calf—abortion—usually between the fifth and eighth month of pregnancy.

Sometimes a cow can carry her calf to full term even though she is infected. Such animals are a danger to the rest of the herd because the absence of abortion does not raise any suspicion in the farmer's mind. Nevertheless, the placenta and uterine discharges will be as heavily contaminated as in a cow that aborts.

The aborted placenta from an affected cow is highly infective. Furthermore, the uterine discharges remain infective for almost three weeks but occasionally excretion of the germs may continue for several months. When an infected cow becomes pregnant again, excretion of the germ from the uterus stops because of the presence of a plug of thick mucus in the neck of the womb. However, it may recommence at the subsequent calving or abortion.

It is uncommon for a cow to abort twice in succession because an infected cow vaccinates herself. Repeated abortions can, however, occur if the cow is exposed to heavy infection and once it is infected a cow may excrete the germ at each subsequent calving through outher breeding life.

In the non-pregnant adult animal, *Brucella abortus* tends to establish itself in the udder and its associated lymph glands but can invade other tissues as well. Cows with infected udders may excrete the germ in the milk intermittently for the whole of their milking life.

As a general rule, the highest incidence of the disease is in second calvers. The reason for this is that in-calf heifers are usually kept separate from the milking herd and are therefore not exposed to heavy infection until after they calve for the first time. If, however, in-calf

heifers graze fields on which abortion has recently occurred they may pick up *Brucella abortus* and subsequently abort.

When the disease occurs for the first time in a clean unvaccinated herd, the abortion rate may be as high as 50 *per cent.* This is the so-called 'Abortion Storm.' Generally, however, about 25 *per cent* of the herd becomes infected initially and the number of abortions then reduces over a period of years.

It should be noted that abortion may arise from causes other than Brucellosis. Disease such as Salmonellosis, Tick Borne Fever, certain virus infections, Vibrio foetus infection, Trichomoniasis and fungal infections can all be associated with abortion. Few abortions result from accidents or fright and it is therefore essential to obtain an early diagnosis of the cause when abortion occurs.

2.3 How Does a Herd Become Infected?

This can happen in a number of different ways but the most common source of infection in a clean herd is through the unwitting introduction of an infected female. Such an animal may not have previously aborted and she may not do so later, but, as explained previously, her placenta and uterine discharges could be heavily contaminated.

Infection can also be introduced from neighbouring infected farms by contact with cattle at boundary fences, through infected animals straying on to the land, contamination of drinking places or due to dogs, vermin, etc., gaining access to contaminated afterbirth and subsequently transferring organisms to a clean farm. The disease may also be introduced by humans who have been in contact with infected material and who accidentally carry the bacteria on boots and clothing. Similarly, hired or borrowed machinery may carry infection from an infected to a clean farm.

An infected bull could also introduce the disease—either one used for natural service or, very remotely, through AI. In the bull, the testicle is usually the site of the disease and infected bulls may become sterile. *The possibility of semen from bulls in official AI Centres transmitting the disease is so remote that it can be disregarded.*

2.4 How the Disease Spreads within a Herd

The immediate cause of the spread of Brucellosis within a herd is the dissemination of bacteria in the discharges of affected cows.

These discharges contain vast numbers of bacteria—a piece of infected afterbirth, the size of a thumbnail for instance, can contain more than a million *Brucella abortus.*

Infected material can contaminate bedding, floors, feeding area, pastures, fodder and drinking water, thus setting up dangerous sources of infection. Unless contaminated material is dealt with immediately the bacteria can easily be carried all over the farm on boots of workers

or on the feet of animals from the area where the abortion occurred. A cow may be infected by eating or licking a piece of contaminated afterbirth or by licking the skin of an infected cow or contaminated newly born calf.

2.5 The Economic Losses Caused by Brucellosis in a Dairy Herd

The following may have financial implications for dairy farmers.

(i) The loss of a calf (which may be a potentially valuable cow or bull or beef animal).

(ii) The loss of milk—which could account for about one-third of the normal milk yield of the cow for that lactation.

(iii) Interference with planned milk production programmes.

(iv) Interference with breed improvement programmes—through the forced disposal of breeding cows.

(v) Interference with farm investment programmes by having to replace cows instead of undertaking some other planned investment.

3.0 OBJECTIVES OF THE INVESTIGATION

The West of Scotland was included in the early stages of the Brucellosis Eradication Scheme and the College felt that it would be useful to establish factual data on aspects of the following:

(i) The present incidence of Brucellosis based on a sample fairly representative of dairy farms generally in the area.

(ii) Relationships between management practices and the incidence and severity of Brucellosis.

