

APPENDICES

I. INTERVIEW GUIDELINE

Interview guideline

Farmer's background

<i>Beginning of farming activity</i>	Since when are you farming on this farm?
<i>Land status</i>	Have you inherited of the land from your parents? Otherwise, are you renting the land from a private owner or from the state or is the land part of "undivided land"?
<i>Previous production system</i>	Have you brought any changes in your farming system since you are here? If yes: - What were you producing before on the farm (parents or the current farmer)? - Why did you want to change? Market reasons, philosophic, problems with management of pests or diseases, ... ? - Are you satisfied with the changes you brought?
<i>If conversion to organic farming</i>	- When did you decide to convert? - Why did you convert? Why is organic production important for you? (ideology or market or else) - What were the main brakes and levers towards converting? - What are the main changes inside your farming system since the conversion? Did you change the spatial arrangements on the farm? - What changes do you observe in terms of pest and soil management and on the yields?
<i>Education and knowledge</i>	- Did you follow any agricultural education? - Where do you go when you need some technical advice? - Do you feel well supported by the local agricultural chamber and the agents on field?
<i>Relations with other farmers</i>	- How would you qualify your relationship to the other vegetable/fruit producers? - Do you share information about potential techniques?

Farming system

<i>Land Surface Unit and spatial disposition of plots</i>	- How many hectares do you have? - Are the plots on the same area or are your plots fragmented ? If yes: - Do all the plots have access to irrigation? - On which plot are you farming what crop and why ? - Did you observe any differences in terms of soil on the different plots? - Do you sometimes conduct soil analysis ?
<i>Farming "units"</i>	- How do you organise your production on the different farming units ?
<i>Workers #</i>	- How many people are working on your farm? - Is it family workers? Employees? - What is the typical "day schedule" for a worker?
<i>Work organisation</i>	- During a week, how do you organise the work load? - When do you harvest and when do you deliver?
<i>Distribution</i>	- Where do you sell your products ?
<i>Production</i>	- Estimation of the production (ton/week) of the different fruit/vegetables produced - What is the main product that brings the maximum benefit on the farm?
<i>Climate conditions</i>	What are the main sources of stress on your plots in terms of climatic conditions?

Cropping systems

<i>Soil management</i>	<ul style="list-style-type: none"> - Crop rotation (type of rotation, frequency of return of the rotation, rotation between the various plots, plant families in the rotation) - Soil tilling: which type of tilling, when and how often, depth - What types of tools/equipment/machinery are available on the farm ? - Management of water erosion and wind erosion : hedgerows, trees, agroforestry, terrasse, use of vetiver, mulch or plastic cover ... - Fertilisation (organic or chemical): type - when and how often (frequency) - price of products - Amendements: compost, BRF (wood pellets), algae, hen droppings, fish fertilisation, ... - Fallow period: green manure, spontaneous vegetation - Seedlings preparation
<i>Indicators for the “innovative soil management practices”</i>	<p>If special soil management techniques:</p> <ul style="list-style-type: none"> - What changes did you observe since you changed your crop rotation/fertilisation methods/water erosion management...? - What impact on yields/pests/soil fertility?
<i>Pest management</i>	<ul style="list-style-type: none"> - Spatial farm arrangement: species associations on field - flower bed - hedges - intercropping practices ... - Use of biological pest control? Pheromone traps? - Pesticide or herbicide treatment: when - where - why? - Price of the inputs used? - Estimation of the quantity and the frequency of the product used? - When do you use the product, on which observation do you decide to apply a product? Is it a systematic use (prevention) or a curative use ?
<i>Indicators for the “innovative pest management practices”</i>	<p>If special spatial arrangements:</p> <ul style="list-style-type: none"> - What changes did you observe since you change the spatial arrangement on you field? - What impact on yields/pests/soil fertility?

Futur perspectives

<i>Satisfaction</i>	<ul style="list-style-type: none"> - How do you feel about your current farming system (in terms of work amount, yields, revenues, labor,...) ?
<i>Future projects</i>	<ul style="list-style-type: none"> - Do you have any projects in mind for the future? - Expansion/diversification/new ways of selling...? - A desire to convert to organic?

Check-list of indicators:

- LSU
- # Workers
- Irrigation system
- Machinery
- Seedlings preparation
- Inputs of fertilisers and herbicides/pesticides: type/frequency/quantity
- Production: yields, seasonality, regularity
- Soil type: acid, basic, need for liming? —> problems of soil erosion from wind or water?
- Climate: spatial distribution of rain, damages of rain, soil erosion from water excess, drought, ...
- Pest management methods
- Crop rotation
- Green manure or fallow period (spontaneous vegetation)?
- Soil management: tillage, fertilisation, amendements ?
- Main constraints for change on the farming system? Main levers for change?

II. FARM SHEETS

FARM 1 TAHITI

OWNERSHIP

4 ha - organic vegetable production - private property (Mataia)
10 ha - non organic - fruit production (orchard with horses)

OBJECTIVES

- Double the surface up to 8 ha of production as he is not satisfying the market for organic salad (only covers 30%)
- To diversify the production (tomato, cucumber, pepper...) once the actual system will be stabilised and convert the fruit production to organic.

HISTORY

Certified organic "BioAgriCert" since November 2017 after two years of transition period. The farmer's wife influenced him to produce organic, as it seems important to produce healthy food. It became a challenge for the farmer to try to produce vegetables organically to an affordable price.

INPUTS

- hen droppings (coming from neighbour farm 10km in exchange of compost)
- Biodégradable plastic (50'000 F CFP for 100 m2)
- organic coconut wad importation used for the seedlings
- organic seeds-MV CID
- organic fish fertiliser (900 F CFP/L)
- Algae fertiliser (collected from the sea)
- Compost from Technival (10 m3 = 30'000 FCFP)

PRODUCTION

Vegetable production (2 ha):
- Pak choi (white and green)
- Salad (varieties: Minetto, Chêne Vert, chêne rouge...)
- Ginger
- Coconut

2 WEEKS OLD

FALLOW

COCONUT +
INTERCROP
GINGER

5 WEEKS OLD

Coconut (dwarf variety from Brazil) => to sell the water

Intercropping coconut + salad/pak choi the first 2-3 years only. Once the coconut leaves make too much shade, intercropping with ginger (as the plant likes shade conditions).

4th quality of mixed salad production grows for 3 months, and he just cuts part of it to make the fresh cut of mixed salad bags of 200g.

Fruit production (10ha): not certified organic yet but the farmer is interested. 34 horses pasture between the fruit trees, they are fed in parallel so the attacks on the trees are minor (use of potassium, calcium and complete fertiliser): grapefruit, avocado, lemon, mango...

OUTPUTS

- 10 to 20 boxes of salad (from 5-7 kg/box) at each harvest (2 times a week)
- 8 boxes of pota (from 12-13kg) 2 times a week => 3 rows of 60m long collected every week from a little bit of everything.
- Turnip = collected depending on demand.
- Production of 100 bags of 200 g of fresh cut mixed salad 2 times a week. Cost of a 200g bag = 250F

CONSTRAINTS

TECHNICAL CENTRE TO REPAIR MACHINERY=> when machinery issues -> risks of important delays for boat transportation (3 months)
MACHINERY: brush crusher to valorise the available organic matter on the land + greenhouse installation (family issue)
ORGANIC REGULATION: conflict with Gilles Parzi about communal water use and its potential content of chlorine use

MANAGEMENT

- Harvest and deliveries twice a week (Mondays and Thursdays)
- Seedlings prepared during 1 day every 2.5 weeks.
- Spatial organisation of the farm to optimise the work organisation
- "organic philosophy"

SOCIO-ECONOMIC ENVIRONMENT

Distribution: everywhere, from big to middle size stores and other networks. No organic label yet on the salad bags.

Product price of organic salad = low (similar to conventional salad) because the farmers has the philosophy that organic food should be accessible to all. However, the vegetable production is apparently not economically sustainable for the moment.

PEDOCLIMATIC CONDITIONS

Hydromorphic soils (depending on tablecloth height).

Farm based on the littoral plain, on flat lands, that are sometimes hydromorphic. The farmers extracted soil from the mountain to gain some altitude in comparison to the table cloth altitude. Extracted soil = very compact and difficult to work after rain => need for compost and organic matter to improve the soil

WORKFORCE

6 employees full time during dry season. At minimum 4 employees (they take holidays during rainy season).
- 3 employees: vegetable production
- 2 employees: fruit production
- 1 employee: delivery
There is a clear desire to improve the conditions for the employees. The fruits trees (papaya, banana, coconut) are there for them, and the spatial organisation (short fields) helps them to keep motivated.

EQUIPMENT BUILDINGS

- Shade system (imported from New Zealand) that are shorten in their width, to decrease surface that can be taken over by the wind.
- Water pump
- Rotavator
- Rotary slasher
- Field cultivators
=> Important amount of of rocks in the soil that lead to quick damage of machinery

FARM 1 TAHITI

Soil management

CROP ROTATION: One cycle = 6 month approx. => 2 cycles per year. Every plot has the same rotation and organisation. 1. Salad (6 weeks) = product making the biggest margin 2. Pak choi (6 weeks) 3. Radish (6 weeks) 4. Turnip (6 weeks) => no/little market because very hot taste, only Chinese communities like using it! Function = removing the excess of ammonia gas in the soil ("cleans" the plot before starting a new cycle)

FALLOW: no green manure but rather spontaneous vegetation. Trial of sowing soy but bad results. Destruction of the fallow by driving through the plot with a rotary slasher and then with a field cultivator to aerate the soil.

