# 1st mission report

## Regenerative Agriculture in Belize

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# 1_ Context and objectives of the mission

TexBel is a company focused on the production and commercialization of high value products such as citruses, juices and coconut water. Its supply comes from its own 4 farms in Belize totalling 2'190 acres planted, and from outgrowers, 16 at the moment.

TexBel has been certified Global GAP since 2013 and is now interested in evolving towards regenerative agriculture practices and Organic certification in its farms, but also to share knowledge and provide guidance to its outgrowers. The Agroforestry Technical Assistance Facility (ATAF) is funding a 1-year support in order to help TexBel achieve these objectives.

This assignment is undertaken by the NGO Nitidae with the support of 2 external consultants, Esteban Pereira from the Costa Rican consulting company Sembrando Flores, and Loren Luyendyk from the USA consulting company Santa Barbara Organics.

# 2_ Purpose of this document

This assignment will be carried out through 3 field missions. The first field mission has been carried out between the 9th of July and the 18th of July 2021. Its main objectives were to hold a review of TexBel's practices in order to identify the current non-compliances with the Organic certification's requirements (NOP and EU standards), and propose an initial conversion plan with related agronomical recommendations. This document contains the findings of this mission that are organized in 3 parts:

1. List of the identified non-compliances (at farm and processing level) with related mitigations actions;
2. Proposition for a conversion plan for TexBel and its outgrowers and its rationales;
3. Initial set of technical recommendations.

# 3_ Agenda of the mission

| Day | Date | Activities |
|---|---|---|
| Friday | 9th July | Trip to Belize and discussions with Jennifer Faulkner |
| Saturday | 10th July | Preparation of materials and review of documentation<br>Meeting with the manager of the outgrower farm "Silk Grass Farm" |
| Sunday | 11th July | Visit of TexBel's LimeCo farm and of the outgrower farm "Lemon tree farm" |
| Monday | 12th July | Introduction to organic certification and risk analysis training with farm team<br>Visit of TexBel's Camalote and Texstar farms |
| Tuesday | 13th July | Risk analysis training with processing facility team<br>Visit of the processing facility, verification of TexBel's traceability system |
| Wednesday | 14th July | Visit of outgrower farms "Obregan farm" and "TUN & associates"<br>Visit of a potential supplier of organic input (processing factory of seafood) |
| Thursday | 15th July | Visit of TexBel's Camalote farm and of potential suppliers of manure and dolomite in the city of Spanish Lookout (local breeders with chicken barns) |
| Friday | 16th July | Redaction of the report, debriefing of the mission with external consultants |
| Saturday | 17th July | Redaction of the report |
| Sunday | 18th July | Trip back to France |

# 4_ Gap assessment for Organic Agriculture certification

The gap assessment's objective is to identify the current non-compliances that could prevent TexBel from obtaining the Organic Agriculture certification, and provide mitigation actions. Since TexBel is seeking certification for its final products (raw fruits, coconut water and fruit juices), it means that the certification must be held at farm and processing level.

Here below are the lists of risks of non-compliances, their level of risk, an explanation on the level of risk, and the related mitigation action in order to comply with Organic Certification.

## At farm level

| Type of risk | Level of risk | Explanation on the level | Mitigation action |
|---|---|---|---|
| Contamination by contiguous non-organic farms/plots | Maya C **Low**<br>Texstar **Low**<br>LimeCo **Medium**<br>Camalote **Medium** | Maya Center and Texstar have at least 50ft between their boundaries and other non -organic farms. However, LimeCo and Camalote have 20ft with other non-organic farms. (see Annex 1) | For Maya Center and Texstar nothing to do, risk is already low. Only show maps during audit.<br>For LimeCo and Camalote, plant rapid growth tree hedges. |
| Vehicle disinfection procedure when entering the farms | **Medium** for every farm | TexBel has a procedure of disinfecting every vehicle entering a farm with forbidden product called Sanigen. | 2 possibilities:<br>Use an authorized product for this disinfection procedure or wait for the product to dry before entering farm. |
| Use of forbidden product (fertilizer, herbicides, insecticides, fungicides) | **High** for all the farms | In all of the farms, chemicals have been recently applied, mainly granular or foliar fertilizers. Burnt lime (used in LimeCo) is also forbidden. | Use authorized organic inputs such as dolomite, coconut mulch, fruit residues, manure, sawdust, seafood residues… With document to show the origin of the inputs. |
| Contamination by production tools (knapsack, machetes…) | **Medium** | No production tool can be used for organic if already used for conventional farm. | Purchase new tools dedicated to organic farm management, easily identified with specific color or label. |
| Contamination by runoffs of engine oil or gasoil | **Medium** for all the farms | During the gasoil filling of mobile equipment, some gasoil can be spilled on the ground. | Put in place a policy of filling the equipment with caution, and notify the workers on this risk. |
| Contamination by water irrigation | **Medium** for LimeCo, and **Low** for the other farms | LimeCo is the only farm with an irrigation pond and drip system. | Regular analysis of the water and if products are used to wash the pipes, choose authorized products. |
| Contamination by watercourse, road, | **Medium** for all the farms | Highway close to all of the farms. | Plant rapid-growth tree hedge at the boundaries of the plots |

| | | | |
|---|---|---|---|
| watershed runoff | | | close to the highway. |
| Risk of mixing organic with conventional prod | Low if one entire farm is organic | It is better to have only organic production in one entire farm. | According to the proposed conversion plan, Maya C should be entirely converted first, and then the other farms, one after the other. |
| Contamination with field bags | Medium | No bag, box or pallet can be used for organic if also used for conventional | Purchase specific field bags, box and pallet that will be exclusively used for organic products. |
| DURING TRANSPORT FROM FARM TO PROCESSING PLANT | | | |
| Contamination by surfaces of the trucks | Medium | Dedicate one truck to organic transportation and easily identified for organic purposes. Train handlers, drivers and handling supervisor. If not, any truck arriving at the plant with organic products must have a cleaning certificate and this certificate is an integral part of the receipt file for each batch received | |
| Contamination during unloading | Medium | Dedicate a specific place for the unloading of organic products. If not, use the unloading dock only for organic and at the end of the day make sure to have a special washing SOP. Train workers. | |
| Risk of mixing organic and conventional products | High | Have specific bags/box/pallets… for organic, easily recognizable. Train handlers, drivers, storage responsible, and handling supervisor. Have a specific and unique harvest ticket per plot. | |

## At processing facility level

| Type of risk | Level of risk | Explanation on the level | Mitigation action |
|---|---|---|---|
| Risk of mixing organic and conv products at the storage | Medium | Create a specific storing place for organic. At least a section in the storage place well separated (10 meters) and easily identifiable (colors, lines… Train storage responsible and internal handlers and everybody that have access to storage place. | |
| Every processing lines (Tamblex, Voran, Zumex…) | Medium | Risk of contamination inside the machine Tamblex. | If used for organic and conventional, set up SOP procedure (models available) between organic and conventional batches. Ideal is to dedicate one day for organic process. |
| Washing and grading lines | Low | No processing line, just washing and grading. | Dedicate one day for washing and grading organic and special SOP after conventional batch. |
| All juice tanks | High | No tank can be used for organic if used also for conventional products. | Dedicate juice tanks to organic. Create SOP to check there is no risk of mixing juice |

| | | | |
|---|---|---|---|
| | | | in tanks. |
| For Lime juice through sunkist squeezer | Medium | If used both for conv/organic risk of contamination. | Dedicate one day for organic and special SOP after conventional batch. |
| Contamination during HPP process | Low | As the machine works with closed bottles, no contamination possible | Just identify well organic batches (bottles or BiB), to avoid mixing. Such as lid of different colors. |
| Mixing of organic and conventional products (raw or finished) in cold storage rooms. | Medium | Either dedicate one entire cold storage room for organic raw materials, ingredients and finished products, or delimitate a specific space in cold storages for organic products. Clearly identified with color line on the ground and label on the wall. | |
| Contamination by biocides used by staff (mosquito repellent, etc.) | High | Avoid mosquito repellent in the plant and avoid direct contact with skin (gloves) | |
| Contamination by pest control products (rats, birds, mosquitos…). | Medium | It seems that pest control is managed with traps, no chemical? If so no risk at all. | Identify reseller. The products must be submitted to the certification body, which must validate their biological safety beforehand. |
| Transport by truck till Texas | Low | Product is already in a separated refrigerated container, so risk of contamination is low. | Trenulsa company have to be declared and should be registered as organic if asked by the certification body. |

### Identified auditor

The company Mayacert, located in Guatemala, has been identified as a potential auditor. It is the only auditing company that has conducted an audit for Organic Certification in Belize. They also conduct Global GAP certification, so the costs of audit could be divided.

# 5_ Proposition of conversion plan

### For TexBel

The conversion to Organic Agriculture entails several potential risks for the company and should be undertaken cautiously. That is why a conversion plan is needed: converting all of the farms at the beginning could be too ambitious and risky for the company.

