# *Farming on the peatlands of the Falkland Islands*


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## Abstract

The Falkland Islands (Long 57-62°W; Lat51-53°S), land area 12,200km$^2$ have a cool temperate (2.2°C.- 9.4°C), oceanic climate. Rainfall varies between 400-800mm and is lowest in spring. The islands were glaciated only on the highest ground with surrounding land affected by a periglacial environment. During the Post-glacial period acid, organic soils have formed mainly because of low temperature and the impervious clay-rich subsoil creating conditions which favour waterlogging. Upland peat, lowland peat or tussac (coastal) peat cover a large area of the entire land surface. Vegetation is typically dwarf shrub heath on drier soils and magellanic moorland on wetter soils. Agriculture is confined to extensive sheep farming in large enclosures (89% > c. 2000 ha).

In the early days of the Colony (early 1800s) cattle roamed the islands and sheep were first introduced in the 1860s. They quickly became the main source of income on the (approx. 30) large farms which existed up until the early 1980s. Lord Shackleton's Economic Survey (1976) recommending subdivision of the large farm units and transferring land ownership to local owners transformed the agricultural industry on the islands. Subsequently, the building of a certified abattoir in the early 2000s created further major opportunities. Traditionally, pasture improvement through reseeding and fertilising was practiced only on a very small scale. Recently the development of pastures with improved grasses and legumes coupled with rotational grazing has received much greater priority than previously. There are concerns that climate change predictions have indicated a steady temperature rise resulting in an unfavourable precipitation-evapotranspiration balance and other factors may contribute to the instability of the peatlands. Now and in the future, agricultural management practices will play a key role in ecosystem services delivery and climate change mitigation in the islands.



*Keywords: climate change, overgrazing, farm restructuring, ecosystem services*


## Introduction

(i) Background

The Falkland Islands are an archipelago of 782 islands (Woods 2001) situated in the South Atlantic Ocean between latitudes 51°S and 53°S and longitudes 57°W and 62°W. They cover an area of c. 12,200km$^2$ and are approximately 500 kilometres from the nearest point on mainland South America. The climate is cool/temperate/oceanic, mean January temperature is 9.4°C, mean for July 2.2°C, and ground frosts can occur throughout the year. Rainfall is low with a mean annual precipitation at Stanley of 640 mm. Rainfall is unevenly distributed across the islands, is lowest in spring and this, combined with strong winds, reduces plant growth (McAdam 1985; Summers & McAdam 1993). Climatic variation across the Falkland Islands archipelago is poorly understood. Recent climate change predictions estimate approximately 3°C increase in mean annual air temperature over the next 80 years and no

appreciable change in rainfall though given such a temperature rise, change in frequency and severity of rainfall can be predicted (Jones, Harpham & Lister 2014).

(ii) Soils and Peatlands

Soil formation and vegetation cover have been described in McAdam (2013). A typical Falkland soil comprises a shallow (usually no deeper than 30cm) peaty horizon overlying a compact, poorly drained, silty clay subsoil (Figure 1). Mineral soils occur in areas wherever the underlying geology is exposed, particularly on mountain tops and in eroded and coastal areas. Most Falkland soils are shallow peats (less than 30cm deep and too shallow to qualify as Histosols) but in places deposits of 11-12m have been recorded. They have a pH in the range 4.1 to 5.0 and are deficient in calcium and phosphate (Cruickshank 2001).

