Hydroponic Crop Production on Ascension Island: History, Current Situation and Potential

Leigh Morris – January 2019

BLUE MARINE FOUNDATION

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The Author:

Leigh Morris has >35 years of experience working in horticulture, agriculture and the wider environmental sector. Holder of an MSc in International Horticulture (Crop Production) and Higher National Diploma (HND) in Crop Production & Marketing. Leigh worked in and managed commercial nurseries, before transferring into the delivery of education and training at the Welsh College of Horticulture, also directing their horticulture nursery and organic farm. Leigh led education and learning at the Royal Botanic Garden Edinburgh for 10 years developing programmes of horticultural education and horticulture capacity building in several projects across the globe. He carried out a Voluntary Service Overseas (VSO) placement for the Ethiopian Horticulture Producers and Exporters Association, delivering upskilling in flower and vegetable farms. Leigh Chaired the Grow Careers Initiative (2006-14), a UK-wide campaign to raise the profile of horticulture as a career and served a term as President of the Chartered Institute of Horticulture (2012-14). In 2015 he became the first Chief Executive of the UK National Land Based College, championing skills development across agriculture and associated industries. Since January 2018 he has been based on St Helena, working as a consultant for the Blue Marine Foundation and St Helena Government (SHG). Leigh recently carried out a Training Needs Analysis for agriculture and production horticulture for SHG and is now commencing delivery of the upskilling recommendations.

Executive Summary:

Consultancy: Blue Marine Foundation (BLUE) Consultant, Leigh Morris visited Ascension July/August 2018 and made two visits to AIG's hydroponics farm (Ascension Hydroponic Services - AHS). His brief was to carry out a rapid appraisal of the horticulture production and evaluate if there was any requirement and potential for the Blue Marine Foundation to support the farm going forward. This report is based on the consultant's on-island observations, discussions with the AHS Manager and others on Ascension, and subsequent communication with key individuals, plus desk-based research.

History: The first hydroponic farm was set-up on Ascension by the USA military in 1945 to produce fresh vegetables for the c.2000 servicemen on the island. Other subsequent initiatives to produce crops on Ascension include the Cable & Wireless farm on Green Mountain, the Ascension Island Gardeners Club and various small-scale 'back garden' hydroponic nurseries.

Ascension Island Government (AIG) set up AHS to enable the supply of fresh produce after the Royal Mail Ship (RMS) St Helena was discontinued, and to help tackle some of the island's diet-related health problems. AIG commissioned a consultant to look at options and the decision was taken to construct the island's own hydroponic farm, which opened in June 2016. The farm then apparently saw a period of initial success; '*we managed to obtain full production of leaf and vine crops and sold to the local supermarket, The Chandlery and the NAAFI as well as the small convenience store at Two Boats village'*; before issues arose in 2017 around cropping, pest and diseases (P&D) and marketing.

Current Situation: In August 2018 the visible overall crop quality at AHS was not high, and the majority of the older crops could be regarded as poor. There was high prevalence of both P&D and there was very little produce available for harvest on the vine crops. There was evident dissatisfaction amongst the island population at the lack of fresh produce coming out of AHS.

AHS operates closed-system hydroponics, which allows a grower to precisely manipulate the different crop growth and development stages, to maximise yield and quality for specific market windows. Such a closed system is also better for the environment as there is no run-off of waste water or nutrients. The greatest benefits from such a system, however, requires the economies of scale of monocropping and an effective way of monitoring, adjusting, filtering and sterilizing the nutrient solution, before it is recirculated around the crops. There was no such filtering/sterilization equipment in place in August 2019 and according to the Administrator at the time AHS was set-up *'the initial production system selected and constructed was basic in design, in order to keep it cheap'.*

Since AHS opened in 2016 there have been four different individuals managing the farm. The current AHS manager is aware of the challenges he has inherited, and one strategy being implemented by him is to replace the closed-system with an open-system, within which the solution is not recirculated. Communication from the AHS Manager (Jan 2019) indicates that this strategy is slowly progressing.

Conclusions: A successful horticulture farm is required and wanted, and this is achievable. The current situation, however, is poor, with P&D infected crops, low yield and little produce getting to market, resulting in a more poorly nourished, disgruntled local population. AHS had gone through its initial honeymoon period, but the problems eventually arrived, and then there was no effective Integrated Pest Management (IPM) and/or water treatment in place ready to deal with them. This, coupled with the lack of consistent management and external support, has had devastating results.

The existing AHS Manager is well/appropriately qualified and he is trying sensible approaches to develop the farm. The Manager does not, however, have significant hydroponic growing experience, he is working very much alone and has significant inherited problems to tackle. AHS needs a period of sustainability with its manager, who needs to be supported, developed and directed as necessary.

AHS requires the design and implementation of a robust and detailed cropping plan (including a comprehensive IPM plan). The decision must be taken whether to switch completely over to open-circuit hydroponics, or establish an effective way of treating the nutrient solution and maintain closed-circuit system. The AHS Manager will likely need additional expertise to assist him with this planning.

AHS should aim to be more *market driven*, growing more precisely what their market wants, which could be achieved through closer negotiation with their potential customers. A sensible approach would be to reduce the range of crops produced and instead focus on a smaller number of crops that are highly demanded by the market. This would allow fine tuning of the production systems, with individual crops being catered more specifically for, likely resulting in higher yield and quality.

The consultant has recently carried out a review of St Helena agriculture. He believes there are mutual benefits to be gained from knowledge exchange, technology transfer and collaboration on procurement, marketing and accessing external expertise, between production horticulture on both islands. For example, there are hydroponic farms operating on St Helena, which are producing higher quality and far greater yields than AHS and this experience could be accessed. The potential also exists to appoint 3rd party consultancy to support horticulture production on both islands. This could perhaps be extended across the South Atlantic to include Tristan de Cunha and the Falklands, which are also receiving horticultural development from the UK.