Since TexBel has 4 farms, with different situations, and many finished products, the conversion plan should be thought out at farm level or product-level. Indeed, Organic certification forbid to have the same crop in organic management and non-organic management on the same farm. It means that, for example, you cannot have organic coconut trees and non-organic coconut trees in the farm Maya Center.

Since the crops are most of the time associated in agroforestry systems, it seems very difficult, even impossible, to certify only certain plots in a farm. Also, converting only 1 crop in a farm may not be relevant since most of TexBel's finished products are a mix of several crops. Hence the proposed conversion plan is presented at farm level.

In order to select which farm(s) should be certified first, several factors have been taken in account:

- Agronomical performances: soil characteristics (pH, organic matter), health condition of the trees, yields;
- Proximity to the processing facility: access to the factory's residues for input, more control and attention from the management, less risks for contamination during transport;
- Mix of crops: if a lot of crops present in the farm, easier to have a large range of finished products;
- Date of last application of chemical: the certification can happen only 3 years after last application of chemical.

| Farm | Agro conditions | Proximity to HQ | Mix of crops | Date chemicals |
|---|---|---|---|---|
| Maya Center | Relatively good soil with average pH and organic matter acceptable. | Very close to the processing facility and the dump site | All of the crops in association | March 2021 |
| | ++ | ++ | +++ | Same for all |
| Texstar | Poor soil, trees are very yellow, low pH and organic matter | Very close to the processing facility and the dump site | Lime and coconut trees | February 2021 |
| | -- | ++ | ++ | Same for all |
| LimeCo | Poor soil and low pH, citrus trees look good though | 63km away from the facility | Only lime trees | March 2021 |
| | + | - | + | Same for all |
| Camalote | Some trees in bad shape, better soil with higher pH and organic matter | 115km away from the facility | A lot of ageing orange trees, some lime and coconut trees | February 2021 |
| | - | -- | - | Same for all |

According to the matrix above, we recommend the following agenda of conversion:

- Year 1: Converting 100% of Maya Center to Organic Agriculture, applying technical recommendations and testing the inputs.
- Year 2: Following Maya Center results and based on the reaction of the trees, converting Texstar to organic, and possibly LimeCo if Maya Center lime trees do not present any issues with the organic management.

- Year 3: Converting Camalote to organic agriculture, at the end of Year 3, audit of Maya Center and the processing facility to get the certification.
- End of year 4: Audit of Testar, and possibly LimeCo.
- End of year 5: Audit of Camalote.

## For its outgrowers

During the field mission, 4 outgrower farms have been visited: Silk Grass farm, Lemon Tree farm, Obregan farm and TUN & Associates farm.

The first observation is that TexBel only has 16 outgrowers, which have on average more than 400 acres of plantations. This scheme cannot enter in a collective certification of smallholders through a cooperative. It means that the outgrowers must be certified individually at their own expenses, and it is not sure that expenses could be collectivized. This opportunity will only interest outgrowers with enough production to support the certification fees (more than 3'000 USD per farm).

According to TexBel team, only 3 outgrower could enter this category: Silk Grass farm (3'000 acres), Obregan farm (3'600 acres) and TUN & Associates (300 acres as of now, plan to plant 1'500 acres in total). Indeed, Lemon Tree farm is way too small (60 acres), and the other farms are complicated to get in touch with since they are run by Mennonites communities, with confidentiality habits. However, it would seem that these farms should be around 200-400 acres.

After having met with the managers of the 3 potential supplying farms, it appears that they are all interested in considering organic certification but that they would not get involved into it before having received clear proofs of good performance of TexBel's orchards under organic management. All of the managers have strong background in conventional commodities (banana) and are doubtful of the feasibility and profitability of organic agriculture.

Having said that, they are all interested in launching trials in their fields also to assess the feasibility of organic management. At a first glance, it would seem like TUN & Associates farm would be the one that would convert more easily, thanks to existing agro-ecological practices (hedges, green corridors, smaller plots, EM application) implemented by the manager Michael Ferslev. Whereas farms such as Silk Grass and Obregan, managed in a more intensive monoculture design (higher densities, poor soils, no biodiversity, presence of disease because of origin of seedlings), would have more difficulties.


Photos of TUN & Associates (on the left) and Obregan plots (on the right)

# 6_ Technical recommendations

## Shred and spread the coconut husk short-term + composting on the long-term

The TexBel processing facility produces a large amount of organic residues that are left in a dump site, currently unused, as can be seen on the photos below.


Photos of TexBel dump site with tons of dried coconut husks (left) and rotting fruit residues (right)

This material is of high importance for an organic fertilization plan. Indeed, coconut husk has a very high content of potassium (around 1,5-1,7%[1]), apart from the fact that it has positive impact on organic matter and water retention, 2 key factors for coconut farming.

A trial of shredding and spreading the coconut husk was held during the mission with TexBel farm manager Kenneth Moore. 500 pounds of husk can be shredded in 1 hour, a performance that can be increased in dry season. The husk has been applied at the foot of several coconut trees with a ratio of 180 pounds per tree, as shown in picture below. This operation was realized manually, with 3 people (1 driving a tractor with a trailer, 1 on top of the trailer shovelling the material, and 1 organizing the material around the coconut tree), and took 5 minutes per tree.


Photos of coconut husk mulch shredded 1 year ago and applied during the mission

1 The Use of Organic Fertilizer in Coconut (A Research Note), J.A. Mantiquilla, L.H. Canja, R.Z. Margate, and S.S. Magat1, Philippine Journal of Coconut Studies 19(1): 8-13, June 1994

In order to complete the mulching of 1 acre of coconut trees, around 12'600 pounds of coconut husks must be shredded, meaning around 25 hours for shredding, and 6 hours for spreading.

In order to optimize this time of application, a mulch spreader should be acquired (as in the picture on the right). However, the mulching should be done in a way that do not hinder the mowing activities.

This machine will also be useful to apply any other organic input such as manure, compost or lime.

The coconut husks could also be composted with a more advanced technique (regular turning of the pile with thermometer, balanced composition with nitrogenous material), however, due to the lack of space available, and the need for quick fertilization of the trees, it would be more advisable to go for the simple shred and spread strategy in the short term.

Composting should be the long-term goal: develop a simple program to shred, mix, and ferment biomass, to develop high quality humus material. The compost process requires some management, observation and attention, so it is important to do it in several phases until the farm reaches the right amount and quality of compost.

When a proper fertility program is developed, very few external inputs are needed, or at least no finished commercial input is imported, this depends on the soil and crop condition.

Comments of few key elements for compost making:

| Element | Source | Usage and comment |
|---|---|---|
| N | Manures, fish and sea products | In compost, very little is needed, normally when good compost and cover crops are implemented no N sources are needed. |
| P | Sea products, rock phosphate, ashes. | Added to compost |
| K | Coconut husk, bamboo ashes, wood ashes, potassium sulfate | Used in compost |
| Ca | Calcium carbonate, gypsum, dolomite | Direct to soil |
| Mg | Dolomite, ashes, magnesium sulfate. | Added to compost and liquid fertilizers |
| Zn, B | Sulfates, ashes, sea products | Added to compost and liquid fertilizers |
| Other especial minerals | Added by the use of ashes and rock dust | Add to compost |

The proper organic management can rely only on biomass, rocks, ashes and manures, for fertility programme, the good administration of this inputs, with an attention on microorganisms can develop high quality fertility.

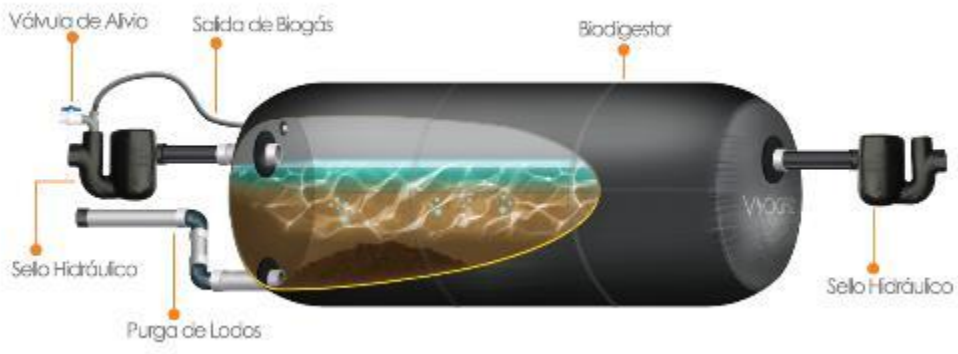
## Possibility of biodigester for the fruit residues

Fruit residues produced by TexBel processing facility are highly sugary and nitrogenous materials that, if not processed, will quickly deteriorate and ferment (in a bad way). In order to take advantage of this material, a possibility could be to install a biodigester that could provide as well rich liquid fertilizer authorized in organic farming.

The biodigester is an anaerobic sealed tank, that receives and ferments the organic matter from any source, some requirements like solid separation, and or pH control needs to be installed before the system. Inside the digester, the fermentation process, driven by methanogenic bacteria's, decomposes the organic material, creating two main by-products:

- BIOL a liquid concentrated effluent, that has high potential for organic fertilization. Normally a small digester produces enough material for hundreds of hectares. This product can be used directly on the fields or post fermented, together with soluble minerals, like sulphates, to develop a rich fertilizer.
- Biogas, the system also creates energy, the biogas can be used to substitute LPG gas, or gasoline in small simple engines, but in medium to big scales, and electric generator can be installed.
- Solids and fibres, since the system requires a solid separation, there is also material available for composting.