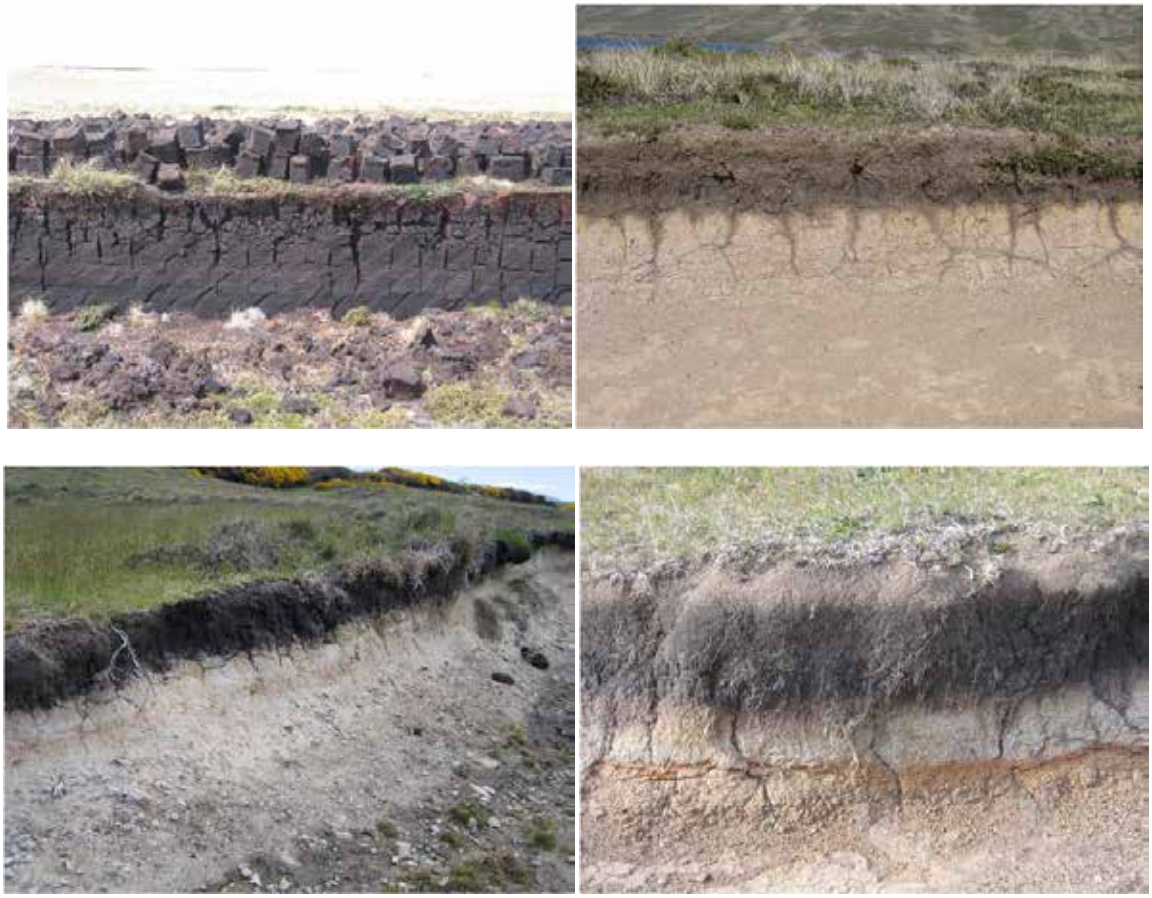

**Figure 1: Typical soil profiles from the Falkland Islands (photos courtesy of Burton, R).**

The IUCN define peatlands as 'areas of land with a naturally accumulated layer of peat formed from carbon-rich dead and decaying plant material under waterlogged conditions'. Joosten & Clarke (2002), define peats as 'sedentarily accumulated material consisting of at least 30% (dry mass) of dead organic material'. Most soils in the Falklands come under the definition of peat as they have a fibric surface horizon >20% (OC organic carbon) in upper layers (this is more than the 30% definition of organic material above); deeper layers tend to be sapric. The International Mire Conservation Group Global Peatland Database (Joosten, 2010) cites the Falklands as having 11,408 ha of peatlands (93.7% of total land cover). In reality no proper soil survey of the Falklands has been carried out. The peatlands of the

Falklands have been described by McAdam & Upson (2012) and McAdam (2013) among others.

King *et al.* (1968) carried out a Land Systems Analysis of the Falkland Islands. This involved some soil description and depth profiling. Apart from a brief scientific visit by Etcheverere (1975) and Cruickshank (2001), Maltby & Legge (2003) , and Burton & Leeds-Harrison (2007) have been the only soil scientists/surveyors to attempt to describe the soils. There is no comprehensive soil map available. Burton & Leeds-Harrison (2007) characterised the Islands' minefields, a legacy of Argentine occupation in 1982, for a feasibility study, recording 186 profiles for texture, depth, pH but not OC or bulk density. Burton, McAdam (T) and Marengo have recently been trying to construct a soil map based on surface drift geology, the Land Systems Analysis (see above) and soil profiling from a limited range of sources. This work is part of a larger (EU funded) project to determine the potential impact of climate change on the terrestrial ecosystems of the Falklands (Upson & McAdam, 2014). This work will have significant impact on the future development of farming on the islands.

(iii) Vegetation

The main vegetation types , acid grasslands dominated by *Cortaderia pilosa* and dwarf shrub heathland dominated by *Empetrum rubrum* (Ericaceae), have been little altered over the vegetation history of the islands, but scrub communities dominated by *Chiliotrichum diffusum* (Asteraceae) or *Hebe elliptica* (Plantaginaceae) would have been much more widespread before the introduction of livestock as was a coastal community dominated by the tall grass, *Poa flabellata* which today survives mainly on small offshore islands. There is no native tree cover. Peatland types and vegetation cover have been described by McAdam & Upson (2012), and McAdam (2013). Some reseeding has been carried out using introduced European forage species but most of the grassland is extensively grazed throughout the year without serious impact as much of the material is indigestible.

## Land use and Farming in the Falklands

(i) Early development

The islands had no indigenous human population and human impact on the landscape only began with the first settlement approximately 250 years ago, when cattle, pigs, sheep and goats were introduced by French settlers (Summers & McAdam 1993). The earliest attempts to farm sheep in the islands were by the Whittington brothers who, in East Falkland between 1835 and 1840, successfully introduced Leicester rams from England for crossing with ewes from Montevideo in Uruguay. This was done in an attempt to produce a breed suitable for the Falkland Islands.

However, G. Rennie, Governor of the Falkland Islands in a letter to *The Times* 21 January 1857, wrote "Up to the present time no settler in the Falkland Islands has ever maintained himself by agriculture alone and the numerous experiments I made – convince me that it is impossible to do so". Despite Rennie's pessimism, sheep were farmed commercially from the 1860s (in 1874 the status of the colony was officially described as "sheep farming") numbers increasing up to a maximum of 800,000 in the early 1900s. This population was probably too large, and overgrazing of the better pastures may have led to the reduction in numbers of sheep after the turn of the century. Stock numbers declined to about 600,000 by 1930 and remained relatively constant (at a mean stocking density of approximately 1 sheep

per 2ha) until early in the 1980s when a programme of farm sub-division was introduced (McAdam1984a; Summers & McAdam 1993).

**Figure 2: Farming in the Falklands is based on sheep production for wool.**

The total wool clip over the years followed the trend in numbers but when the population declined after 1900, the wool clip remained static at around 2,100 tonnes because improvements in individual wool yield compensated for the reduction in numbers .

Gibbs (1946) stated that the approximate average density of sheep "varies from 1.09 acres (0.44 ha) per sheep on the best estate to 7.43 acres (3.01 ha) per sheep on the worst". At present, sheep density is roughly one sheep per two hectares although this varies enormously from area to area. Adie(1951-reprinted in 2012) gave one of the first published descriptions of the traditional nature of sheep farming in the islands.