(iii) The financial implications of the incidence of Brucellosis to herd owners.

To obtain some of this information the College Agricultural Economics and Veterinary Medicine Divisions conducted a survey of those milk producers already co-operating with the College in the collection of financial data for Price Review purposes. This is as near a representative sample of dairy farms in the Province as is practical in normal voluntary 'co-operation' circumstances between the College and farmers.

4.0 THE FARMS IN THE INVESTIGATION

A total of 125 dairy farms co-operated in 1972 and 1973, in providing annual financial information to the College, and all of them agreed to allow access to Brucellosis health records for the purpose of the investigation. The farms were located in the following counties:

County	*Number of Farms*
Argyll	4
Ayr	29
Dunbarton	3
Dumfries	28
Kirkcudbright	13
Lanark	26
West Perth	1
Renfrew	3
Stirling	3
Wigtown	15
	125

5.0 THE INCIDENCE OF BRUCELLOSIS ON THE FARMS IN THE INVESTIGATION

Out of the total of 125 farms, 50 were affected with Brucellosis at the time of the investigation. The affected farms were classified into those with either a 'high' or a 'low' incidence of Brucellosis. Farms were described as having a '*high incidence*' of Brucellosis when 10 *per cent or more* of the cows in the herd were affected and a '*low incidence*' when *less than* 10 *per cent* of the herd was affected.

Of the 50 affected herds one-third reported a 'high' and two-thirds reported a 'low' incidence of Brucellosis.

Relating this to the sample as a whole, about one farm in four had a low and about one farm in seven had a high incidence of Brucellosis.

6.0 SOME RELATIONSHIPS BETWEEN MANAGEMENT AND OTHER FACTORS ON DAIRY FARMS AND THE INCIDENCE AND SEVERITY OF BRUCELLOSIS

A number of relationships were studied. These included the association between Brucellosis and the following: location, herd size, breed, replacement policy, type of housing, main type of bulk feeding, system of grazing, stocking intensity, milk production per cow, seasonality of milk production, the provision of separate calving accommodation, the provision of cattle-handling facilities and a number of combinations of these factors.

6.1 Incidence of Brucellosis Related to Region

Table 1

INCIDENCE OF BRUCELLOSIS RELATED TO REGION—125 FARMS

Region (1)	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low*	High*
				% of Infected Farms	% of Infected Farms
Northern	62	17	27.4	82.4	17.6
Southern	63	33	52.4	57.6	42.4

*Low Severity=equal to or less than 10% of Cows Affected.
High Severity=more than 10% of Cows Affected
(Chi-square=8.1125 d.f.=1 P <0.01 Highly Significant)

(1) *Northern Region* Includes the counties of Argyll, North Ayrshire, Dumbarton, Lanark, West Perth, Renfrew and Stirling
Southern Region Includes the counties of South Ayrshire, Dumfries, Kirkcudbright and Wigtown

From Table 1 it is apparent that variation in the incidence of Brucellosis on the farms in the sample was associated with geographic location. Approximately one-quarter of the farms in the 'Northern Region'* reported the incidence of Brucellosis compared with approximately one-half in the 'Southern Region.' (This difference was highly significant statistically.)

A higher proportion of infected herds in the Southern Region reported a greater severity of Brucellosis—four out of ten affected farms in the Southern Region had a high incidence of the disease compared with less than two out of ten in the Northern Region.

The 'cause' and 'effect' of the regional difference in the occurrence of Brucellosis are, of course, difficult to establish. Was the disease more prevalent in the Southern Region regardless of herd size or was it that the disease was likely to be more prevalent in large herds which were found mainly in the South? Were there differences in method of housing or type of feeding in the two areas? Has a lower proportion of herds in the Southern Region undertaken voluntary testing than in the Northern Region?

*Northern—Argyll, North Ayrshire, Dunbarton, Lanark, West Perth, Renfrew and Stirling
Southern—South Ayrshire, Dumfries, Kirkcudbright, Wigtown

6.2 Incidence of Brucellosis Related to Herd Size

The farms were grouped according to herd size—smaller herds with up to 79 cows (86 farms) and larger herds with 80 cows and over (39 farms). The incidence of Brucellosis related to herd size is shown in Table 2.

