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An OFE legacy on remote pasture improvement: the history of the Falkland Islands

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Abstract

We report here on the Falkland Islands' history of formal agricultural research which, since inception in the 1970s, had to involve On-Farm Experimentation (OFE) to answer the challenges of a particularly remote and disperse population scattered over vast and mostly uninhabited environments, in conditions that were challenging for human settlement let alone a research programme.

Previous pasture improvement for wool production from extensive sheep farming had been largely led by individual efforts, based on external advice. Then, logistic challenges around communications and transport, and the need to embrace the range of soil diversity, led to using the small settlement schools associated with each farm to implement a series of reseeding trials across the islands. Participation involved teachers, children and their farming parents, providing both community engagement and an opening to discuss basic principles of reseeding and soil fertility. Lessons for today's efforts in renewing OFE on the islands are discussed, notably possibilities for digital tools in this very remote environment.

Introduction

The Falkland Islands (Lat 51-53°S), land area 12,200km2 have a cool temperate (2.2°C.-9.4°C), dry (400-800mm) oceanic climate. Soils are mostly organic and vegetation is typically dwarf shrub heath on drier soils and magellanic moorland on wetter soils. Agriculture is confined to extensive sheep farming in very large enclosures, 90% of which over 2000 ha. Farms averaged 10,000 ha typically managed by 2-4 persons.