The sheep are mainly Corriedale and Polwarth breeds, but other breeds, particularly pure Romney and pure Merino, have been crossed with the stock (Figure 2). Both the Corriedale and Polwarth have proved suitable for the islands for they can withstand the rigours of the climate and produce a fine wool which fetches a good price. The climate is not suited to pure-bred Merinos but the crossing of Merino blood with Corriedale has greatly improved the wool quality. The Department of Agriculture continues to test alternative breeds for the changing market demands in the Falklands.

The development of the present flocks progressed by trial and error during the early years and a number of unsatisfactory cross-bred sheep resulted. However, following the detailed recommendations of Munro (1924), the first agriculturalist to visit the islands, some attempt was made to improve the stock by importing pedigree rams. This resulted in an increase in wool yield between the 1920s and 1966. The mean wool yield per sheep, which was 2.39 kg over the years 1890-1900, increased to 3.08 kg by 1919, 3.47 kg by 1940, was 3.88 kg in

1966, 3.46 kg in 1972, 3.75 kg in 1983, 3.90 kg in 1993 and, 3.75 kg in 2013 (DoA Farming Statistics).

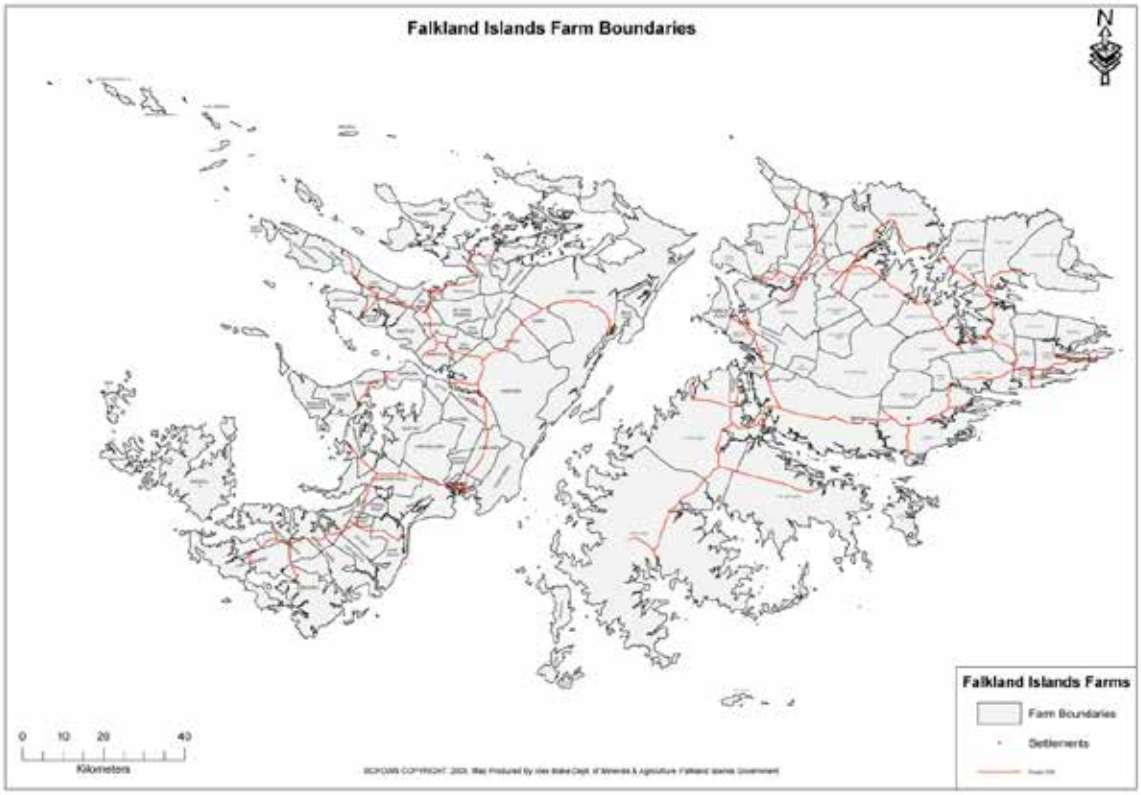


**Figure 3: Farm boundaries in the Falkland Islands.**

(ii) Farm structure

It is only since 1980, and particularly during 1984 to 1988, that the farming structure in the Falklands has undergone the first changes of any note in the entire history of the colony. Up until then, the estates were all large, with the ownership of the land divided amongst very few people. In 1979, there were thirty-six farms, seventeen on East Falkland, seven on West Falkland and twelve on the smaller islands. Of the total, nine were "sole traders" or partnerships and another four could have been defined as owner-occupied in that the farm residents held more than 50 per cent of the company shareholding (Shackleton 1976). The other twenty three farms were owned by a total of fourteen companies; the Falkland Islands Company, with eight farms, being the biggest. Under this scheme, farms on East Falkland varied from 31,050 hectares to 161,000 ha in size. Those on West Falkland tended to be larger; most being in the 40,000-80,000 ha range. The majority of farms on the smaller islands were less than 2,000 ha (Theophilus 1972). Each farm had a settlement (collection of owner's and workers' houses and farm buildings) in a sheltered coastal inlet so that goods could be brought in and wool taken out by sea to Stanley. Settlements were usually composed of a manager's house, houses for shepherds and navvies, a cook house, galley, social hall, garage, warehouses and shearing shed.

Peat has been the main fuel on farms until the 1970s. There are no figures available for the amount of peat used for fuel locally but because of the low population density and the dispersed nature of the farm settlements, the impact of peat extraction for fuel has been low. In 2012, peat was used to heat less than 2% of houses in Stanley but almost 20% on rural (mostly farm) houses (FIG 2013). Farm settlements are increasingly using wind turbines for energy.

