Prepared for:

Regional Development Australia
TROPICAL NORTH

An Australian Government Initiative

COMPOST FOR A FARMING FUTURE

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1. EXECUTIVE SUMMARY

Regional Development Australia Tropical North Inc (RDATN) were engaged and funded by the *"Commonwealth Government Department of Agriculture, Water and the Environment (DAWE) under the national Land care program in May 2019 to facilitate research/analysis and to deliver a feasibility study and business case into the commercial production of green waste compost for commercial use in agriculture along the east coast of Queensland"*.

Central to this program was a comprehensive study and report conducted by Central Queensland University (CQU), with support from Price Waterhouse Coopers (PwC) of Brisbane, where the potential benefits claimed from compost use as a partial replacement of chemical fertiliser were studied. The compost and productive benefits claimed were those from compost produced by Shark Recyclers (SR) located north of Mareeba on the Atherton Tablelands, and from the banana farming operations conducted at Swiss Farms at Lakeland Downs north west of Cairns. Both operations are owned and operated by the Inderbitzin Family with over ten years of compost production experience, as well as consistent application of compost on their farmland.

Following this initial review by CQU and by PwC, which was concluded in December 2020, Outsource Management Pty Ltd (OM) was engaged in August 2021 to join the RDATN team and to conduct additional supporting investigation into the potential for compost to be an effective partial replacement for chemical fertiliser.

Following an extensive assessment of both the CQU and PwC reports and the conclusions established by both organisations, RDATN conducted an in depth assessment of both reports concluding that additional research and industry engagement work was warranted. This additional work was to support the previous work done, and to help build a more robust and compelling case for compost as a partial replacement for commercial fertiliser.

The subsequent research and investigations completed by OM concluded that:

1. The findings of the CQU report were largely confirmed where the use of compost by Swiss Farms for their 300 ha banana farming operation as a partial replacement of chemical fertiliser delivered the following benefits:
    - Improved soil fertility and health
    - Reduction in chemical fertiliser use
    - Banana yields improved
    - Banana fruit quality improved
    - Soil organic matter (SOM) improved with corresponding increases in soil organic carbon (SOC)
    - Water consumption decreased with water holding capacity improved
    - Water and sediment runoff reduced.

2. Additional benefits identified in addition to those reported within the CQU report were:
    - Productive crop life extended
    - Potential carbon credit benefits of compost use over a number of years.

3. Whilst compost use is a well-established practice used by Swiss Farms for over ten years, OM's research supports previous research that in general, commercial scale use of compost in broad acre agriculture/horticulture is in its relative infancy, not only in North Queensland but nationally. The potential benefits of compost are not well established and due to the industry's relative immaturity, the value of compost relative to chemical

fertilisers has remained low. In real terms, the price of compost has remained steady and unchanged for ten or more years with values ranging from $80 to $150/mt plus GST. Comparatively, compost is considered an expensive way of delivering key nutrients compared to the concentrated levels available in chemical fertilisers. However, the true value and the cost of compost needs to be viewed from an overall soil conditioning perspective. With the significant increase in chemical fertiliser costs in recent years, the value of compost needs to be considered and assessed in light of its overall and accumulative potential benefits. Refer to Appendix 1.

4. Due to the cost imbalance when comparing compost to chemical fertiliser, the CQU report identified the need for an eight percent production improvement that would be necessary to compensate for the higher input cost of using fertiliser. Monetisation of the key benefits of consistently reduced water usage, extended crop life and yield improvements deliver the necessary productive benefit to overcome the cost impost of replacing up to 60 percent of chemical fertiliser on the studied banana farming operation. Furthermore, this provides additional support for further and deeper investigation of the true potential value of compost not only as a source of nutrient but as an overall soil conditioning agent, with a focus on a range of additional crops.

5. In addition to two industry workshops which were conducted with influential Atherton Tablelands and coastal farming groups, nine interviews with key growers provided unequivocal recognition of the anecdotal benefit of compost use and for the support for the adoption of compost as a potential alternative to the partial replacement of chemical fertilisers. Five interviews were also conducted with composters.

6. The ability to produce compost is however dependent on the availability and consistent supply of organic biomass. This is a recognised challenge facing the potential future adoption of compost use on a much broader demand scale. The review conducted has identified that in time, organic biomass needs for the consistent production of compost may be possible with the improving and strengthening of the commitment of all tiers of Government to sustainability and recycling in conjunction with a review of current common practices such as land clearing and the burning of organic mass. This review has identified significant volumes of biomass that is currently in existence and potentially available which could be bought on stream in the future. For example, Australian sunn hemp (Crotalaria juncea L) is a broad acre crop that has the potential to satisfy many of the requirements for cost effective production of biomass. Refer to Appendices 2 and 3. With a production rate of 37 mt/ha, an estimated cost of production of $8.00 to $10.00/t is achieved which is approximately the cost FNQ composters are currently paying local councils to access limited volumes of green biomass from council dump sites. The seed available for the forthcoming planting season, is estimated to produce 100,000 mt of sunn hemp biomass by early 2022. This is the volume identified by SR as being the optimum volume they would need to maximise their current composting facility's capacity.

7. Low density of biomass inputs and subsequent freight cost imposts have the potential to impact the economic viability of biomass sources for compost. Engineering solutions involving compaction of lightweight materials, such as achieved by the Peanut Company of Australia with peanut shell in the mid 1990s, in combination with the potential to cut and bale sunn hemp at the right time (e.g. stalk thickness of three to five millimetres and at a height of one metre) in a similar manner as is regularly achieved with crops such as rhodes grass and 'stalky' product oaten hay, has the potential to convert sunn hemp into a road transport friendly commodity. This could achieve payloads similar to what is

being regularly achieved by the hay industry across Queensland. Savannah Sun Foods recently confirmed that baling sunn hemp similarly to traditional hay products is a distinct possibility and worthy of trials being conducted. Additionally, the supply of inputs will also be assisted following determination of a true value of compost which may offer composters the opportunity of affording to purchase inputs currently not economically feasible and viable to purchase. Refer to Appendices 2 and 3.

8. Freight costs have been identified as a significant challenge to the establishment of a viable composting industry. This impacts the ability of composters to be able to provide compost to the farming sector at an affordable and competitive price. The varying densities (i.e. light weight and leafy) biomass materials significantly impacts the ability to achieve payloads on transport vehicles. This is also compounded the further away the biomass and other raw resources are from a composting site. There are potential solutions to this challenge through the use of mechanical innovation (compaction and containment), adopting and using a broader approach to the use of existing infrastructure and equipment to harvest and transport and store materials (harvesting systems and baling), research and development (R&D) into changing the profile of light weight bulk compost into a much denser form that will allow for larger payloads of finished product (pelletising). Undoubtedly further and focused R&D supported by funded trials, as well as the consideration by Governments to freight subsidies for both composters and the farming sector as viable answers are sought to this challenging problem will assist the composting industry to gain significant momentum in the short to medium term and until R&D can deliver the answers through the use of innovative thinking and planning. Refer to Appendix 4.

1.1. HISTORY AND BACKGROUNDING

Whilst partial replacement of chemical fertiliser has been well documented and successfully used by the Swiss Farms operation at Lakeland Downs for a period of over ten years, overall, broad scale use of compost as a nutrient source in broadacre agriculture is in its relative infancy in North Queensland and nationally.

Seven productivity improvement benefits claimed by Swiss Farms resulting from the replacement of a portion of chemical fertiliser in growing bananas have been extensively reviewed by CQU.

At a sell price of $80/t plus GST, the compost application rate recommended by Swiss Farms is four applications each of six t/ha/pa or 24 t/pa. At this level of compost application, 60 percent of the normally added fertiliser can be replaced.

The benefits cited by Swiss Farms and subsequently validated by the investigations conducted by CQU can be summarised as follows:

- **Soil fertility and health is improved.** Available P, ECEC, Organic Matter, EC are all improved. Parasitic nematodes were reduced, and overall soil microbiology improved. CQU stated that *"compost delivered higher fertility with lower parasitic nematode levels and higher beneficial nematodes". "The evidence supports improved soil fertility and health with compost".*
- **Chemical fertiliser use is reduced.** CQU state *"there is a significant contribution of N from compost to the system".*
- **Fruit production increased.** Swiss Farms yields of 70 t/ha are 17 percent higher than the average Lakeland Downs yields of 60 t/ha. CQU stated that whilst they were not

prepared to say whether this improvement was from compost use, the evidence was supportive.

- **Fruit quality improved.** Brix test analysis confirmed higher values for compost fruit compared to non-compost fruit. CQU concluded that there was a *"consistent result for the better tasting fruit claim"*. Further claims that waste fruit was reduced to 5 percent compared to the average of 15 to 20 percent in the opinion of OM may be a result of mechanical handling equipment rather than due to compost.
- **Soil Organic Matter (SOM) increase.** CQU confirmed that *"soil organic matter increased with compost addition."* An increase from 2.5 to 5 percent was observed which would deliver a water retention benefit and a Soil Organic Carbon (SOC) increase.
- **Water consumption decrease.** As a consequence of the 2.5 percent SOM increase, water holding capacity was calculated to improve by 0.593 ML/ha which is equivalent to 59 mm of rain.
- **Sediment and run off decreased.** CQU state *"the fact check on the claims made for compost use were overall supportive..."*.

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Additional benefits were also identified by OM in addition to those above and include:

- **Extended crop life.** Swiss Farms indicated that due to the improved soil health, their banana crop life span has increased from a standard industry crop lifespan of eight years to 16 to 20 years. Conversations with other banana farmers indicated that tree life varied from 8 to 12 years depending on location, soil type and condition, available moisture, and farming practices.
- **Potential carbon credit opportunity** resultant from an increase of SOC due to the increase in SOM.

CQU's research identified that the cost differential of replacing chemical fertiliser with compost, when calculating the N&P requirements of banana, combined with the relative costs of fertiliser and composts at the time of their analysis, was $3,178. From a cost perspective, compost is a less effective way to deliver key mineral nutrients to a crop compared to chemical fertiliser. To compensate for this cost impost and based on an assumption that 100 percent of chemical fertiliser was to be replaced by compost, an eight percent productivity improvement would be needed to compensate for the additional costs incurred with a change over to compost use.

This finding by CQU reflects that compost is, when directly compared to chemical fertilisers as a source of N,P and K, a less efficient or more costly form of nutrient addition. However, based on the work completed, compost should be viewed not simply as a source of nutrient but a soil conditioning agent which serves to improve soil health with improved SOM, SOC and water holding capacity. It may be invalid to consider compost as simply a fertiliser replacement. The relative value of compost needs to be determined from the overall perspective of the beneficial value it provides over the longer term and not simply on the basis of its chemical nutrient levels. The benefits of compost use deliver outcomes that chemical fertiliser alone anecdotally cannot.