Hence, the Biodigester provides a very efficient tool to process organic matter, and integrated into the farm fertility and energy programs. In Costa Rica the company VIOGAZ S.A (www.viogaz.com) produces and sells high quality biogas systems.




Viogaz Digester 4.0

The Viogaz digester, is made of PVC membrane, and has 20 different models from 2 to 150 m3.

The digester on the photo below produces 800L of liquid fertilizer per day, enough for 8000 L of spray mix, with a potential to treat over 20 hectares per day. It is fed with 150 L of manure per day. Image as example, the right digester for the farm has to be calculated according with the residue produced.

Viogaz digester model V25, with a liquid fertilizer system connected for good usage and IBC tanks on the right of the photo

The proposal of a biodigester to generate all the liquid fertilizer needed can be summarized as follows:

1- Material is feed in to the biodigester, either fruit pulp or animal manure
2- The digester ferments the material and produces the liquid fertilizers called Biol.
3- The Biol will be stored in 2000L tanks, and then minerals like ashes, bone meal, seafood residues, yeast can be added.
4- The biol is then matures, and it is ready to spray after 1 month of resting.
5- The product is sprayed at 10% dilution ground focused, every 2 months ideally.

A 15 m3 biodigester is needed to cover the needs of the farm, with 6 sprays per year, in 1000 ha, using 300L of mixture /ha (30L/biol/spray). This needs only 100L of manure per day. This can be produced with 5 to 7 cows, sleeping in the barn all nights.

Note: this will only be enough to produce Biol, for composting more manure is needed.

It is recommended to have up to 20 cows, with a low intensification model (80% of the time grazing), using a V20 model of digester. This biodigester option will be presented and described by Esteban Pereira during its coming mission at TexBel.

## Buy and process organic fertilizers

The coconut husk mulch is a very good input; however, it will take time to get incorporated into the soil and hence make its nutrients available for the trees. Also, it is a material with high carbon content, that could create a temporary nitrogen deficiency. Indeed, the process of incorporating carbon into the soil mobilizes nitrogen, which then is not available for the plants for a time, but will be released later on. In order to avoid this phenomenon, the organic fertilization plan should also include inputs with sufficient nitrogen content such as manure or hydrolysed proteins, as explained below.

## Chicken manure in Spanish Lookout

Indeed, manure is probably the most used source of nitrogen in organic agriculture. Depending on the origin of the manure, the nitrogen content varies:

**Table 2**
**Composition of different animal manures (Loehr 1974)**

| Animal | Weight Head (lb) | Total Solids (lb/day) | Susp. Solids (lb/day) | N (% by wt) Solid/Liquid | Phosphate (% by wt) Solid/Liquid | Potassium (% by wt) Solid/Liquid | Carbohydrates (% by wt) Solid/Liquid |
|---|---|---|---|---|---|---|---|
| Horse | 950 – 1400 | 15.00 | 12.50 | 0.50/1.20 | 0.3/trace | 0.31/1.60 | 27.10/1.90 |
| Cattle | 900 – 1250 | 15.00 | 12.50 | 0.30/0.90 | 0.21/0.03 | 018/0.93 | 16.70/1.30 |
| Pig | 100 – 300 | 1.70 | 1.10 | 0.60/0.30 | 0.50/0.15 | 0.12/0.50 | 15.50/0.30 |
| Sheep | 100 – 150 | 2.50 | 2.00 | 0.65/1.70 | 0.51/0.02 | 0.03/0.25 | 30.70/0.90 |
| Chicken | 2.0 – 4.0 | 0.12 | 0.05 | 1.40/0.50 | 0.90/ | /0.50 | 30.00/0.10 |
| Duck | 3.5 – 5.0 | 0.15 | 0.07 | 1.50/0.80 | 0.89/ | /0.40 | 12.00/0.10 |
| Goose | 7.5 – 9.5 | 0.35 | 0.10 | 1.80/0.80 | 1.20/ | /0.70 | 14.00/0.10 |

Breeding is not the most common agricultural activity in Belize, but it is increasing though, especially with Mennonite farmers who produce a lot of grain for animal feed. The city of Spanish Lookout, close to Camalote farm, gathers a lot of farmers that have medium scale chicken barns (photo on the right). This kind of barn can produce around 40 tons of manure per year, but they use some part of it.

However, it would be feasible only if we can find a wholesaler that could gather large quantities and sell them directly to TexBel. Indeed, collecting bags of manure in each farm would be very difficult in terms of time and logistical organization.

Also, the quality of the manure must be well checked, it must be well dried and composted with sawdust in order to prevent possibility of germs. There will be no problem with the organic certification since any kind of manure is authorized as long as it does not come from a fully industrial production unit.

Nevertheless, this material is only recommended in the starting point of the conversion, conventional, highly intensive animal farms should be avoided. Development of an own organic animal programme is recommended. Never use fresh untreated manures to the farm directly.

## Production of organic foliar with seafood residues

Another point to take in account is the fact that the trees in TexBel orchards are in dire need of fertilization, since very little fertilizer have been applied for 2 years (apart from lime trees from LimeCo which received fertilizers every year, even if not at full conventional recommendation).

As said before, solid organic input such as coconut husk, and even manure, will not bring the boost of fertilization that need TexBel's trees. That is why organic foliar fertilizers should be used; however, no authorized foliar have been identified for purchase with TexBel's regular input suppliers. Also, these inputs are usually very expensive, especially if certified organic. This leads us to recommend the production of liquid fertilizers from residues.


First possibility would be production of liquid fertilizer with the fruit residues of TexBel's processing facility through a biodigester. This option has already been presented in this report.

The second opportunity would be to collect seafood residues from the factory called "Rainforest Seafood" located near Placencia, 50km away from Maya Center, 25 minutes' drive. This facility produces high protein residues such as fish, shrimp and lobster heads, and is currently burying it in a dump site. The factory has been called and they agree to give the residues for free. It is complicated though to evaluate precisely the amount of residues and their frequency of production. However, it should be largely sufficient.

These residues can be easily turned into liquid fertilizer generally called Fish Amino Acid (FAA), via way of fermentation. The process is relatively easy to do and cost-efficient:

1. *Optional: Mix the residues with an industrial blender, it is optional but makes fermentation easier and quicker;*
2. Put as much residues than molasses or jaggery in terms of mass, in a large recipient with an opening to allow gas exchanges;
3. Add a small amount of EM, stir once a day and let it ferment for 8-days, until there is no more solid residue;
4. Filter if necessary;
5. Test the pH, if lower than 4, you can store it easily, if not you need to use it quickly;
6. Before using it, neutralize pH with water (ratio 100x more water than FAA) or powder dolomite so that it reaches 7.

Fish wastes with equal quantity of jaggery (left) and finished tank of FAA (right)

In Annex 2, a very easy manual is included with images. The best option would be to realize this operation in big plastic tanks such as 500L to begin with and then 2000L. But for the first experimental trials, drums or even buckets can be used.

This input is also recommended to be mixed with rock dust, rock phosphate, and added to compost piles. Smaller amounts can be treated as explained above, or added to the biodigester mix. Never use this material fresh on the farm.

## Efficient Microorganisms

TexBel team already buy Efficient Microorganisms (EM), this practice should be continued and the application implemented seriously:

- Beauveria bassiana to control coconut weavel
- Azospirillum brasiliense to increase nitrogen in the grass of the interrow (to be sprayed on the grass) → 200mL per acre applied with tractor ideally.
- Initiate frequent sprays of EM on the soil, and develop a MM technology, to produce its own EM, decreasing the cost of purchase EM.
- It is crucial that pesticide free equipment is used to spray all organic inputs.

### Adjust the liming strategy

According to the 2019 soil analysis, pH of the farms are still not very good for fruit and coconut trees (as can be seen in the maps in Annex 3). Most of the plots are still in the range of pH 4-5, which is very acidic.

To correct this pH, dolomite in powder should be used, since white/burnt lime is not authorized for Organic Agriculture. However, since 2019, lime applications have not been fully realized, apart from LimeCo which received 23 tons in 2019, 120 tons in 2020 and 40 tons in 2021.

For the other farms, at least 500kg/acre of dolomite should be applied. This is low compared to conventional recommendations, but coconut husks bring also a high content of Ca, which neutralize soil pH as well.

Soil analysis should be carried out every year to asses this topic, also a pH meter should be available to have field easy tools to judge the pH behavior.

### Resume rational chemical fertilization on the other farms

If the conversion plan proposed in this document is followed, only Maya Center should stop to receive chemical fertilization to switch to the organic fertilizers proposed above. The other farms should wait until the results are clearly positive for Maya Center (at least 1 year). This means that chemical fertilization can, and should, be used until this date to feed the trees with their nutrient requirements.