TILLAGE & SOIL AMENDMENTS: After harvest, tilling with the rotavator in the opposite direction of the rows to flatten and equalise the crop residues left on the land. Then, he builds the raised beds during a second passage with a rotavator. Finally, he applies hen droppings by shovel approx. 1 shovel per square meter, and after 3 weeks of rest following the organic regulation, the seedbed is ready to be planted. Two weeks after planting (not directly when planting to avoid that the plant "burns" because of nutrient excess), application of compost on the rows approx. 1 shovel per square meter.

FERTILISATION:

- Fish fertiliser dilution of 100 cL for 15 L of water, applied with a water pump => Not as efficient as algae (no effect on root system).

-Algae, dilution of 50 cL for for 15 L of water, applied with a water pump => Algae are put in a barrel with water and they infuse. The salt allows to kill the slugs/snails and the algae are rich in nitrogen. Good for strengthening the root system. Boom for tomatoes !

- Compost: 10 m³ bought from Technival allows him to cover practically the whole vegetable fields along the year.

IRRIGATION: rotative sprinkler (better than drip irrigation that was not sufficient and often led to the burning of the leaves). Water comes from the communal water reserve.

SOIL ANALYSIS: pH 6-7 —> Analysis on a plot when the farmer searches answer to a problem

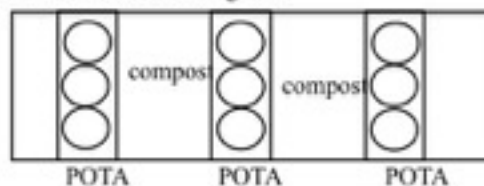
SEEDLINGS: prepared on coconut wad (organic, bought from the outside)

Pest management

SPATIAL FARM ARRANGEMENT: every 6 rows of 60 meters long, there is a hedgerow playing the role of a barrier against pests. The choice of 60m long rows is also a way of improving the employees' conditions. Amaranth = plant indicating a good soil quality (upon the farmer). Not too many insect problems on the salad.

PEST MANAGEMENT: Management of insects with BT and NEEM OIL (efficient if alternation of the treatments). Caterpillars attack pak choi => application as soon as the farmer sees caterpillars. Flowers = planted as hedgerows (only one for the moment as the cost of the seeds was high, but he will keep the seeds to plant flowers everywhere afterwards). Flowers chosen for their bright colours to attract insects (Malva sylvestris, Ocimum basilicum, Lemon grass). It requires time to manage the flowers with a brush cutter. Not too many problems with rats as they don't attack so much the leaf-vegetables.

WEEDS: Problems of infestation of wild eggplant. Optimisation of the weeding (by hand) => Compost between the lines avoids the weeds to grow.



WIND EROSION MANAGEMENT: Management of wind erosion with the coconut trees (+ protection against insects). Once he will obtain his brush crusher, he will apply wood pellets on the rows to protect the soil from wind erosion.

Problem statement: which indicators? Observation: the farmer takes decisions by observing signs from nature.

Knowledge based decisions: "Knowledge coming from youtube videos of farmers in the Philippines."

Levers to the new management practices :

Achieving a brush crusher: Wood pellets would be a good way of managing weed instead of applying plastic, in addition he will be able to produce his own compost as the quality of the bought compost is very bad, and he might be able to produce the algae mixture as well.

Main constraints of the new management

PRICE => Difficult to compete on the market with hydroponic salad . Cycle two times quicker in hydroponic systems —> For organic salad, the price has to be higher to compensate the longer production cycle. But there is still space on the market for organic salad as he only responds to 30% of the demand for organic salad.

FARM 2_TAHITI ISLAND

OWNERSHIP

- 4 ha of greenhouses approx. + 1ha fruit production (Papara)
- 25 ha in open field on 3 fragmented sites (Taravao)
- Private property, renting state land and private land

OBJECTIVES

- Market orientation → optimisation of the system to produce as much as possible. Choice for cucumber production in the greenhouse: provides the maximal margin!

HISTORY

The farmer was producing on the 25 ha in Taravao (higher in the mountains) since 20 years. He took over the 4 hectares on the littoral plain since 1.5 years (opportunity to take over a farm). The 4 ha of greenhouses allows the farmer to expand his production and produce regularly the whole year, which increases his competitiveness on the market. The greenhouse production allows him to be very reactive (short cycles) and to constantly adapt to the market demand.

INPUTS

- Hen droppings (bought from the neighbour farm)
- Biodegradable plastic cover
- Herbicide: Round-up 1000 F/L
- Lime (given by the chicken farm in exchange of the building clearing)
- Fertiliser
- Gravel for hydroponic production: bought from construction company
- Substrate for seedlings: "potemix" (agritech)
- seeds (one variety per vegetable)
- Pesticides

PRODUCTION

Papara:

- Greenhouse (4 ha) = hydroponic cucumber. One cycle of production (starting when you plant the seedling) = 6 weeks
- Open field (1 ha) = cucumber, papaya, lemon trees. Papaya production (approx. 2000m²): herbicide applied between the rows every 6 months approx., hen droppings applied at the tree base every 3 months.
- Lemon and avocado production (approx. 1000m²)
- Insecticide application: once/month (against aphids and tobacco mosaic)

Taravao (25 ha):

- pakchoi (very short cycle of 3 weeks, no plastic cover)
- corn (4-5 months)
- onion (6 weeks)
- cucumber
- ginger (9 months) => High price at the moment: 2000F/kg
- tomatoes
- eggplant
- long green beans
- zucchini (open field and trials under shade cultivation to manage water excess => if better yields he will cover them all)
- cabbage

Since 2 years: Installation of 60 bee hives (trials). Better yields since installation, but correlation with hives?

OUTPUTS

- Cucumber yield comparison:
- hydroponic: 2 tons for 4 rows of 50m
 - Outdoor open field: 1.6 tons
 - Greenhouse open field: < 1.6tons for 4 rows of 50m

CUCUMBER = Source of the maximum margin (most important product). Overall, 20 to 30 tons of cucumber produced every month!

CONSTRAINTS

INVESTMENTS: Important investment in the greenhouse/hydroponic installation. Strategy to invade the market with his important production and kill the competitors.
COMPETITION FROM NEW COMPETITORS: The farmer is scared of the impact that VERDEEN and AGRIFARM might have on him in the future.
VARIETIES: Finding varieties that are resistant to diseases

MANAGEMENT

- Regularity of production (hydroponic production)
 - Rotations depend on the market demand
 - Spatial arrangement depends on the work organisation
 - Harvest and deliveries = every day.
- => The farmer is a real manager organising and optimising the work. He has knowledge about soil and tries to bring the most adapted fertilisation to increase the production.

SOCIO-ECONOMIC ENVIRONMENT

Distribution: everywhere!

Economic strategy:
=> During the season, overproduction of cucumber to out-compete the small producers (more convenient for the grocery store to buy to a minimum number of producers)
=> Outside the season (advantage of greenhouse hydroponic production): sell to higher prices

PEDOCLIMATIC CONDITIONS

Papara field = flat with installation of greenhouses

Taravao fields (higher in altitude => 3°C less and important humidity => risk of soil erosion from water (steep slopes) + wind as there is important wind. Acid soils (approx pH = 6)
=> Requires liming every year.

WORKFORCE

- 5 full time employees (Papara)
- 11 employees (Taravao) working 36 hours/week

The farmer uses the term "slaves" or "robots" when talking about his employees.

EQUIPMENT BUILDINGS

- Cleaning sector for vegetables (Taravao)
- Rotavator
- disk plow
- Machine to apply the plastic cover
- Slurry spreader
- 4 ha of greenhouses with hydroponic systems
- Seedlings nursery in Taravao and in Papara

→ Irrigation on Papara
→ No irrigation on the Taravao but as it is humid zone, it is not such an issue.

FARM 2_ TAHITI ISLAND

Soil management

CROP ROTATIONS: no fixed crop rotation → depends on the market needs (economic logic). No alternance between families but large diversity of products.

CROP DESTRUCTION - SOIL AMENDMENTS - SEEDBED PREPARATION (3 days transition in total):

- After Harvest → Take off the plastic - Destruction of the plot with a rotary slasher to flatten the plot → Spread the hen droppings on the rows → Preparation of the seedbed by driving through the rows with a rotavator → Apply the plastic (unless it is a short cycle crop such as pak choi) → Plant the next crop

FALLOW: Intensification of the production → No green manure and no fallow period => "lost of time!"