Table 2

INCIDENCE OF BRUCELLOSIS RELATED TO HERD SIZE—125 FARMS

Herd Size	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Up to 79 Cows	86	27	31.4	66.6	33.4
80 cows and over	39	23	58.97	65.2	34.8
ALL FARMS	125	50	40.0	66.0	30.0

Average size of infected herd = 82
Average size of non-infected herd = 57
Using t test the difference between means was found to be very highly significant
($t = 4.355$ d.f. = 123 $P < 0.001$)

In the smaller herds about one-third reported the occurrence of Brucellosis. In the larger herds, six out of ten farms reported the incidence of the disease. There was, therefore, a significant difference (statistically) between the larger and smaller herds in the incidence of the disease—larger herds reporting a proportionately greater incidence than smaller herds.

Larger dairy farms are more common in the Southern Region of the College province. Accordingly, it could be expected that there would be a higher incidence on 'Southern' than 'Northern' farms in the province. The severity of the disease on affected farms was similar in the larger and smaller herds—approximately two-thirds of affected herds showing a low and one-third a high incidence of Brucellosis.

6.3 Incidence of Brucellosis Related to Type of Housing for Dairy Cows

A comparison was carried out between type of housing for dairy cows and the incidence of Brucellosis. The results are presented in Table 3.

Table 3

INCIDENCE OF BRUCELLOSIS RELATED TO TYPE OF HOUSING FOR COWS—125 FARMS

Type of Housing	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Loose Housing Systems*	44	23	52.3	47.8	52.2
Byre-Tied Up	81	27	33.3	81.5	18.5

*Includes Loose Housing in Byres, Cubicles and Courts but is mainly cubicles
(Chi-square=4.2613 d.f.=1 $P < 0.05$ Significant)

Of the 125 farms in the survey, approximately two-thirds housed the herd in byres and one-third had 'loose-housing' systems. There was a strong association between loose-housing systems and the incidence of Brucellosis with over half such herds being infected. Only one-third of the farms with byre systems reported the occurrence of Brucellosis.

Of the affected farms with byres, more than eighty per cent had a 'low' incidence of the disease but in the loose-housing systems, more than half the affected farms had a high incidence. *The occurrence of Brucellosis was not only more common but also more severe with loose-housing systems than where cows were in byres.*

In byre systems, cleaning out is usually a daily routine so that infected material tends to be removed to a midden; cows do not have the same opportunity to sniff at excrement or aborted foetuses as they do in loose-housing systems where cows mingle freely and the standard of cleanliness may not be always as high as in byres. Accordingly, cows in loose-housing systems have a greater opportunity to pick up infected material than in byres.

These findings are not necessarily unexpected but they stress the need for precautionary management measures to be carefully observed, particularly with loose housing systems.

6.4 Incidence of Brucellosis Related to Type of Housing and Region

In Table 4 the incidence of Brucellosis is related to the type of housing and the region. Care has to be taken in the interpretation of the results due to the low number of farms in some of the groups, particularly 'loose-housing' in the Northern Region. Nevertheless in both byre and loose-housing systems the incidence of Brucellosis was higher in the Southern Region than in the Northern Region, appreciably so in the case of loose-housing.

In the Northern Region there was no significant difference in the incidence of Brucellosis between byres and loose-housing systems.

In the Southern Region, the severity of the disease was greater in loose housing systems than in byres.

Table 4

INCIDENCE OF BRUCELLOSIS RELATED TO TYPE OF HOUSING AND REGION—125 FARMS

Type of Housing and Region	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Loose Housing					
Northern	18	4	22.2	100	—
Southern	26	19	73.1	36.8	63.2
Byre					
Northern	44	13	29.5	76.9	23.1
Southern	37	14	37.8	85.7	14.3

Northern Region
Chi-square (corrected) = 0.07 d.f. = 1 Non-significant

Southern Region
Chi-square (corrected) = 6.25 d.f. = 1 $P < 0.05$ Significant

6.5 Incidence of Brucellosis Related to Type of Bulk Feeding of Cows in the Winter

A comparison was made between type of bulk feeding of cows in the winter and the incidence and severity of Brucellosis infection. (See Table 5.)

Table 5

INCIDENCE OF BRUCELLOSIS RELATED TO TYPE OF BULK FEEDING OF COWS—125 FARMS

Type of Bulk Feed	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Mainly Hay	61	14	22.9	78.6	21.4
Mainly Silage	64	36	56.2	61.1	38.9

(Chi-square = 14.4297 d.f. = 1 $P < 0.001$ Very Highly Significant)

Of the 125 farms in the sample, 61 fed a 'mainly hay' and 64 a 'mainly silage' bulk feed diet in the winter.

There was a strong association between the type of bulk feed and the incidence of Brucellosis. Under one-quarter of the mainly hay-feeding farms were affected with Brucellosis compared with well over half the mainly silage-fed herds.