Continued Contact: The consultant has maintained email contact with MC since his visit to Ascension in July/August 2018 and sent MC a copy of the report on St Helena Agriculture (Morris 2018). The AHS Manager provided the Consultant with an update in January 2019, prior to publication of this report.

Summary of Recommendations:

1. Revise production methods in operation.
2. Become more market driven.
3. Design and implement a robust, detailed and streamlined cropping schedule.
4. Establish knowledge and technology exchange with St Helena.
5. Upskill existing AHS Staff.
6. Set-up long-term external consultancy support.

1. Introduction:

Blue Marine Foundation (BLUE) Consultant, Leigh Morris ('The Consultant') spent three weeks on Ascension 23 July – 12 August 2018. The consultant's primary role was to support communications delivery for the new Ascension Island Government (AIG) waste management plan, however, while on island the consultant also made two visits to AIG's hydroponics farm (Ascension Hydroponic Services) on the 9th and 10th August 2018 and met with the Hydroponics Manager (Matt Castle).

BLUE have supported wide ranging environmental initiatives on Ascension and (with his horticultural/ crop production background), the consultant was encouraged to engage with the hydroponic farm. The brief was to carry out a rapid appraisal of the horticulture production and evaluate if there was any requirement and potential for the Blue Marine Foundation to support the farm going forward.

This report is based on the consultant's observations at the Ascension hydroponics farm (and the crop production on Green Mountain), communications with the current Hydroponics Manager, discussions with others on Ascension Island while on-island, subsequent email exchanges and telephone conversations with key individuals, plus desk-based research.

2. Crop Production Before the Current Hydroponic Farm:

2.1 USA Military Hydroponic Farm: The first hydroponic farm was set-up on Ascension by the USA military in 1945 towards the end of World War II to produce fresh vegetables for the c.2000 servicemen on the island (Figure 1 – over page). The growing of vegetables using hydroponics was at that point in its infancy; indeed the station on Ascension was believed to be only the third large-scale production plant built (Avis 2002a).

The farm grew a range of crops (initially cucumbers, tomatoes, radishes, green peppers and lettuce) in beds filled with the black clinker (rock) found locally. According to Avis (2002a), in a modern attempt at hydroponics in 1985, the black clinker was found to be a superior medium than today's commercial product, Perlite. This apparently highly successful farm was featured in The National Geographic Magazine (Moore, 1945). This USA farm closed in mid-1946 c.1 year after the end of WWII. Between 1946 and the existing hydroponic farm opening in 2016 there were other initiatives to produce local crops on Ascension.

2.2 Green Mountain Farm: A successful farm existed for over 20 years (c.1950s-1960s) based at the Red Lion on Green Mountain, with some production taking place in other locations around the island. This farm produced food for the Cable & Wireless (C&W) company employees and dependants, employing c.20 staff and managed by C&W's Peter Critchley. The crops were produced in field beds, using guano from Boatswain Bird Island as fertilizer, and the farm also kept a range of livestock (Avis 2002b). It is no longer in operation, but some limited small-scale allotment style growing was being carried out on the old farm site in August 2018 when the consultant viewed the site (Figure 3 p.6).

2.3 Ascension Island Gardeners Club: This was established by residents (dates unknown) who constructed a shade house for local people to grow their own crops in. This structure is still in place (Figure 2 – over page) adjacent to the existing hydroponic farm but is now derelict. NB: according to Mike Haworth, former AIG Waste Manager (personal communication); *'Matt Castle started using this area when he arrived on island to grow crops, but this was stopped by AIG due to the amount of water being used. He did have a very good melon crop at the time.'*

2.4 Other Hydroponics: There was at least one example of small-scale hydroponic crop growing on Ascension in-between 1946-2016, in the form of a lettuce production unit set-up by Mr Martin Joshua who was previously the Fire Safety Officer on Ascension. Martin subsequently returned to his home on St Helena, where he used the knowledge gained on Ascension to establish one of the two largest hydroponic farms on St Helena, which now supply the bulk of that island's tomatoes, lettuces and cucumbers. Avis (2002a), makes reference to hydroponics being tried in 1985, but no further information was unearthed on that during this research.

Figure 1: USA military personnel with fresh produce outside Hydroponics Station No.1 Laboratory on Ascension Island (Source: Ascension Hydroponic Farm Facebook Page).

Figure 2: The remains of the shade greenhouse (photographed August 2018) previously used by the Ascension Island Gardeners Club. The shade netting has rotted away, but the structure looks sound.

Figure 3: The growing area at Red Lion, Green Mountain, with a crop of onions in the background (August 2018).

3. Ascension Hydroponic Services (AHS):

3.1 Setting up the new hydroponic farm:

Marc Holland (MH) was the Administrator of Ascension Island for three years (2014-17) and he can be credited with setting up the existing hydroponic farm on the island. Horticulture produce (both frozen and refrigerated) is historically supplied to the island by the sea and in 2015 AIG were considering its future food supply after the Royal mail Ship (RMS) St Helena was discontinued. In addition, MH was keen to help tackle some of the island's diet associated health problems (e.g. type 2 diabetes and obesity), by providing a sustainable source of fresh fruit and vegetables for the civilians on the island. NB: both the UK and US military flew in their own fresh produce but this was not available to non-military employees.

In 2015 MH commissioned a consultant, Stephen Herron (SH) to conduct a review of current and future food supply options for the island. SH was at that time residing on St Helena, the partner of Nicola Moore, Attorney General of St Helena, Ascension and Tristan de Cunha. SH had previous experience of food chain management, the retail sector and of agriculture and hydroponics in harsh climates, including previously managing a hydroponics farm in the Cayman Islands (Naturally Cayman Ltd.) He offered to look at the situation on Ascension Island as he was travelling back to the UK.