The only small paddocks on the farm tend to be those adjacent to the settlement where milk cattle, young stock, stud rams and working horses are kept. Hay was sometimes cut from these paddocks where fertility is high as a result of heavy stocking and application of artificial fertilisers. The rest of the farm was sub-divided into large enclosures, over 25% of which were over 2,000 ha. The siting of fence lines has been largely based on convenience, distribution of vegetation types and ease of gathering sheep. For example, fences are often sited on the isthmus of a large promontory. The whole farm of Port Stephens (before sub-division) was divided from its neighbour Fox Bay West, by a fence on an isthmus 2 km wide. Traditionally, the large farms employed staff to carry out all the tasks necessary to run that farm, resulting in relatively high manning levels. However, during the 1970s and up until 1982 a steady decline in the labour force through emigration or alternative employment (mainly in Stanley) led to severe labour shortage on the farms, especially during shearing. There was little movement of labour between farms but from about 1977, itinerant shearing gangs have been an important development. Sub-division of many of the large farms into smaller one-man units did not appreciably alter this arrangement.

In his economic survey of the islands, Lord Shackleton (1976) recommended that the economy (which he presumed would continue to be based on agriculture) would only survive if farms were sub-divided and sold to the local people; *i.e.* transferred into local ownership. He also stressed the need to introduce some form of diversification into agriculture in the islands. At that time, the average farm size was 32,500 ha and only 4% of the sheep belonged to farms wholly in local ownership.

Lord Shackleton's recommendations, although slow to be implemented initially, had already started to come about several years before the Falklands Conflict in 1982 (McAdam, 1984a). The most significant change to the existing farm structure in the Falkland Islands has been fragmentation of the larger farms into a number of smaller 'one family' units.

**Table 1: Transfer of farms and stock to private ownership.**

| | | Company Owned | Privately Owned | Total |
|---|---|---|---|---|
| Number of farms | 1979 | 23 | 14 | 36 |
| | 1988 | 9 | 75* | 84 |
| % of Total Sheep | 1979 | 95.7 | 4.3 | |
| | 1988 | 46.0 | 54.0 | |

(* Includes 5 Falkland Islands Co Ltd Share Farms)

The creation of small farm units was the most significant event in the history of farming in the Falklands so it is worth considering its widespread ramifications. Initially, the industry, while recognising the social benefits of creating relatively small owner-managed or tenant farms, was concerned at the effect of sub-division on unit costs and, through fragmented breeding policies, on wool quality. Because some results of sub-division of sheep farms in South America were discouraging, early opinion in the Falkland Islands was divided. However, despite these reservations, the Falkland Islands Company – in response to the

Shackleton recommendation (1976) – offered one of its major farms (Green Patch) to the Government for sub-division on an experimental basis. The offer was accepted and the farm was sub-divided with the full co-operation of the company and on attractive financial terms arranged by the Falkland Island Government. Following this, two major farms on West Falkland were made available for sub-division. Since then the process of sub-division proceeded at a rapid rate. The proportion of land in overseas ownership decreased from 76% in 1980 to 27% in 1988 (FIDC 1988). There were, in 1988, 84 farms in the islands, with only a few more resulting from the sub-division of Port San Carlos planned (Table 1). In 1991, the Falkland Islands Company sold their remaining holdings to the Falkland Islands Government and almost all the Falkland Islands are now in local ownership (Figures 3 & 4).

(iii) Performance and output

The performance of Falkland Islands' agriculture had not improved to any appreciable extent from the turn of the 19th century up until the radical structural change brought about by sub-division. The size of the sheep population declined gradually from the early 1900s until the 1950s but remained static over the next 20 years and although increases in the total wool clip occurred during 1971-76, these were not sustained and indeed, there was a slight decline in the late 1970s. One of the reasons for lack of progress was the lack of investment of profits in the farms. Also, profit margins had been reduced due to high costs and these have possibly contributed to the reduction in pasture improvement programmes on many farms between 1975 and 1980, which in turn may have checked output. In addition, the decline of the labour force was detrimental, although providing some saving in wages. Grassland improvement schemes, fencing, general building, and estate upkeep all suffered as a result of labour shortage.