With 'mainly hay' feeding systems, just over 20 per cent. of the affected farms reported a 'high' incidence of Brucellosis. Silage feeding was predominant in Southern herds (57%) and hay feeding predominant in the Northern herds (55%).

From the foregoing it appears that the occurrence of Brucellosis was more common in herds feeding a 'mainly-silage' diet than in herds feeding 'mainly-hay.' It would seem logical to ascribe this to self-feeding silage systems where cows are in close contact with each other and where the opportunity for cross infection could be greater. However, closer examination of silage-feeding farms indicates that this is not necessarily the case. Table 6 shows the incidence of Brucellosis related to the system of feeding silage to cows.

Table 6

INCIDENCE OF BRUCELLOSIS RELATED TO SYSTEM OF FEEDING SILAGE TO COWS—64 FARMS

Type of Silage Feeding	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Self Fed Silage*	37	20	54.0	50.0	50.0
Other methods of Silage Feeding	27	16	59.2	75.0	25.0

*Includes Mechanical Feeding

There was apparently no significant difference in the occurrence of Brucellosis between self-feeding systems and other methods—predominantly hand fed or rationed silage feeding—but the severity of the disease tended to be greater in the self-feed silage group.

It could be that silage cut from infected pastures is an excellent medium on which the bacteria can survive and multiply. Slurry and manure from middens, containing infective material, is often spread on silage fields and could be a source of contamination. Hay may be less likely to contain infection due to the dessication of the crop at harvest whereas the moisture and warmth of silage may favour survival of germs. This is speculation—*clearly there is need for further investigation of these possibilities.*

6.6 Incidence of Brucellosis Related to Bulk Feeding and Region

The relationship between the occurrence of Brucellosis and bulk feeding when region is taken into account is illustrated in Table 7.

Table 7

INCIDENCE OF BRUCELLOSIS RELATED TO BULK FEEDING AND REGION—125 FARMS

Bulk Feeding and Region	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Hay Farms					
Northern	34	7	28.6	71.4	28.6
Southern	27	7	25.9	85.7	14.3
Silage Farms					
Northern	28	10	35.7	90.0	10.0
Southern	36	26	72.2	50.0	50.0

On both hay and silage feeding farms the occurrence of Brucellosis was higher in the Southern Region than in the Northern Region. The difference was very marked in the case of the silage-feeding group where about one-third of the herds in the Northern Region and over two-thirds in the Southern Region were affected. The disease also tended to be more severe on Southern farms.

Table 8 indicates that the percentage occurrence of Brucellosis on silage feeding farms was appreciably higher in large herds than in small herds. It also indicates that the Southern region had not only a higher proportion of large herds but also that, even in herds of up to 69 cows, Southern farms had a higher incidence of the disease!

Table 8

INCIDENCE OF BRUCELLOSIS ON SILAGE FEEDING FARMS RELATED TO HERD SIZE AND REGION—64 FARMS

Herd Size (No. of Cows)	No. Farms	No. Infected	% of Total Infected	Low Incidence		High Incidence	
				No.	% of Infected Farms	No.	% of Infected Farms
	Southern Region						
Up to 69	12	8	75.0	4	50.0	4	50.0
70 to 69	11	6	54.5	4	66.6	2	33.3
100 to 129	5	5	100.0	2	40.0	3	60.0
130+	8	7	87.5	3	42.8	4	57.2
	Northern Region						
Up to 69	16	6	37.5	5	83.3	1	16.7
70 to 99	9	2	22.2	2	100.0	—	—
100 to 129	1	1	100.0	1	100.0	—	—
130+	2	1	50.0	1	100.0	—	—

On silage-feeding farms in the Southern region the incidence of Brucellosis in herds over 100 cows was very high with 12 out of 13 farms being affected. Nine of the 12 affected farms—75 per cent.—were using self-feed silage systems.

6.7 Incidence of Brucellosis Related to Type of Housing and Bulk Feeding

In Table 9, the incidence of Brucellosis is related to both types of housing and bulk feed.

Table 9

INCIDENCE OF BRUCELLOSIS RELATED TO TYPE OF HOUSING AND BULK FEED—125 FARMS

Type of Housing and Bulk Feeding	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Loose Housing					
Hay	5	2	40.0	50.0	50.0
Silage	39	21	53.8	47.6	52.4
Byre					
Hay	56	12	21.4	83.3	16.7
Silage	25	15	60.0	80.0	20.0

Infected herds only:
Chi-square (corrected) = 6.19 d.f. = 1 $P < 0.05$ Significant

In byres there was a markedly higher occurrence of Brucellosis when silage rather than hay was the main feed. In loose-housing systems the difference between hay and silage farms in the incidence of Brucellosis was much less, though it must be pointed out that the sample size of hay feeding farms with loose housing systems was probably too small to draw any worthwhile conclusions. It would appear, however, that silage as a winter feed again emerges as a potential source of *Brucella* organisms!