FERTILISATION:

- Chemical fertiliser: complete fertiliser 20-9-9
- Organic fertiliser: ORGALIZ

SOIL AMENDMENTS:

- Hen droppings: rich in Nitrogen as well → applied before every new cycle (during the seedbed preparation)

MANAGEMENT OF EROSION: Taravao plots => observation of the natural way of the water flow out of the fields. But the rows are done in the direction of the slope in order to "evacuate" the water better. Important soil erosion causing "chocolate bays". The farmer explains that the plastic cover protects the soil containing the nutrients from water erosion. Management of wind erosion by planting some lemon trees as wind breakers on the borders of the plots.

IRRIGATION: Only in Papara unit (greenhouses) → Hydroponic system = everything is set in an automatic system. Water pumped either from the river going through the farm or from the state reservoir.

SOIL ANALYSIS: done on the different plots to choose the appropriate type of fertilisation and adapt the liming

Pest management

SPATIAL FARM ORGANISATION

- In terms of work needed: the products that require the less labour are placed far away (example: lemon trees). Plants with short growing cycles are placed close. Optimisation of the work allows to maximise the production!
- Security: some plots have mixed production (rows of tomatoes, pakchoi and onion). The hypothesis is that the farmer does not put "all the eggs in the same basket". In case of pest attacks or bad climatic conditions, he ensures at least a minimal amount of production. Potentially, the crop association can also benefit to the insect population by attracting auxiliaries (but not clear if it is a goal of the farmer to do that).

WEED MANAGEMENT: mechanical and chemical management.

By hand on the row, with glyphosate on the alley 2-3 weeks after planting (depending on the need). Approx. 2 applications of glyphosate per year on every plot. Glyphosate used maximum 3 weeks before harvest. Quantity applied as written on the bottle (no abuse of quantity because of the product's price (?)).

PEST MANAGEMENT: chemical pesticides used preventively every week.

No fungal or nematodes problems.

Against birds: scare crows and discs hanged on field (not sure about the efficiency)

How are decisions taken?

Plant observation and soil analysis: to adapt the need of fertiliser => main indicator: the yield

Pesticide and herbicide: applied systematically (preventive use)

Market analysis : to produce and react rapidly to what is needed

Strategy

Production of cucumber => less technical than tomato production. Better market price for cucumber. Market demand currently. If market changes, he can adapt the hydroponic part quickly as the cycles last 6 weeks and he is organised in sub-systems in order to deliver cucumber every day. So he can change constantly.

Future projects

- 100% hydroponic and greenhouse installation on the Papara part for cucumber production
- Open field (1 ha) Papara (where no irrigation system and no greenhouses): tiare, lemon, grapefruit production

FARM 3_TAHITI ISLAND

OWNERSHIP

4.7 ha - agricultural lot that are blocked for pineapple production (DAG) (on a total of 20 ha blocked to satisfy the demand for fresh pineapple for the island of Tahiti)

OBJECTIVES

- Upscale to 20 ha of pineapple production in order to make rotations and leave land under fallow for a year
- Agroforestry system: coconut + pineapple

HISTORY

The farmer comes from a farming family (livestock farmers with coconut and pineapple). His 3 brothers are also farming and they work together under an agricultural society (SA). He followed an agricultural education at Opunohu college for 6 years. After his studies, he worked for a pineapple producer for 3 years, but he was the one managing everything and bringing the knowledge. He decided to start his own production on new land and achieved the agricultural lot in 2015. Next to that he works 3 days a week with his brothers.

INPUTS

- hen droppings + feathers 10 tons/ha
- biodegradable plastic
- complete fertiliser (15-5-20)
- Floral Induction (FI) bought at ACE price: 200mL bottle for 1000 F
- herbicide (Amctrync)
- raticide

PRODUCTION

Pineapple = perennial crop that last 3 years. After, the fruit production is lower so it is more efficient to plant again.

3 ways of replanting pineapple shoots:

- Bulblet => easiest solution as they come of the plant easily and there are 4 bulblets approx per pineapple plant, but slow growth, only after 14 to 18 months
- Crown => easy to take but only one pineapple, however it grows quicker than bulblets (growth after 12-14 months)
- Pineapple shoot => difficult to collect (technical skills required) but quickest growth (after 8 to 12 months)

Floral Induction: applied locally on every plant. One month later = red fruit appears.

Efficient workers: approximately 1500 plants are sprayed/ hour (slow worker 1200)

Limitation to 30L of Floral Induction treatment used per week (2 tanks of sprayer) => allows to FI approx. 2000 to 2400 plants = ORGANISATION OF THE HARVEST!

Intensive crop => 40 tons of pineapple produced per hectare = important exportation of nutrients. Important to give back to the soil after cultivation/leave time for rest (fallow).

OUTPUTS

Every week harvest of approx. 1.5 to 2 tons of pineapple.

Cost for installation of the pineapple plantation: 100 F/m² or 1'000'000 F/ha => 4'700'000 F

Benefit from total farming activities => 30'000'000 F

CONSTRAINTS

EQUIPMENT: time allocated to get equipment from Hitia (2 hours drive away) from the agricultural society owned with his brothers. Need to organise work to avoid bringing the machinery to do a small task.

LAND constraint to a more extensive management, not possible to implement fallow period. The farmer is waiting for approbation of other agricultural lots from the DAG.

MANAGEMENT

- Time allowed to the harvest of pineapple (much longer than time for the Floral treatment induction)
- Time for the collection of the shoots: 4 workers required during one entire week to collect 10'000 shoots, equivalent to approx. 20 rows (1/4 of the total farming surface)
- Harvest every Monday: approx. 2000 pineapple/week (= 1.5-2 tons per week)

SOCIO-ECONOMIC ENVIRONMENT

Distribution:

- Cruise boats (Aranui)
- restaurants
- to private people
- To another farmer producing juice (juice bars)

Price:

Strategy to produce out of season in order to sell pineapple to a higher price!
Price (in season): 50 F/kg
Price (out of season): 170-200 F/kg
=> one big pineapple (1.8kg) = 400 F!!

PEDOCLIMATIC CONDITIONS

Fields situated :

- at a high in altitude 237 meters on Taravao agricultural lots => fresh climate (sometimes slows down the maturation of the fruit)
- on steep slopes => important water erosion

Soil = acid (good for pineapple) but not sufficiently draining the water excess (too much clay) => requires drainage!

WORKFORCE

- 2 workers (CAE contract)
- 2 workers (still on trial)

Need of 1 Men work unit (UTH) for the year (on 4.7ha).

WORKING PEAK = plantation (need for 5 workers)

EQUIPMENT BUILDINGS

- Spreader (hen droppings)
- Vibrating harrow
- Rotavator
- Cover crop
- Machine to apply the plastic film on the raised beds and to directly make holes for the plantations

FARM 3 TAHITI ISLAND

Soil management

CROPPING SYSTEM: plantation → after 7 months = Flower Induction Treatment. After 6 months, first harvest and application of floral treatment locally on the shoots. Only apply the treatment on 2000 pineapples per week to plan the harvest and manage the plantation until it is 3 years old, when the production decreases. Renew the plantation.

TILLAGE & SOIL AMENDMENTS:

- hen droppings : application of 10 tons/ha on the soil with the spreader and then he goes through with a vibrating harrow that allows to stabilise the droppings that are left from 2 weeks to one month max and then he plants the rejects. This stabilisation period allows the soil to incorporate the droppings and avoid soil compaction (because of the humidity of the droppings)
- vibrating harrow => aeration of the soil (very important for pineapple to have light soil as the roots are thin)
- pineapple = very sensitive to excess water => needs filtrating soils. SUB-SOILING→ Deep soil tillage allows to de-compact the soil on 30-40 cm layer and to allow the water to be absorb on this entire layer. If only superficial tillage => water would stagnate on 15-20cm, which would increase risks of development of phytophthora.

FERTILISATION: complete fertiliser (15-5-20), quantity: approx. 700 kg/ha, applied directly on the raised beds just before applying the plastic cover on the rows. Application just once at the installation of the pineapple plantation.

FALLOW: not yet (not sufficient land) but projects of planting panicum maximum as a green manure during his potential one year fallow period after a 3 year pineapple plantation. Panicum Maximum, naturally grows in the region, and is rich in silicium (that pineapple needs to grow), free and easy to destroy with a shallow tillage (15-20cm depth). Vetiver, is also rich in silicium, but it requires to be planted and it is more difficult to destroy with the vibrating harrower.

MANAGEMENT OF WATER EROSION:

- Biodegradable plastic: keeps the nutrients and the soil under the plastic when there is heavy rain, keeps the soil humidity, increases the temperature under the plastic which stimulates root growth (pineapple needs heat). Why biodegradable? Practical => you destroy everything with the cover crop after the 3 year plantation.
- Rows installed in diagonal of the slope => not possible to build perpendicular rows as there is too much slope and the mechanical work would be hindered.
- Water channeled on the side of the plot with an installation of 3-4 water decantation basins of 20 m³capacity that collects soil after heavy rainfall. Water evaporates from the basin and the top soil can be collected. He reapplies the soil on the top of the plot every year with a tractor, which is time consuming.

IRRIGATION: No irrigation needed for pineapple! Sufficient rain locally! And shape of pineapple made to collect water!

Pest management

WEED MANAGEMENT: Chemical management by using herbicide (ametryne) applied locally where there are weeds with a 15L sprayer. Major issue = weeds (wheatgrass, vedelia and commelina nudiflora)... there is no substitution to Ametryne in the farmer's opinion.