Indeed, quasi no fertilization have been applied for 2 years, and the soils of the farm being relatively poor and acidic, this lack of nutrition has a negative impact on the health condition and productivity of the plants. Even though it could result in a relative addiction from the part of the plants, it is still recommended to reinforce the tree conditions before entering the conversion phase.

Rationale chemical fertilization should then be resumed at Texstar, LimeCo and Camalote. Following previous recommendations and the practices of other conventional estates: 6-10 pounds of 18-18-18 per tree seems a reasonable dosage, along with the use of foliar micronutrient boosts, in function of the leaf analysis results.

## 7_ Next steps and things to do

1- Create a full-time team to shred and apply the coconut husk as fast as possible;

2- Prepare a first batch (can be only 50L) of Fish Amino Acid by following the guidelines proposed in this report, and apply it to some trees to evaluate their reaction to this material (don't hesitate to contact us on the whatsapp group if you have questions);

3- Investigate more purchase of manure and organic fertilizers
   - Find a wholesaler of manure, assess price and quality of the material

4- Investigate the purchase of a mulch spreader that can spread shredded coconut husk, compost and rock dust

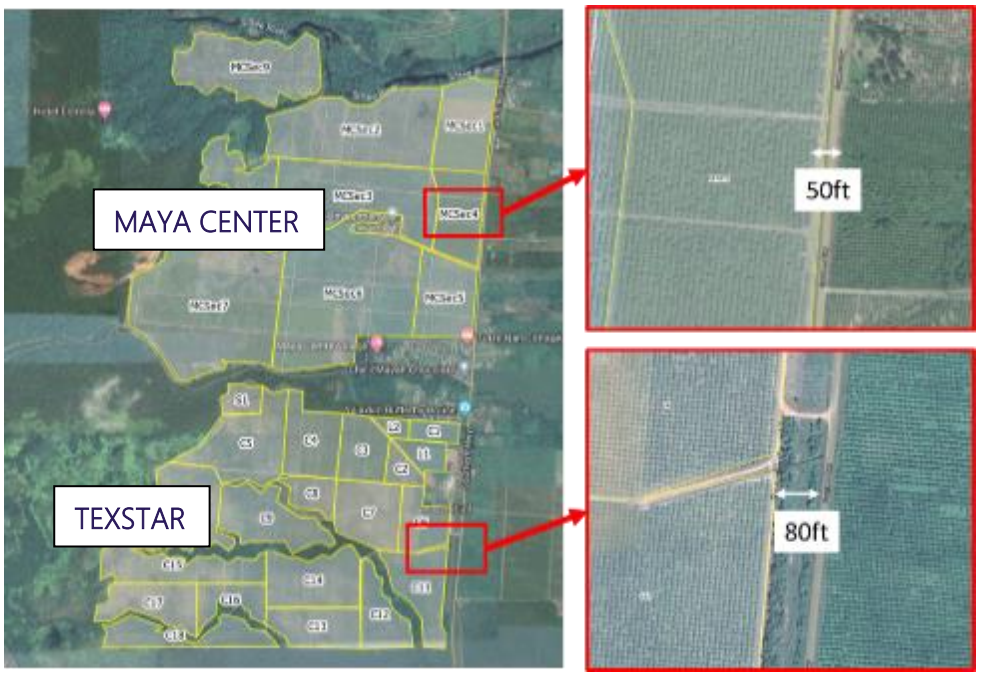
5- Make a soil and leaf analysis. Last soil and leaf analysis was very complete and hence very expensive. This time, we can select a lower number of soil and leaf samples to decrease the costs:
   - Maya Center:
     **Soil analysis:** Sections 2, 4, 6 and 8
     **Leaf analysis:** Coconut in section 6 and 9, Lime in section 1 and 7
   - Texstar:
     **Soil analysis:** C5, C7, C14 and C17
     **Leaf analysis:** Coconut in C5, C14 and C17, Lime in C11 and C16
   - LimeCo:
     **Soil analysis:** Sections 2, 4 and 6
     **Leaf analysis:** Lime in sections 2, 4 and 6
   - Camalote:
     **Soil analysis:** Blocks C, E, H and K
     **Leaf analysis:** Orange in block H, Lime in block C, Coconut in blocks E and L

     TOTAL = 15 soil analysis and 16 leaf analysis

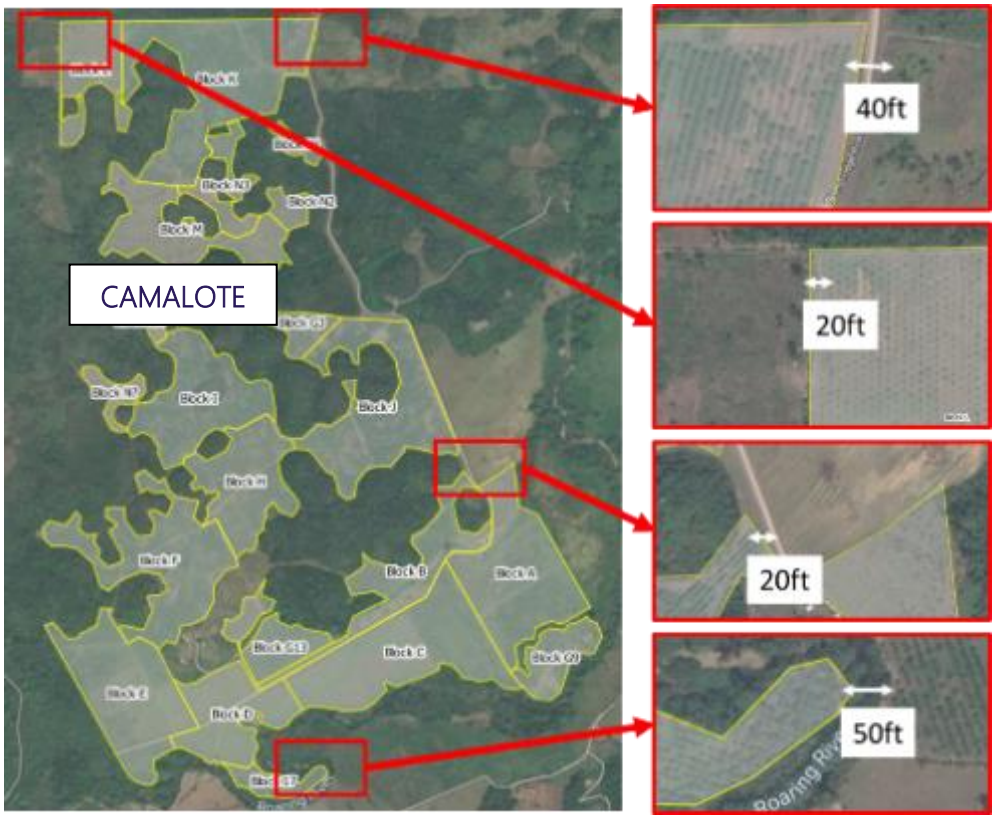
6- Find a laboratory that can do organic fertilizer analysis, to evaluate the chemical compositions of manure that can be bought, shredded coconut husk, produced FAA… Any input that is used for the organic fertilization plan should be tested to apply relevant dosages.