6.8 Incidence of Brucellosis Related to Replacement Policy

The incidence of Brucellosis could be related to replacement policy—those herds 'buying in' being more likely to be affected than those rearing their own replacements.

Table 10 shows that the incidence of the disease was higher on farms buying in replacements regularly—nearly three-quarters of the latter category of farms were affected—but the number of herds was small.

Table 10

INCIDENCE OF BRUCELLOSIS RELATED TO REPLACEMENT POLICY—125 FARMS

Herd Replacement Policy	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
All Home-Bred	107	37	34.6	64.9	35.1
Some or All Purchased	18	13	72.2	69.2	30.8

(Chi-square=9.0970 d.f.=1 $P < 0.01$ Highly Significant)

Of the 107 farms which reared their own replacements only about one-third reported Brucellosis.

In section 3.3 it was pointed out that the most common source of infection is through the unwitting introduction of an infected female. The results seem to underline this danger.

6.9 Incidence of Brucellosis Related to Breed

Herds which are in the process of changing breeds often have less chance of culling their replacements and may also have purchased some replacements. A comparison between herds of pure bred cattle (both Ayrshire and Friesian) and those containing crosses is shown in Table 11.

Table 11

INCIDENCE OF BRUCELLOSIS RELATED TO PURE BREEDS AND CROSS BREEDS—125 FARMS

Breed	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Pure Breeds	45	9	20.0	100	—
Crosses	80	41	51.3	58.5	41.5

(Chi-square = 11.718750 d.f. = 1 $P < 0.001$ Very Highly Significant)

There is a significant difference between cross-bred herds and pure-bred herds in the occurrence of Brucellosis. The disease was more prevalent in herds where Ayrshires were being crossed towards a Friesian herd than in herds with pure breeds (either Ayrshire or Friesian). Of the 45 farms with pure bred cattle, 9 farms reported Brucellosis—all with a low incidence of the disease. On the other hand, of the 80 farms with crosses, 41 farms reported Brucellosis and, significantly, over 40 *per cent* of these reported a high incidence of the disease. *This is clearly a matter for further investigation;* the limited evidence from this investigation shows that herds with a high proportion of second-crosses had a higher degree of infection than those with a high proportion of first crosses.

6.10 Incidence of Brucellosis Related to System of Grazing

Brucellosis might appear to be more likely to occur on farms practising intensive grazing systems (such as strip grazing and paddock grazing) than when less intensive grazing systems are practised because the cows would be (*a*) in closer proximity to each other and (*b*) more likely to graze the pasture closely and therefore have a greater opportunity to pick up infection. The farms were divided into 'intensive' and 'other' grazing systems according to the foregoing classification and the results are presented in Table 12.

Table 12

INCIDENCE OF BRUCELLOSIS RELATED TO GRAZING SYSTEM— 125 FARMS

Grazing System	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Intensive Systems	59	28	47.5	53.6	46.4
Other Systems	66	22	33.3	81.8	18.2

(Chi-square = 2.5894 d.f. = 1 Not Significant)

There was no significant difference between intensive grazing systems and other grazing systems in the occurrence of Brucellosis but the disease tended to be more severe on those farms practising intensive grazing compared with herds practising other methods.

6.11 Incidence of Brucellosis Related to Stocking Intensity

In addition to grazing and winter feeding systems, the intensity with which stock was carried might be considered a possible predisposing factor to the dissemination of Brucellosis within a herd. The intensity of stocking was measured in terms of the number of grass acres (whether as grazing or conserved products) required to support a cow (or its equivalent in other cattle and sheep) for the year. The average stocking density on the farms in the survey, measured in this way, was 1.3 acres per Grazing Livestock Unit. The sample was divided into two groups—those with an above and those with an average or below average stock carry. The results are shown in Table 13.

Table 13

INCIDENCE OF BRUCELLOSIS RELATED TO STOCK CARRY—125 FARMS

Stocking Intensity	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Above Average (less than 1.3 acres per Grazing Livestock unit)	63	25	39.7	68.0	32.0
Below Average (1.3 acres per Grazing Livestock unit or more)	62	25	40.3	64.0	36.0

There was no significant difference between the two groups either in the intensity or severity of the disease.