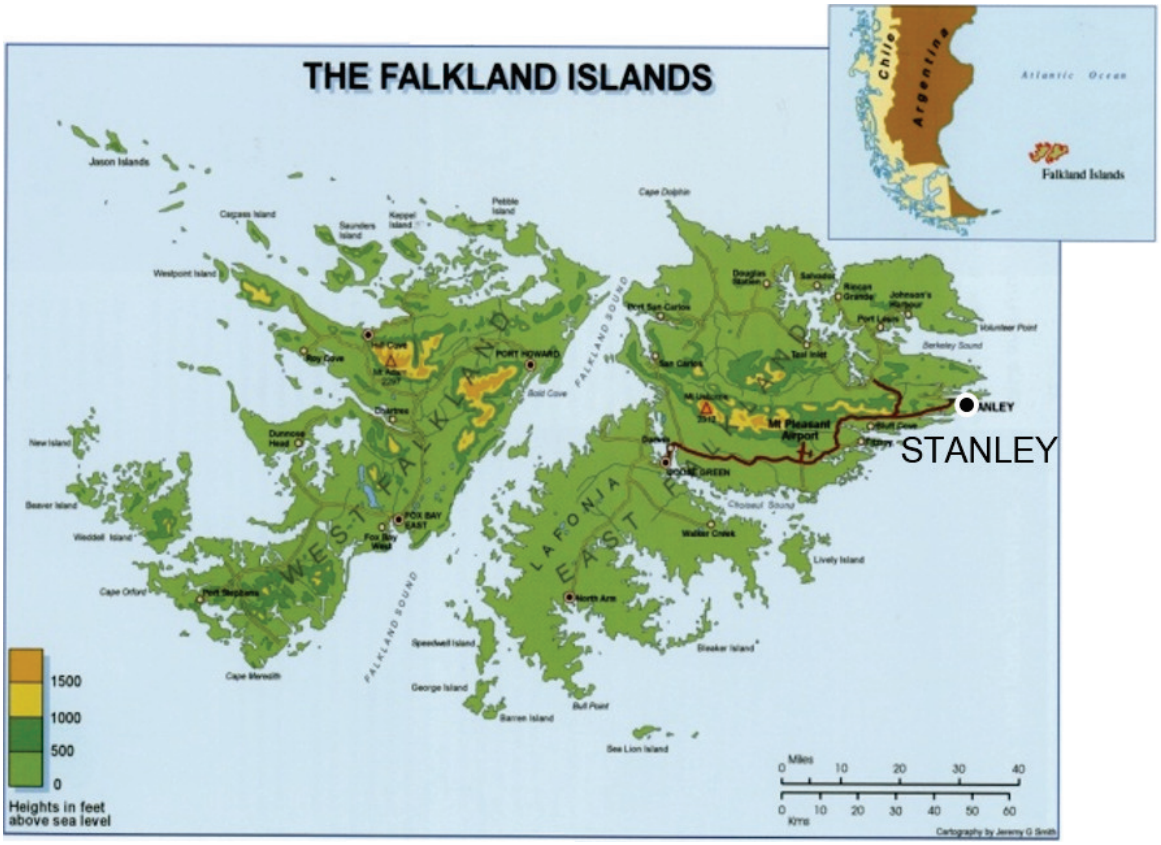

Figure 1 | Map of the Falkland Islands

Sheep farming for wool had been the main source of income on the approx. 30 large farms which existed from 1860 up until the early 1980s. At that time, the rural population (<500) was widely dispersed over this small number of large farms and there was no internal road network. Farm structure was thus 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 (McAdam, 2014), but this does not necessarily imply a decline in productivity, rather farmers taking more advantage of agri-tourism opportunities, an internal road network, inter-island ferry, adapting to the business potential of an abattoir in 2004, and restructuring their farms accordingly. We describe here how over 40 years of research accompanied this agricultural evolution, with a focus on the origins, nature, roles and changing importance of on-farm experiments in a particularly remote and challenging agricultural environment.

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Agricultural 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 in 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 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 some measurements and field trials on farms. One of their main recommendations 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 the main tasks of this unit (the Grassland Trials Unit - GTU) was to test the emerging research carried out by the UK's Hill Farming Research Organisation (HFRO) in Scotland. Subsequently the GTU became the basis for a fully equipped Department of Agriculture in the Falklands with responsibility for research, advice, plant and animal health.

In the early days of the GTU and indeed subsequent to the purchase of a government research farm on East Falkland, there was a reliance on carrying out the research programme on individual farms - OFE. The limitations of OFE (not that it was recognised as a valid discipline in its own right in those early days) were lack of oversight and control and, in the wider context, a reluctance of the global scientific community to embrace the concept of OFE. This lack of scientific validation, in turn, tended to unfairly denigrate the quality and message of the research. This was exemplified in the reluctance of the mainstream scientific literature to publish research based on OFE, even when these were led by researchers. However, given the logistic constraints in the Falkland Islands, the OFE route was seen as the only viable one to follow. One such example was through the use of the small settlement schools to advance the agronomy programme in the islands in the 1970s.

Use of rural schools for agronomy R&D in the Falklands

It was then abundantly clear that any long-term improvement in agriculture must come from additional wool yield per hectare, which in turn must be based on increased nutritional benefit from improved grasslands. It is in this situation that the role of introduced grass species was considered to be of importance. The agronomy programme (which the first author was responsible for initiating) was therefore concerned with investigating the native pasture and its improvement through species introduction. The use made of local settlement schools as a means of agricultural extension within this programme is outlined below.

Rural Infrastructure and Education

At that time, the majority of farms had established settlements at locations convenient to good harbour facilities since there was no internal road network in the Islands. Overland travel was on horseback or by 4-wheel drive vehicle and was slow and inefficient.

The government operated a small (2 planes) domestic air service based at Stanley and utilizing either floatplanes or light aircraft using grass airstrips or sandy beaches at the various settlements. Radio was widely used as a means of communication and entertainment.

The Falkland Islands Government is responsible for education throughout the islands. Outside the capital, Stanley, however, the communication difficulties and the scattered and sparse nature of the rural population made a satisfactory education system much more difficult to implement. Six of the farm settlements had full-time schools providing education mainly for children aged five to twelve. Some of these schools had full-time teachers employed by the government and some were staffed by part-time teachers who were otherwise employed as bookkeepers on the farms. The teaching generally took place in small classrooms provided at the settlements or in the pupils' homes. In 1983 a total of 135 children were receiving education in settlement schools or rural farmhouses (Strange, 1982).

The use of Settlement Schools in the Agronomy Programme

One of the fundamental problems initially facing the agricultural research programme in 1975 continued to be that of logistics. The limitations of transport and communications made the siting of experiments (especially grass species and fertilizer trials) on a range of soil types very difficult. As there were no back-up or support staff recruited for the first 18 months of the project, laying down and servicing of experiments within the agronomy programme was a major limitation which had to be overcome. On travelling round settlement farms which were potential trial-site hosts it was felt that one resource which might be usable in this context were the small settlement schools. In a different context in the UK, 'on-farm trials' had proved most valuable (Crame, 1984).

Following a teachers' seminar organized by the Education Department in Stanley, a basic 'kit' was designed and sent out to teachers containing materials and instructions as to the layout of a simple experiment including the type of observations which might be made. The experimental kit forwarded to each of 6 schools throughout the Islands contained the elements to make meteorological observations and to lay down a replicated field-plot experiment.

Weather Recording

In order to classify each site and to obtain a better picture of the range of climatic variables over the island, it was decided to supply as many settlements as possible with basic weather recording equipment. A soil thermometer and rain gauge are easy to read and can teach schoolchildren much of the basics of meteorology and the concepts of the effect of weather on plant growth through practical involvement. Exposure was measured using tatter flags (McAdam, 1980).