PEST MANAGEMENT: Little diseases on pineapple → adapted to tropical climate and difficult to attack with thick skin.

Why not organic?

Three major weeds difficult to manage with only mechanical means → Cost of pineapple 5 times higher if weeds were managed mechanically. In terms of environmental impact: choice between more soil erosion (mechanical management) or more pollution from local herbicide treatment.

Problem statement → which indicators?

- Observative person
- Re-evaluating red spots → new soil analysis to have an update on the situation if he observes a problem on a specific plot in order to find a solution (but cost = 11'000F/analysis)
- Constant desire to adapt to the consumer's demand

Brakes and levers to the new management practices

IF MORE LAND → more extensive use of the land with the integration of a period of fallow. Observation that the pineapple was growing better next to a certain bamboo, called panicum maximum, that is an important source of lignine and of silicium, two components that are important for pineapple. He plans to use these plants as cover crops (6 month to one year of fallow). Their high content in silicium is important as it is the chemical component bringing the shiny aspect to the pineapple leaves.

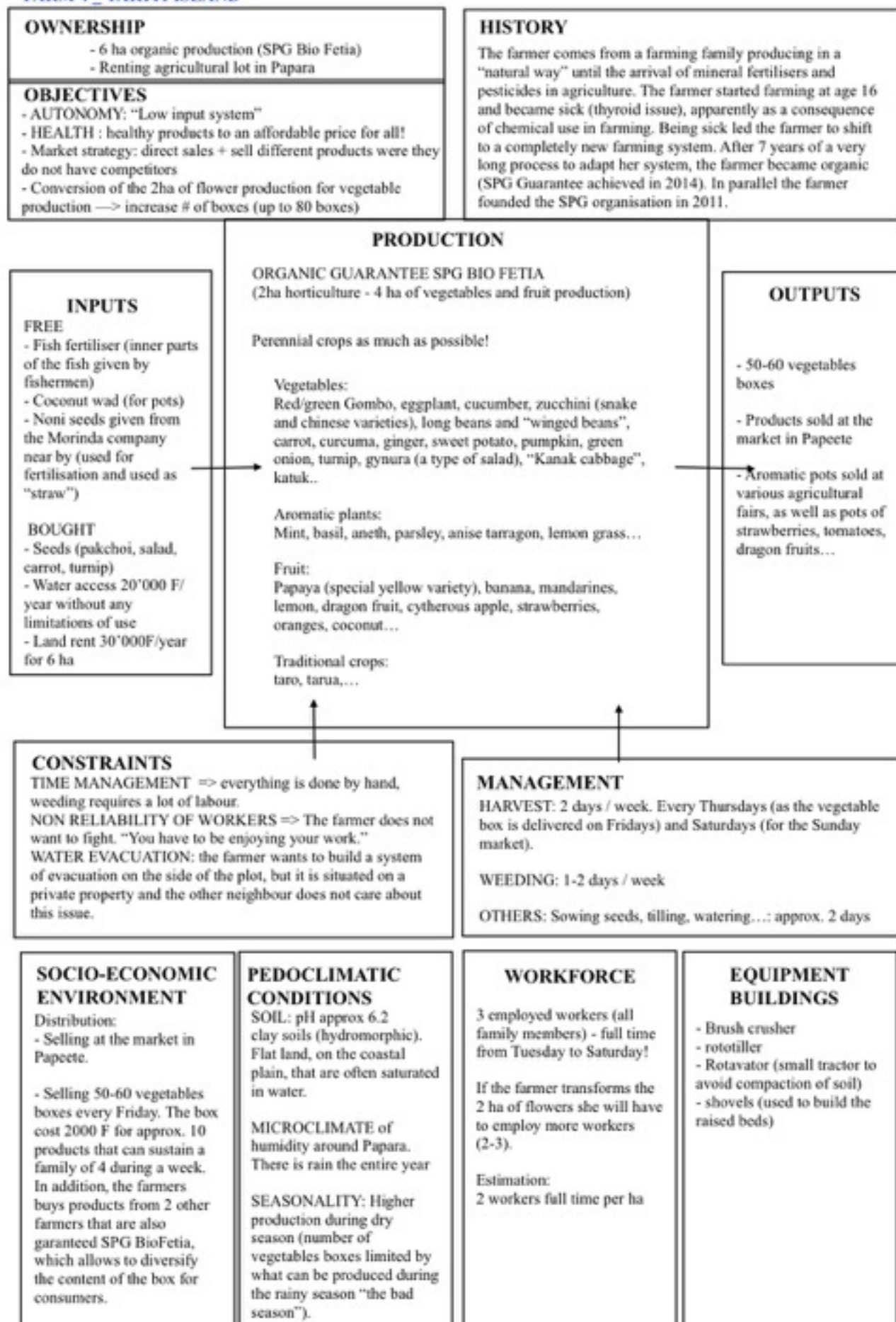
Cover crop will allow the soil to rebuild its stability which will decrease the erosion risks, which is an insurance of stabilised yields on the long term.

Advantage: easy destruction of the cover.

STABILISATION OF THE SYSTEM: First harvest of pineapple this February! Many ideas of further development.

- Either installing rows of vetiver in the middle of the slope to build a physical barrier against erosion (and sell the vetiver root for perfume industry).
- Or building an agroforestry system: coconuts + pineapple in order to sell coco water (good money).

FARM 4 _ TAHITI ISLAND



FARM 4 _ TAHITI ISLAND

Soil management

SOIL TILLAGE: After harvest, the farmer tills the soil at a depth of 15-20 cm (superficial tilling) which allows to manage the weeds and to reintegrate the organic matter. Then the farmers builds the raised beds with a shovel and when the plot is ready the farmer plants or sows seeds by hand. He waters every day either in the evening or early in the morning. He applies the fish fertiliser 2 to 3 times/week, once the plant starts to come out with a watering can (application locally).

CROP ROTATION for leafy vegetables - only located on the most draining plots:

Crop rotation 1: Turnip - Eggplant - Winged beans (you can eat everything on it! Very small demand for nutrients)

Crop rotation 2: Salad - Cherry tomato - Beans (long bean or winged beans)

=> Glyricidia (=legume) playing the role of tutor for the beans (fixes nitrogen!).

SOIL AMENDMENTS:

- Hen droppings: sometimes collected from the neighbour farm (for free) and applied in the holes before planting trees

- Compost: accumulation of their plant residues. Composed filtered and then used for the seedlings in addition of noni seeds.

- Noni seeds fertilisation: use of noni seeds that have lost their capacity of germination (through the different process that they have undergone at MORINDA company to extract the pulp of the fruit). It is also important to wait at least 6 months before applying the seeds as they are very acid when they are young. The seeds allow to drain the soil as small pebbles or gravel would do. Noni seeds also plays the role of fertiliser when they are decomposing. The noni seeds are added in the soil after tilling, when they make the raised beds with the shovel. When they decompose they smell like humus.

FERTILISATION:

- Fish fertiliser: Neighbour farmers give the fish interior which are left to ferment in a 100L barrel for 3 months. The barrel is completely filled with fish and just a little bit of water is added. Once ready, the fertiliser is applied once per month at the base of the fruit trees and on the leafy plants (eggplant, pakchoi, salad, tomato...). No fertiliser applied to perennial plants and legumes.

MULCHING: Before they mulched with wood pellets but when there were strong rains, everything was washed away. They stopped doing mulch as it was intense in labor and easily destroyed. Noni seeds are also washed away!

NO GREEN MANURE—> Trial once with a legume, Arachis Pintoï, but ≠ sufficiently competitive against weeds.

NO FALLOW —> lack of space

IRRIGATION: Water comes from the community reservoir + access to a source when there is no water available from the reservoir. Two irrigation methods: rotating sprinkler + hand watering

Pest management

SPATIAL FARM ARRANGEMENTS:

- Plots that are often saturated in water => traditional crops (tarua, sweet potato) + pumpkin

- Plots that are more draining => vegetables (eggplant, turnip, salad, tomato...)

- Trees displaced in the edges. Observation: they are more robust there.

PEST MANAGEMENT:

- Rats: Many dogs on the farm that hunt them! (the dogs dig holes as well, down point).

- Insects: No specific problems with pests and insects as they do not grow so many fruit, and they practically only grow vegetables that are "rustic"/ landraces => well adapted to climate and soil

- Lemon grass: She wants to add lemon grass all around the farm => market demand for fresh lemon grass.

WEED MANAGEMENT= the most important pressure. Philosophy: "We let them live with our plants, If you weed everything, you have even more weeds!" => "You should not become a slave of your work".

- Vetiver: She tried to use vetiver as a mulch material but the problem is that there is too much humidity and the mulch needed to be turned over very often to avoid that the root system develops itself!

WATER EROSION MANAGEMENT: Digs a "gutter" around the plot to improve water evacuation. Limit: time consuming.

Projects

- Plant lemon grass all over the farm (Insect repellent and market for it)
- Upscale to 80 boxes per week and convert the 2 ha of flowers where the farmer has lost her market to vegetable/fruit/traditional crop production, as there is a demand for more boxes!
- The farmer dreams of having 20 small pigs but they would need to be guarded by someone otherwise the numerous dogs will attack them.