SH visited Ascension (12-17th July 2015), toured the island and met with key stakeholders. His 8-page report on his visit (Herron, 2015) contains a key paragraph in his conclusions that recommends setting-up a hydroponic farm on the island: *'There is a lack of fresh produce at present, this will only get worse if there are longer periods between ships in the future, that is assuming a regular ship service is even agreed post-RMS. It is therefore logical to capitalise on the ideal climate on Ascension to grow, using hydroponic techniques, those products that cannot be shipped in easily (tomatoes, salads, peppers, melons, broccoli, etc.). All inert fresh produce (potatoes, onions, carrots, ginger, squash etc.) can be shipped and stored relatively easily, meaning that Ascension would not need to burden itself with the labour intensive and costly production of root vegetables'.*

SH's report was discussed at the Ascension Island Council meeting on 24th August 2015 (Annex B). The Council felt there was a clear need for on-island production of fresh fruit and vegetables and they discussed public and private options for using hydroponics. These Council minutes recorded that *'the Governor was interested to read SH's report as St Helena was also looking to expand its food production and would find the report useful'.*

An outline business plan was presented to Council (this document was not available from AIG due to confidentiality) and it was agreed that AIG would pursue a public model. AIG proposed hiring consultant support for the first few weeks of operation, through to the first crop and AIG committed to have this model up and running by the time the RMS ceased. The tender process (to run the farm) would extend to the parties who were involved in the analysis.

AIG subsequently appointed SH as the consultant to set-up a hydroponics farm and he arrived on-island to do this in March 2016. The farm, Ascension Hydroponic Services (AHS), was sited just below the Two Boats settlement, in a location previously used by the Ascension Island Gardeners Club. AHS officially opened on Monday 27 June 2016 (Figure 4 below) to provide a supply of fresh, local horticulture produce, specifically those crops that have a shorter shelf life, would be expensive to air freight. These include the salad crops; cucumbers, tomatoes, peppers, lettuce and other salad leaves.

The AIG communications on the opening (AIG, 2016) stating; *'securing a supply of fresh salad and vegetable produce has been high on the Government's priorities… Up to now, islanders have relied on the monthly call of the 'RMS St Helena' for a limited supply of fruit and veg from south Africa. With the future decommissioning of the RMS, there was a real concern about the availability of fresh fruit and vegetables on the island…. Hydroponics allows us to take advantage of the island's benign climate… Local production means fresher veg, lower prices and a constant supply'.*

SH subsequently handed over the running of AHS to the Site Manager, Regan Tourand (RT), who arrived from Vancouver, Canada, where he had been grower for Mooie Exotic Plants Ltd. and had also previous experience growing in Southeast Asia.

Figure 4: Ascension Hydroponic Services (AHS) Opening June 2016. L-R: Marc Holland (AIG Administrator), Stephen Herron (Hydroponics Consultant), Regan Tourond (Farm Manager), Adrian Henry (operative in AIG Facilities team) and Matt Pritchard-Evans (AIG Project Manager for the building of the farm). Source: AIG 2016.

3.2 Initial Success:

Following the opening of AHS in June 2016, the farm then apparently saw a period of initial success, with good quality crops, which is depicted in photos on the AHS Facebook Page (e.g. Figure 5 below).

According to Iain Robertson, the former AIG Director of Operations and was responsible for AHS between 2016-17 (now Director of Development & Commercial Services, Falkland Islands Government); *'The (hydroponics) system was already set up when I arrived on ASI ….. When I was there, we managed to obtain full production of leaf and vine crops and sold to the local supermarket, The Chandlery and the NAAFI as well as the small convenience store at Two Boats village. We produced crops for the Residency events and when I left we were talking to the US military about supplying them with produce'* (personal communication, 18th November 2018).

Figures 5: Ascension Hydroponic Services (photograph taken October 2016) showing a healthy looking and uniform crop of tomatoes, with cucumbers behind (Source: Ascension Hydroponic Services Facebook Page).

3.3 Year 2 Decline:

Indications are that in 2017 issues arose with the operation of AHS. According to Marc Holland (personal communication 26-11-18); *'there were problems with the cleanliness of site, a lack of proactive marketing and seeking of new business, so we decided to change the manager in June 2017. The prospects then seemed good, though making a profit was always going to be a challenge'.* Regan Tourond was replaced by Nathan Cridland (Head Gardener for the Ascension Administrator) on a short-term basis until the current manager, Matt Castle (MC), arrived from the UK on 1st Nov 2017.

According to Paul Mildon, Babcock Station Manager for BBC Atlantic Relay Station; *'for the first 18 months (of the farm in operation) the crops were plentiful, but it appears that in the last 12 months the hydroponic farm has been struggling with insects/bugs which is affecting the crops, so very little makes it to the shops here'* (personal communication, 23rd November 2018). An on-line blog (O'Berg 2017) written in Oct 2017 while Nathan Cridland was manager, refers to problems being encountered.

According to Stephen Herron (personal communication 13 December 2018), *'There is huge potential on Ascension (and St Helena) to practically produce more food, but there are many factors that need resolving before that can happen'.*

3.4 Situation in August 2018:

The Consultant viewed AHS on August 9/10th 2018. Most of the shade greenhouse was under cropping, however there were notable gaps, with areas of the greenhouse not in production. There were younger crops that looked to have potential to yield well, but the visible overall crop quality was not high and the majority of the older crops could be regarded as being poor (Figures 6-8, below). There was high prevalence of both pests and diseases (P&D), some of the lettuce crop was beyond its optimum age for sale, and there was very little produce available for harvest on the vine crops (i.e. tomatoes, cucumbers and peppers).

Individuals spoken to by the Consultant on Ascension in July/August 2018 stated that the supply of the fresh crops from AHS was *'very limited and not as good quality as it used to be'*. MC, the AHS manager stated that he is *'heavily criticized by members of the population because of the reduction in supply of crops (particularly tomatoes) to the local retail outlets'.*

Figures 6, 7 & 8: Taken by the Consultant on 9th/10th August 2018. **Fig 6 (top left):** Young tomato crop. **Fig 7 (top right):** Aubergine heavily infested with the pest Red Spider Mite. **Fig 8** (below): Old and diseased tomato crops, with one new row of tomatoes in-between, and domestic baths filled with red Spider Mite infested Aubergine plants (acting as a reservoir of infestation for the other crops).