7- Resume rational chemical fertilization in LimeCo, Camalote and Texstar

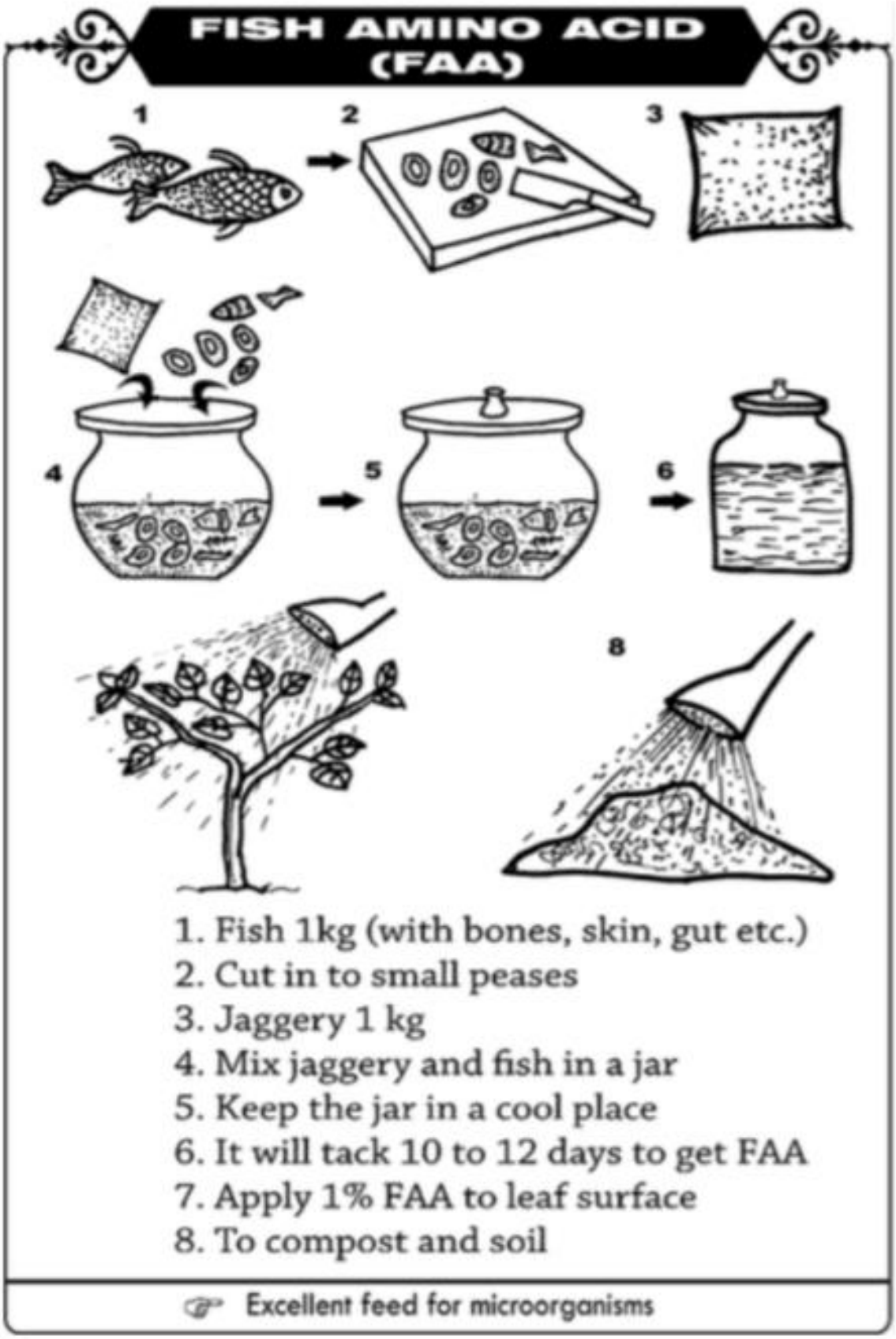
# Annex 1: Boundaries of TexBel's farms



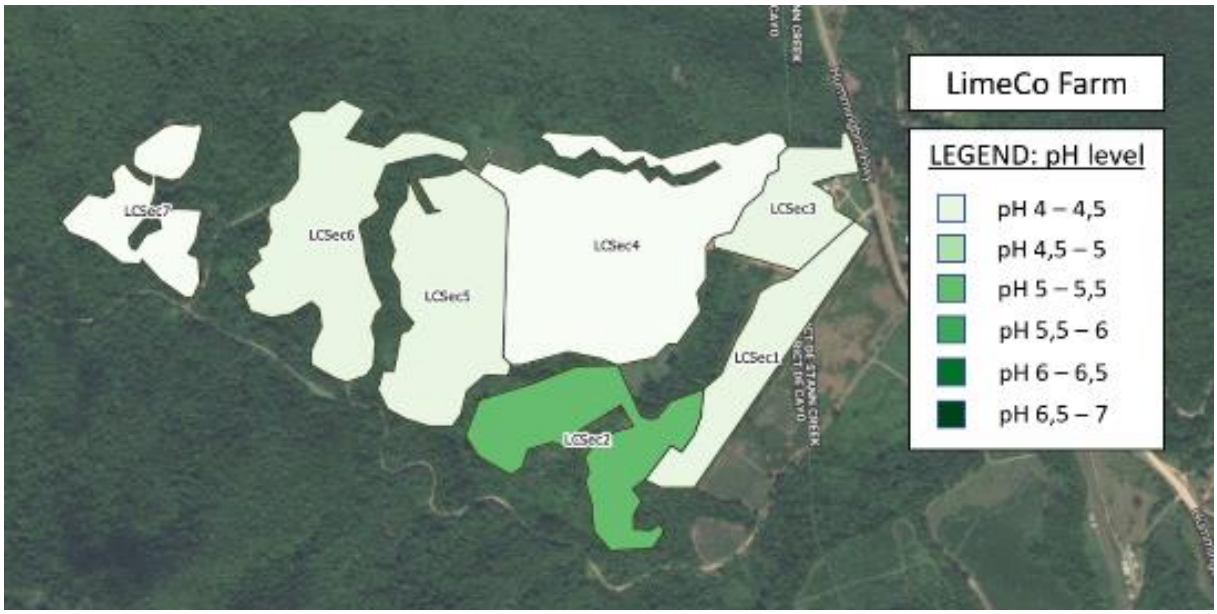


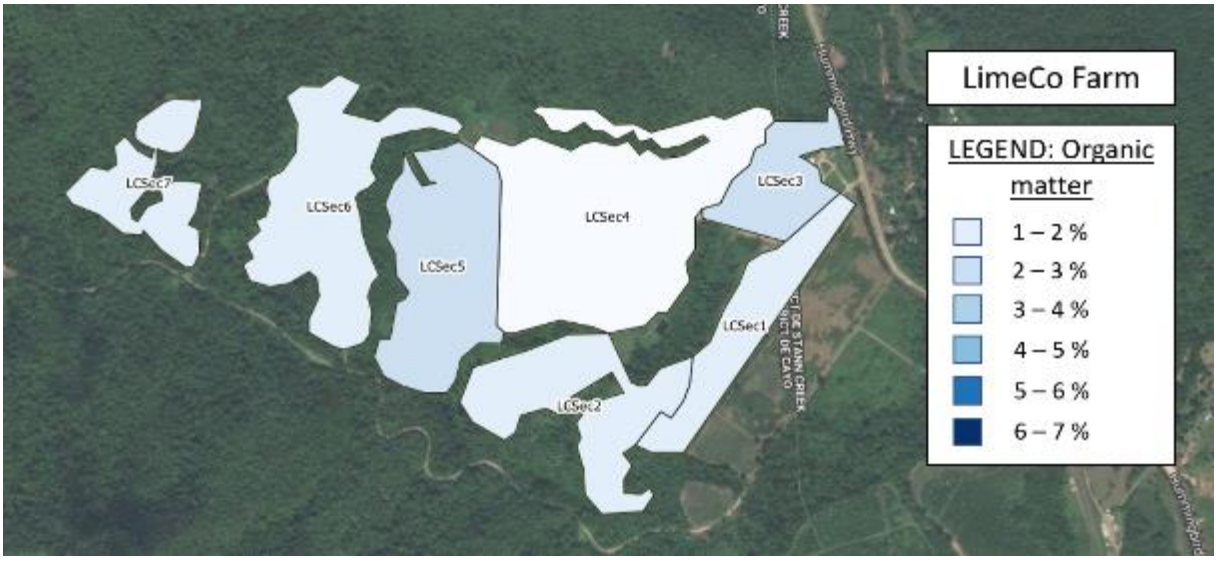


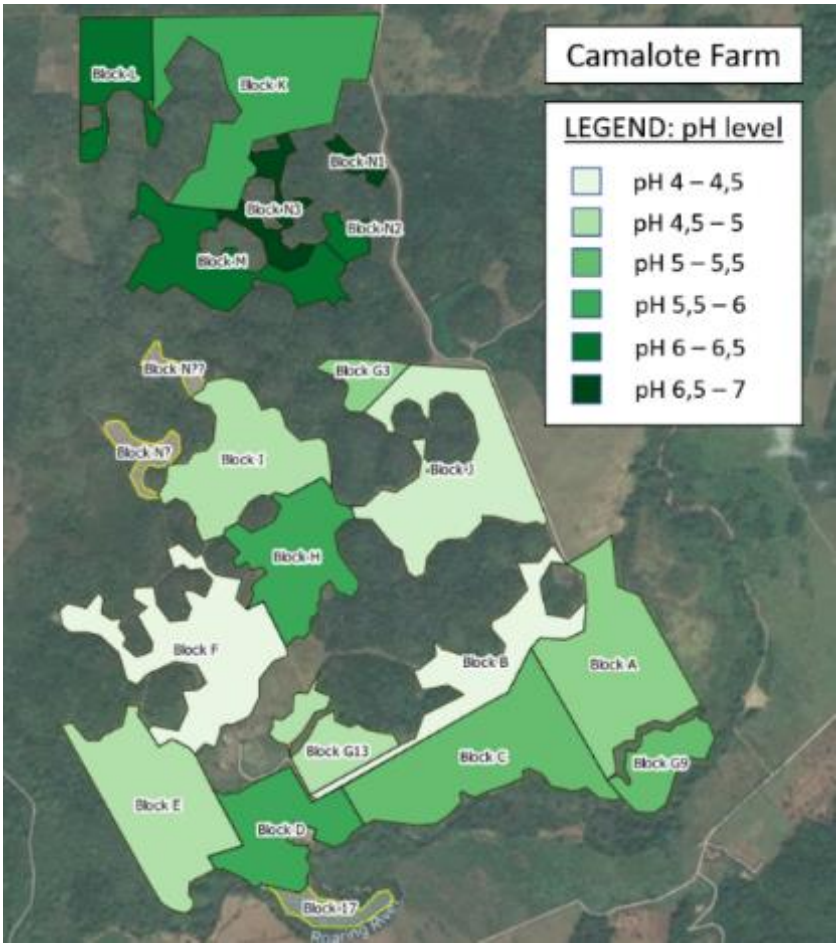
## Annex 2: Manual for production of Fish Amino Acid