Ideology Passion about farming, respect of food (harvest will delicacy), healthy food to an affordable price, leave space for nature don't try to control it.

FARM 5_ TAHITI ISLAND

OWNERSHIP

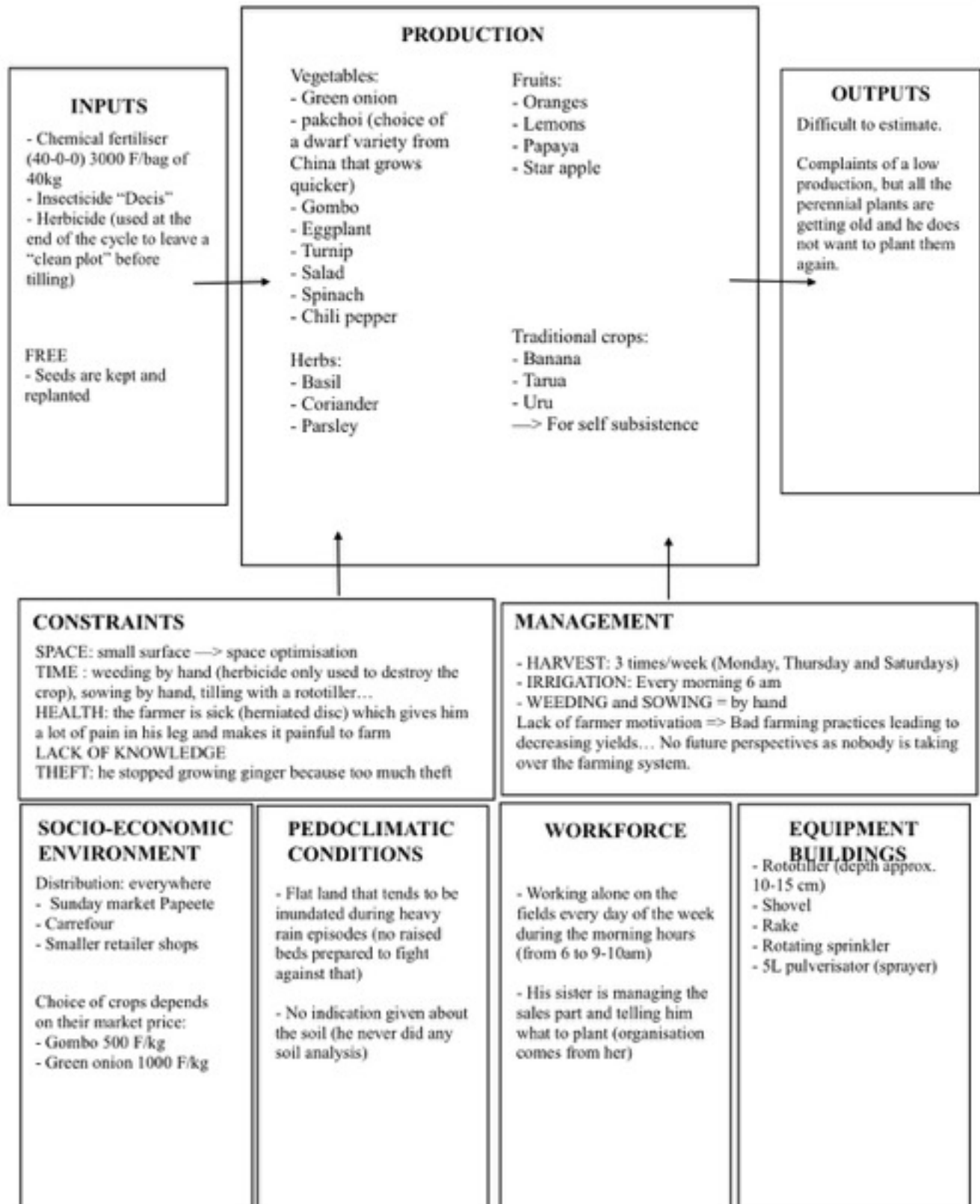
- 3000 m² (Punauia) - conventional farming - precarious arrangement with a private owner (does not pay any rent)

OBJECTIVES

- market orientation (product chosen for their market price)
- optimisation of land use (in time and space)
- no fallow, no green manure...

HISTORY

The farmer comes from Raiatea, his family was producing Vanilla. They moved to Tahiti when he was 6. He worked in different sectors in the city for years and got tired of it. He decided to farm (as he has no education, it is the only thing you can do with no education. Since 2000, he farms on this location (precarious arrangement with the land owner who allows them to farm on her land for free). The farmer does not have any children that could take over the farm.



FARM 5_ TAHITI ISLAND

Soil management

CROP ROTATION: no specific rotation → he plants what is needed on the market (when there is a demand/good price for it) at the moment when a plot is free.

SOIL TILLAGE: Rototiller → shallow till (10-15 cm). When he finished harvesting, he applies a herbicide to destroy the remaining crops. Then he goes through the plot with a rake to clear out the destroyed plants. Then he goes through the plot with a rototiller to till the soil and he sows directly when the plot is tilled. This procedure is the same for all the crops.

FERTILISATION:

- Chemical fertilisation 40-0-0 applied on every plant (even on "winged beans" that stock the nitrogen from the air).

SOIL AMENDMENTS:

- No compost applied.
- Important bare soil
- No green manure
- No fallow period (no space to do so).

NO MANAGEMENT OF WATER EROSION: Many problems with water flooding when there are heavy rains. But he does not do anything against it (no raised beds, no cover to capture the water, no drainage system on the sides of the crops).

IRRIGATION: every morning (free access to water)

SOIL ANALYSIS: never done → no comprehension about soil

Pest management

SPATIAL FARM ARRANGEMENT:

- Interesting optimisation of land use by planting the gombo in a circle which allows him to do some intercropping in the middle and at the same time (spinach and persil), and facilitates the harvest of the gombo.
- Many fruit trees all around the farm → shade areas
- Association green pakchoi + spinach + turnip all together on one plot (sown by hand). Good combination of crops (they grow without out-competing each other with shade or nutrients). = Technique to optimise land use
- Association: parsley + onion → grows well

PEST MANAGEMENT

- Insecticide used (DECIS) applied by pulverisation on the entire fields (5L pump).
- "Not too many problems with diseases on the farm"
- Bird traps against the red vented Bulbul (*Pycnonotus cafer*) that attacks all the crops such as eggplant and are invasive (out-competing endemic birds such as monarche).

Perspective on organic farming

"Organic works the first year and the second, you are invaded by pests and diseases. It is impossible."

Brakes to the current management practices

No desire from the farmer to improve his system. He seems to be simply tired of farming. He sees farming as the result of having no other options as he did not follow any education. He wishes to stop cultivating.

FARM 6_TAHITI ISLAND

OWNERSHIP

- 6 ha of vegetable production in Papara PK 40
- Renting to a private owner for 30'000 F/month/ha => contract that has to be renewed every 3 years (Land security)

OBJECTIVES

- MARKET ORIENTED
- OPTIMISATION OF LAND USE (because not sufficient land surface in the farmer's opinion)

HISTORY

The farmer did not follow any agricultural school, rather he has learned by working with his father for 15-20 years. At the death of his father, he started his own farm with an associate, but their team did not work, which forced him to find a new plot and led him to rent these 6 ha of private lands. The land was before occupied by an agro-pastoral system (coconut trees + bovine), leading to fertile soil when the farmer took over. Plus, when cutting the coconut trees, he produced wood pellets that he uses to drain the soil.

PRODUCTION

Vegetables:

- Eggplant (8 weeks approx)
- Pakchoi (green and white) - (4 weeks growth)
- Cucumber, Ginus Variety (1 month growth)
- Salad (Mineto)
- Cabbage
- Chilli pepper
- Zucchini
- Corn (for his own production)

Herbs:

- Mint
- Basil
- Coriander

Fruit:

- Papaya, Red Lady variety (chosen because the market price is very high as there is a disease on the papaya currently and production is lower). Choice of a resistant variety coming from Hawaii (Red Lady).
- Dragon fruit -> trial stage as there is a demand for dragon fruit (high price on the market)

OUTPUTS

Difficult to get answers from the farmer (not sufficient time allocated for the interview)

-> The farmer said that he had "lost one hour and a half of his time" at the end of the interview!

INPUTS

- Land rent (30'000F/ha/month)
- Fertiliser 12-12-17-2
- Irrigation system (river water pumped (oil price): 100'000 F/month during the dry season)
- Fungicide CUPRO ANTRACOLE against the attacks from *Putella Xylostella* (on turnip, cabbage, pakchoi)
- Pheromon traps against "fruit flies"
- Glyphosate (3000 F/L)
- Anti-germinative 4000F/L
- Seeds (agritech)
- Compost (Technival)
- Lime (Hotu Ura) 3000 F/40 kg bag
- Biodegradable plastic

CONSTRAINTS

- COMPETITION on prices that is very important on the market for vegetable production, with very big players in hydroponic production that put pressure to lower the prices.
- TIME -> "lack of time" (time is money) that pushes the farmer into a very intensive system

MANAGEMENT

- Very good work organisation
- Optimisation of land use and time use -> "high input system" = a lot of money spent on inputs compensated by important yields
- Strategy of overproduction: He prefers to throw excess production, than not satisfying his clients demand.