3.5 Crop Pests and Diseases (P&D):

There was a high prevalence of P&D problems witnessed at AHS in August 2018, which have clearly impacted on the crops to greatly reduce both their yield and quality. For example, there were symptoms of soil and soil water borne diseases such as phytophthora, and the Aubergine crops were infested in the pest Red Spider Mite (Figure 7 – previous page).

MC believes many of these P&D problems had; *'swept into the hydroponic farm in 2017'* and that much of his and his assistant's time is now spent trying to control the P&D problems he inherited (personal communication, November 2018). Residents of Ascension are aware of the P&D problems at AHS, for example, Dr Bill Hardy, AIG, Senior Medical Officer stated; *'currently there have been severe problems involving either a virus or mould which has decimated the tomato crop'* (personal communication, 21st November 2018).

3.6 Production Methods:

AHS operates closed-system hydroponics (Johnson, 2010) i.e. water and nutrients are circulated (pumped) around the crops, which have their roots suspended in the constantly circulating nutrient solution (Figures 9 & 10 – below). The solution returns to the stock tanks, before being pumped around the crops once again. AHS has two tanks to allow for two different nutrient mixes as required. The water is currently mains water, with the ambition to collect and utilise rain water in future.

Figures 9 (left): Ascension Hydroponic Services. Stock tanks, from where two nutrient solutions are circulated around the crops. **Fig 10 (right):** Hydroponic table system for growing lettuce.

Closed-system hydroponics offers potentially great advantages to a grower in terms of precise fertilizer regimes. This enables the greatest efficiency from the nutrition applied and potentially allows fine adjustments in respect to different nutrient ratios and levels. This results in a grower being able to precisely manipulate the different crop growth and development stages, to maximise crop yield and quality for specific market windows. Such a closed system is also far better for the environment as there is no run-off of waste water or nutrients, so reducing water use and preventing pollution.

To achieve the greatest benefits from closed-system hydroponics, however, requires the economies of scale of monocropping (i.e. full greenhouses of the same crop at the identical growth and development phase). It also requires an effective way of monitoring and adjusting, and (most crucially) filtering and sterilizing the nutrient solution, before it is recirculated around the crops.

When the consultant viewed AHS in August 2018, there were a range of crops in production, on a relatively small scale (i.e. one or two rows or benches of individual crops) and there was no facility or regular system in place to filter and/or sterilize the nutrient solution before it was re-circulated around the greenhouse. According to Marc Holland (personal communication, November 2018), *'the initial production system selected and constructed was basic in design, in order to keep it cheap'.*

According to Iain Robertson *"no water/nutrient filtration and/or sterilization equipment was installed when the farm was set-up in 2016. I don't know why. This was a continuing problem, but the manager we employed did not come up with a solution. This was raised as we were getting constant pest and fungal problems and the lack of water filtration/sterilization was believed to be a reason for this"* (personal communication, November 2018).

SH was unaware of the current issues; *'...nobody from Ascension has been in touch asking for assistance since I left the Island and a hydroponic farm in perfect condition…. my immediate thoughts would to install UV filters to kill bacteria, add Hydrogen Peroxide (if you can get it shipped to Ascension?), a small amount of household bleach also is an easy fix but not recognized by any food standard'* (personal communication, December 2018). Hydrogen Peroxide is commonly used within hydroponic systems to kill pathogens in the nutrient solution (Modular Hydro 2018).

Conversations between the Consultant and MC in July/August 2018 indicated that he is very aware of the challenges he faces to ensure a consistent supply of high-quality fresh produce from AHS. MC recognises the significant P&D problems and the negative impact of having no water sterilization /filtration system in place. One strategy being implemented by MC in August was to remove the constant circulation system from some of the areas in the greenhouse and replace with plants being grown in media, which are watered/fed as required, with no re-circulation (Fig 11 below).

At the request of the consultant, MC carried out a SWOT analysis of AHS (Annex C), in which MC states *'Hydroponics (closed system) does not work for vines due to disease problems, we are therefore moving over to bag and dripper system'.* The consultant discussed crop production issues with MC, briefed him on hydroponic production on St Helena, which operate open circuit hydroponics (Morris, 2018). He agreed that, without proper cleaning/filtering of the nutrient solution, such an open system could be far more appropriate for AHS. MC indicated he would acquire individual planters and experiment.

Figure 11: Ascension Hydroponic Services: These plastic troughs used to contain crops growing in rockwool slabs, enabling the constant re-circulation of liquid feed solution (NFT – Nutrient Film Technique). The rockwool has now been replaced with a more standard soil/organic matter growing media. The liquid feed is dripped in and any excess is allowed to run away, it is not collected or recirculated (i.e. 'Open Circuit Hydroponics'). The crops depicted are peppers, tomatoes (background) and dot plants of strawberries, which MC is keen to try.

3.7 Staffing:

SH stressed the need for AHS to have a manager with *'…experience of plants and who understands the island and the challenges of growing and living there'*. According to Marc Holland (personal communication, November 2018); *'it was always a challenge finding the right manager – one who was technically able but also able to run a business and get the produce in the shops'*.

The original advertisement and summary job description for the initial post (Annex D), advertised in late 2015, is available on-line (AIG, 2015), which states that *'the work would include:*

- *Assisting in the construction and set up of a hydroponics site;*
- *Learning on the job about effective hydroponics management;*
- *Monitoring and caring for crops, tending to them on a daily basis;*
- *Managing crop rotations independently, being able to spot and address potential threats to production;*
- *Communicating with customers and distributors, ensuring a consistent supply and delivering on time;*
- *Running the hydroponics business, monitoring sales, adjusting planting to meet demand, managing budgets and pricing strategy, reporting on the financial success of the project;*
- *Having computer and report writing skills and being able to communicate via email;*
- *Working with the school and interested members of the community.'*

Since AHS opened there has been a lack of a consistent person in charge, with four different individuals managing the farm since June 2016; Stephen Herron, Regan Tourond, Nathan Cridland and now Matt Castle (Figure 12 – below). MC is a BSc Commercial Horticulture BSc graduate (2008-11) from Hadlow College in Kent, UK and is featured in their alumni magazine (Hadlow College 2018). After graduating MC worked for Defra as a plant health inspector at Heathrow Airport before relocating to Ascension.