Agronomy experimentation

Over the previous 25 year most farms had made some efforts to improve grassland. The various methods attempted have been reviewed in Davies et al., (1971). The method of reseeding following conventional cultivation proved the most successful. However many of these reseeds are characterised by very low dry matter production of poor quality herbage and a low plant population leaving a considerable proportion of bare ground. Reseeds in this condition are generally referred to as reverting, with a noticeable ingress of native vegetation.

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The problems of pasture establishment and the selection of appropriate species remained unsolved for many sets of conditions and sites.

Many of the problems encountered centred around the use of Holcus lanatus, which was widely sown. However it was felt that the tendency of Holcus lanatus to put much of its energy into seed production early in the season and its seeming inability to spread and form a dense sward in most situations was an undesirable characteristic in view of the modified grazing management programme being developed by the Unit. The problem under consideration was whether to attempt to improve the reverting reseeds or, if considering reseeding, to commence on a fresh site. The first of these alternatives, renovation of reverting reseeds, was investigated using the settlement schools to establish and run a small plot trial involving fully replicated split-plots (one half oversown with a mixture of seeds of species considered to have potential for the islands) and a range of lime and fertiliser treatments. All the materials were supplied to the schools already weighed, bagged and labelled.

Suggested measurements

Schools were encouraged to make some basic measurements. A list of suggestions for more detailed measurements was also provided which the teacher could pursue depending on their interest and the enthusiasm and involvement of the pupils in the project. These included daily rainfall, soil and air temperatures and monthly tatter flag measurements. Seedling counts and measurement of herbage production were recommended in the agronomy experiments. For more advanced work, domestic oven drying was suggested for dry matter determinations, and pH measurement were also recommended.

Results - Scientific and Educational

Value. As would be expected, the quality and quantity of the results obtained were very variable and were largely dependent on the degree to which teachers were involved in the OFEs. Nevertheless, after one season of these trials, some valuable scientific information was obtained.

Climatic information

For example it was confirmed that the drier settlements were generally those in the southern part of the archipelago, while those with higher rainfall occurred in the north and were generally situated immediately north and east of high ground. There was a tendency for increasing temperatures towards the west and south of the islands. Tatter flags indicated that inter-site variation between flags was small. However, tatter rates were higher in the Falkland Islands than in almost all other areas of the northern British Isles (McAdam, 1980).

Reseed renovation

Holcus lanatus responded to applied fertilizer and lime (in most situations). Oversowing of reverting Holcus reseeds was not successful and other techniques, such as direct drilling and cultivation, needed be investigated. The growth characteristics of Holcus lanatus, and its subsequent lack of late production, impose limitation on its use. Improved species (such as Dactylis glomerata and Festuca rubra) were capable of much higher production than Holcus under fertilised and unfertilised conditions.

For example, at one site (Darwin), annual dry matter yields of approximately 6 t/ha were obtained from Dactylis-dominant swards whereas Holcus-dominant swards receiving the same levels of Nitrogen fertiliser (45 kg N/ha) yielded 3 t/ha. On this basis, more detailed agronomic trials involving the introduction of Dactylis were laid down and a useful reseeding package provided for farms.

Educational value

Depending on their interest and the degree to which they wished to become involved in the project by supervising the children in the relatively simple tasks of laying down and recording the experiment, the teachers were given a valuable educational aid. Basic application of principles of geometry, mensuration and mathematics (tabulation and presentation of results) were learnt as well as simple practical skills directly useful to them such as fencing and woodwork and the construction of quadrats. The project also allowed teachers to develop educational programmes on simple meteorology, basic botany (plant identification and biology), soil science and grassland production and management as related to agriculture.

Project evaluation

The project was evaluated on the infrequent occasions when the settlements could be visited. Instructions had been left for teachers to send in regular reports and results, but these were rarely adhered to and it was found that most information was obtained from a personal visit. On a visit the progress of the trial was observed and discussed with the teacher and any results collected were studied. Even when a trial had been set up and the teacher was not able to participate further, a personal visit meant that some information, even from observation, could be obtained. Often, in such cases, it was possible to take cuts from the plots and at least have the benefit of having the trial set up. The pupils generally associated the trial with the teacher and did not relate it to infrequent visits by research staff.