From a monetisation perspective, it may be possible for an eight percent improvement in productivity in bananas to be achieved from a reduced water requirement due to the improvement in SOM, an extended crop life, potential soil carbon credits resulting from improved SOC levels and a potential 17 percent yield improvement in fruit production.

In summary, whilst the benefits of compost use as a partial replacement for chemical fertiliser in bananas is compelling, further, and detailed future research is strongly recommended. Ideally, trials investigating a range of compost specifications at various levels of fertiliser replacement, under controlled conditions with a range of crop types, soil types, environmental conditions are warranted to determine statistically the validity of the productivity improvements. This will also be essential in being able to put a credible case to the farming community to consider the benefits of changing their crop fertiliser practices in favour of the use of compost. Considerable engagement with the FNQ farming community was undertaken by OM and the results of those engagements feature later in this report.

With validation of the benefits that compost could potentially deliver, the ability of composters to source biomass resource inputs to be in a position to supply the anticipated volume demand becomes a future challenge. Whilst a significant range of potential biomass sources have been identified for potential use in compost in this report, a number of practices, such as land clearing and the burning of biomass, which if stopped, could deliver a significant additional resource of biomass for composting.

Furthermore, any future uptake of compost will in practical terms be one where demand will build over time and is expected to take years as trials are completed, information amassed and presented to the agricultural sector, and for the sector to progressively change practices and to gear up accordingly. Whilst the availability of biomass suitable for composting at the moment is a common challenge identified by composters nationally, there is a level of confidence expressed by these same composters that current commitments to recycling and sustainability by all tiers of Government and in turn commitments by large businesses, such as fast-food chains, and national brand retail supermarkets will (they believe) result in the considerable increase and availability of compost inputs in the next few years. With the anticipated benefits of compost use as an outcome of the recommended trial work, which in practical terms will take a number of years, this timeline is anticipated to align with the expected growth in availability of compostable inputs that should become available with the growing attention to recycling and sustainability by all tiers of Government, communities across Australia, and business and industry alike.

2. INTRODUCTION

OM were engaged by the RDATN to join their team as internal Consultants. The engagement was scoped to include desktop research, fieldwork, document development and liaising with PwC to identify detail that may assist in the completion of a Business Case Report by PwC. As indicated in the Executive Summary, project work to date involved research conducted by CQU and PwC.

For the purposes of this report, the 'Compost for a Farming Future' will be referred to as 'the project'.

RDATN identified five stages that would frame the project:

STAGE 1:

1. Access data from Inderbitzin, including from their compost operation at SR and their Lakeland Downs farming operations (Swiss Farms) to feed into the PwC project detail. The key actions targeted were:
    a. Review the CQU work to date with RDATN to identify the critical elements either missing or an impediment to completion of the Business Case by PwC.
    b. Review the detail delivered in PwC reports to identify the key detail required to complete the Business Case.
    c. Engage and meet with Peter and Franziska Inderbitzin and their team at both their farming operations at Lakeland Downs and SR.

STAGE 2:

1. Identify and liaise with users of SR compost to capture key information relating to their productive experience using compost. Surveys were developed to underpin customer reviews.
    a. Collation of relevant data and share with RDATN and PwC.

STAGE 3:

1. Identify other manufacturers of compost and capture information including quantities, sources, location, and relevant factors impacting supply and relevant to SR.
    a. Conduct interviews with two to three compost producers to capture pertinent information particularly relating to accessing input raw materials, quality parameters, biosecurity concerns, raw material factors, and relevant market detail.
    b. Conduct research and identify potential untapped compost input resources to overcome previously identified supply issues.
    c. Explore availability of unidentified options and potential solutions to both producers and end users cost and handling challenges.

STAGE 4:

Hold two workshops with grower groups

1. Supported by detail captured in the earlier stages, identify key influential and representative farmers from the Tablelands. Conduct a workshop to identify factors both favourable for compost use and factors impeding compost use when comparing compost use against traditional fertiliser practices.

2. Supported by detail captured in the earlier stages, identify key influential and representative farmers from the coastal strip from Mossman to Tully. Conduct a workshop to identify factors both favourable for compost use and factors impeding compost use when comparing compost use against traditional fertiliser practices.

STAGE 5:

1. Engage with PwC and RDATN throughout each stage and provide the necessary detail for PwC to complete the Business Case.

3. PROJECT PLAN/GANTT CHART

The key project activities and corresponding timelines were scoped and framed with a supporting Gantt Chart (Appendix 5) with a project start date week commencing 09 August 2021 and concluding week commencing 01 November 2021. Despite challenges associated with access and feedback to and from key stakeholders, combined with a number of the project stages running in parallel, the OM team have in the main adhered to the agreed timelines with the initial PwC Business Case report anticipated to be available by the end of November 2021.

4. SWISS FARMS AND SHARK RECYCLERS – A SUMMARY

The Inderbitzin family have been developing and conducting farming operations at Lakeland Downs, north west of Cairns for over 30 years growing a variety of produce but principally bananas. The family have established a large and modern compost production operation at Biboohra north of Mareeba on the Atherton Tablelands known as SR. Compost has been produced there for the last ten years and used principally as an integral part of the family's agronomic practices.

Whilst currently having the capacity to produce 100,000 tonnes of compost per annum, due to the challenge associated with access to potential biomass inputs on a cost neutral basis, current productive output is between 8,000 to 12,000 tonnes. The vast majority of this is used on their own farms with very limited local sales to other farmers. SR do not actively market their product at this stage as a result of concerns of demand potentially exceeding supply at this point in time. According to the firm's Principal, based on the available land size, the operation could be expanded to potentially produce 250,000 t/pa.

The challenge for compost production is the availability of input biomass raw materials. The indication from SR is that to produce 100,000 tonnes of finished compost, a green biomass volume of c. 250,000 to 300,000 tonnes would be required. Feedback received by OM from other composters, such as BiobiN in South Australia, and Candy Soils in South East Queensland indicate that currently the challenge is in accessing enough biomass to meet demand, limited by existing Government legislation with respect to sustainability and recycling practices both domestically and commercially.

Swiss Farms currently have approximately 300 ha planted to bananas at Lakeland Downs and indicate productive outputs of 70 t/ha, which in comparison to the stated average yields achieved elsewhere on Lakeland Downs and Queensland, are significantly higher (Reference CQU report).

As scoped in the engagement document between OM and RDATN, a substantial questionnaire and survey form was developed by OM and framed the basis of the investigation with both Swiss Farms and SR.

As a summary of the SR investigation, the major component of their compost is derived from a range of green waste sources (timber waste, sawmills, councils, land clearing, gradings from seed cleaning operations and packing sheds etc.). As indicated, the ongoing challenge faced not only by SR but the composting industry in general (as identified following discussions with other composters) is the availability of suitable raw material inputs which limit the ability to produce the volume of compost that in time may be required as demand increases. As a consequence, the majority of the compost produced by SR is used internally by Swiss Farms on their own farms with only a small volume sold ex gate in 25 litre bags and bulk bags.

Due to the supply side challenges, SR have not considered and are currently reluctant to undertake a targeted marketing campaign for their product given the inability to supply more than current production volumes. However, based on the demonstrated positive productive impact of compost in their operations, Swiss Farms are of the view that there is a significant demand upside to be fulfilled provided access to input raw material volumes could be achieved

and grown over time. Certainly, the feedback gained from OM's workshops with influential members of farming communities on both the Atherton Tablelands and coastal regions is that there is a growing awareness and a positive perception of the productive benefits to be achieved from compost use.

To ensure consistency of compost product, SR has indicated that they have a focused target to ensure a consistent C:N ratio is maintained as input materials change. Biosecurity and traceability of inputs for quality purposes are managed by ensuring the composting process is operated under the Australian Standard for composting (AS4736-2006).

From a process perspective, SR has adopted a windrow technique which includes water addition as a key ingredient to ensure required temperatures are reached and exceed and are maintained at 60 degrees C which is critical for sterilisation of material. All inputs delivered to site for use in compost production have track and trace records maintained, and every batch of compost is analysed by an independent laboratory. The process takes approximately six months for a cured batch to be completed and is not considered fit for purpose until temperatures have stabilised.

Compost consistency and adherence to specification is critical and a Certificate of Analysis or Material Safety Data Sheet (MSDS) warranted. The recommendation is that SR develop a MSDS for their product. Examples of MSDS and specification detail from other composters (Rocky Point Mulching and CQ Compost) have been included for reference at Appendix 6.

Currently the commercial value of compost remains to be determined. SR has held the price of compost at $80/t plus GST for nearly ten years despite the significant increases in commercial fertiliser prices and the growing costs of labour and compost inputs over that period. Given the reluctance to increase their compost price point, where possible, SR is of the view that raw material inputs should be received to site at no cost. Furthermore, the ideal aim for SR is for a gate fee approach to be implemented if possible. With a stated production cost of $55 per tonne, the sell price of the product has remained unchanged for ten years at $80/t ex gate plus GST or delivered within a 12 km radius. In addition, SR offer a spreading service within the delivery radius free of charge and has modern purpose-built spreading equipment capable of covering 140 ha per day.

As indicated, whilst the cost of chemical fertilisers has increased substantially in the last ten years, SR have been reluctant to increase price. In discussions with other composters there is a recognition that the value of fertiliser is yet to be determined when compared to fertiliser costs. Price elasticity of compost needs to be established in relation to fertiliser prices and crop type and this is likely to vary from region to region depending on the availability and cost of raw resources and market demand. There is a general consensus amongst composters that current sell prices do not reflect its true value (Appendix 7). From a comparison perspective, OM investigations have confirmed that pelleted organic sources of nutrient with custom blends at a delivered price of $750/t plus GST in one tonne bulk bags are being used on the Tablelands for organic certified crops. This suggests that compost is currently undervalued with its true value, when compared to the fluctuations in chemical fertiliser, to be determined.

Swiss Farms believe that there is a significant upside to compost demand if many more growers could be made aware of the impact of compost on the claimed improvements in SOM, SOC and soil health. Additionally, discussions with other windrow composters in South East Queensland provides further support for the view that the value of compost is yet to be more readily

accepted in broad acre farming operations. This amounts to farmer education and awareness being an imperative in this process.