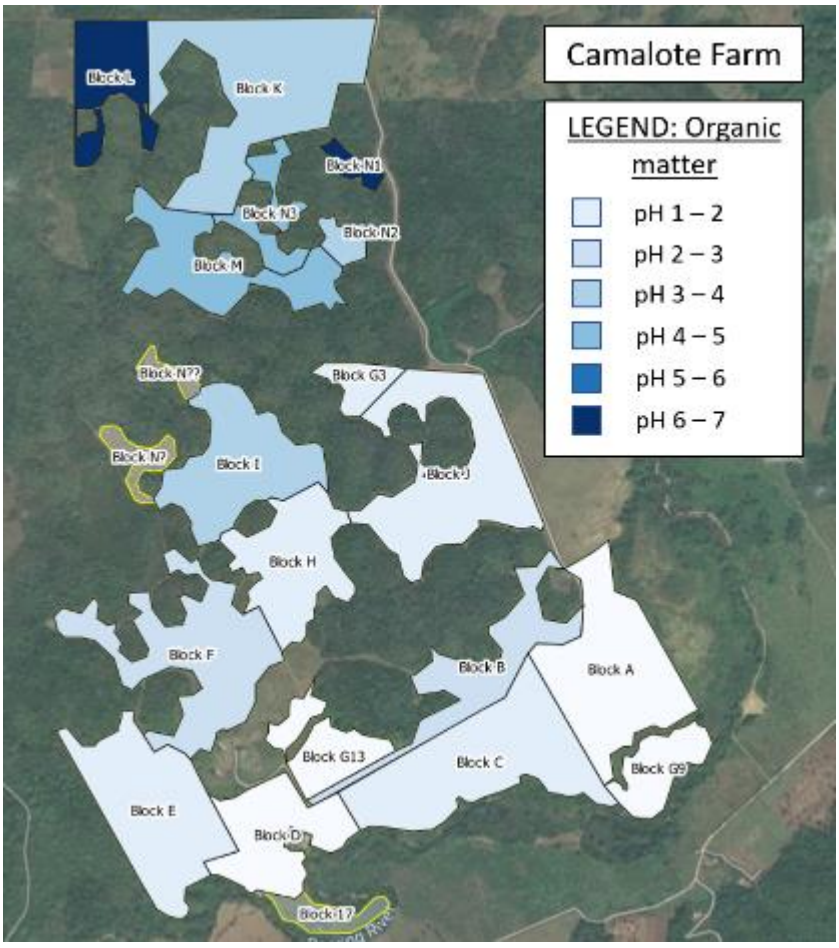


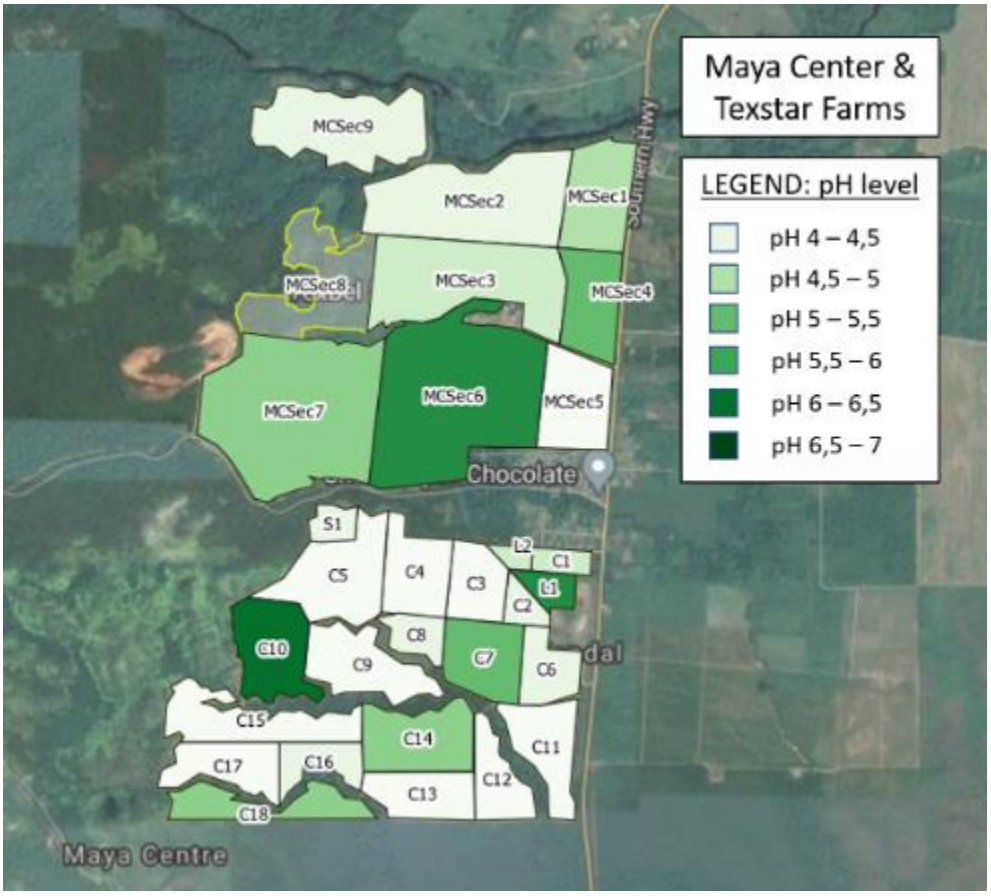
# Annex 3: pH and organic matter maps of TexBel farms

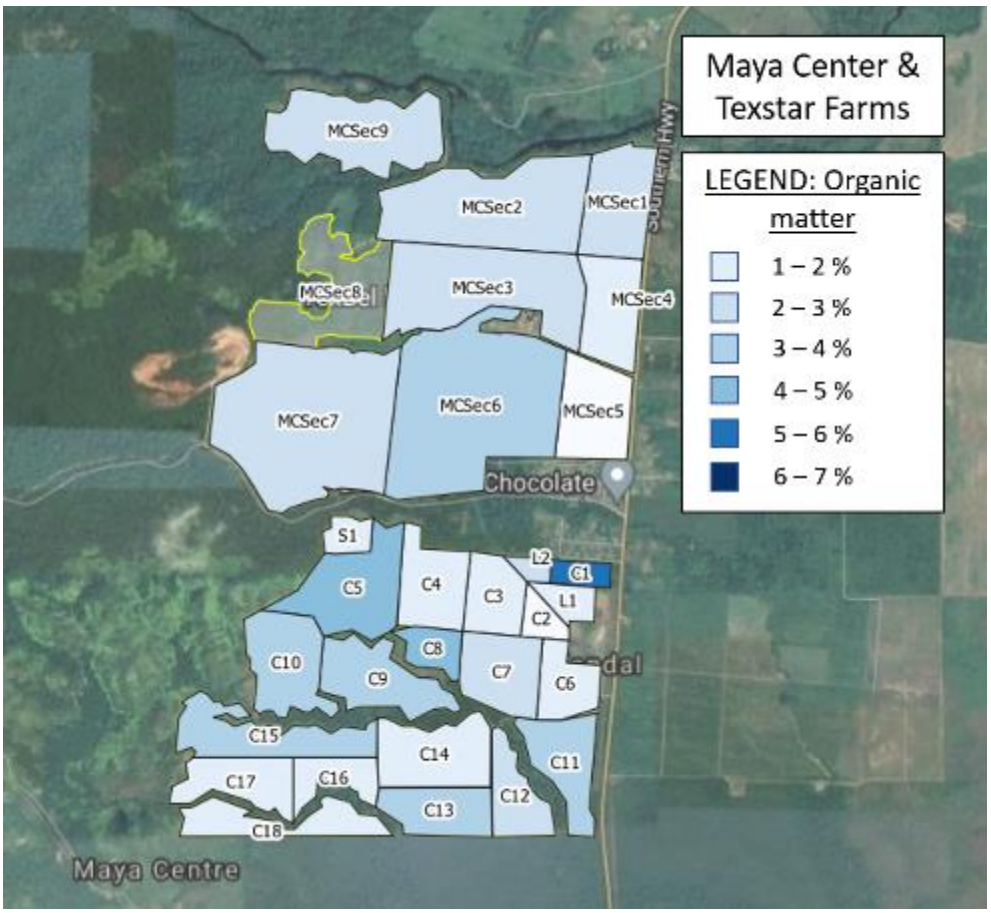



Camalote Farm
LEGEND: pH level
pH 4 – 4,5
pH 4,5 – 5
pH 5 – 5,5
pH 5,5 – 6
pH 6 – 6,5
pH 6,5 – 7
Block L
Block K
Block N1
Block N3
Block N2
Block M
Block N??
Block G3
Block N?
Block I
Block J
Block H
Block F
Block B
Block A
Block G13
Block C
Block G9
Block E
Block D
Block 17