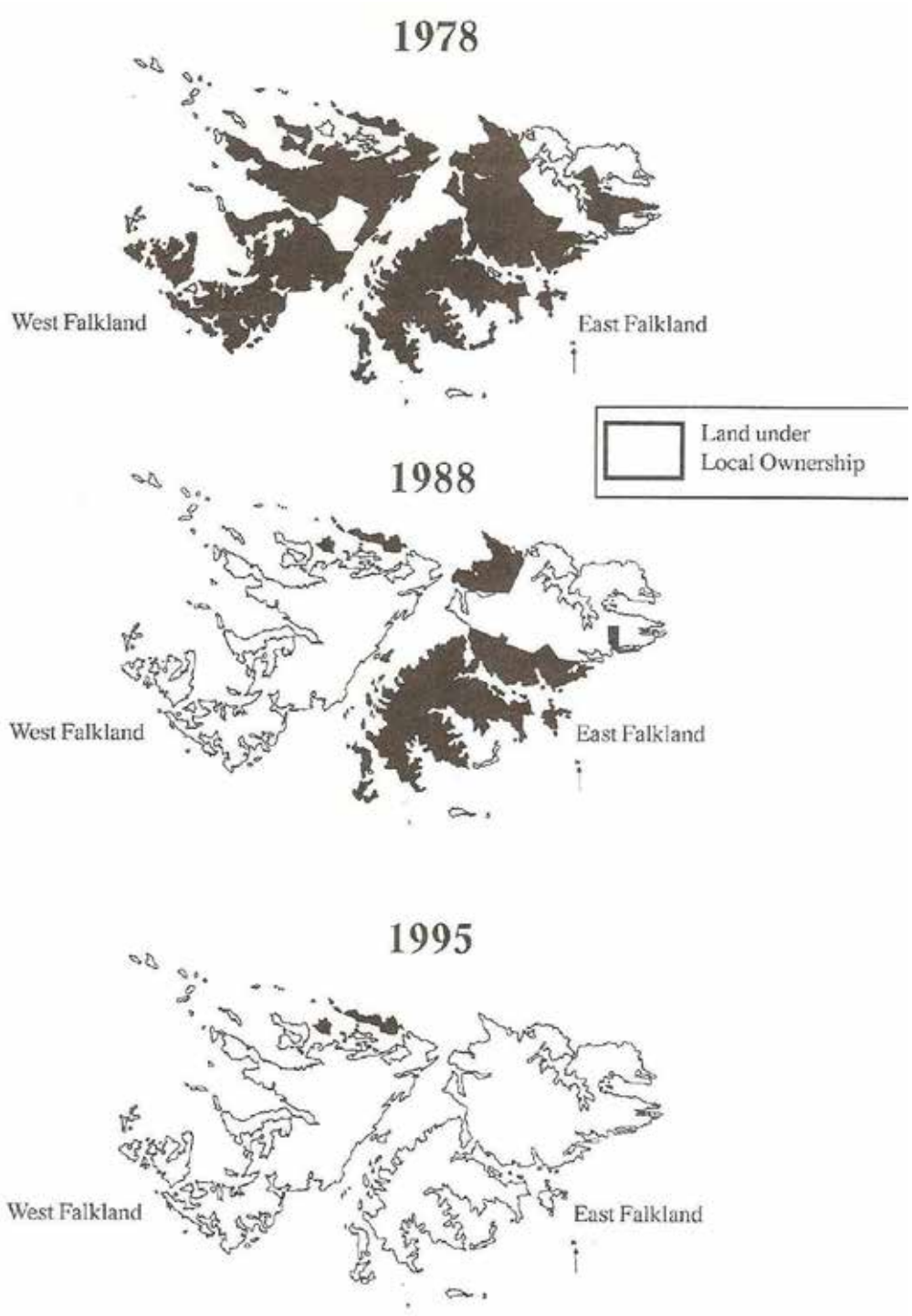


**Figure 4: Land reform in the Falkland Islands 1978-1995 (From: Falkland Islands Farm Management Handbook and Statistical Review 1995).**

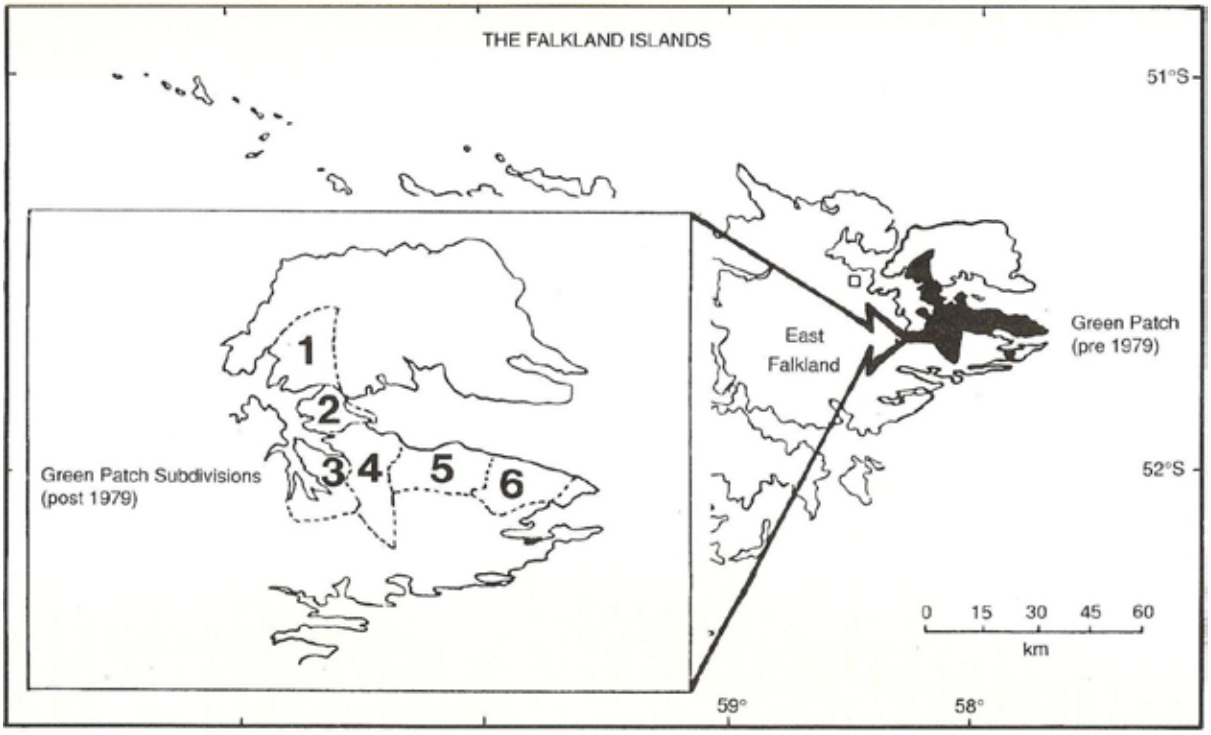


**Figure 5: The sub-division of Green Patch farm, 1979/80 (From Summers and McAdam, 1993).**

It is interesting to consider the effect of the land reform on productivity and output from the farms. Green Patch farm was the first to be sub-divided; into six units in 1979/80 (Figure 5). The total output from the six individual family farms which replaced the one single unit, had increased substantially immediately after subdivision (Table 2).