Whilst manufacturing to the Australian Standard and ensuring temperature and moisture levels are managed in accordance with required practices, there is a held view that compost poses no risk to non-target crops or animals. However, whilst the composting process is considered a means of producing a safe product, OM's research uncovered the view amongst some users that raw animal manures and raw biosolids that are spread on farms directly rather than being subjected to the composting process, present a potential threat to animals and from an environmental perspective, potentially a high nutrient water contaminant. Therefore, as a practice, certain members of the community regard the spreading of such materials as a potential contaminant with a view being put forward that may warrant Government intervention to prevent such a practice. Should such a practice be deemed by Government to warrant intervention, this material could be redirected to composting reducing the threat to both the environment and waters running to the Great Barrier Reef (GBR).

In addition, current land clearing and burning practices not only destroy valuable timber resources that could be used in the composting process, in broad terms the practice could be viewed as having a negative impact on the environment, particularly in the current global context. In the horticultural sector the trimming of trees such as mangoes, avocados, and citrus trees is a regular and common practice that generates a considerable tonnage of biomass across northern Australia each year. To obtain an approximate amount a survey would need to be conducted, however it is understood that an amount of this material is shredded and deposited back under trees and the majority is usually amassed and burnt on the headlands. There is a view that these practices may warrant scrutiny by Government to discourage and/or prevent such practices as this may also be a contributing factor to global warming through carbon emissions. Such material could also be redirected to composting which would provide a range of benefits currently being lost as well as the reduction in environmental damage.

By using compost at the rate of 24 t/ha/pa, Swiss Farms claim a benefit to the environment from a reduction in runoff to waterways. When using compost on a consistent and long-term basis, SOM increases giving rise to an improved soil water holding capacity. Inderbitzin claim that for each one percent increase in soil carbon per ha adds 140,000 litres of water holding capacity. For every one and a half percent increase in SOM, a one percent increase in SOC is claimed (Reference Appendix 8 - Presentation by Corporate Carbon 2018 AORA National Conference Brisbane).

From a nutrient perspective, every tonne of SR compost is claimed to contain 250 kg of carbon. Additionally, every batch of compost produced is analysed by an independent laboratory with results claiming the product to contain one percent N, half a percent K and two percent P in slow-release form.

For compost to provide a balance of nutrients, poultry manure is considered an ideal source of N. With a significant broiler chicken and egg producing industry currently located on the Tablelands, this presents an ideal source of N. However, with the considerable value placed on poultry manure by certain elements of the farming sector due to its relatively high N content, there are a number of competing users for this input in its raw form. Alternatively, recent Queensland Government announcements of green hydrogen and green ammonia production facilities being established in Brisbane may present an opportunity for alternative and sustainable nutrient sources for composting (Appendix 9).

SR are of the view that potentially up to 40 percent of all materials going to landfill could be redirected to compost. Referencing a 2017 article (Appendix 10) by University of Queensland and University of Southern Queensland researchers, Queensland operates 152 landfill sites operated by local councils and private companies. The article reports Queensland landfill receival volumes of c. 4 million t/pa with the three categories of material being household rubbish, commercial and industrial waste, and construction and demolition waste. As a consequence, SR and other composters believe that there is both the need and opportunity for local, state and federal Governments to review currently accepted practices to target sustainable and ultimately compostable materials and practices. From a timeliness perspective, the Queensland Government's recent release of its Draft Queensland Organics Strategy 2022-2032 is reassuring (Appendix 11).

The adoption of compost as a partial replacement of chemical fertiliser, requires a long-term view and commitment by farmers. The experience of the Inderbitzin family demonstrates that the benefits of compost accrue over time and are without doubt sustainable. It is apparent that some within the farming community have explored the use of compost, however, have ceased using compost for a range of different reasons including for example, the expectation of a rapid productivity improvement, difficulties in accessing sufficient volumes, being confident of quality, being confident of no inherent risks, and not being equipped to store, handle, and distribute compost appropriately and efficiently. As a standard practice Swiss Farms has been taking soil and leaf samples on a monthly basis from a number of blocks for up to ten years for independent laboratory analysis. This reinforces the long-term commitment required and OM was provided with the opportunity to view and verify these records, which in the main supported the conclusions made by CQU in their research work. A sample of these results is provided at Appendix 12 of this report.

5. COMPOST DEMAND AND SUPPLY CONSIDERATIONS

Compost is not viewed, nor has it been used as a total replacement for chemical fertiliser by the Swiss Farms operation. The experience of the Inderbitzin family is that it is to be used in conjunction with fertiliser and as a consequence provided them the opportunity to reduce the use of chemical fertiliser by up to 60 percent and by the same token maintain a production level that exceeds both Queensland state average yields as well as yields of un-composted commercial banana farming at Lakeland Downs.

As previously indicated, the sell price of SR compost has been held at $80/t plus GST and has remained unchanged for ten years. There is a resistance to move the price by SR, however, if fertiliser prices continue to increase and the benefits of compost as claimed are further statistically validated by recommended future trials under controlled conditions, this may warrant the opportunity to review price points and elasticity of price relative to traditional fertiliser inputs. As a consequence, with an increase in potential compost value, biomass sources not currently considered viable due to their relative cost, may well become an affordable input.

Whilst there is an admission by Swiss Farms that a cost benefit analysis for the use of compost has yet to be definitively completed, they are unequivocal from their experience that it provides benefit, and that compost use is a central farming practice in their operation, or they would not have continued using it. Additionally, due to their experience combined with their commitment to sustainable farming practices, they are committed to sharing their journey with others.

Whilst the majority of the compost produced is for their own use, combined with the challenges of producing large volumes due to accessing inputs, some sales to local users are made but on a small scale. These sales are based on collection at site either in their own trailers or SR can bag into 25 litre bags or bulk bags (sample provided and retained for reference).

When reviewing commercial prices for composted product, bagged product is sold for an equivalent c. $300/t in 25 litre bag sizes. From a density perspective, a 25 litre bag will hold approximately 15 kg of compost. Naturally, consideration from a price point perspective would need to take into consideration the nutrient specification of product for any valid price comparison.

Interestingly, Swiss Farms has used the Columbian banana industry as the ideal model to adopt and to drive operational efficiencies. A significant component of this model involves the mechanical handling of fruit which minimises product waste. Waste from their Sun Valley Farm has been claimed to be reduced to five percent down from a stated industry average of 15 to 20 percent. Whilst compost use is claimed to improve fruit quality from a taste perspective, quality of fruit from a blemish or damage perspective, the reduction in damaged product is most likely attributable to the mechanical handling processes introduced.

Whilst a number of key benefits of compost use, as claimed by Swiss Farms and as validated by CQU have been included in the report, a further summary of the benefits claimed are provided below:

- Organic matter of soil is improved. Data records made available to OM by Red Valley Bananas for review, whilst on an overall basis are somewhat inconclusive, do reflect organic matter increases on specific land blocks for certain time periods. With validation through future recommended trials under controlled conditions, this could deliver a

potentially significant water saving and contribute substantially to monetisation calculations towards production improvements.

- As a consequence of the improvement in SOM, SOC in soil is improved. The claim is that with every one and a half percent increase in organic matter in the soil there is a resultant one percent increase in SOC levels. The subsequent claim by Swiss Farms is that for their Red Valley Farm, for every one percent improvement in SOC, the water holding capacity increases by 140,000 litres/ha. This water holding capacity claim is made in reference to the presentation at the 2018 AORA National Conference by Corporate Carbon (Appendix 8). From a water use perspective, one Swiss Farms property at Lakeland Downs has claimed to have reduced its water needs from ten ML/ha to eight ML/ha.
- Swiss Farm records indicate that for Red Valley the soil quality improvements have resulted in the life of their banana crop being extended. Swiss Farms believe a 20 year crop life is achievable compared to a current industry standard of seven to eight years. Following validation, this would provide a significant saving with costings provided by Swiss Farms for their Red Valley Farm indicating savings of $15,055/ha over eight years.
- Banana quality is claimed to have been improved in terms of taste, as validated with Brix analysis, and claimed feedback from the major retailers which has been stated to have led to increased sales demand and sales volume.
- Swiss Farms advised that Red Valley Farm yields have increased to two and a half cartons per bunch versus a claimed standard of one and a half cartons per bunch. CQU research validated yield increases of 17 percent or from a Lakeland Downs average yield of 60 t/ha/pa to 70 t/ha/pa.
- Product waste due to blemishes and damage is claimed to have decreased with industry waste cited at c. 15 to 20 percent compared to that being achieved by Swiss Farms with waste of c. five percent. As indicated previously, there is reason to consider the implementation of mechanical handling practices as a driver of reduced waste rather than compost use.
- Being consistent with their sustainability position, the practice of trimming banana trees and composting the material back has been adopted rather than a traditional practice in the industry of ploughing in or burning the trimmings.
- Water runoff is claimed to have been reduced with substantiation being in the form of the SOM impact. Additionally, Swiss Farms indicated that on the Red Valley Farm they have been testing water sources on the property which provided support for a decrease in nutrient and sediment runoff. Water runoff has been collected and tested for N with the claim that all Red Valley runoff as measured is well below threshold levels. They have indicated that it is their intention to begin testing below ground water for nutrient analysis to validate a reduction in environmental impact.
- Compost use has resulted in healthier soils with resultant improved nutrient uptake due to healthier root systems, soil microbiota, nematode control, pythium control, Panama disease protection are amongst the claimed benefit of compost use. After years of compost use, Swiss Farms indicate they have no natural soil disease issues. On a ‘normal’ banana farm it is claimed more fertiliser is required each year to sustain the same productive output – compost is a reverse of this with soil quality improving and longevity of crop being extended. A further benefit of composting is that fertiliser use is reduced rather than increased over the years with up to 60 percent fertiliser being replaced with the adoption of compost.

It is worth noting that a family member located in the Dimbulah region is currently engaged in a compost trial with a lime crop where the soil is sandy. Whilst early in the trial, observations reported at this stage indicate 50 percent less water is required compared to the trial area where compost has not been used. In addition, and anecdotally the lime trees from an appearance perspective appear healthier with higher yields per tree being reported. Photos taken by OM during research are provided at Appendix 13. The recommendation, as with the recommendation following the claims of benefit for bananas, is to conduct trials under controlled conditions where compost addition at varying rates of fertiliser replacement, on varying soil types, on various crops under varying environmental conditions can be studied. It is envisaged that such trials would be conducted by an appropriate tertiary institution with a reputation for tropical agriculture. Such trial work could provide a solid foundation for both undergraduate and post graduate qualifications.