Figure 12: AHS Manager Matt Castle (MC), tying up vine crops at the AHS farm (August 2018).

3.8 The Market for Produce:

When AHS opened, the aim was that *'the produce will be sold from Solomon's Georgetown Store and from JAMS in Two Boats and to the island's clubs and food outlets. A delivery schedule will be arranged with the stores and clubs to ensure a continuous supply'* (AIG 2016).

Indications are that initially the production and marketing from AHS went as planned '(*in 2016-17) we managed to obtain full production of leaf and vine crops and sold to the local supermarket, The Chandlery and the NAAFI as well as the small convenience store at Two Boats village (JAMS). We produced crops for the Residency events and when I left we were talking to the US military about supplying them with produce'* (Iain Robertson, personal communication, 18th November 2018).

By July/Aug 2018 the situation had changed dramatically for the worse, with very little produce being produced or sold. Some produce was still being supplied to The Chandlery in Georgetown, but this was predominantly lettuce leaves of a poor quality (brown/damaged leaves, unwashed).

Personal communication with MC and others on-island during July/August 2018 indicated that the supply of fresh horticulture produce from AHS was *'going through a very challenging period'.* MC stated that he was now receiving much criticism from the population (some quite angry) in respect to the lack of fresh produce being supplied from AHS, particularly the lack of tomatoes. To build greater understanding and more support for AHS from the population on Ascension MC has produced the first, of what he aims will be, quarterly Ascension Hydroponics Newsletter to inform the population of progress and challenges (first issue July 2018).

3.9 Situation Update January 2019:

In an email exchange with the Consultant (8th January 2018) MC provided an update on the situation at AHS; *'I have been working alone since early December due to staff annual leave. I have now installed three rows of substrate bags (open-circuit hydroponics), containing beef and cherry tomatoes and cucumbers (first crop of cucumbers in over a year). A row of peppers is going to be set-up this week.*

The system looks better as it is purged daily of a third of the water contained in the re-circulation tanks. This turns the water over more quickly and therefore I believe the tomatoes growing in the hydroponics look better. We have put potassium levels to c.4 times that of the nitrogen levels, the plants (appear to) have responded well to this, but I have no comparison and yields are still yet to prove my hypothesis.

Tomatoes in the bags have fruited more quickly, but suffered from blossom end rot, I believe due to incorrect watering regime. Daily watering is now implemented. Red Spider Mite is showing up monthly and I think I will have to expand my use of pesticides (Acaricides) as I am very worried about multiple resistance building in the crop.

We now supply the widest range of crops (so far during my tenure) to the market which is positive'.

4. Conclusions:

4.1 A successful horticulture farm is needed on Ascension and this is achievable:
There is a clear demand for locally grown fresh produce (fruit and vegetables) on Ascension Island. Previous crop production on the island (by USA military in 1940's, Cable & Wireless and initially by AHS in 2016), indicates that it is possible to grow successfully on the island, and specifically using hydroponic methods to supply fresh produce to the local population.

A regular supply of locally grown produce would benefit Ascension by improving the diet of those living on the island and reducing the dependency on more expensive imports. A successful farm would also be an important aspect in any offer for tourists visiting the island, provide an opportunity to educate local children about food production, and be an overall 'good news story' for the island.

4.2 The situation (in August 2018) at AHS was poor:
The AHS farm was visibly struggling. There were a relatively wide range of poor looking crops, with low yield and therefore little produce getting to market, resulting in a disgruntled local population. It was evident that the crop planning and overall husbandry needed to be greatly improved.

A significant factor was the high pest and disease (P&D) levels. NB: With any new plant production facility there is a honeymoon period, when the crops are free of pests and diseases and growing is relatively easy. Then, after a period of time (perhaps weeks, months, or even one or two years), the P&D problems will arrive (as they clearly now had at AHS) and without effective Integrated Pest Management (IPM) systems and hygienic practices in place, the impact can often be devastating.

According to Marc Holland (personal communication, November 2018), *'the initial production system selected and constructed was basic in design, in order to keep it cheap'.* The belief of the consultant is that the decision not to install proper filtration/sterilization/cleaning systems initially was false economy and likely a medium to long-term poor decision.

The article in the National Geographic magazine on the USA hydroponic farm (Moore 1945) portrays an extremely successful farm. Research shows, however, that the USA farm was likely only in operation for just over one year and Avis (2002a) states that pests and diseases did attack their crops. Moore (1945) doesn't indicate that any nutrient sterilization or filtration was taking place, so it could be hypothesised that after their *honeymoon period*, pests and diseases did become a serious issue.

The current manager MC highlights that he inherited many challenges, but he agreed that the situation (in August 2018) was poor and he was determined to tackle the issues. The indications from MC were that in August he was very much in a *fire fighting* situation – trying to combat a multitude of issues but struggling to tackle all at once. There was no indication or evidence that MC inherited robust production, marketing and/or IPM strategies, and MC is in the situation of trying to create and instigate such plans, while at the same time tackling significant P&D and production challenges.

4.3 The high turnover in AHS staffing has been unhelpful:
It is unfortunate that there have been at least four different people responsible for overseeing AHS since its operation commenced. The evidence indicates that after Stephen Herron (SH) had initially designed and set-up the farm he left it in a good position, with systems in place, healthy plants, and crops going to market. It should be pointed out, however, that under SH's tenure there was no nutrient filtration or sterilization systems installed.