Camalote Farm
LEGEND: Organic matter
pH 1 – 2
pH 2 – 3
pH 3 – 4
pH 4 – 5
pH 5 – 6
pH 6 – 7
Block L
Block K
Block N1
Block N3
Block N2
Block M
Block N??
Block G3
Block N?
Block I
Block J
Block H
Block F
Block B
Block A
Block G13
Block C
Block G9
Block E
Block D
Block 17


Maya Center & Texstar Farms
LEGEND: pH level
pH 4 – 4,5
pH 4,5 – 5
pH 5 – 5,5
pH 5,5 – 6
pH 6 – 6,5
pH 6,5 – 7
MCSec9
MCSec2
MCSec1
MCSec3
MCSec4
MCSec8
MCSec7
MCSec6
MCSec5
Chocolate
S1
C5
C4
C3
L2
C1
L1
C2
C10
C8
C9
C7
C6
C15
C14
C11
C17
C16
C13
C12
C18
Maya Centre


Maya Center & Texstar Farms
LEGEND: Organic matter
1 – 2 %
2 – 3 %
3 – 4 %
4 – 5 %
5 – 6 %
6 – 7 %
MCSec9
MCSec2
MCSec1
MCSec3
MCSec4
MCSec8
MCSec7
MCSec6
MCSec5
Chocolate
S1
C5
C4
C3
L2
C1
L1
C2
C10
C8
C9
C7
C6
C15
C14
C11
C17
C16
C13
C12
C18
Maya Centre

# Annex 4: Manual to take soil sample and sample map

Below are the guidelines for taking good soil samples, as explained by the consultant Kinsey Ag, well recognized as an expert in soil analysis:

## Taking a Good Soil Sample

**The way the soil samples are taken is extremely important, as the recommendations you receive from soil tests will only be as good as the samples you send for analysis**. Following the instructions below will assure that the samples you send are taken in the way we need them for a proper analysis.

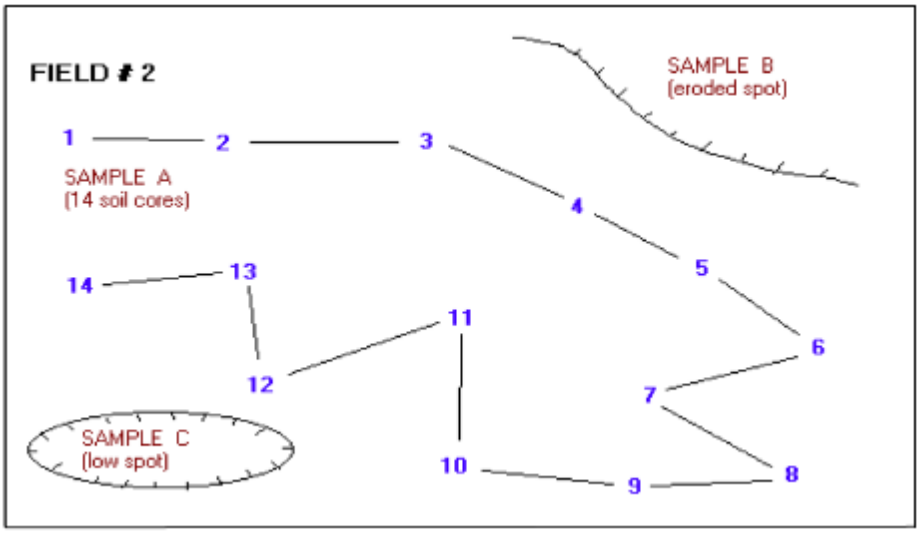
***When to take a soil sample***. Soil samples may be collected any time of the year, provided that the area is not suffering from prolonged drought, that no nitrogen has been applied in the last 30 days and no sulfur has been used in the last six months. Late spring and early summer sampling avoid the rush, shows the soil's fertility at its best and gives time to plan a fertility program which can begin directly following harvest if necessary. However, **if no samples have been taken within the last two years, the best time to sample is as soon as circumstances permit**.

Generally, sampling should be done every year if fertility is high and / or trace elements are being used to achieve top yields. CAUTION: without special arrangements we recommend that, if possible, no soil samples ever be sent for analysis when a soil is so extremely dry that plants will not grow there.

***Prepare a map of the areas being tested***. *A good map makes your sampling repeatable from year to year and is useful at the time of fertilization.* Designate a number, or some other identification, even a name - up to 8 characters - for each field. Use permanent lines such as roads, ditches and fences for boundary lines. Divide the field map into areas that have the same color, slope, texture, drainage and past history of erosion. Each area should have the same cropping history, fertilizer and manure treatments and the same intended crop for all the ground within that area. Assign each of the areas sampled a specific number or letter (or a combination of both) so you can correctly identify it.

For example, Field #2 could have three areas: A – the high ground, B – the sloping ground, and C – the low, level ground. The numbers written on the sample bag would be 2A, 2B, and 2C.

***Sample map***:



It is recommended that sampled areas represent no more than 20 acres (8-9 hectares) the first year our testing program is used, even if soils are uniform in texture and relief. Areas with taller or shorter plants, different weed or grass patterns, higher or lower yields, etc., should be avoided, or sampled separately if large enough to fertilize properly. The next time samples are taken, combine those areas that by analysis have been shown to be alike.

You may wish to combine very small areas that have all the same characteristics, into one composite sample.

Sample at least 300 feet (92m) away from gravel or crushed limestone roads and stay at least 20 feet (6m) away from fence rows or the edge of a field.

***Avoid, or sample separately:***

- Eroded hillsides or low spots
- Terraces, ditch banks, old roadbeds or fence rows
- Animal droppings, urine spots, burn piles, old manure, straw or hay stacks
- Areas around sheds, barns and / or where buildings have formerly stood
- Lime, fertilizer, chemical spill areas and fertilizer bands
- Dead and back furrows
- Drought-stressed areas
- Areas where large amounts of sulfur have been applied in the last two to six months, or where nitrogen has been knifed in or recently broadcast in large amounts.

## Collecting the Sample(s)

***The sample bag***: Use a new soil-sample container, plastic bag or plastic container. Soil-sample bags are available free from Kinsey Agricultural Services. Zip-loc bags are fine – as long as they have never been used - but put Scotch tape over the writing or attach masking tape to write on because all types of marking ink can rub off the bag during shipment. **Do not use paper sacks from the grocery store, bread wrappers, or such items**, due to possible contamination. Avoid using a plastic bucket that has been used for other purposes. Even repeated washings of a bucket used to mix salt and minerals for feed can still result in contamination of the sample.

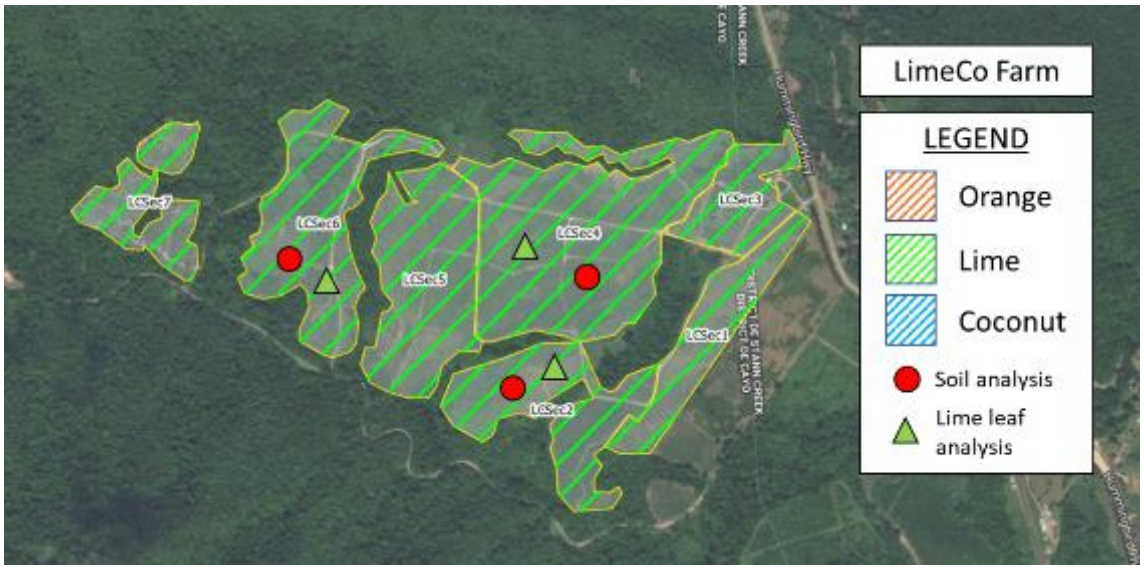
***Label the sample bags*** with your name, the farm name if any, field number and sample area. Prepare a map or sketch of the area for your own records. Make sure the labeling on the bag matches the number of the field and area on our map. Labeling the bags to match the areas *before* taking the sample helps.