**Table 2: The productivity and output of Green Patch Farm in the last full year of operation before sub-division into six units (1979/80) and the total of the individual units in subsequent years following sub-division.**

| Year | Sheep (x 1000) | Wool (tons) | % of Total East Falkland Sheep | % of Total East Falkland Wool |
|---|---|---|---|---|
| 1977/78 | 15.42 | 58.47 | | |
| 1978/79 | 14.85 | 56.52 | | |
| 1979/80 | 14.86 | 53.70 | 4.38 | 4.71 |
| | | Sub-divided | | |
| 1980/81 | 17.49 | 61.51 | 5.75 | 7.10 |
| 1983/84 | 19.34 | 76.86 | 6.48 | 6.18 |
| 1984/85 | 21.58 | 73.93 | 5.96 | 6.22 |
| 1985/86 | 23.10 | 80.95 | 6.14 | 6.14 |
| 1986/87 | 22.03 | 76.66 | 5.60 | 6.10 |
| 1993/94 | 22.58 | 91.72 | 5.80 | 6.18 |
| 2011/12 | 15.85 | 63.30 | 6.65 | 6.65 |
| 2012/13 | 15.84 | 62.05 | 5.61 | 6.35 |

The wool output increased from under 57 tonnes up to 77 tonnes representing a real increase (allowing for seasonal differences) from 4.7% to 6.2% of the wool produced from East Falkland. Figures from the other farm sub-divisions made during 1980-1985 indicate increased stocking rates of up to 23% and increased wool production of 27% (Figure 6; DoA, 1997; FIDC 1988).

In the first 10 years after subdivision sheep numbers increased by approximately 20% (Summers, Haydock & Kerr 1993). This rate of increase slowed down over the next 10 years and by 2000 numbers were starting to decline. This was caused by a number of factors, principally a destocking of many of the outlying islands and the construction of an EU standard abattoir which made meat production an option and alternative to complete reliance on wool. Between 2004-6 farming went through unprecedented change when farmers critically evaluated features such as sheep breed, flock structure, grazing management and product sales. They re-evaluated the age at which they could cull sheep for meat and, given the wool and meat prices at the time, most started to retain less sheep on the farm and cull at an earlier age. This resulted in a decline in total numbers of mature wethers(castrated male sheep) and a subsequent decline in overall stock numbers(Judd, 2006). Total sheep on farms was 485,937 in May 2013, down from approximately 650,000 at subdivision.

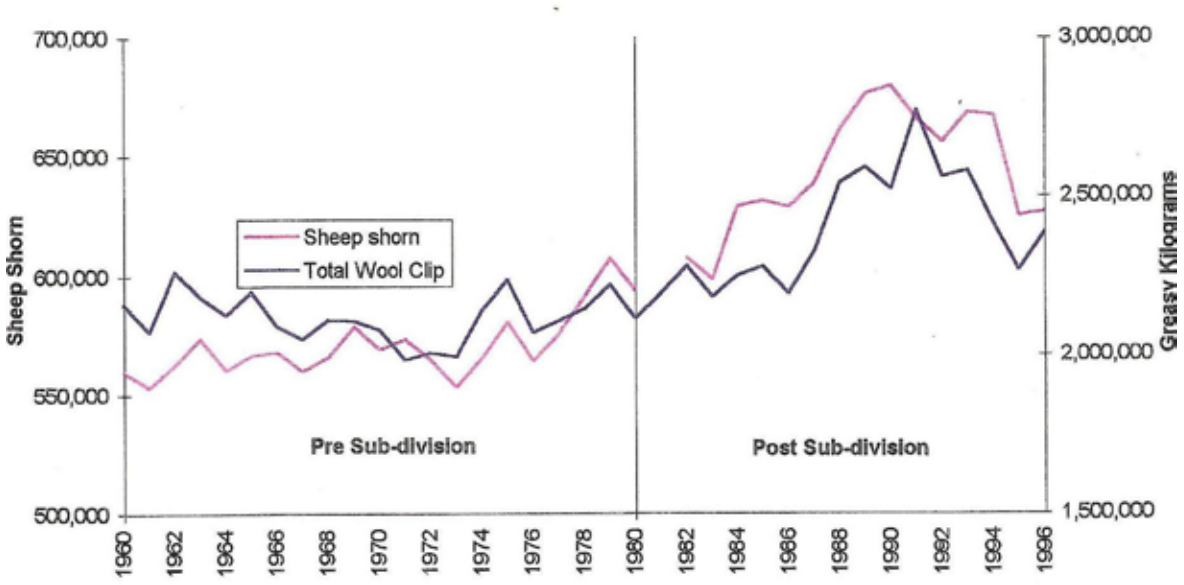


**Figure 6: Number of sheep shorn and annual wool production on all Falkland Island farms 1960-1996 (From DoA 1997).**

(iv) The Abattoir

The construction of a Government funded and run abattoir to EU standards in the early 2000s was a hugely significant development as it meant that there was an alternative product to market. In its first full year of operation (2003-4), 21,466 sheep were killed. In 2012/13 this number had risen to 56,704. In addition, 490 cattle and 186 pigs were slaughtered.

(v) Other livestock.

Given the very large paddocks in the Falklands, horses and dogs have been essential to gather sheep throughout most of the history of farming in the islands. There were typically up to 4000 horses in the islands up until the 1970s when use of motorcycles, improved fencing infrastructure and a decline in the farm labour force brought about a decline in their number. In 2013 there were 442 horses and 416 working sheepdogs. Cattle have been used for local meat and milk production and in the years leading up to subdivision there were approximately 10,000 cattle. Numbers steadily declined to below 5000 by the time the abattoir was constructed. Despite concerted efforts by the Department of Agriculture to improve stock genetics and create a National Beef Herd , there are still only 4,220 cattle (2013) on the islands.