The existing Manager, Matt Castle (MC), is well/appropriately qualified with a BSc in Commercial Horticulture, MC does not, however, have significant experience in running a hydroponic unit. If MC had been asked to manage a unit that was operating successfully, he would have had issues to tackle, but for him to take over a farm with fundamental problems (lack of water treatment and high pest & disease levels), in an extremely remote location, without any direct support, was extremely challenging. AHS now need a period of sustainability with its manager and MC needs to be supported, developed and directed as necessary to ensure he successfully meets the challenges ahead.

4.4 The crop production systems at AHS need to be reviewed and revised:

The existing closed-circuit hydroponic system at AHS does not have any system in place to filter and/or sterilize the nutrient solution between cycles, and there is no regular draining and cleaning of the whole system carried out. This, coupled with the relatively high variety of crop types being grown, results in two fundamental problems for AHS:

- Any soil/water borne pests or diseases (P&D) are likely circulated to all the plants in the system i.e. it becomes a very effective way of rapidly spreading such problems (e.g. *Phytophthora* sp.).
- The yield/quality of all the various crops is not maximised, as all are receiving precisely the same nutrient solution, regardless of the crop type, age or their stage(s) of development.

The indications in August 2018 are that MC is trying new ideas (e.g. moving some crops towards an open-circuit hydroponic system). MC's update (email 8th January 2019) indicates that he is progressing with his plan for a switch over to open-circuit hydroponics, but is still encountering challenges with watering regimes, nutrition and P&D. All that MC is implementing at AHS seems sensible (from afar), but, as MC admits himself, he is not certain that the approaches he is implementing are the right ones.

MC's approach is, by some degree of necessity, a reactive one, but what is required instead is the design and implementation of a more robust and detailed cropping plan (including a comprehensive integrated pest management plan). It must be realised that getting materials, equipment and spare parts to Ascension takes time (2-3 month lead time via ship), so a longer-term production plan would better enable specific supplies to be bulk purchased and stored. Perhaps producing some vegetables in the field plots on Green Mountain once again could be an option? It is probable that MC would need some additional guidance to assist him with this detailed long-term planning.

The decision must be taken if AHS is to switch over to open-circuit hydroponics, or establish an effective way of treating the nutrient solution and maintain a hygienic closed-circuit system? MC has already started to switch some crops to open-circuit, but the perception is that a full options appraisal has not been carried out. All factors must be considered and viewed on a long-term basis e.g. the amount of water required for open-circuit hydroponics is significantly higher than in closed-circuit systems, which is impacted on by water availability and cost.

There are options available for treating the water, ranging from the use of hydrogen peroxide (Modular Hydro 2018), to the installation of mechanical filtration and Ultraviolet Light sterilization equipment (Fluidquip 2019), combined with particle filtration. Options need to be properly appraised in terms of the future production system and the particular challenges of producing crops on Ascension (i.e. climate, location, access to technical support, etc.).

4.5 AHS could develop more market driven production:

Production horticulture is a demand led business and AHS must ideally aim to be *market driven*, whereby they grow precisely what their customers want. In an ideal situation knowing they have a buyer before crops are grown. The indications are that discussions had taken place with the stores on and on that basis initial crops were selected, however, there were no specific contracts and the failures in production over the last year+ has resulted in an increasing lack of confidence by the stores in AHS.

Initial crops from AHS were sold to the local supermarket, The Chandlery, NAAFI and the small convenience store at Two Boats village (JAMS). Crops were also grown for Residency events and conversations had taken place with the US military about supplying them with produce. NB: According to MC, the USA military is currently constructing their own hydroponic farm once more.

Future production at AHS could be more market driven and the opportunity exists to negotiate supply contracts with a range of customers on the island. A sensible approach to explore, could be to reduce the variety of crops produced on AHS and instead focus on a smaller number of crops that are highly demanded by the market. This needs to be planned in tandem with the production system. A reduction in the range of crops would also allow improved fine tuning of the production systems, with individual crop requirements being able to be catered more specifically for.

4.6 Ascension should develop horticultural linkages with other Islands:

Ascension is part of the wider UK Overseas Territory including St Helena and Tristan de Cunha. The Consultant recently carried out a review of St Helena agriculture (Morris 2018) and believes there are mutual benefits from horticultural collaboration between the two islands.

The links between the two islands are intrinsic and the potential exists for knowledge exchange, technology transfer and collaboration on procurement, marketing and accessing external expertise. The potential for horticultural collaboration between the two islands is supported in principle by Darren Duncan, Head of the Agriculture & Natural Resources Division (ANRD) on St Helena (personal communication).

There are hydroponic farms operating on St Helena, which are producing higher quality and far greater yields than AHS and there would be value in either MC visiting St Helena's hydroponic farms, and/or the leading growers from St Helena visiting AHS to provide consultancy and assist with detailed planning. One of the leading hydroponic growers on St Helena would be keen to discuss how he might support AHS (personal communication). MC stated that *'any sharing of technical expertise between islands is welcomed, as is the building of links with the horticultural industry in similar climates….but I would not want to compromise the intellectual property of Ascension Island Government'.*

There is a need for ongoing 3rd party consultancy support for Ascension and St Helena and also potentially Tristan de Cunha and the Falklands, both of which have received recent horticultural development initiatives from the UK. NB: Although the Falklands is a separate UKOT, they are in the South Atlantic and have a productive horticulture hydroponic farm. The potential also exists to collaborate with the USA military on Ascension, who are currently building a new hydroponic farm.

The potential exists to access horticultural consultancy services for more than one island, perhaps even the whole Governance, which could provide economies of scale e.g. Harper Adams University (one of the UKs leading agricultural universities) have been involved in the upskilling of people from Tristan de Cuhna and have indicated that they are keen to be involved in the development of agriculture on St Helena (Morris 2018). Some of the challenges faced by AHS are comparable to those on St Helena, and it is feasible the Harper Adams (or another organisation) could provide technical support for multiple islands. Much of this technical support could be delivered 'remotely', using well-developed existing agronomy support tools offered by various agencies/organisations.