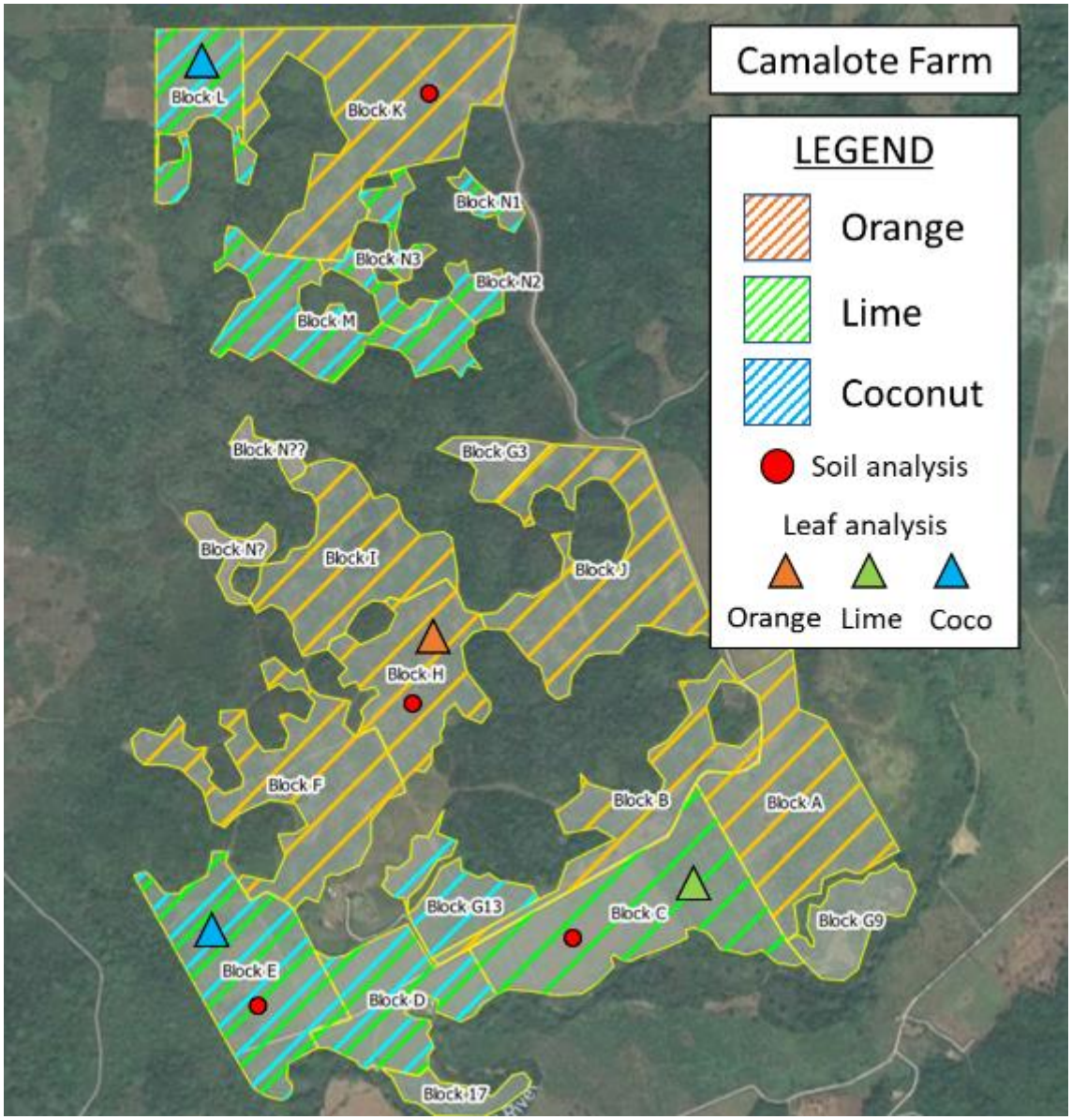
***A Soil Probe*** is recommended for easiest and best sampling results. Using a soil probe or shovel, sample down to a depth of 6½ -7 inches (17cm), or to the depth the soil will be thoroughly mixed when worked if that will be deeper than 6½ -7 inches. *For no-till crops, orchards, vineyards, pastures, hay meadows, lawns, etc., where soils will not be worked, the depth should be 4 inches (10cm)*. **Sampling to the proper depth is extremely important if we are to provide each grower with the correct recommendations**.

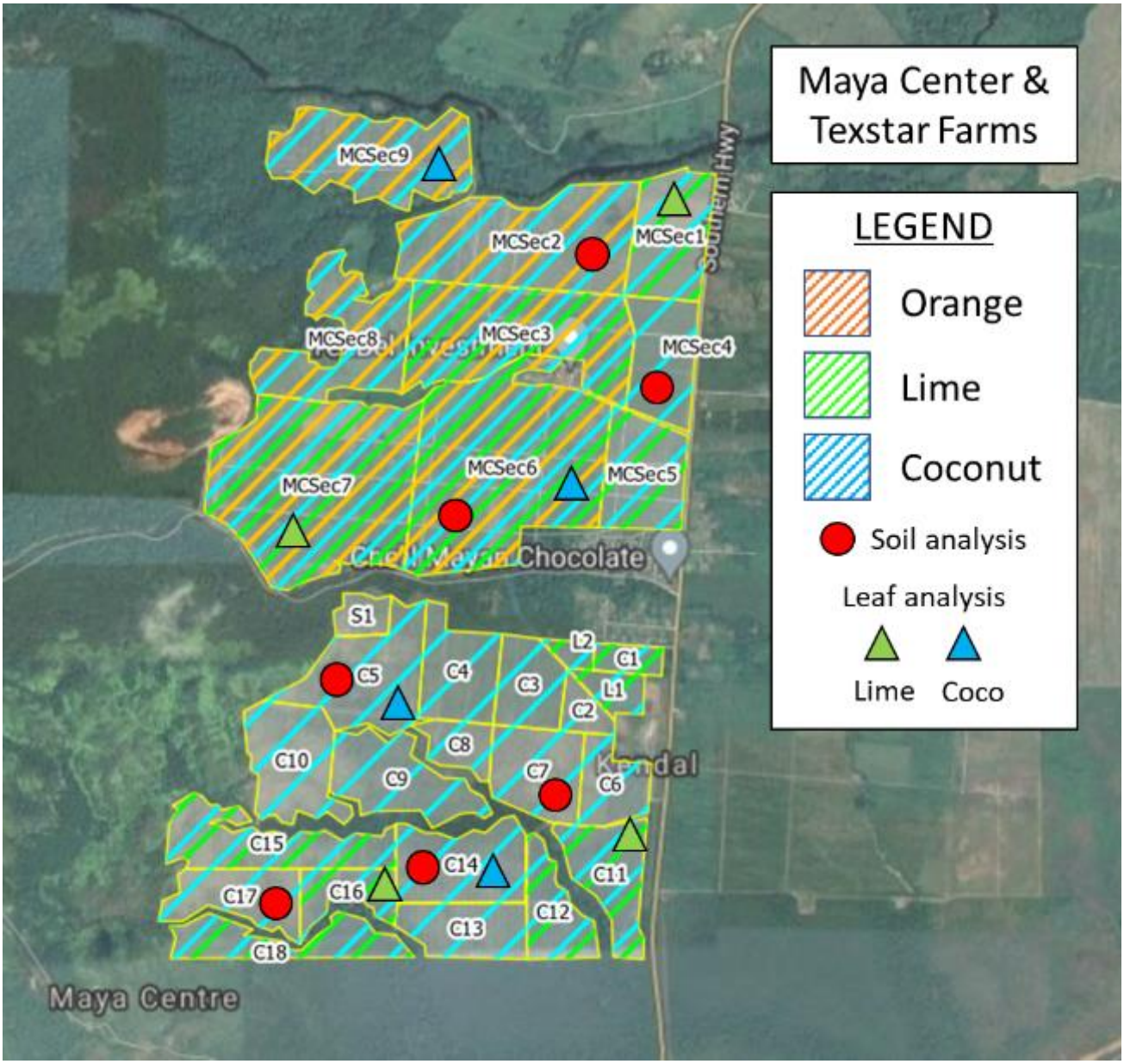
Put the soil, using several probes from like areas to make up the sample, into the sample bag. Removal of obvious debris (roots, leaves, etc.) is fine but unnecessary as it will not adversely affect the sample. If you do remove debris from the sample, be careful that none of the actual soil is removed with it.

Probe the soil every 50 to 100 paces, always taking a minimum of 5 probes per composite sample for smaller areas, and one probe for every 1 (one) to 2 (two) acres from larger areas. Only a small amount of soil is necessary for analysis. A cupful of soil is more than enough. Just be sure your sample represents the entire soil profile, if mixed, in order to send only a small portion.

# Annex 5: Recommended maps of soil and leaf sampling




Maya Center &
Texstar Farms
LEGEND
Orange
Lime
Coconut
Soil analysis
Leaf analysis
Lime
Coco
MCSec9
MCSec2
MCSec1
MCSec8
MCSec3
MCSec4
MCSec7
MCSec6
MCSec5
Cru'Maya Chocolate
S1
L2
C1
C5
C4
C3
L1
C2
C8
C10
C9
C7
C6
Kendal
C15
C14
C11
C17
C16
C12
C13
C18
Maya Centre