Generally teachers expressed enthusiasm about the project. The main reason for this was the access to materials they could not otherwise obtain such as seed, fertilizers and thermometers. When teachers visited Stanley, they were encouraged to visit the Agricultural Research offices and the frequency of these visits increased noticeably as the project progressed. This was one of the most useful results of the project. In a situation where agriculture is the largest rural employer, and no formal agricultural education is available, a small exercise such as this went some way to increasing awareness of basic biological and agricultural principles. Importantly, the children and their parents, (who worked on the farms), took an interest in the results and the project provided an opening to discuss basic principles of reseeding and soil fertility.

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Figure 2 | Shelterbelt trials (2006)

Subsequent agricultural development

Following 1982, the local government invested substantially in agricultural research and development - particularly in the fields of improved and native pasture production, sheep health and productivity and on cattle production. Although they did acquire an experimental farm, given the still dispersed nature of the farm settlements and a better realisation of the climatic and soil diversity across the islands, there was considerable emphasis in OFE to deliver the programme.

The United Kingdom Falkland Islands Trust was formed in 1981 to provide specialist advice and contacts to assist in the economic, environmental and social development of the Islands. It has been an initiator of ideas and concepts, and a catalyst to support growth and, for most of its life, the main focus has been supporting initiatives and advice in rural development and environmental sustainability. The Trust supported projects outside the normal remit of government, then relied on those being taken up by either government or private individuals where appropriate. Trials on potential for seaweed use, planting tussac grass, tree planting for shelter and biological husbandry were underpinned by OFE across the islands.

More recently, there has been an awareness that the farmed peatlands of the Falkland Islands have a critical role in delivering a range of ecosystem 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).

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 peatland ecosystem and their capacity to deliver the range of ecosystem services listed above is critical. Climate change predictions 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.

The need was identified for an online peat and soil map for the Falklands to best determine areas at risk to climate change and where agricultural development can proceed sustainably. This resource provides a digital tool for farmers and advisors to take OFE to a different level and gives farmers access to a much wider range of expertise and advice than has been previously possible. It also facilitates further research on peatland conservation and restoration and enables the local government to develop climate resilience strategies.

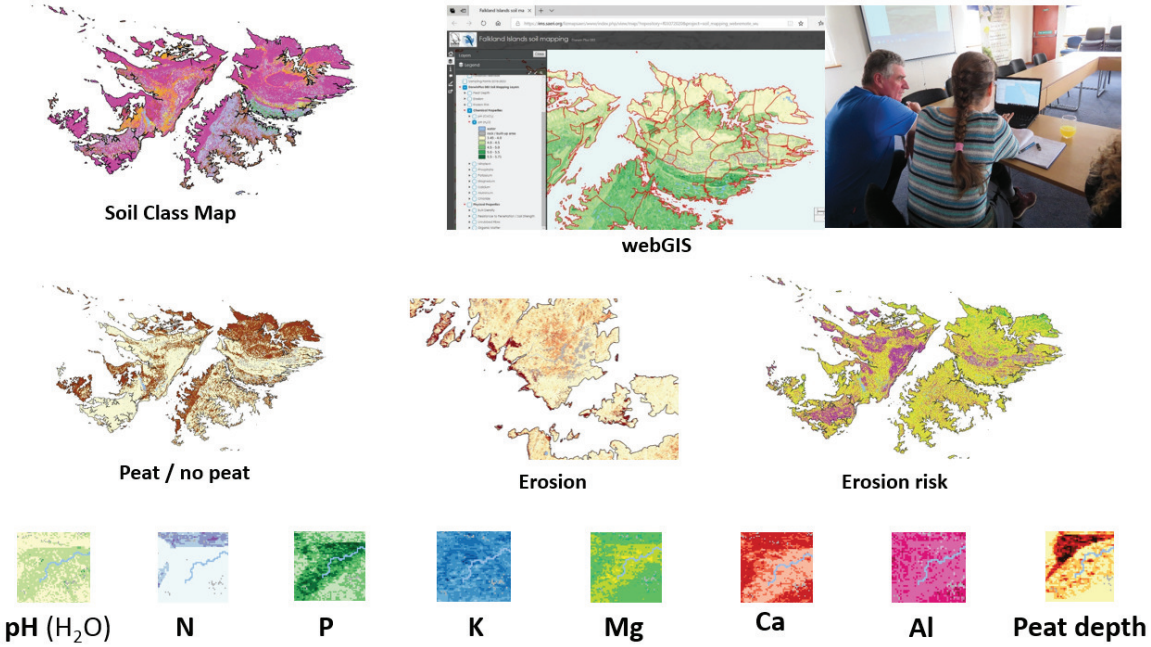

Figure 3 | Examples of outputs from the SAERI digital project (the South Atlantic Environmental Research Institute)

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