6.12 Incidence of Brucellosis Related to Milk Production Per Cow

The herds were divided into those yielding 800 gallons per cow and over and those yielding less as in Table 14.

Table 14

INCIDENCE OF BRUCELLOSIS RELATED TO MILK PRODUCTION PER COW—125 FARMS

Yield per Cow (gallons)	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Up to 799	51	19	37.3	68.4	31.6
800 and Over	74	31	41.9	64.5	35.5

(Chi-square=0.2705 d.f.=1 Not Significant)

Using t-test the difference between the average yields of infected and non-infected herds was found to be non-significant.

The results in Table 14 indicate—and statistical analysis of all results supports this evidence—that there was no significant difference between the level of yield and the incidence or severity of the disease.

6.13 Incidence of Brucellosis Related to Seasonality of Milk Production

The herds in the sample were classified according to seasonality and an analysis carried out to ascertain if the incidenceof Brucellosis was related to seasonality of calving. The results are shown in Table 15.

Table 15

INCIDENCE OF BRUCELLOSIS RELATED TO SEASONALITY OF MILK PRODUCTION—125 FARMS

Seasonality of Milk Production	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Summer	44	14	31.8	100	—
Intermediate	46	21	45.7	57.1	42.9
Winter	35	15	42.9	46.7	53.3

There was no significant difference between the seasonality of milk production and the incidence of Brucellosis. However, all the 'summer' milk herds reported a low severity of infection, whereas a relatively large proportion of herds in the 'intermediate' and 'winter' groups reported a high severity of infection. This may be worth further investigation.

6.14 Incidence of Brucellosis Related to Provision of Separate Calving Accommodation

The provision of separate calving accommodation is frequently advised as a preventative measure against the spread of the disease. The farms in the investigation were grouped according to the presence or absence of separate calving accommodation and the results are given in Table 16.

Table 16

INCIDENCE OF BRUCELLOSIS RELATED TO THE PROVISION OF CALVING ACCOMMODATION—125 FARMS

Type of Calving Accommodation	No. of Farms	No. Infected	%of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Separate Calving Accommodation Available	79	37	46.8	64.9	35.1
No separate Calving Accommodation	46	13	28.3	69.2	30.8

(Chi-square=4.18 d.f.=1 P <0.05 Significant)

The group of farms with separate calving accommodation showed a greater incidence of Brucellosis than the group of farms with no separate accommodation. This result was surprising, but since separate calving accommodation is often associated with loose-housing of cows, the higher incidence of Brucellosis might have been due more to type of housing than to the calving accommodation *per se*. The sample was grouped by calving accommodation and type of housing and the results are shown in Table 17.

Table 17

INCIDENCE OF BRUCELLOSIS RELATED TO THE PROVISION OF CALVING ACCOMMODATION AND TYPE OF HOUSING—125 FARMS

Type of Housing and Provision of Calving Accommodation	Number of Farms	Number Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Loose-Housing Separate Calving Accommodation Available	41	22	53.60	45.4	54.6
No Separate Calving Accommodation	3	1	33.33	100.0	—
Byres Separate Calving Accommodation Available	49	19	38.78	78.9	21.0
No Separate Calving Accommodation	32	8	25.00	87.5	12.5

In loose-housed herds, the majority had separate calving accommodation, the number of loose-housed herds without calving accommodation being too low to draw any valid comparison. In byre-housed herds, 60 *per cent* had separate calving accommodation available.

On farms with separate calving accommodation available, the percentage of infected farms was markedly higher and the severity of the disease was greater in loose-housed herds than in byres. This suggests that the difference was associated with the method of housing.

With byres, those farms with separate calving accommodation showed a higher incidence of infection but there was little difference in the severity of the disease on infected farms.

It must be remembered that routine use of calving accommodation will not necessarily mean the isolation of cows aborting between the 5th and 8th month. Nevertheless, it is important to isolate cows after they have aborted in order to avoid further dissemination of infection and to disinfect the area where they aborted. Obviously, the calving accommodation should also be thoroughly cleared and disinfected after use.

6.15 Incidence of Brucellosis Related to the Provision of Cattle Handling Facilities

A similar result to that obtained for calving accommodation was found when the farms in the investigation were grouped according to the presence or absence of cattle handling facilities. This is shown in Table 18.

Table 18

INCIDENCE OF BRUCELLOSIS RELATED TO PROVISION OF CATTLE HANDLING FACILITIES (1)—125 FARMS

Type of Cattle Handling Facilities	No. of Farms	No. Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Separate Cattle Handling Facilities (1)	47	24	51.1	50.0	50.0
No Cattle Handling Facilities	78	26	33.3	80.8	19.2

(1) Portable or Fixed Crushes, Crush and Race
(Chi-square=3.8417 d.f.=1 $P<0.05$ Significant)

A significantly higher proportion of farms in the group with separate cattle handling facilities reported Brucellosis compared to those with no facilities.