Although individual islands have their own governance and priorities, the hope is that as part of the same UKOT (or at least UKOTS in the South Atlantic), collaboration could be facilitated and enabled to potentially reduce the overall consultancy cost, better share knowledge, and potentially benefit all.

NB: The consultant has maintained email contact with MC since his visit to Ascension in July/August 2018 and sent MC a copy of the report on St Helena Agriculture (Morris 2018). The consultant also encouraged MC to visit St Helena if possible and liaise with him before he comes so that visits to St Helena growers can be organised in advance.

5. Recommendations:

5.1 **Revise production methods in operation:** Carry out an options appraisal on a move entirely away from closed-circuit to open circuit hydroponics, and/or the setting up of nutrient solution filtration/sterilization systems. Bench mark existing production systems against those being operated elsewhere i.e. growing media, containers, propagation methods, etc. Consider utilising the field plots on Green Mountain for some vegetable production.

5.2 **Become more market driven:** Engage with outlets and potential customers on Ascension to better assess market requirements and demand. Negotiate production quantities in advance of propagation whenever possible.

5.3 **Design and implement a robust, detailed and streamlined cropping schedule:** To deliver target crops for specific markets/customers and incorporating a comprehensive integrated pest management programme. Reduce the range of crops produced, to enable greater efficiencies and improved crop and pest management. Look to produce 2-4 key crops only.

5.4 **Establish knowledge and technology exchange with St Helena:** Access hydroponics knowledge existing on St Helena. Build a strong relationship with the Agriculture and Natural Resources Division (ANRD) of St Helena Government, and appraise other options for collaboration between the horticultural production on both islands.

5.5 **Upskill existing AHS Staff:** Carry out a training needs analysis (TNA) of the two AHS staff and initiate a development programme as required (potentially linked to the upskilling programme being delivered on St Helena by the Consultant during 2019).

5.6 **Set-up long-term external consultancy support:** Establish long-term 'remote' agronomy consultancy support for AIG/AHS. This should ideally be in tandem with the other islands within the Governance (South Atlantic?) to provide greater economies of scale.

NB: Recommendations 5.1 to 5.3 to be delivered by AHS manager, 5.4 to 5.6 to be led by AIG, with potential 3rd party consultancy required to support all elements.

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Annex A: Individuals engaged with via Personal Communication during research for this report:

- **Matt Castle:** Hydroponics Manager, AIG. Started in post 1st November 2017. Face-to-face meetings August 2018, subsequent emails hydroponics.manager@ascension.gov.ac
- **Jane Disley:** Head of the Administrator's Office / Clerk to Island Council, AIG. Email exchange re Council Meeting Minutes Jane.Disley@ascension.gov.ac
- **Dr Bill Hardy:** Senior Medical Officer, AIG. Email exchange Bill.Hardy@ascension.gov.ac
- **Mike Haworth:** former AIG Waste Manager (2016-18) and a volunteer at Ascension Hydroponic Services. Face-to-face discussions on the hydroponics in August 2018. Subsequent email exchange mthaworth@gmail.com
- **Stephen Herron:** Hydroponics consultant, AIG. The partner of Nicola Moore, Attorney General of St Helena, Ascension and Tristan de Cunha in 2015. He visited Ascension in 2015 and made recommendations to AIG for the construction of a hydroponics farm. Subsequently employed by AIG to set-up Ascension Hydroponic Services. Email exchange November 2018 naturallycayman@hotmail.com
- **Marc Holland:** Administrator of Ascension Island (2014-17). Instigated the establishment of Ascension Hydroponic Services. Now DHM, British Embassy Copenhagen. Email exchange Nov/Dec 2018. Skype conversation 5/12/18 Marc.Holland@fco.gov.uk
- **Martin Joshua:** Producer of hydroponic crops on Ascension while Fire Safety Officer there. Now hydroponic farmer on St Helena. Face-to-face discussion 28/11/18 and email exchange Martin.JBCP@helanta.co.sh
- **Paul Mildon:** Babcock Station Manager for BBC Atlantic Relay Station. Email exchange November 2018 Paul.Mildon@babcock.co.ac
- **Matthew Pritchard-Evans:** AIG Policy Officer who project managed the construction of Ascension Hydroponic Services. Now Copernicus and ESA Policy lead – Earth Observation and Climate, UK Space Agency. Email exchange November 2018 Matthew.Pritchard-Evans@ukspaceagency.gov.uk
- **Iain Robertson:** Former AIG Director of Operations. Responsible for Ascension Hydroponic Services 2016-17. Now Director of Development & Commercial Services, Falkland Islands. Email exchange November 2018 ddcs@sec.gov.fk
- **Nicky Stevens:** Former employee of the hydroponic farm on the Falklands. Now the owner of 'Kaiser's Growers' hydroponic farm, St Helena, which produces lettuce, tomatoes, cucumbers on a closed-circuit hydroponic system. Face-to-face discussion January 2019.

Annex B: Extract from the minutes of the Ascension Island Council Meeting 24 August 2015 – relating to potential to set-up a hydroponics farm.

Food Supply

AIG was considering its future food supply after the RMS is discontinued. The Administrator said that on 21 September he wrote to the Board of Directors of Solomon & Company, PLC to ask them to state their intentions with regards the future operation of the shop. The letter asked for a response from the Board by 21 September to give an indication of their plans, so that AIG could take contingency measures as required.

Councillors were given a copy of a report by Stephen Herron (SH) who visited Ascension in July and looked at food production. The Administrator said that the paper concluded that Ascension was not suffering from a food shortage but that there was more of a problem with the current supply chain, storage and management of Solomon's shop – how it is done, rather than the fundamentals. There was also a clear need for on-island production of fresh fruit and vegetable on a small scale, which SH felt had good chance of success. The Governor was very interested to read the report; St Helena was also looking to expand its food production and would also find the report useful.