**Figure 7: Cattle numbers are low but there are moves to increase the beef herd.**

A few farmers keep pigs, goats and reindeer, though numbers are very low (132, 133 and 243, respectively in 2012).

**Figure 8: Horses were traditionally used to gather sheep on the large farms.**

(vi) Sheep and grassland management

Generally the sheep population on a farm includes the following approximate percentages of each class of sheep – 2% rams, 33% breeding ewes, 1% cast ewes (ewes at the end of their useful life), 9% maiden ewes (female sheep from about one year old until they produce their first lambs), 33% wethers and 22% hoggets (ewe, ram or wether from weaning to shearing). Ewes are generally at the end of their economically useful lives after 5 or 6 years. The non-breeding sheep tend to be the best wool producers.

Mating in April or May results in lambing in October and November. The degree of flock supervision at lambing is minimal, partly from lack of labour, but also because human disturbance can lead to lambs and ewes becoming separated. From four weeks before lambing to about six weeks, afterwards the energy demands of breeding ewes are greatest and yet pasture growth is still very slow. When the lambs are about 8 weeks old, the ewes and lambs in each camp are driven into a pen for year marking (with an ear tag), castration, tail docking, counting and weaning. The timing of weaning involves balancing the needs of the growing lamb with the needs of their mothers, which must be allowed sufficient time to regain body condition before the next mating. Weather permitting, shearing commences in November and can last up to early February. Sheep under these free-ranging conditions have a cyclic reproductive pattern and, consequently, their energy demand varies over the season.

Each enclosure consist of a mosaic of vegetation types usually dominated by Whitegrass, a coarse, wiry tussock-forming grass of low livestock feed value, with only a small proportion of good quality pasture in valleys with short grazed, productive grass species("greens"), around ponds and on coastal greens. These greens tend to be overgrazed by sheep which largely ignore the poorer Whitegrass pasture, with the result that overall levels of utilisation of the pasture within enclosures is very low (only about 20% of pasture production is consumed by stock). Davies *et al*. (1971) estimated that the stocking rate for greens was 1.2 ha per ewe equivalent. This compared favourably with the poorer 'lax' Whitegrass associations – 2.1 ha per ewe – and 1.9 for uniform Whitegrass. In addition,such an uneven grazing pattern exacerbated the conflict between the sheep and an extremely numerous indigenous wild geese, as geese also tend to concentrate on the greens.

Sheep losses tend to be high, especially among young sheep. In general, from 100 ewes mated, 95 lambs will be born, 66 lambs will be marked, 59 will be weaned, 54 hoggets will be shorn and only 48 will reach 2½ years of age (Ferguson 1980). Annual losses in adult sheep amount to 10%. The loss of 10% of the adult sheep each year is substantial since it is necessary to mate approximately four ewes to obtain one mature replacement ewe. Such a limitation on a sheep farm is obvious when one considers that the non-breeding sheep are the best producers. Diseases are not a significant problem and regular, compulsory dipping of sheep for skin parasites has eliminated these, dipping no longer being practiced.

Mortality amongst lambs is primarily due to a combination of the adverse spring climate (high frequency of strong gusting winds), inability to get out of narrow gullies if they fall in and the fact that their mothers often cannot produce adequate milk from their meagre diet. Most losses in adult sheep are a result of poor nutrition and severe weather, particularly during late winter and early spring.

(vii) Pasture improvement

Despite the problems of growing plants on the acid, peaty soils of the Falklands, the Department of Agriculture has done extensive trials on the suitability of a range of grass, legume, cereal and brassica crops (Figure 9). Depending on situation and season, these can prove economically viable, particularly to fatten stock to supply the abattoir. In 2013, 221 ha of reseeding was carried out in the Falklands, and total annual forage available on the farms was 639ha.

The low soil pH limits growth substantially. There are limited stocks of Calcified Seaweed deposits and although these have the potential to enhance legume growth on the peat (Radic, 2010), they are limited in extent and location (Figure 10). There are huge seaweed resources in the waters around the Falklands and The United Kingdom Falkland Islands Trust (UKFIT) has supported a research programme on the potential for its use in the Falklands as stock feed and fertiliser (www.ukfit.org).

There is a need for shelter to reduce stock losses and improve plant and animal performance. UKFIT tested a range of conifer options (Figure 11) and the Department of Agriculture has demonstrated that these can be successfully grown on a range of sites though their economic viability remains unproven.

**Figure 9: Cereals, brassicas and legumes have been tested on most farms in selected areas.**

**Figure 10: Calcified seaweed deposits are the only local lime source. It has been used on a limited scale to increase soil pH (Department of Agriculture Falkland Islands).**


**Figure 11: Shelterbelt trials with Lodgepole Pine (*Pinus contorta*), West Falkland.**

**Figure 12: Burning of cultivated ground prior to reseeding. Pasture burning is largely falling out of favour but is still practiced (Dept of Agriculture, Falkland Islands).**

In the past, burning pastures in spring to reduce the standing fund of dead herbage and encourage fresh green growth was carried out (McAdam 1984b; Figure 12). Given the fragility of the peatland ecosystem and the risk of fires getting out of control this practice is no longer encouraged.