OM's investigations have shown that there may be some hesitation in introducing compost which may have residues that may expose a grower to Panama disease. Of interest is that Panama resistant plants are currently being trialled by Swiss Farms at their Red Valley Farm which may in time resolve any hesitation that a grower may have. Secondly, there are scientific papers (Appendix 14) where the fungus Fusarium has been shown to be destroyed by the composting process. Trials which specifically target Panama disease fusarium and the ability of the composting process to destroy the fungus may be worth future consideration.

From a supply and operational perspective, SR presents as well managed and well maintained from an operations perspective. As stated, they are of the view that if more green waste is accessible, demand will exhaust all the compost they could produce at the present time.

As indicated, the current stated capacity of 100,000 t/pa of compost with the current infrastructure is the productive output. The belief is held that all tiers of Government have a role to play in legislating the manner in which organic wastes are disposed of. Having a Swiss background, the Inderbitzins believe that the model in place in Switzerland is ideal from a sustainability perspective and could be adopted in Australia. They have a genuine passion for establishing a model that benefits the environment and community and this may well be demonstrated in the fact that they have held the sell price at $80/t plus GST despite ratcheting up fertiliser prices. Recent draft state Government sustainability initiatives are viewed as a favourable and supporting development for composting.

It is worth noting that OM has received the suggestion that at the moment poultry manure from the intensive chicken industry in FNQ is being sold to farms and is being spread directly on to the ground. If this practice can be validated, the question being asked is whether this is an appropriate and environmentally suitable way to dispose of poultry manure which is extremely high in N. The question being asked of this practice is could the exercise of spreading poultry manure directly onto the ground be a potential runoff issue affecting waterways emptying to the GBR that could be better managed by composting?

At the moment SR only receives waste poultry manure from one farm out of eleven for use as a source of N, and in addition receives poultry processing by products from a regional poultry processing operation.

During OM's research it was suggested that biosolids from sewerage plants may also be being spread directly onto farmland. Similarly for the question posed in relation to the handling of poultry manure waste, is the possible spreading of biosolids as a claimed practice environmentally appropriate and impacts future soil contamination? Elsewhere in the world, biosolids cannot be handled in such a manner and are burnt for energy. Biosolids could be an additional compost source and a more appropriate way for councils to manage their disposal.

Ideally, SR favour a gate fee system which if introduced would see the general public and companies deliver green waste to a collection point. They believe the current system does not manage waste effectively and in fact encourages shortcuts where green waste is lost as a potential compost source and is also contaminated. A favoured position is stated as one where the burning of green waste as a practice is legislated against because this practice results in a significant amount of organic matter being burned as it is currently a cheaper option for the landowner. If the environment is a major concern of Governments, the question being posed is should this practice warrant policy changes that allow a more environmentally friendly outcome to be achieved? This in turn would provide a secondary benefit of substantial compost material.

As an additional source of input for composting, a suggestion by SR is for building sites to be required to have multiple skips to enforce collection and disposal of compost inputs in an appropriate manner rather than the current process where all waste is dumped to landfill and subsequently lost as a resource. They believe there could be as much as 40 percent of building site wastes that could be used in compost and argue that wastes cannot continue to be dumped and buried. As such, Government assistance to achieve this outcome is viewed as a critical action. *"Around 40% of Australia's waste, or some 19 million tonnes a year, comes from construction and demolition. This typically includes timber, concrete, plastics, wood, metals, cardboard, asphalt, and mixed site debris such as soil and rocks. However, only 8.5 million tonnes ended up in landfill, as levies in most states make it cheaper to recycle this material. About 10.5 million tonnes, or 55% was recovered and recycled in 2008-09 with recovery rates of greater than 75% being achieved by best performing jurisdictions"*. (Taken from Appendix 10 article).

With a view to the future, SR believe the adoption of the domestic wheelie bin system is counterproductive, encourages people to dump anything into bins and is counter intuitive. The view is that people are encouraged to hide wastes, whereas the Swiss system operates by placing a cost impost on people for a bag to put their waste into which in turn encourages appropriate segregation of inputs and appropriate behaviours. The belief is by charging people, the right behaviours will be driven. This is a system not dissimilar to what Governments adopted and legislated for in the retail sector to eliminate or minimise the use of plastic bags. It became a user pay system where one either has to take along their own multi use bags for groceries etc. or one is required to pay 15 cents for each bag required. Coles for example has a plastic bag that is made from 80 percent recyclable plastic; however it is noted that this bag is actually manufactured in Malaysia. Whilst this is not directly related to the manufacture of compost it is interesting to note that the Australian Government has legislated to stop the export of a range of waste materials including plastics, however through the importation of millions of plastic bags made in Malaysia, Australia is assisting another country to reduce it landfill problem whilst continuing to contribute to our own landfill crisis.

SR are of the view that their composting process is a replicable process that could, with the appropriate support, be replicated down the eastern Queensland coast. Townsville is viewed as having a sustainable supply of inputs and is viewed as a possible location for a compost site. Due to the tyranny of distance and the low density of both input materials and product, freight is a significant challenge for what at current values is a low margin product.

SR estimate that it is possible to only load approximately 18 t of green biomass on a semi-trailer. SR have five trailers each of 90 cubic metre volume. Dried or 'old' waste can potentially deliver up to twenty tonnes per trailer. OM is currently investigating a claimed process to compress green waste and increase payloads to improve the current viability challenges (refer to section 9 of this report).

An additional consideration to combat access to available low density green inputs may be to consider establishing a land site in or around Cairns where green waste could be delivered free of charge. In combination with the claimed process of increasing density of green waste and subsequent trailer payload to be freighted to the SR operations or other sites, this may have merit. However, from an efficiency perspective, the compost site is the best location to grind compost inputs which ideally would be delivered to site. In practical terms this is unlikely and reinforces the need for a true valuation of compost to be established.

From an operational perspective and sustainability commitment, SR are aiming to be self-sufficient for energy as power costs continue to escalate. Discussions included energy sources such as solar and hydrogen technology.

An additional application when using compost is for compost to be a carrier or vehicle for blending other farming inputs. For example, compost is a potential vehicle to blend other soil additions such as gypsum for a 'once application' rather than the farmer needing to make multiple applications. Such a practice would provide additional operational savings for the grower.

As stated, the current SR capacity is 100,000 tonnes of compost per annum provided access and availability of inputs was unlimited. To produce 100,000 tonnes of compost, SR indicate that approximately 300,000 tonnes of green waste is needed. Green waste breaks down 5:1 which is for every five tonnes of green waste one tonne of compost can be produced. The area of land that is owned by SR and which could be cleared for expansion, would result in a potential capacity of 250,000 tonnes of compost per annum capacity. On that basis, 750,000 tonnes of green waste would be required. As discussed, given the freight efficiency limitations faced, multiple, regional, replicable composting operations down the eastern coast may be a more effective consideration.

From a processing perspective, the remaining 30 to 40 percent of inputs for compost need to provide additional nutrient sources such as N which may include inputs such as poultry manure, biosolids and so on. Therefore, the non-green waste component needed would be approximately 40,000 tonnes to produce 100,000 tonnes of compost and up to 100,000 tonnes of non-green waste for 250,000 tonnes of compost output. Such volumes provide further argument for Governments to consider interventions which prevent the widespread practice of burning off and also of the claimed spreading of animal manures and biosolids directly onto land.

6. OTHER COMPOST PRODUCERS

Without duplicating the list of compost producers previously presented by PwC, OM identified three additional composters considered significant in contributing to the depth of information particularly in light of their standing within the organic composting industry.

- BiobiN and Peats Soil and Garden Supplies. Located in South Australia. The Managing Director Peter Wadewitz is the current Chair of AORA.
- Candy Soils. Located outside Ipswich in South East Queensland. The Managing Director is Greg Whitehead and is currently a Director of AORA.
- Rocky Point Mulching. Located at Jacobs Well in South East Queensland.

The summary of discussions with these three composters is given below:

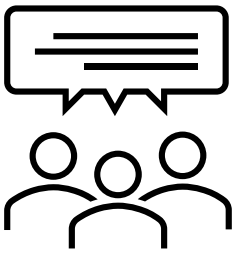
- Peter Wadewitz is Managing Director of BiobiN Technologies and is currently Chairman of AORA.
- Rocky Point Mulching were noted as a result of being featured on Gardening Australia with the coverage providing an insight into their targeted approach to composting. Their approach is one of tailoring specific products with a customer base dominated by smaller landscape gardeners and where blends of specific ingredients such as zeolites and urea are used. The majority of their base biomass wood chip material is sourced from Sunshine Coast state forest plantations. From a reference perspective, MSDS from Rocky Point Mulching are included at Appendix 6.
- Candy Soils operate a windrow composting approach to compost production which appears to be a similar model to that of SR. The majority of their green biomass comes from tendered local councils in South East Queensland where local councils tender out the sale of green wastes from collection locations. By aligning with a third-party chipping capability, Candy Soils gain access to a core source of compost material.
- In discussions, both Candy Soils and BiobiN indicated that the economic value of compost as a nutrient has yet to be fully determined with this value seen as an important consideration for future access to input materials. In other words, the higher the value placed on compost, the higher the affordability that can be given to input resources which currently may not be economically viable to purchase as a biomass source.
- Discussions generally confirm that the value of compost will be dependent on a number of factors including biomass input sources, resultant compost specification, the crop being grown, by region and by soil type. As a consequence, further targeted study is warranted by an appropriate research organisation which, under controlled conditions, can trial various compost, crop, climate conditions versus chemical fertiliser to validate not only the productive impact of compost but also establish an economic price point for compost.
- Like any organisation, Candy Soils is aiming to continue to grow their business, with ambitions of supplying larger commercial farming operations. However, to some extent business growth is being hampered with the need to validate or convince farmers of the benefit of compost use on a larger scale. They have indicated a willingness to align with the efforts of SR and of the aims of the project. There is a general consensus that there is an opportunity to educate farmers on the value of compost on a broader scale. This position further warrants the recommendation of future steps in evaluating and validating the benefits of compost use as a source of nutrient.