The Administrator said that Council was being asked to make a decision on which of the models to pursue and the timing was critical as the island needed to have some food supply measures in place by May, which was the final call of the RMS from South Africa. He explained that it would take about 5 months to get to a stage where the first crops are produced.

The Administrator and DoR took Council through options for future food production using hydroponics, which included examination of a private model and a public model. Council was given a financial analysis of the two models and the risks involved with both. The private model required AIG to underwrite a large proportion of the capital investment and yielded a low profit. The financial forecast for this venture seemed quite fragile with very modest figures. If the venture failed, AIG would have to underwrite up to two-thirds of the investment plus an overdraft. The public model would be funded and managed by AIG and would require a capital investment of £46.5K. A financial analysis of this model showed that this was a less risky option and would yield a higher profit.

Given the evidence that was provided, AIG felt the public model provided the most value for money and was more geared towards local demand. The Governor commended the work that had gone into the analysis and said that given the circumstances of Ascension he agreed that public sector ownership was the way to go. Councillors also agreed with the view that a public model was a safer, less risky option.

It was agreed that AIG would pursue a public model. The DoR set out an option to get consultant support for the first few weeks of operation, through to the first crop and AIG would aim to have this model up and running by the time the RMS ceases. The tender process would extend to the parties who were involved in the analysis and also look at potential interest in St Helena.

Actions:

1. To send a copy of the report to the Governor (Amy Soar).
2. DoR and Amy Soar would take the project forward to the next stage, the tender process.

Annex C: SWOT Analysis of the existing Hydroponics farm by the present Farm Manager, Matt Castle (personal communication November 2018)

Strengths:

- The site is perfect (up the mountain water is free but light levels drop and pests are more prevalent), towards Georgetown is hotter.
- We have room to do other interesting things (water collection off barns), Gardens club area an old allotment plot springs to mind. All of which could add more revenue streams.

Weaknesses:

- The netting is getting old and has holes, we are looking to upgrade to plastic.
- Hydroponics does not work for vines (disease) moving over to bag and dripper system.
- Dependency on supply from one grower.
- Loss of knowledge when I move on.
- Islanders want food items which are popular in northern Europe and St Helena but may not be possible to grow on the island, need to focus on tropical horticulture and educate population.

Opportunities:

- We are currently working with Haifa (Trump Group :-( ) South Africa on slow release fertiliser substrate bags to grow tomatoes in. We have moved some of the site over to Hadopots and substrate filled them ready to start testing when slow release arrives. We are also upgrading the site to dripper (just waiting sign off) this will hopefully iron out peaks and toughs. (You have a follower on Instagram ruggfortress there is a photo of the current one row set up on that account).
- I will submit cost for plastic for the site soon.
- With no runway if we can get it right it should be a winner for all.
- I have been researching Korean Natural Farming (which could have potential)
- With more funding: Would probably build more tunnels on the same site and have them dedicated to individual crops we have a lot of pest coming in for the glory of the kale or cabbage currently growing on the site and then setting up on tomatoes, herb etc. Mainly caterpillars.

Threats / Risks:

- No predators and the ban on importing them seems likely to stay this is a big risk to production on site.
- The long freight times cause big issues, I have come close a few times, a lot of time spent on logistics. One wrong off load or missing order the site goes down for 3 months.
- Pump system for currently both leaf and vine system is very vulnerable and costly to run

Annex D: Advert for AHS Manager 2015

ASCENSION ISLAND GOVERNMENT

ASCENSION HYDROPONIC SERVICES

VACANCY FOR A SITE MANAGER

A unique and exciting opportunity has arisen for a Site Manager for the newly created 'Ascension Hydroponic Services'. AIG seeks an individual who is passionate about growing fresh fruit and vegetables and relishes the opportunity to become involved in the successful set up of a hydroponics site that will significantly improve the supply of fresh produce on the Island.

The candidate will be given full training in the method of hydroponics growing and will be involved in every aspect of the site's setup. This is not a job that falls within regular working hours, candidates should be prepared to tend to crops every day and manage their own time relative to the needs of the crops. As a result, candidates that can demonstrate enthusiasm and flexibility will be preferred. This position is comparable to a Team Leader level within the Operations directorate and with a certain degree for independent working; the ideal candidate will also demonstrate integrity and be trusted to work independently.

The work includes:

- Assisting in the construction and set up of a hydroponics site;
- Learning on the job about effective hydroponics management;
- Monitoring and caring for crops, tending to them on a daily basis;
- Managing crop rotations independently, being able to spot and address potential threats to production;
- Communicating with customers and distributors, ensuring a consistent supply and delivering on time;
- Running the hydroponics business, monitoring sales, adjusting planting to meet demand, managing budgets and pricing strategy, reporting on the financial success of the project;
- Having computer and report writing skills and being able to communicate via email;
- Working with the school and interested members of the community.

We are particularly interested in hearing from candidates with experience in gardening and running a business.

We can offer you:

- A friendly, supportive work place;
- The opportunity to work on an exciting new project that will introduce a regular supply of fresh fruit and vegetables to the community;
- Personalised training and development in hydroponics production and management.

Salary will depend upon experience and ability. The post is offered as an Accompanied Status Contract and includes: rent free housing, utility allowances, food allowance, a mid-tour flight, free medical and dental care and access to a vehicle for work purposes. Before applying for the post please feel free to contact the Head of Policy Development, Amy Soar on 67000 ext. 116 for an informal chat about the post so that you have a good understanding of the role and what will be expected of you, or email amy.soar@ascension.gov.ac.

Application forms and a job description are available from AIG's Human Resources in Georgetown by telephoning (247) 67000 extension 132 or by e-mailing: patsy.moyce@ascension.gov.ac. Completed forms should be returned to the aforementioned email address or by fax to (247) 66816 by no later than **midday on Monday 11th January 2016**.

Administration Building
Georgetown
Ascension Island

A H Nicholls
Director of Human Resources