(viii) Research and Development

The history of agricultural research and development in the Falklands is a long one. The first official agricultural scientist to visit the Falklands (from New Zealand) was Munro (1924). Thereafter there were visits from Davies (1939) of the Welsh Plant Breeding Station and significant development and advances, often by trial and error, of individual farmers and land owners. All of these reached broadly the same conclusion- that the food resource (pasture) was not of sufficient quality to support productive livestock systems without improved grazing management or pasture improvement through fertilising and/or reseeding.
Probably the most significant visit of all was that funded by the then Overseas Development Administration in 1969 (Davies *et al*., 1971). This was a very comprehensive visit, by a multi-disciplinary team which carried out field trials on farms. One of the main recommendations of the Davies team was to establish a permanent agricultural research unit in the Islands with the capacity to conduct field trials on which to base their advice. One of their main tasks was to test the emerging research carried out by the UK's Hill Farming Research Organisation( HFRO) in Scotland. Their work, particularly on integrating sheep nutritional requirements with pasture quality and growth into what became known as the "*two pasture system* of hill sheep management" was a huge advance in hill sheep farming in the UK and became the central core of the research unit established in the Falklands – the Grassland Trials Unit. Subsequently this became the basis for a fully equipped Department of Agriculture in the Falklands with responsibility for research, advice, plant and animal health.

(ix) Rural Life
The rural population is small (309 people in 2013) and though most are still engaged in agriculture, farm-based tourism has steadily increased in popularity in recent years and become economically more significant than sheep farming on several islands. A Government-run air service provides a vital link to outlying settlements on the few inhabited islands and to West Falkland, particularly during the summer (tourist) season. A rural roads programme, commenced in 1985, has made access to the countryside more widespread and a regular ferry service across Falkland sound in recent years has made a highly significant impact on agricultural and wider rural development.

## The Future -Sustainability of farming on Falklands peatlands

In terms of ecosystem services delivery, the farmed peatlands of the Falkland Islands have a critical role in delivering the following services. -
*Provisioning* services- meat, wool, drinking water, land for renewable energy
*Regulating* services- climate change mitigation, carbon storage, water purification, flood control
*Supporting* services- peat accumulation, biodiversity, nutrient cycling,
*Cultural* services- archaeology and heritage, tourism, sense of place, landscape, walking, fishing.

If farming is to have a sustainable future it must consider carefully how it delivers across the range of these services. Fundamental to delivering a balanced, sustainable land use is more knowledge of the peatland systems of the Falklands and how the biological processes they support will respond to changes in stocking and cultivation. Given that the peat cover in the Falklands is shallow and the climate harsh (cool, dry and windy) the peatlands can be

considered a relatively fragile ecosystem. Hence an estimate of potential climate change and what it might mean for the components of the peatlands ecosystem and their capacity to deliver the range of ecosystem services listed above is critical. An EU funded research project on this subject -TEFRA: Terrestrial Ecosystems of the Falklands – a Climate Change Risk Assessment (Upson, McAdam & Clubbe, 2014) has just commenced. Climate change predictions by the University of East Anglia are for a potential 3°C increase in temperature and little change in overall rainfall. This has highly significant implications for the seasonal balance of evapo-transpiration from the shallow peat soils. Such a temperature rise would almost inevitably result in heavier rainfall episodes and in increased storminess. A workshop was held in the Falklands in May 2014 to enable the local population to have an input to the project and to prioritise impacts of climate change on agriculture. These were identified as the potential for:

- Increased soil erosion
- Increased run-off/ erosion caused by high intensity rainfall events
- Increased water use by animals in dry periods
- Reduced water resources available for direct removal caused by changes to runoff and recharge
- The need to increase national food security
- The response of native grass species in pasture to increased temperature

## Summary

Most soils in the Falkland Islands can be classed as peatlands of varying depths and, given the cool dry windy climate, grass growth is slow, highly seasonal and is of low nutritional value. Farming in the Falkland Islands consists basically of sheep grazing the peatlands in a free-ranging pattern over large enclosures which are made up of a mosaic of vegetation types. These vegetation types vary considerably in their productivity and quality but essentially most contain only a relatively small area of the more productive types – the greens, reseeded pasture and tussock-forming Whitegrass.

In the early days of the colony between 1850 and 1898 the numbers of sheep rose from just over 7,500 to 807,000. There was then a gradual decline and numbers stabilised at around 630,000 by 1923 and remained at that level until the late 1970s. Following subdivision numbers rose to almost 700,000 and are now (2013) 485,937.

Stocking rates can be as low as 3.0 hectares per sheep. The stock are, mostly Corriedale, with Polwarths on some of the farms. Selective breeding has aimed for wool quality though now the abattoir is operational, carcass composition is of increasing importance.

Lambing rates are low, sheep mortality is generally high, but diseases are not a serious problem. Sheep have a cyclic pattern of energy demand and the high-energy demand in spring is not satisfied by the native pastures. Hence, in most cases, overall productivity of sheep is low.

As wool was the only feasible agricultural export up until 2004, as a result of poor world wool prices along with a shortage of re-investment of profits in the farms, there was some stagnation in the agricultural economy in the mid-1970s. The construction by the Government of an abattoir fundamentally altered the range of business options open to farmers.

Farm structure was characterised by large estates with the ownership of the land divided amongst relatively few people, a pattern of farming which changed little from about 1880 until the late 1970s. Since then, a radical programme of sub-division recommended by Lord Shackleton (1976) has resulted in the number of farms increasing from 36 to 84 with most of the land and sheep now in private ownership. Stocking rates and hence overall farm productivity increased in the early years of sub-division. They have fallen back in recent years, but this does not necessarily imply a decline in productivity, rather farmers adapting to the business potential of the abattoir in 2004 and restructuring their farms accordingly.

The farmed peatlands of the Falklands deliver a wide range of ecosystem services and their sustainable development must be based on a thorough understanding of the resource and how to manage it under potential climate change scenario of a 3°C increase in temperature over 80 years and inevitable changes in rainfall distribution and storminess.

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