- Likewise, Peter Wadewitz has indicated that he is more than happy to engage with SR and this project for the continued growth and awareness of the benefits of composting. As an example of the benefits of compost use in a winery operation, he cited resultant soil quality improvement with a significant worm count increase with the claim that the value of the winery's bottled wine increased from $10 per bottle to $90 per bottle.
- As a general consensus, it was held that most LGAs, state Governments and the federal Government need to improve their current commitment to recycling and sustainability practices. There were however 'green shoots' recently emerging and by way of example, it was claimed that the NSW Government had committed $55 million to local Governments so that every household will have a green waste bin for recycling.
- It was stated that most large companies are targeting a *"Recyclable, Renewable, Compostable"* position and are doing so with urgency. Companies such as KFC, Hungry Jacks, McDonalds and Ikea to name a few were specifically nominated who are moving rapidly to reduce waste and are targeting recycling and sustainability practices.
- There was general agreement that there is a disconnect between supply and demand with respect to compost inputs and demand.
- The discussions reinforced that when it comes to increasing awareness and as a consequence increasing compost use in larger commercial situations, supply of input biomass has been a challenge.
- However, there was a level of confidence that with the current commitments by Governments and local councils generally (nationally) that within the next two to three years with companies segregating wastes for recycling, that the supply side issues currently being experienced would be overcome.
- As part of the discussions, the general background of what the project was looking to achieve was shared. Interestingly, with the discussion around volume input requirements of green biomass, the consensus was that to produce 100,000 tonnes of compost, 200,000 to 250,000 tonnes of green biomass would be sufficient rather than the 300,000 tonnes indicated by SR. This is significant given the current challenge of finding sufficient biomass to underpin the volume of compost that would be required. This represents 60 percent of what had been initially flagged as being required by SR in their operation.
- BiobiN indicated that in conjunction with green wastes they rely heavily on mushroom farm wastes as a source of substrate. It can be noted that the Swiss Farms operation is in the process of establishing a sizable mushroom operation which will produce a volume of waste suitable for composting (volumes yet to be determined).
- In terms of compost value and the current challenge of establishing a relative value for the product (which will be influenced by each individual compost specification), BiobiN indicated that on an NPK value basis, compost has from their perspective a value of c. $150/t.
- The true value of compost was felt to not be captured in the market at the moment. Price indications given were average sell price of $60 to $80/t (not dissimilar to SR's prices) but up to $150/t in some circumstances.
- There is a view that there is the opportunity for composters to be adding additional nutrient sources such as N (urea, poultry manure) which would boost the value proposition.
- The AORA Chairman indicated MRA Consulting Group was referenced as a key player in the sustainability position in Australia.

7. COMPOST USERS/CUSTOMERS

A targeted cross section of farmers was interviewed on a one-on-one basis with the aim of accessing representation from a broad cross section of the farming community. The growers interviewed represented not only a diversity of crop types but also a diversity of farming practice and philosophy. A summary of the interviews conducted are provided at Appendix 15 of this document.

Farmers interviewed included a traditional broadacre coastal sugar grower, a coastal organic banana grower, a Tableland organic citrus grower, a certified farming system known as Ecoganics (identified in the marketplace as wax tipped bananas), a mixed farming operation of banana, sugar cane, coffee, avocados, maize and peanuts, and mixed farming operation of maize, peanuts, potatoes and legumes. Consistent with the findings from the workshops, feedback from each interviewed grower, regardless of crop or farming practice, was that compost had a role to play in their operations.



Of significant feedback, whilst the initial view held was that sugar cane is an industry with an intensive and well entrenched approach was that compost may not be viewed favourably. However, the feedback provided was one of strong support for the potential of compost in the growing of sugar cane. Compost was sourced from the Cairns Bedminster system with a staged approach adopted where the compost was applied only to plant cane and only on a defined area of one farm (note that this was not a replicated trial nor was it independently monitored). With heavy sandy soils, the observation from using compost were visibly plants of a vibrant blue purple in colour in comparison to non-composted plants. A key observation was that in combination with trickle irrigation the composted land with an application rate of 100 tonnes compost per ha, on his sandy soils, produced a noticeable difference.

However, despite the positive results achieved, the use of the Bedminster product was terminated due to increasing costs as it became unviable when compared to the purchase of sugar mill ash at competitive prices and in closer proximity. Despite this, the grower is adamant that with good quality compost, at a competitive price, compost would be a viable proposition for plant cane.

Common to all compost users is the need to spread the product which requires dedicated equipment. This represents a potential capital outlay for each farm with estimates of $150,000 to $200,000, or alternatively, consideration could be given to contractor supplied equipment. Use of contractor provided spreading equipment however raises the potential issue of cross contamination from farm to farm.

A coastal farmer growing commercial cavendish bananas, and also growing bananas under organic and ecoganic protocols provided further support for the use of compost product. This view was further supported by the fact that the grower has, on their own property, adopted composting practices to supply their crops. Whilst the grower has not maintained records comparing compost grown crop to standard crops, and currently not using compost due to supply issues, the grower was adamant that based on their experience using compost they would definitely use compost if they could find a good quality and economically viable product.

Following a positive trial where a citrus grower trialled SR compost approximately five years ago, this grower now produces their own compost and is committed to compost as an integral practice on their property. Biomass for their compost is sourced from the Tablelands Regional Council. Consistent with other interviewed growers, the benefits of using compost were significant, however records have not been retained to provide comparative data detailing the benefit versus non compost practices. However, the results of using compost were so significant that the practice has been adopted by this farming family.

Whilst no records have been maintained, the feedback is that compost practices result in better product shelf life, significantly better plant colour and vigour, and an evident reduction in water usage.

A coastal operation dedicated to the ecoganic certified farming system (wax tipped banana brand), is registered with both the Department of Agriculture and Fisheries (DAF) and the Barrier Reef Foundation. The protocol has been adopted by other growers including avocado and pineapple producers both domestically and internationally. They produce a wax tipped banana which is sold both domestically and exported internationally. Whilst not currently using compost, they believe that with further trials to provide detailed data, there is no reason why compost could not be adopted in their operation. Given the specific nature of their certification, there was a level of concern in relation to potential cross contamination that would warrant further consideration.

The mixed farming operations are considerable commercial enterprises with employee numbers of between 400 to 500 staff with cropping across 1,250 ha. Howe Farming on the Atherton Tablelands has been investigating compost use since 2017-18 including undertaking a study visit to the United States spending three days in the Napa Valley with a leading composting advocate. This investigative tour reinforced that composting as a practice was one to be considered further with a focus moving forward involving the need to monitor, measure and record the impact of compost use. Overlaid with the commercial ramifications, there was a very strong awareness of the challenges farmers faced in future assessments of the GBR.

Focusing on growing potatoes and sweet potatoes to organic certification, a mixed farming operation, following soil analysis, began using compost from SR in 2010. Rotating their cropping activities with maize and pasture, they have described a significant improvement in both soil health and yields. More recently, the operation has sought further performance improvements and is currently purchasing a blended pelleted compost product manufactured in South East Queensland. Of note, the pelleted product is delivered in one tonne bulk bags at a delivered price of $750/t plus GST which is a further indication of the need to establish a relative value for compost. As reported in this document, establishing a value price point for compost which may be in excess of current price points may offer the opportunity for composters to access biomass inputs due to improved affordability.

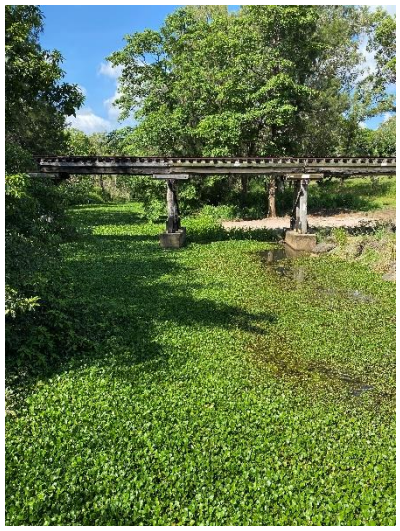
8. ALTERNATIVE SOURCES COMPOST INPUTS

ORGANIC MATERIALS THAT MAY BE AVAILABLE FOR USE IN COMPOST – APPROXIMATE VOLUMES PRODUCED PER ANNUM

1. **Settlement pond waste (1000 to 2,000 mt)** - Dairy farmers and pig producers are faced with increasing pressure from environmental agencies regarding how their effluent is being managed and where the runoff from settlement ponds ends up. This material can easily be pumped into tankers and would be a valuable resource for composters and the environmental spinoffs and pressure relieved for the farmers involved would be significant.

2. **Water hyacinth (volumes impossible to estimate)** unfortunately is an invasive category three restricted invasive species occurring in many freshwater rivers and streams in Queensland. This aquatic plant destroys native habitats, and also seriously depletes waterways of oxygen, increases water loss, and provides a breeding ground for mosquitoes (Appendix 16 – Biosecurity Queensland Fact Sheet). Therefore, it's removal from waterways creates significant environmental benefit. Because it takes up and retains significant volumes of water as well as various minerals etc. from water it is a potentially valuable resource for composting. The vegetative material can be relatively easily harvested but being a regulated species cannot be grown as biomass supply for composting. Under the Biosecurity Act each local Government must have a Biosecurity Plan that covers invasive plants in its area and therefore may be approachable in relation to supporting its removal from waterways that are infested. However, its long-term regenerative capabilities means that it is unlikely to be eliminated from waterways for years to come and as such will remain a viable source of green waste for composting.

   This photo was taken at Granite Creek Mareeba on Saturday 13 November 2021 showing almost total stream blockage for approximately 800 metres and evidence of further coverage above and downstream of where the photographs were taken. Further photos are provided at Appendix 17.



3. **Feedlot manure and discharges (1500 to 2,000 mt)** – There are three feedlots in operation in FNQ (Sugarbag Station – 10,000 head, St Ronan's Station 6,000 head and Morganbury Meats – Walkamin). There is currently 1,000 mt of certified and tested compost on site at Sugarbag Station available for market. Feedlot wastes are a regenerated supply, and the establishment of catchment and containment systems could be installed to capture this valuable resource which will prove to be an easier proposition for composters to collect. This will also provide a valuable service for feedlot and abattoir operators in helping to keep their sites clean and free of contaminants and potential disease spreading organisms.

4. **Roadway slash materials (10,000 mt) - V**arious contractors and councils undertake this work, and this material could be collected and used in composting processes. Source identified however volumes to be further validated.

5. **Domestic and high-tension electricity grid vegetation (10,000 mt)** management creates significant volumes of green biomass which is already chipped and cannot be left under the power lines because once dried constitutes a supply of fuel for fires that could damage lines. Specialist contractors such as Mossman Port Douglas Tree Lopping (MPDT) and Eastern Trees Services (ETS) undertake this work. Discussions with ETS identify 5,445 mt/pa in the Townsville to Cairns corridor, 7,290 mt in South East Queensland and 2,700 mt in the Wide Bay/Toowoomba region. ETS, estimate they have two-thirds of the Queensland market at 15,000 mt and suggest 22,000 mt/pa is the available Queensland volume.