SOCIO-ECONOMIC ENVIRONMENT

Distribution: big retailers, restaurants, snacks

PRICE: Difficult to produce during hot and rainy season when prices are high whereas there is an overproduction during the fresh season as everybody produces more (Tubuai products flow on the market) and there is less market demand (holiday period) which lowers the market prices.

PEDOCLIMATIC CONDITIONS

SOIL ANALYSIS (done when taking over the plot 2 years ago): pH = 5 approx. Lack of calcium

FARM LOCATION: on flat lands, hydromorphic soil (necessary to grow on raised beds), rather clay soils...

SEASONALITY: important climatic difference in terms of production between dry season and the humid season

WORKFORCE

- 3 employees (100%)
- 4 family members (100%): him, his wife, his daughter and his son.

WORK ORGANISATION

- Preparation of seedlings every Tuesday: wife
- Deliveries every Tuesday + Friday: son and daughter

WELLBEING: speaks about the "working quality" (shade from papaya and cultivation of herbs on tables to decrease back pain...)

EQUIPMENT BUILDINGS

- Rotative sprinkler irrigation on every field (radius of 3 meter)
- Disk Plow
- Rotavator
- Rotary slasher
- Field cultivator
- Tables for seedling production

FARM 6_TAHITI ISLAND

Soil management

NO CROP ROTATION: The farmer just avoids to sow the same crop twice in a row (he only grows leaf-vegetables and fruit-vegetables, but he did not speak about inverting these two types of crops). He plants what is demanded by the clients.

NO FALLOW PERIOD: optimise land use "the land should not sleep!", max length of time without crops 2-3 weeks

SOIL AMENDMENTS:

- Lime applied once per year everywhere

FERTILISATION:

- Chemical fertiliser: After 7 days and after 21 days: application of the chemical fertiliser (12-12-17-2) → 2% of oligo-elements (magnesium, calcium...). Same fertiliser applied on every plant, also at the base of the papaya trees. Applied once per month as the base of the papaya trees .

- Organic fertiliser: compost bought from "Hotu Ura" applied before harrowing WHEN HE HAS TIME (never?)

SOIL TILLAGE: No plowing, no use of the disk plows → "not necessary and time demanding".

- Once he harvested, he destroys the crop using glyphosate.

- Once the plants are killed, he drives through with the rotary slasher that grinds the organic matter at the front and reintegrates it in the soil at the back

- Then he goes through with the field cultivator teeth (to aerate the soil more deeply approx. 20 cm).

- Finally, having applied with a shovel some "coconut tree pellets", he goes through with the rotavator after that he modified in order to make the raised beds (⇒ shallow tilling = harrowing). After doing that, the plot is ready to plant the seedlings.

SEEDLINGS PREPARATION: capacity of seedlings preparation defined the shape/surface of the plot units! (example: for one plot of salad, 40 plate of seedlings are needed. Compost from Technival used for the seedlings.

MANAGEMENT OF WATER EROSION: by sowing on raised beds! No clear marks of soil erosion (flat land)

IRRIGATION: rotative irrigation, rotation in the morning on all his fields → 20 minutes per plot

SOIL ANALYSIS: done before starting to farm 2 years ago, but no intention to do one again as it is expensive and "the soil does not change". Lack of calcium detected in the soil and an acidic pH (5 approx)

Pest management

SPATIAL FARM ARRANGEMENT:

- For work organisation rather than pest management goals. Papaya intercropping = objective of optimisation of land use and not "agroforestry". Plus, it allows to bring shade on the farm, which is enjoyable for the employees.

PEST MANAGEMENT:

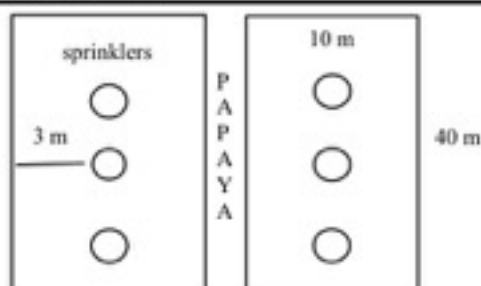
Partial mineral and organic management

- Fungicide (Cupro Antracol) applied once/month → Problems with the *Putella Xylostella* (caterpillar eating the heart of the cabbage and also attacking pakchoi and turnip)

- Herbicide (Glyphosate) applied between the raised beds, "if there is too much grass, there are too many insects infestations."

- Pheromone traps for "fruit flies" (but not sure that they are still working)

- Perennial plants (basil, eggplant, zucchini) grown under biodegradable plastic in order to manage the weeds. But better yields when it is uncovered (more surface for fertiliser applications)



Opinion about Organic?

"Organic does not work on large scale systems! It takes too much time to prepare compost/algae fertiliser or fish fertiliser. It is much easier to organise work with chemical inputs. You buy them and apply them when you need to without having to worry about their efficiency (time of fermentation for fish fertiliser, collection of algae, organic matter to crush for the compost...)"

Brakes to new management practices

- If there are positive results from organic management (in terms of yields) why not. But he needs to see results, on a large scale system oriented towards production (and not just "gardening").

- He observed that one side of his farm (the one next to the river) has lower yields (as it is more often saturated in water. The other side of the road, there is sand at a depth of 1m50 that drains the water better. However he does not take this information into account). Installing a gutter/pipeline system for water would hinder the mechanisation on the farm, so he prefers to do nothing.

- Before he was applying hen droppings, but he stopped because it took too much time and there "were problems with the neighbours because of the smell."

FARM 7_TAHITI ISLAND

OWNERSHIP

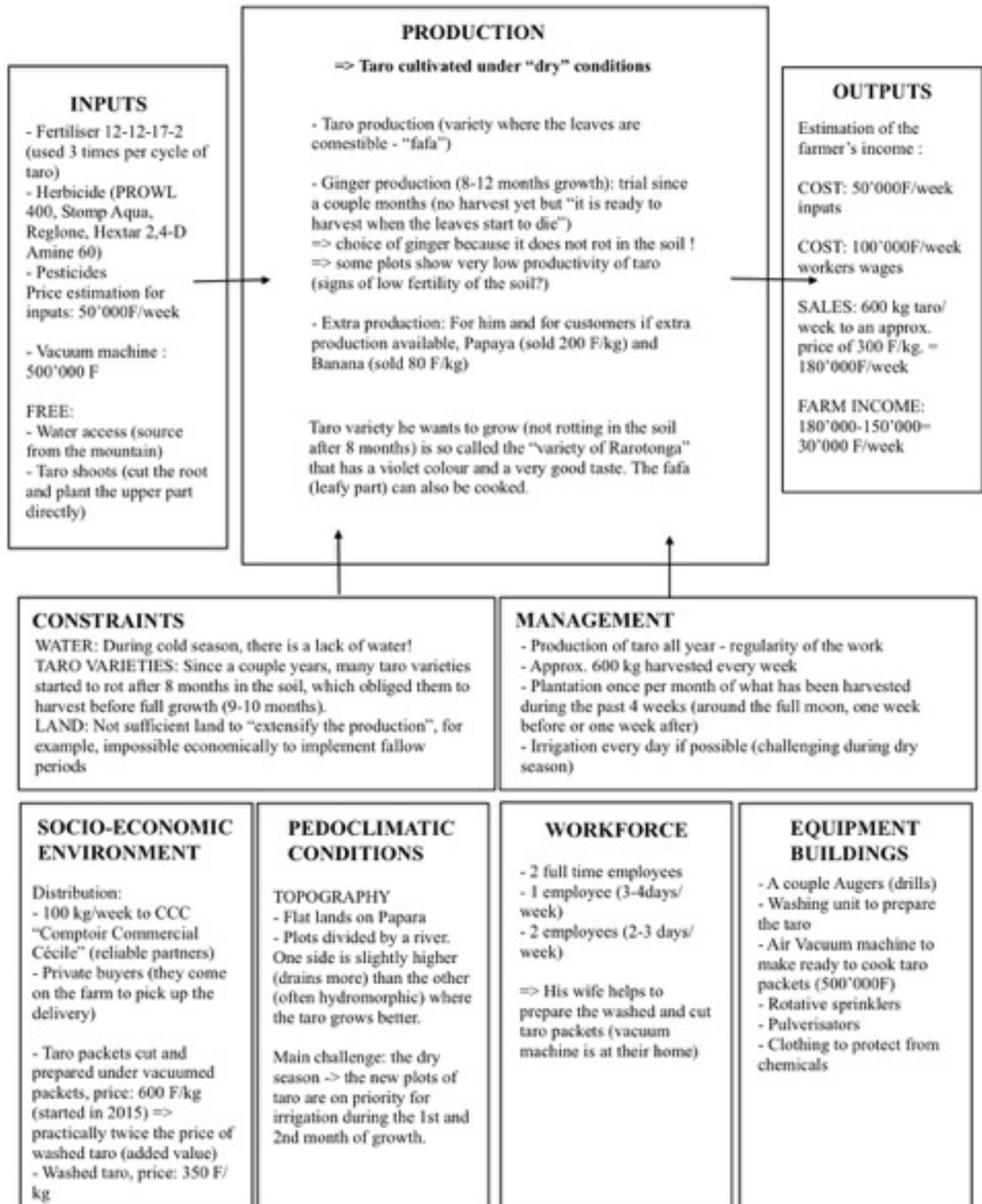
- 5 to 6 ha approx - Papara - Conventional farming with 1 ha (official private land) and 5 ha "unofficial private land"

OBJECTIVES

- Passionate about farming (not only source of income)
- Desire to transmit his knowledge to young farmers (teacher) and to give a future to young generations (employment)

HISTORY

The farmer comes from the Tonga islands where he grew up on a farm. He arrived in Tahiti as he got married with a Tahitian woman. In 1989, he rented one hectare of land that the owner sold him 9 years later. The land owner also had 5 extra hectares that he ask the farmer to take care during his absence. Time past and the owner die, which led the farmer to become the unofficial "land owner" of the additional 5 hectares (free of charge).