The sample was grouped by cattle handling facilities and type of housing. The results are shown in Table 19.

Table 19

INCIDENCE OF BRUCELLOSIS RELATED TO THE PROVISION OF SEPARATE CATTLE HANDLING FACILITIES* AND TYPE OF HOUSING—125 FARMS

Type of Housing and Provision of Cattle Handling Facilities*	Number of Farms	Number Infected	% of Total Farms Infected	Severity on Infected Farms	
				Low	High
				% of Infected Farms	% of Infected Farms
Loose-Housing					
Separate Cattle Handling Facilities Provided	25	15	60.0	33.3	66.7
No Separate Cattle Handling Facilities	19	8	42.1	75.0	25.0
Byres					
Separate Cattle Handling Facilities* Provided	23	11	47.8	81.8	18.2
No Separate Cattle Handling Facilities	58	16	27.6	81.2	18.8

*Portable or Fixed Crushes, Crush and Race

In loose-housed herds, almost 60 *per cent* and in byre-housed about 30 *per cent* of farms had cattle handling facilities.

In both loose-keeping and byres, the farms with cattle handling fcailities showed a higher incidence of Brucellosis than farms without such facilities.

It was not possible to determine whether the presence of handling facilities was due to a previous history of the disease resulting in late remedial action as could have been the case with the presence of calving accommodation.

7.0 THE FINANCIAL IMPLICATIONS OF BRUCELLOSIS TO HERD OWNERS

In Section 3.5 the economic losses caused by Brucellosis were listed. These were impossible to measure in the short-term and the investigation is to continue over at least three years in an attempt to establish the nature and magnitude of losses on affected farms.

Initially, an attempt was made to measure differences, if any in the 'Management and Investment Income'* and 'Return on Tenancy Capital'** on infected farms compared with those farms with no Brucellosis. The results are summarised in Table 20.

Table 20

AVERAGE MANAGEMENT AND INVESTMENT INCOME PER ACRE AND AVERAGE RETURN ON TENANCY CAPITAL RELATED TO INCIDENCE OF BRUCELLOSIS—1971/72 FINANCIAL YEAR

	'Clean' Farms	'Infected' Farms	Severity of Infection	
			Low	High
Average Management and Investment Income per acre	£23.00	£25.42	£25.38	£25.49
Average Return on Tenancy Capital	23.5%	26.1%	25.2%	27.8%
Average Size (acres)	150	209	195	234

There was no significant difference in the average 'Management and Investment Income per acre' between 'infected' farms and 'clean' farms. Indeed, the average Management and Investment Income was £2.42 per acre higher on the 'infected' farms. Examination of the range of Management and Investment Income in each group showed a similar dispersion, the highest income of £80.45 per acre being obtained on a farm with a relatively high incidence of Brucellosis.

Examination of the 'Average Return on Tenancy Capital' revealed a similar picture to 'Management and Investment Income.' There was no significant difference in the average return on tenancy capital

*_Management and Investment Income_ represents the net farm income trading revenue minus the total of (i) trading expenditure excluding interest charges (ii) depreciation including the fixed capital charge (adjusted for stock and valuation changes) reduced by an estimated charge for the manual work of farmer and wife.

**_Tenancy Capital_ represents an estimate of the working capital on the farm. This is calculated by taking the average of the opening and closing valuations of stock, crop, equipment and building improvements.

between 'infected' farms and 'clean' farms—the average return was higher on 'infected' farms than on 'clean' farms—an additional 2.6 *per cent* return on capital. The range was similar in all groups and the highest return on tenancy capital—63.2 *per cent.*—was obtained on a farm with a relatively high incidence of Brucellosis.

The sample was grouped by type of housing and Management and Investment Income per cow and Return on Tenancy Capital were re-examined. The results are shown in Table 21.