6. **Traditional practices of tree pruning** (volume TBC) is an essential practice for the maintenance of tree health and results in considerable volumes of on farm green biomass waste being burnt annually and lost as a source of compost raw material. Ideally, if burning becomes a discouraged, controlled, or disallowed practice considerable volumes of material would become available for composting (atmospheric carbon reduction provides climate change improvements as a result of not burning which would be an added benefit). Additionally, as farmers become more aware of composting as a possible alternative to high-cost commercial fertiliser, they may be more inclined to make this material more readily available for composters to produce materials that they are able to put back into their farms rather than burning it.

7. **Poultry manure (26,000 mt to 28,000 mt)** from North Queensland operations, with the exception of one farm, is being lost to composting and is sold and spread in concentrated form directly onto some farming operations. If proven to be correct this may be a questionable activity with subsequent unidentified environmental impacts.

8. **Tree trimmings and removal and destruction of aged plantations** (volumes TBC) **-** e.g. old, spent, or diseased mango and avocado trees. Heavier material is pushed up, burnt, and lost as a compost input source. This photo was taken on 13 November 2021 of the partial removal of a mature mango tree plantation. The dead trees constitute two piles approximately 30 to 40 meters long, eight to ten meters wide and approximately five to six meters high and likely to be destined for incineration. Further photos are provided at Appendix 18.

9. **Numerous domestic/suburban tree lopping businesses** dump biomass at council dumps which is lost as a compost input. Much of this appears to end up in landfill as according to PwC captured data from LGAs fronting the GBR only 95,000 tonnes of biomass are accounted for annually. Per head of capita this is an extremely low rate of accumulation indicating that the real data is not able to be captured by councils and believed to be well in excess of 95,000 mt/pa.

10. **Pine forest plantations (**10,000 t**)** - HQ Plantations indicated that they have 200,000 ha under pine plantation in Queensland. In terms of availability of biomass for composting, they are focused on integrating their operations to minimise *'non-value'* waste. For example, much of the waste material is chipped and used in fibre board production. From a price point consideration, HQ Plantations indicated any for sale material would incur a price of $100 to $300/t. This represents further support for the true value of compost to be established. At the moment some plantation materials are sold to produce wood shavings for use as litter on the broiler farming operations on the Tablelands.

11. **Other plant species (> 100,000 t)** and legumes offer considerable biomass. For example, sunn hemp represents a significant opportunity which is currently undergoing commercial seed multiplication evaluation in FNQ and shows significant promise as a high-volume biomass generator. Kenaf (Hibiscus Cannabinus) is another promising biomass source which has been successfully grown in FNQ. Savannah Sun Foods Managing Director Tony Matchett advised in writing that they envisage harvesting 35 to 40 tonnes of seed at Mareeba by mid December 2021. This will be sold and planted to 2,000 to 3,000 ha at a seeding rate of 15 kg/ha. Yields are estimated to be 25 to 50 t/ha on the Tablelands and 5 to 100 t/ha in coastal areas with biomass available following a four month growth period. With average yields, 100,000 tonnes of biomass is projected. Retention of five tonne of grain for seed is projected to produce 200 plus tonnes of grain for biomass planting. This will allow the potential scale up to over 10,000 ha for biomass production in the 2022/23 summer. For following seasons, the limitation on volume is land availability only but projections of 50,000 ha considered feasible. At an average green biomass of 35 t/ha this could generate over one and a half million tonnes (Refer to Appendix 19 from Savannah Sun Foods).

    In 2012/2013 Mackay Sugar conducted significant research and trialled both sunn hemp and Kenaf as potential sources of biomass that could be broad acre farmed to determine if they were able to supplement the fuel needs for their boiler furnaces. Sugar mills generally run short of bagasse (their main source of fuel) during their crushing season and must resort to using much more expensive fossil fuels to maintain operation. In broad summary, the Mackay Sugar report concluded that sunn hemp was definitely a worthwhile option as it ticked most of the boxes in terms of cost to grow, yield, its chemical makeup, high calorific value, ease of harvesting using a slightly and inexpensively modified cane harvest, and being able to use existing cane haulout equipment to load the harvested sunn hemp on to road transport. The one significant downside was the cost of road freight that made it a nonviable proposition for Mackay Sugar to move the project to operational status. This came down to being unable to load a 100 m3 road train with sufficient weight volume to make a payload. Engineering solutions involving compaction of light weight material as achieved by the Peanut Company of Australia with Peanut shell in the mid 1990s, as well as the potential to cut and bale sunn hemp at the right time (e.g. stalk thickness of three to five mm and at a height of one metre) in a similar manner as is regularly achieved with crops such as Rhodes grass and "stalky" product oaten hay, has the potential to convert sunn hemp into a road transport friendly commodity. And to achieve payloads similar to what is being regularly achieved by the hay industry across Queensland.

    Savannah Sun Foods recently confirmed that baling sunn hemp similarly to traditional hay products is a distinct possibility and worthy of trials being conducted. Additionally, the supply of inputs will also be assisted following determination of a true value of compost which may offer composters the opportunity of affording to purchase inputs currently not economically feasible and viable to purchase.

12. **Significant numbers of feral cattle (3,500 mt)** from remote Cape York properties and FNQ national parks to date are culled by shooting on ground and from helicopters. Carcasses that are left to decompose (once culled) could be a valuable source of nitrogen if trapped, transported, control euthanised and composted. Sugarbag station dealt with eight hundred head of deceased cattle in 2020 and estimates are that up to 2,000 head of substandard cattle with an average body weight of 300 kg could be trapped and processed annually. This would amount to 600 mt of cattle body weight that could be processed through composting.

13. Robert Henry of **Sugarbag Station (5,000,000 mt)** advised that he is advanced in negotiations to sell approximately 4,000 ha (10,000 acres) of his land to an agricultural development company who intend to farm cotton. According to Robert they plan to log previously planted forestry plantations and clear fell the remainder. Robert estimates that approximately five million tonnes of biomass will be accumulated and potentially burnt off if not able to be used for other purposes. The Henry family indicated that if this does not proceed, they are going to investigate the milling of the timber themselves because of the shortage of quality timber and ramping up prices. They would entertain the potential for composters to access the significant biomass that would be left from the harvesting process. Furthermore, whilst not compost users, the waste from their 10,000 head cattle feedlot combined with cattle mortalities has led to the production of c. 1,000 tonnes of compost located on his Mt Garnet site. This volume is available for purchase. With expansion planning underway, licensing and zoning approvals have been gained to establish an abattoir. Once operational the abattoir will be a source of valuable compostable wastes such as paunch material, blood, and offal. Based on anticipated slaughter yields, and using an average live weight of 500 kg per animal processed, c. 125 kg per beast would be available for composting. With processing numbers estimated to be 600 head per day, this will generate 75 tonnes of waste per day, 375 tonnes per week operating a five days per week processing schedule. Operating 48 weeks of the year this represents 18,000 tonnes of compostable animal material and in combination with an estimated 12,000 tonnes feedlot waste, represents a c. 30,000/t/pa of compostable material from this location.

14. **Biosolids (6,950 mt)** from various sewage treatment plants around FNQ could be a potential source of compost raw materials. There are a range of views pertaining to how this material is handled and dealt with, however, it does not appear any of this material is ending up in composting which would reduce its potency. There are considerable tonnages produced annually and from some sectors there are concerns expressed in terms of how it is being disposed of. This material is classified as a regulated waste and research needs to be carried out that identifies how and where it is being disposed of. Particularly that it does not (a) pose a threat to agriculture activities involved in the production of crops or livestock for human consumption, or (b) lead to environmental pollution that could have an effect on fresh water sources, run off into rivers, streams and consequently the GBR.

15. **Fast food outlets (volume TBC)** - Discussions with AORA representatives provide an indication of commitment to long term sustainability practices. As such significant organic wastes may become available for composting. Given the geographic spread of these outlets and the stated freight challenge associated with low value compost inputs and product, regional composting operations may be a recommended solution.

16. **Butcher shops (volume TBC) -** As for fast food outlets above.

17. **Crocodile farms -** Offal and waste material following harvest of valuable carcass materials are currently being generated by an abattoir in Cairns. As for 15 and 16.

18. **Banana farms (50,000 mt) - b**ased on feedback from compost user interviews, banana waste is on average 15 percent of production. FNQ produces c. 94 percent of the national volume. 11,280 ha produce 364,970 tonnes banana. At 15 percent waste, a potential 50,000 tonnes of waste biomass may be available. However, a significant caveat on this volume is the issue of Panama disease and the risk of cross contamination from farm to farm. As indicated, Panama disease resistant plants are currently being trialled and may offer a solution to this issue in future.

19. **Timber and saw millers (13,000 to 14,000 mt)** - Ravenshoe Sawmills indicate that they generate the nominated annual volume of sawmill residue which at the moment is sold to sugar mills to be burned as a fuel source for their boilers.

20. **Government initiatives** - An **e**xample is the Victorian Government plan for 650,000 t/pa of household organic waste to be redirected from landfill. The Queensland Draft Organics Strategy 2022-2032 aims to reduce landfill by 50 percent by 2032.

PEAT

- "The Black Stuff" is a humate that has been identified and available in significant volumes from the Southern Tablelands and could be a valuable source of material for addition to the composting process. Contact details - Peter Topperwien (CEO) 833 Topaz Road, Butchers Creek, Phone 0427 916 470.

NITRATE AND AMMONIA PRODUCTION

- Nitrate is now being manufactured in Western Australia and recently announced green ammonia to be carried out in Brisbane by a Twiggy Forrest and Incitec initiative. Yara is a company based in the Pilbara, Western Australia and is investing in and producing 'green ammonia' which is produced using hydrogen obtained through the electrolysis of water with the nitrogen component sourced from the air. These sources of nitrogen could be a potential source for use in composting. As the technology becomes more developed and more readily available this could see the establishment of other plants around Queensland and potential closer to FNQ because of the high demand for nitrogen in agriculture.

VOLUMES OF RAW RESOURCES REQUIRED TO MEET FUTURE DEMAND

- As indicated above there is a significant volume of biomass and animal waste resources that are available and currently untapped that could be used for composting. However, there is little doubt that the estimate of 100,000/t/pa of composting capability of SR could be met. This would deliver an 8 to 12 fold increase in compost volume over what is currently available.

- SR indicated that to produce 100,000 mt of compost, 60 to 70 percent is provided by green waste with a five to one ratio of green waste raw material to composted product needed. Therefore, to produce 100,000 tonnes of composted product, a green waste input of c. 300,000/t/pa would be required (note: other composters indicate c. 250,000 t). The remaining 30 to 40 percent of 'non green waste' component of compost is made up of sources of N including inputs such as poultry manure, carcasses etc.