FARM 7_TAHITI ISLAND

Soil management

CROP ROTATION: The farmer does not grow anything else than taro. Before he was growing 10 varieties but now because of issues of rotting taro, he decided to only grow one variety of taro that does not rot. The only "rotation" the farmer does is that every new cycle of taro is planted in new holes, interspersed between the old one, making a sort of a grid.

SOIL TILLAGE: no tractor! The farmer does not want to use a tractor as it destroys the soil structure (soil becomes like dust), that takes years to rebuild. He never tills his soil and has been cropping taro for the past 30 years approx.

MOON CYCLE —> He plants taro between one week previous to the full moon to one week after the full moon because they grow better. Apparently this type of knowledge is known by all communities in the Pacific ocean.

TARO PLANTATION: Drill the new holes —> plant straight away the taro (when you harvest, you can collect the rejects that you will plant on the next plot) —> do not bury the hole with soil (the taro root would be much smaller) —> wait one week to add fertiliser (it is useless to fertilise directly as there are no roots yet that allow the taro to absorb the fertiliser. —> Fertiliser used = 12-12-17 with the quantity of approx. one hand full per hole. Fertiliser added by hand 3 times in the cycle of the taro: after one week, 5 weeks and 9 weeks. Then you only wait during 8-9-10 months to harvest. Meanwhile, you have to observe the growth of the taro and the weeds.
The taro is not covered with straw or leaves because it would take too much time upon the farmer. He also says that quickly, "the taro is big enough and produces shade itself, that protects the bare soil."

IRRIGATION: canalisations done by hand with a shovel => extremely work intensive (but done only once, as he does not till the soil (?)). Irrigation : rotative sprinkler used every day if possible (water source is sometime dry during the fresh season)

FALLOW PERIOD: Not feasible economically

SOIL ANALYSIS: Since 30 years, two soil analysis were done -> apparently the farmer was told his soil was "good".

Pest management

SPATIAL FARM ARRANGEMENT: Taro planted everywhere —> difference of yields observed. The fields are separated by a river, one side is more productive than the other (the one lower in altitude, is more often saturated with water, so the yields are higher). He observed a decrease of production as well on the edges of the river on one side, and he saw that there is gravel on the bottom soil, that drains the water at that location, so he decided to grow ginger as the price on the market is very high. However, the ginger is fully exposed to sunshine and seems to suffer from too much heat. The ginger that was the closest to the trees (close to the river) were much greener.

WEED MANAGEMENT: Chemical products applied directly on the weed with the sprayer. The goal is to spray when the weed is sprouting, otherwise there are risks that the product kills the taro as well (leaves become yellow). The use of the sprayer allows the workers to avoid bending all the time. The farmer complains about his neighbour that does not use herbicide => "Dispersion of the seeds from the weeds on his fields."

Use of five herbicides that have apparently various effects depending on the plant growth stage:

- Prowl 400: (no information)
- Stomp Aqua: (no information)
- Glyphosate: applied BEFORE planting the taro
- Reglone 2: used AFTER having planted the taro
- Hextar 2,4-D Amine 60: used to destroy *Commelina nudiflora*

PEST MANAGEMENT : if a pest is seen on the leaves, he sprays the entire field. First, the farmer insists that it is important to respect the doses of applications, but later during the interview he says that sometimes what is written does not allow to kill the pest, which forces him to apply more.

Opinion about organic farming

"People against pesticides are stupid. The problem is only the farmers not respecting the doses."

"Organic fertilisers is just a question of marketing. In the end, there is no difference between hen droppings or chemical fertiliser. it is all nature." => He does not seem to understand the impacts of herbicides/pesticides on the soil quality.

Opinion about the DAG

The farmer is used to struggling by himself to find solutions. Apparently, the DAG is not really a source of knowledge for him, rather he is the one bringing knowledge and experience to them! The government as well is not a source of support as they are adding taxes on machinery and adding costs to his system.

FARM 8 TAHITI ISLAND

OWNERSHIP

- 3.5 ha (location from the grand father) managed in association with his mother in Taravao
- 1 ha (bought from his grand-father) managed by himself
- 2 ha (location to a private owner) in Papara

OBJECTIVES

- Autonomy (machinery) and independence (towards family)
- Food security for French Polynesia (especially Islands)
- Develop the local capacity and use the available labor force
- Develop agrotransformation (Polynesian + world market)

HISTORY

The farmer did not finish his studies (did not get his baccalauréat) and preferred to work on the farm with his family when he was 17. He was first working with his older brother, but soon, family conflicts (different perspectives on the work management) pushed the farmer to associate himself with his mother, leaving his father and his brother working together. He did not follow any agricultural school but has learned everything by doing. Transmission of knowledge by his family and heritage of land and material.

INPUTS

- Land rent: for 3.5 ha 200'000 à 300'000 F/month
- Rent for 2 ha (Papara) to a private owner : 20'000F/ha/ month
- Hydroponic production (computer, substrates, irrigation system, structures, capillary tubes fertilisers, water...).
- Coconut grove substrate: 280 F/ bag to 400F/bag (one bag = three holes)
- High quality seeds for HP
- Seeds: Agritech/Gautier
- Plastic (non biodegradable)
- Electricity for pumping water 120'000F/month (300-400 m3 pumped/day)
- Foliar fertiliser
- Anti-germination product
- Pesticides

PRODUCTION

HYDROPONIC SECTION

- Salad: lettuce (4 varieties: "chêne blanche", "chêne rouge", Minetto, Romaine)
- Herbs: basil, parsley, mint, cress, spring onion

GREENHOUSE PRODUCTION

- Tomato
- Cucumber

FIELD PRODUCTION

- Pakchoi
- Cucumber
- Corn
- Ginger
- Curcuma
- Turnip
- Cabbage
- Eggplant

DESIRE to go back the field production. Hydroponic production requires too much inputs (high production price) whereas the yields are not sufficiently higher, only the quality is really better (conservation and texture). However, the final price is not sufficient to compensate the production cost and consumers prefer to buy a cheaper products. Difficult to manage the pests and diseases as well. " The production price will always be cheaper in field production".

OUTPUTS

No time to discuss about outputs

CONSTRAINTS

FAMILY PRESSURE: " He does not have free hands". Desire to get his own plots to do as he wants.
HYDROPONIC PRODUCTION: "Open cycle" => requires a lot of inputs applied daily and pest problems (TCLV) are easier to manage in field production. Hydroponic production = very technical and difficult.
COMPETITION: everybody fights for the same market. Demand for organic vegetables -> potential market?

MANAGEMENT

- Monday + Thursdays : Harvest
 - Tuesday + Fridays: Deliveries
 - Saturday: Harvest for Papeete Market
WORK ORGANISATION: seedlings produced 2 times per week (salad) + **SPATIAL FARM ORGANISATION** (fields size) allowing rotations and a good distribution and regularity of production and optimising land use.

SOCIO-ECONOMIC ENVIRONMENT

DISTRIBUTION:
 - Small groceries
 - Papeete market (Sunday)
 - Big grocery stores
 Important competition: not so much cooperation, share of information (ex: if a new variety of resistant tomato is found)
 Papeete Market = strategy to sell the veggies that are not accepted by the big groceries (standards). After 7-8am they lower the prices to liquidate the products.

PEDOCLIMATIC CONDITIONS

SOIL CONDITIONS :
 - TARAVAO: Soil = rather volcanic, aerated and easy to work. Too many rocks=impossible to work with the Disc Plow. Less clay content than soil on Papara fields. Major problem is the wind that dries the soil (important needs of irrigation), but fields higher in altitude on Taravao are not as dry!
 - PAPARA: either too dry or too wet! Difficult to manage water.

WORKFORCE

- 8 full time employees + the farmer and his mother
 The farmer splits his time:
 - 2 days/week 2ha in PAPARA
 - 2 days/week 3.5 ha in TARAVAO (with his mother)
 - 3 days/week 1 ha in TARAVAO (alone)
 "With a good work distribution and organisation, you can delegate tasks."