Table 21

AVERAGE MANAGEMENT AND INVESTMENT INCOME PER ACRE AND AVERAGE RETURN ON TENANCY CAPITAL RELATED TO TYPE OF HOUSING AND INCIDENCE OF BRUCELLOSIS—1971/72 FINANCIAL YEAR

	'Clean' Farms	'Infected' Farms	Severity of Infection	
			Low	High
Loose-Housing				
Average Management and Investment Income per acre	£26.9	£32.6	£33.5	£31.9
Average Return on Tenancy Capital	25.2%	31.2%	31.7%	30.8%
Number of Farms	21	23	11	12
Byres				
Average Management and Investment Income per acre	£19.3	£19.5	£20.5	£15.6
Average Return on Tenancy Capital	23.1%	24.4%	24.6%	23.7%
Number of Farms	54	27	22	5

Loose-housed herds showed, for both clear and infected farms, a higher Management and Investment Income and a higher Return on Tenancy Capital than their counterparts with byres. In clear, loose-housed herds, the average Management and Investment Income was £7.6 per acre higher than their counterparts in byres, the average return on tenancy capital being 2.1 per cent. higher. In infected herds, loose housed farms had an average Management and Investment Income of £13.1 per acre higher than their counterparts in byres

and the average return on tenancy capital was higher by 6.8 per cent. The above differences may be a reflection of differences in the intensity of farming.

The loose-housed group was almost evenly divided between clear and infected farms. Infected farms gave on average about £6 per acre higher Management and Investment Income than clear farms. This, again, may have been due to intensity of farming.

In the byre group the ratio of clear to infected farms was 2 : 1. There was little difference in Management and Investment Income although, as shown in the table, there was a marked difference between herds with low and high levels of infection—whereas there was little difference between these two groups in loose-housed herds.

From the above results it appears that the financial implications of the disease were not unduly severe. This, of course, does not mean that the disease was without financial consequences since modern intensive loose housing systems with silage feeding could be expected to produce markedly higher Management and Investment Income and return on Capital than less intensive systems. A more detailed and longer term examination of the financial effects of the disease on the farms in the sample would be necessary to measure the consequences of Brucellosis.

8.0 PREVENTIVE MEASURES ON THE FARM

Precautionary measures against the introduction of infected stock are clearly vital. Unless they come from an Accredited Herd, newly purchased animals should be isolated for 60 days after purchase or until 14 days after calving—whichever is the longer period. They should then pass a blood test before being admitted to the herd.

Where stock are grazed away, care should be taken to ensure that they are not allowed contact with other stock which might be affected. Fences should be kept in good order to prevent straying and possible contact.

Once a herd is infected, the infection is spread most commonly at the time of abortion or at the time of an infected full-time calving. The following precautions are extracted from the Ministry of Agriculture, Fisheries and Food and Department of Agriculture and Fisheries for Scotland Advisory Leaflet 93.

(i) Cows which are about to abort, or which have aborted, should be isolated until all discharges have ceased.

(ii) Cows which have aborted at a previous pregnancy should be isolated at the current calving even though this is at full term.

(iii) All cows in an infected herd may be carrying infection and should whenever possible be calved in isolation boxes where they can remain until all discharges have ceased. If this is not practicable, cows may be calved in a separate cowshed or at the end of the main cowshed and near the drainage outlet.

(iv) Calving in dairy herds should never be allowed to occur in an open yard amongst other cattle and calving out of doors on pasture is to be avoided if possible.

(v) The calving box or stall should always be thoroughly cleaned and disinfected before it is used again.

(vi) Suitable containers of disinfectant should be provided adjacent to the isolation box to enable attendants to dip their boots on entering and leaving the box. Separate brooms, shovels and barrows should also be provided. Stockmen should carry out disinfection of their hands, boots and clothing after handling a calving animal.

(vii) If an animal aborts out of doors and the exact spot is known, the area should be disinfected by covering with a pile of straw and setting it on fire, otherwise the general area where the abortion occurred must be fenced off for two months. A search should be made to ensure that pieces of afterbirth are not left lying around after abortion occurs at pasture.

(viii) Aborted calves, afterbirths and bedding soiled by discharges from infected cows should be burned or buried and not thrown on the manure heap.

(ix) Animals which have aborted should not be served for at least two months after aborting.

(x) Infected fields can safely be grazed by steers while they are being rested from susceptible cattle. While steers may pick up infection, it is unlikely that they can pass it on or contaminate pastures.

(xi) Vaccination by the use of Strain 19 Vaccine in young calves or of 45/20 Vaccine in older animals. The use of the latter Vaccine is strictly controlled by the Animal Health Division in Eradication and Extension areas.

Although these precautions in themselves are insufficient to control completely the disease in a herd, they do reduce the degree of infection and spread. No medicine has so far proved to be effective in preventing or curing the disease but positive action in the form of calfhood vaccination, blood testing, slaughtering reactors and strict attention to isolation of calving and aborting cows, together with proper hygiene and disinfection have been successful in combating the disease.

Jamieson & Munro, Ltd., "Observer" Press, 40 Craigs, Stirling