- Swiss Farms indicate that they have a long term or stage two capacity at the existing SR site of 250,000 tonnes compost per annum. To be in a position to produce this volume of compost, a green waste volume of c. 750,000 tonnes would be needed. A corresponding increase in availability of N sources would be needed for the 30 to 40 percent non-green waste component.

SEASONALITY IMPACTING YEAR ROUND SUPPLY

- Year-round supply is not considered an issue due to the diversity of biomass and other material being available year-round. Although continuous wet weather could cause problems with access to certain materials depending on their location which may limit transport access. However, most material can be stockpiled awaiting the return of favourable weather.

POTENTIAL IMPACT OF INPUT VARIABILITY

- This depends largely on the source and type of material. However, SR has the ability to inspect, weigh and segregate on receival to ensure standards are met. Although any raw resource materials coming from LGAs needs to be treated carefully. Past experience has been that poor separation practices and little effort or education of the general community when dumping material at council dumps or in wheelie bins causes high rates of contaminated material rendering much of what could be composted to being unfit contaminated waste.

POTENTIAL STORAGE AND HANDLING PARAMETERS TO BE CONSIDERED

- Some farmers are concerned about biosecurity and the potential to introduce pest and diseases. Swiss Farms claim that the continuous use of quality compost has resulted in much healthier soils and therefore reduced evidence of soil borne pathogens and diseases.

- SR composting process adheres to the Australian Standard (AS4736-2006) which sets minimum processing standards. These standards, which include temperature, time and moisture parameters deliver a quality of fit for purpose product.

- A public weighbridge and dedicated raw material receival area ensures all inputs are weighed and sampled with sampled inputs sent for quality analysis by an independent laboratory.
- Receival detail guides the operation to blend inputs to deliver a consistent compost product that meets required quality standards.
- Compost is not released for farm use until any microbial activity within the compost has ceased rendering the product suitable and safe for purpose.

OTHER BIOMASS SOURCES

- Council tenders for green waste. The example is given by compost producer Candy Soils (Tivoli, Ipswich) who derive the majority of their green biomass from tendering with a 'grinder' partner for local council tip green material.
- Mushroom waste (BiobiN in South Australia).
- State forest green material (Rocky Point Mulching).
- Plant nursery waste.
- The Victorian Government is introducing a four household bin system where by 2030, organic wastes will be prevented from entering land fill. Estimates put volumes of diverted organic waste from landfill at 650,000/t/pa.
- Queensland Government – Draft Queensland Organics Strategy 2022-2023.

9. FREIGHT CONSIDERATIONS FOR INPUT SOURCES

Freight costs have been identified as a significant challenge to the establishment of a viable composting industry. This impacts the ability of composters to be able to provide compost to the farming sector at an affordable and competitive price. The challenge with green biomass materials is the low density (light weight and leafy) which significantly impacts the ability to achieve payloads on transport vehicles, and corresponding higher freight costs. This is also compounded the further away the biomass and other raw resources are from a composting site.

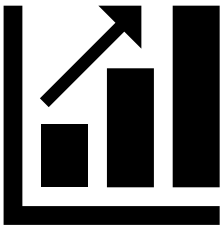
There are potential solutions to this challenge through adopting and using a broader approach to the use of existing infrastructure and equipment to harvest, transport and store materials (harvesting systems and baling), as well as mechanical innovation (compaction and containment) technology which could change the profile of light weight bulk compost into a much denser form that will allow for larger payloads of finished product (pelletising). This would be of great benefit to the availability of green biomass at an economically viable input cost.

In line with this is the determination of the relative value of compost relative to chemical fertilisers to give a base point for the potential purchase of compost inputs which, with the current $80/t plus GST being the sell price of compost, this is a major limitation to access to input materials due to affordability issues. Not dissimilar to cardboard compaction systems and municipal waste compaction trucks technology and engineering capability centred around the use of hydraulics and or a mechanical compression system a Cairns based engineering company, North Queensland Engineering and Fabrication has indicated that a unit could be designed and manufactured to fit on a trailer or truck that is capable of compacting light to moderately dense vegetative material by up to 25 percent or more of volume. The commercial manufacture and supply of such a unit brings a range of market opportunities related to light weight bulk resource recovery. This could be an initiative supported by Government grants to assist the viability of growing the compost production sector.

Undoubtedly further and focused R&D supported by funded trials, as well as the consideration by Governments to freight subsidies for both composters and the farming sector, will assist the composting industry to gain significant momentum in the short to medium term and until R&D can deliver the answers through the use of innovative thinking and planning.

10. CQU KEY SUMMARY

In the initial phone contact engagement with Swiss Farms there appeared to be indications that there may have been other records available that CQU may not have seen, although Swiss Farms indicated they believed they gave CQU access to everything they had. Additionally Swiss Farms indicated that post the research work conducted by CQU they had not received any feedback and were not in a position to conduct their own analysis or provide any form of comparative comment of whether CQU had seen and assessed all of their records.



Following the initial review of the CQU report, OM travelled to Lakeland Downs with Peter Inderbitzin to work with the Swiss Farm team. Access was generously and openly given to all–available records which were scan assessed on site, which provided supporting data indicating improvements in soil health, plant health, and nutrition etc. on certain farm blocks. Based on the detail provided, there did not appear to be any additional records that CQU had not sighted for their report, and subsequently the work conducted by OM concluded there was no further data to be accessed. However, by comparing results over a ten year period on randomly selected farm blocks, and within specific time periods, there appeared to be positive and progressive signs of improved soil health and plant health that appeared consistent with and in line with the claimed benefits.

Seven benefits of compost use were initially claimed by Swiss Farms which were reviewed by CQU over a two to three year period. In the main, the claimed benefits of compost use were corroborated by CQU following the collection of samples and the analysis of data. Whilst CQU concluded that the evidence was supportive of the claimed beneficial productive benefits of compost, CQU in general suggested further validation and trial work was recommended.

CQU concluded that if 100 percent of chemical fertiliser were to be replaced by compost, due to the cost impost of the compost relative to the cost of fertiliser, an eight percent production gain improvement would be needed to warrant adoption of the Swiss Farm approach. In practice, Swiss Farms have not recommended nor in practice suggested 100 percent replacement of fertiliser with compost. Swiss Farms is advocating a 60 percent replacement of fertiliser with compost.

From the CQU Report: ***"analysis of soils and nutrient tests support claims of compost system for improved soil fertility, reduced parasitic nematode levels, increased organic matter, reduced mineral fertiliser use and improved fruit quality"***.

The seven benefits or claims of productivity improvement as a result of using compost use were summarised by CQU as follows:

1. **Soil fertility and health improved.** Available P, ECEC, Organic Matter, and EC were all found to be improved. Parasitic nematodes in soil were decreased and overall soil microbiology was improved.

The conclusion by CQU following their research was stated as ***"compost delivered higher fertility with lower plant parasitic nematode levels and higher beneficial nematodes"***. ***"The evidence supports improved soil fertility and health with compost"***.

2. **Chemical fertiliser use is reduced.**

The CQU conclusion: ***"There is a significant contribution of N from compost to the system"***.

3. **Fruit production increased by 35%.**

CQU's findings in relation to comparing the banana yields achieved by Swiss Farms were:

- Average Australian banana yields = 22.1 t/ha
- Average Qld banana yields = 27.7 t/ha
- Average Lakeland Downs banana yields = 60 t/ha
- Average Swiss Farms banana yields = 70 t/ha

The CQU conclusion: ***"Swiss Farms yields are all from one block and 252% of the Queensland average and 17% higher than other Lakeland yields"***. CQU were not prepared to say whether this improvement was from compost as there were other factors which may be causal. However, overall, the view held was that the evidence was supportive of the claim of improved fruit yields when using compost. The yield comparisons however suggest the claim of a 35 percent improvement may be overstated.

4. **Fruit quality improved.**

Brix test analysis for fruit showed higher values for compost fruit compared to non-compost fruit.

The CQU conclusion: ***"a consistent result for the better tasting fruit claim"***.

5. **Soil organic matter increase from 1.6% to 9%.**

The study confirmed that SOM increased with compost use, however, CQU could not validate an increase to nine percent. They could however confirm an increase in SOM to five percent up from two and a half percent which while a smaller increase compared to the claim, this increase would still deliver a water retention benefit.

6. **Water consumption decrease.**

The study confirmed an increase in SOM from two and a half percent to five percent in one block and as a result, water holding capacity should then be improved by 0.593 MG/ha. This was calculated to be the equivalent of 59 mm rain. Furthermore, soil water holding capacity was found to be increased in the ten year compost soils to five percent or the equivalent of 0.1 MG/ha or 10 mm rain.

In addition to the CQU findings, the Swiss Farms agronomist John Moriconi had been cited as indicating water use on high compost sites had been reduced from 14 ML/ha to 10 ML/ha/year.

The CQU conclusion was that it was ***"not possible to independently verify the values"***.

7. **Sediment and runoff decreased by 60%.**

The conclusion in relation to this claim was that it was not measured but ***"soil bulk density was lower in compost amended soils and water holding capacity increased in 10-year compost amended soils. These attributes should result in increased infiltration and decreased runoff"***.

The CQU Report's overall conclusions can be summarised in their statement:

"The fact checks on the claims made for compost use were overall supportive…".

Throughout the report CQU remained guarded in validating the claims and provided the caveat that the findings from Swiss Farms need to be validated elsewhere or in a controlled trial environment to be able to validate with certainty. In OM's view this appears an appropriate position. The results reported do however, provide support for the improvement claims.

CQU correctly pose the question – that once the five percent SOM level is reached, and if this is after ten years with an annual compost addition rate of 24 t/ha, does the addition rate need to stay at 24 t/ha pa or can it be reduced? Suggested trial research could test this question.

11. MONETISATION OF BENEFITS

The total difference between the Gross Margin for fertiliser and compost cases is $3,178 ($1,153 + $2,025). This amount represents 7.66 percent of the income per ha and is rounded to eight percent.

MONETISATION BENEFITS	CQU REPORT	OM DETERMINED	VALUE $/HA PA	NOTES
Reduced added water – SOM improved.	0.593 ML/ha/pa based on 2.5 percent increase in SOM.		$9.41	Est. $15.87/ML x 0.593 ML/ha/pa based on Sunwater website, with ML costs requiring validation by PwC.
Carbon credits.		1.67 t CO2/ha.	$23.00	Calculated from CQU, SOM improvement of 2.5 percent. Est. $13.80/t. Costing needs validation as OM does not have carbon credit experience.
Extended crop life.		Inderbitzin provided detail.	$1,882	Cost to replenish and replant each crop cycle? Assumes doubling crop cycle – assumes eight years extension. Swiss Farms provided costs of $15,055/ha saving every eight years.
Increased fruit production.	70 t/ha cf. 60 t/ha at Lakelands.		$16,000 pa	Uses $1.60/kg min. sell price for increase of 10 t/ha. NB. Sell price ranges $1.60 to $1.80/kg.
Fruit quality improved.				The improved quality may also be an outcome of improved mechanical harvesting and handling practices which cannot be apportioned to compost.
TOTAL:			$17,832.00	

Based on this it can be concluded that the eight percent in cost represents what is needed to equal the sales from fertiliser based product. The effect of the need to increase productivity can then be inferred as the amount of increase on Gross Margin Profit derived by improvements in the income due to the reduced costs of inputs to achieve this Gross Profit as well as the improvement in product quality and volume to achieve a higher income.

The eight percent productivity gain nominated by CQU is for 100 percent replacement of synthetic fertiliser with compost. It is important to highlight that Swiss Farms recommend up to 60 percent replacement of fertiliser with compost. The productivity gain is represented by an increase in income resulting from increased volume per ha, higher value crops, or reduction in other inputs such as water, all as a result of the beneficial use of compost.

A number of considerations should be made from a timeline perspective when reviewing the CQU report. These include the price of fertiliser which will have increased since the CQU report was completed and has continued on an upward price trend. Fertiliser costs contained within the CQU report were confirmed by the RDATN Project Director in writing to OM and form the basis of the eight percent productivity improvement assertion by CQU and underpin the initial, draft monetisation calculations. The recommendation is that 60 percent chemical fertiliser is replaced with compost. The eight percent productivity improvement calculation of $3,171/ha may therefore be conservative.

The monetisation values included above need validation by PwC with water costs used in the monetisation calculation taken from Sunwater's website. Furthermore, OM does not have experience with carbon credit values and has flagged the potential benefit that may accrue to the farm from compost use and especially so given the recent federal Government's commitment to meeting the 2050 climate change target.

Swiss Farms have provided costing detail for crop replacement with values included in the monetisation table. Banana sell prices of $1.60 to $1.80/kg have also been provided by Inderbitzins with the lower value $1.60/kg used to monetise the 17 percent yield increase.

Productivity improvements from compost use need to be validated statistically through the completion of formal trials under controlled conditions with corresponding ANOVA completion to statistically validate and identify each specific productive improvement. The recommendation would be for an appropriately capable and respected tertiary institution to conduct trials x crop x compost rates against a control of fertiliser. Such trials might underpin undergraduate and post graduate qualifications. The investigations that underpin this project indicate that those crops most likely to benefit from compost use include banana, mango, lychee, macadamia, potato, avocado, citrus and coffee.

12. WORKSHOP SUMMARY

Two workshops were conducted with invitations sent to 20 influential farmers and key industry representatives on the Atherton Tablelands, and 17 key industry influential farmers and key industry representatives around Innisfail, Tully, and Babinda (Appendix 20 - Invitation Lists). The first workshop was held in Innisfail on 20 October 2021, and the second workshop held in Mareeba on 21 October 2021. The purpose of these workshops was to share with growers the findings to date in relation to compost use in bananas and share the experiences of the Inderbitzin family. It should be noted that the Inderbitzin family have been open with the sharing of their experiences and information should be commended.

The overall conclusion from both workshops is that farmers recognise and acknowledge the benefits from using compost. The consensus from the participants was that compost as a farming future was a positive initiative but importantly not to be viewed as a panacea or solution for the varied challenges faced by growers. Continued investigation into the use of compost was recommended with its value seen to be influenced by crop type, soil type, region, environmental conditions, compost specification and so on. Dedicated trial work was viewed as a critical future step in order to validate the benefit that might be achieved from compost use.

Whilst the workshops were attended by growers with differing approaches to farming, the agreed outcome from both workshops was consistently in favour of compost as a practice. The Tableland workshop included growers (The Caamano Family) who are actively producing compost and using their own compost on their farms. They confirmed that they have seen similar positive results as reported by Swiss Farms, however in their lime and pomelo crops. They are committed and concur that the limitation to compost use within their operations is availability of raw material inputs. This is a consistent composting industry challenge nationally.

The Innisfail workshop was attended by growers committed to ecologically sustainable practices where the soil biome was the focus of their efforts. Compost was viewed as a component of the biome and whilst considered a valuable component, the group were recommending ongoing research into the value of compost in terms of their farm practices.

A main discussion point, and question posed to the groups was, is there any factor that might restrict or limit the adoption of compost use as a partial replacement for fertiliser. Front of mind for some growers was the risk associated with transmission of Panama disease. Whilst the discussion included reference to research work where the composting process was found to neutralize Fusarium fungus, further work may need to be conducted on the actual Fusarium fungus which causes Panama disease in order to address these concerns. Furthermore, whilst the composting process may be capable of inactivating the Panama disease fusarium, there would need to be confidence that the composter adheres to Australian Standards for every tonne of produced product. It would only require one incidence of below standard composting to potentially have cross contamination. Additionally, existing on site farm practices limiting movement of plant, equipment and people would need to be maintained.

In terms of Panama disease as a concern for the industry, Swiss Farms at their Red Valley Farm are currently trialling Panama disease resistant banana varieties. The success of these trials will be of significant value if productivity can replicate current banana varieties and provide resistance to the disease.

13. RECENT INITIATIVES

State and federal Government plus regional LGA initiatives in recent months lend direct and indirect support for the adoption of composting practices to replace chemical fertilisers. Internationally, the challenge for Governments has been the adoption of net zero targets by 2050. The federal Government has positioned Australia to deliver on this target. However, in order to achieve this target, it has been suggested that soil carbon is anticipated to be a central pillar of the road map to deliver on the emissions target.

There is an increasing consensus that reliance on soil carbon as a central pillar of the initiative is ambitious. Bio sequestration and carbon capture and storage techniques are practices that may need to be considered.

The research conducted under the scope of this project as led by RDATN has provided strong evidence that the use of compost as a partial replacement of chemical fertiliser has a marked positive impact on soil heath with resultant increase in SOM which in turn delivers an increase in SOC plus the additional benefits of increased water holding, reduced run off and so on. This on the balance of things would appear that the adoption of compost as a broader farming practice will be beneficial to the environment in many more ways than one by potentially being a significant contributor to the health and wellbeing of the GBR. Therefore, it would seem apparent that based on the preliminary outcomes identified in this project, composting may well be a positive and crucial farming practice in assisting the attainment of the net zero targets.

As also identified within the scope of this project, a major limitation or challenge in having sufficient availability of compost, is the limited volume of organic biomass inputs. A number of existing practices that negatively impact availability of organic biomass, such as land clearing and burning, and the mass accumulation of potentially compostable wastes that are currently disposed to landfill have been referenced in the report. As indicated, such practices may warrant Government intervention to ensure these practices are limited.

The commitment of local, state and federal Governments to 'recyclable, renewable, compostable' strategies is viewed favourably by composters and indeed to many farmers in the reference group contacted by OM who believe that within the next few years, availability of inputs for composting will no longer be the challenge that is currently being experienced.

On 10 November 2021, a media release from the Queensland Government by the Minister for the Environment and the Great Barrier Reef, and Minister for Science and Youth Affairs, announced a kerbside collection trial by Townsville's Food Organics, Garden Organics (FOGO). This initiative targets householder garden waste being turned into *"first class"* organic soil enhancer. The Townsville trial is one of three FOGO trials currently being funded by the Queensland Government, with Rockhampton and Lockyer Valley LGAs also currently trialling kerbside collection of green waste. An estimate has been made where 83 percent of organic material currently disposed of in general waste bins will be diverted away from landfill and available for transformation into soil products. Refer to Appendix 21.

Very recently the Queensland Government has released its Draft Queensland Organics Strategy 2022-2032 aimed to improve the management of domestic and commercial food wastes, garden organics and timber. This initiative will directly be supportive of the availability of organic wastes that may become available for composting. In addition, the initiative indicates the significant greenhouse gas emission savings that will be delivered citing that the recycling of

organic wastes in Queensland is the equivalent of 3.8 million tonnes of CO2, the equivalent of planting 844,000 trees and removing 130,000 cars from the road each year. In direct support of the composting industry, and the findings presented in this report, the strategy states *"creating healthy soils through the application of composted organics, helps reduce water, fertiliser and pesticide use and nutrient leaching, while protecting aquatic environments"*.

14. CONCLUSIONS

In conclusion, investigations to date by CQU, PwC and OM find that there is anecdotal evidence indicating a significant range of benefits from partially replacing chemical fertiliser with compost. Whilst there are a number of crops that may benefit from compost use, the majority of the benefits verified in this report are related to bananas, however there was evidence of the use of compost in citrus trees, avocados, and sugar cane. These benefits include productive benefits resulting from soil health improvement but also overarching environmental benefits resulting from a reduction in sediment and water runoff.

Ideally, trials investigating a range of compost specifications at various levels of fertiliser replacement, under controlled conditions with a range of crop types, soil types, environmental conditions are warranted to determine statistically the validity of the productivity improvements. This will also be essential in being able to put a credible case to the farming community to consider the benefits of changing their crop fertiliser practices in favour of the use of compost. Considerable engagement with the FNQ farming community was undertaken by OM and the results of those engagements feature earlier in this report.

Further research is recommended where the prospective benefits of compost use can be studied from the interactions between factors such as sources of compost, soil type, crop type and environmental conditions.

Furthermore, any future uptake of compost will in practical terms be one where demand will build over time. This is expected to take a number of years as trials are completed, information amassed and presented to the agricultural sector, and for the sector to progressively modify existing practices. Whilst the availability of biomass suitable for composting at the moment is a common challenge identified by composters nationally, there is a level of confidence expressed by these same composters that current commitments to recycling and sustainability by all tiers of Government and in turn commitments by large businesses, such as fast-food chains, and national brand retail supermarkets will (they believe) result in the considerable increase and availability of compost inputs in the next few years. The anticipated benefits of compost use as an outcome of the recommended trial work in practical terms will take a number of years. This timeline is anticipated to align with the expected growth in availability of compostable inputs that should become available with the growing focus and attention to recycling and sustainability and the alignment of all tiers of Government, communities across Australia, and business and industry alike.

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