EQUIPMENT BUILDINGS

- 20 horsepower tractor
- 100 horsepower tractor (Papara fields)
- Rotavator (modified for raised beds)
- Thermic back Pulverisator
- Greenhouses
- Hydroponic system
- Disc Plow (30 cm depth)
- Rotative sprinklers low flow (atomisor system)
- A trailer (to apply the hen droppings)

Soil management

CROP ROTATION: "Much easier to make rotations in field than in hydroponic greenhouses." Rotations between vegetables that have the same length of cycle, the same delays needed before harvest and depending on the surface free for sowing.

- Rotation 1: Salad - Pakchoi - Turnip (field production) —> They have the same application delays to be respected before harvest.
- Rotation 2: Cucumber (cycle = 2-3 months) - Tomatoes (cycle = 4-6 months). Alternation of 2 cycles of cucumber for one cycle of tomatoes in the greenhouse.
- Rotation 3: Cabbage - Cucumber (field production) —> They have completely different sensitivities to diseases and pests and the same growing period (2,5 months)

FALLOW PERIOD = 2-3 weeks between each crop cycle (whereas in hydroponic production, after harvesting you plant directly the same day. Extremely intensive.)

SOIL TILLAGE: Disc plow (depth of 30 cm approx.) to aerate the soil, then he goes through the fields with the rotative harrower (improve the soil structure), then he applies CALCIMER (marine lime) mixed with a MINERAL FERTILISER (12-12-17 for example) and finally he applies the HEN DROPPINGS with a shovel. He leaves the hen droppings for 2 days on the surface, for the ammonia gases to evacuate and after that, he goes through with the modified rotavator to make the raised beds. Before sowing he applies plastic cover on some of the crops (20micron plastic) and he makes the holes by hand.

CROP DESTRUCTION: FALSE SEEDBED TECHNIQUE—> After harvest, he goes through the row with the Rotavator a first time, to cut the weeds and bury them. He waits 2 weeks approx, for these weeds to germinate again and then he goes through the row a second time with the Rotavator to destroy the new growing weeds, that have not disseminated seeds yet. Then he sprays an anti-germination product on the prepared seed bed, he waters and he can plant the new crop. After 1 or 2 weeks (when crop is sprouting) he applies fertiliser.

MANAGEMENT OF WIND EROSION: The wind dries off the soil. To preserve soil humidity, irrigation with an atomisor sprinkler system during the late morning hours (10am-11am). In the early morning, dew is sufficient to maintain humidity.

SOIL ANALYSIS: Never done because hydroponic production at the beginning! The farmer says you can deduct the soil quality by observing during the first cycles the different stages of the crop and by working the soil.

SEEDLINGS PREPARATION: He re-uses the coconut grove from the hydroponic bags to grow the seedlings in the nursery, and only if there are no bags to re-use, he buys soil (but it is expensive!). After sowing the seeds, he waters and adds foliar fertiliser and a anti-stress product.

Pest management

SPATIAL FARM ARRANGEMENT: He observed that the eggplant attracts many insects and potential pests, so he leaves the eggplant on isolated parts of the farm. His strategy is to attract the pests/insects on eggplant and to manage them there (maintain control to avoid pest outbreak). Otherwise, there are no special farm arrangements, no use of flower beds...

PEST MANAGEMENT: Mix between mechanical and chemical management

- Crop rotations used to avoid to many diseases and pest.
- Resistant varieties: virus TCLV attacks the tomato and the fusarium wilt attacks the tomato roots. Important economic loss for the farmer! Decision to go back to field production to better manage these threats. Failure of the use of fungicides on the fusarium. Only solution is to find resistant varieties, which allows to have sufficient production for a couple cycles, until often, the resistant variety loses its resistance.
- Insecticides on cabbage against caterpillars *Putella Xylostella*
- Application of organic ("bordeaux mixture") and mineral fungicide treatment (ORTIVA) on cucumber against mildew

WEED MANAGEMENT: Mix between chemical (herbicide) and mechanical management (by hand, rotavator, plastic covers...).

- False seedbed technique = Mechanical destruction of weeds with rotavator favoured for the crop destruction at the end of the harvest rather than systematic spraying of glyphosate. It is more rapid and more economical. No need to wait 3 days for the effect of the glyphosate, no need to pay for an expensive product.

Brakes and levers to the new management practices

For the farmer, it is important to evolve and adapt the knowledge coming from older generations with the knowledge available today. He is very open minded and looks for information available in the outside world. He spoke about his desire to develop agrotransformation to improve the access to vegetables in the islands (except Tahiti and Moorea that have fresh products) and to perhaps access to world markets by developing wheat from taro, uru, manioc and so on, and surf on the VEGAN WAVE.

Opinion about organic farming?

The farmer is conscious about how polluting conventional farming is. He also acknowledges how bad it is to crush the plastic cover with the rotavator, incorporating it in the soil but he says they sometimes don't have time to take it off. He believes that soon, it will become a necessity to go organic. The population is not ignorant anymore. They are conscious about the environmental threats. Polynesia has to surf on the world wave of sustainability, even though he believes it is easier in temperate climates to farm organically than in tropical climates (more pressure from pests and diseases).

FARM 9_ TAHITI ISLAND

OWNERSHIP

- 1.8 ha in Papeari
- Renting a private property 4 years contract
- Since 2016, guaranteed organic by SPG Bio Fetia

OBJECTIVES

- Organic is vital for public health
- Oriented towards the consumers' demand
- Passionate about farming, importance to share the knowledge for the benefits of all

HISTORY

The farmer comes from a farming community in Raiatea. He did a professional qualification (BEP) at the Agricultural school in Moorea (Oponohu). He then started working as a tourist guide until he decided to really start farming. Currently, he has the project to start producing fruit on 3 ha in Raiatea and he wants to build a partnership with a guide to make an "Exotic Fruit Tasting Farm Tour Visit" for tourists.

INPUTS

- Land rent: 5000 F/ month
- Seeds (lower production but resistant)
- Limocide (organic fungicide and insecticide)
- Non biodegradable plastic (use for 4 cycles of crops)
- Hen droppings (bought from neighbour farm 5000F/container)
- Calcimer (liming)
- Patentkali (potassium)

PRODUCTION

Vegetables:

- Zucchini (hybrid variety F1 Tenor) - Good price: 850F/kg
- Cucumber ("Makater" variety)
- Tomato (Variety Hamson - DX-52-12) - they have an excellent taste and resist to drought conditions (no irrigation) => He changes the variety every year to ensure resistance to pests.

Fruit:

- Papaya
- Trial on noni - variety from Tahiti that is smaller (that he would sell at MORINDA society as organic noni)

2 Bee hives since 2017 to improve pollination. Sees good results on zucchini.

Flowers: Companion plant for tomatoes = French Marigold (*Tagetes patula*), 200F per seed packet —> Replant the cuttings (very low cost measure). The flowers are also covered with the plastic as otherwise they have too much competition by mimosa pudica ("sensitive"). French Marigold likes sunshine, it has to be planted in an exposed plot. he flower can also be used apparently in a mixture used as a foliar treatment.

OUTPUTS

Satisfaction about the farm income, however he says that the income from his wife's job at the administration (teacher) is "more than welcome". Insures security of income.

CONSTRAINTS

TIME: Avoid time consuming tasks (example to mulch with vetiver instead of plastic, apply compost or coal, make own fertiliser from fish or algae), that's why he uses Calcimer and Patentkali.

MACHINERY: work by hand! Waiting for achieving tractor + rotoator from the DAG

MANAGEMENT

NO IRRIGATION: Choice of having a low input system and accepting the potential losses.

DIRECT SALES ON FARM: Every Friday in the afternoon, consumers' come to pick up their order.

"FREE HANDS": He works alone and sells what he has. Less stress with contracts or calibration problems and less stress with production variability (seasonality)

SOCIO-ECONOMIC ENVIRONMENT

DISTRIBUTION:

- Sells via internet orders on his website (and Facebook) and consumers come to pick up the products on the farm
- Sells in organic shop and in organic markets (calibration requirements)

=> Too much demand! He is not able to satisfy the demand.

PEDOCLIMATIC CONDITIONS

- Rainfall is distributed during the entire year (even if it is more abundant during the rainy season)
- Farm is on flat lands close to the river & lower in altitude = often saturated

SOIL: observation of an important quantity of worms in the soil (he does not want to till deeper)

WORKFORCE

He works alone on the farm. Very disappointed by experiences with employed workers that were not reliable. More satisfaction working alone.

Soil preparation (till, apply fertiliser, and apply plastic) takes a lot of time as everything is done by hand.

SEASONALITY: More work during cold season.

EQUIPMENT BUILDINGS

- Rototiller
- Brush cutter
- Field cultivator
- Shovel
- Wheelbarrow
- Seedlings prepared on tables where he lives - 800 m2 - (irrigation available and controlled electrically)
- No irrigation on the field! Only a 6m water pump to wash and prepare the vegetables.

FARM 9_ TAHITI ISLAND

Soil management

CROP ROTATION: Chosen for their different sensitivity to pests/diseases

- Zucchini and Tomato: Zucchini (ZYMV) and tomatoes (Mildew, White flies)
- Cucumber and Tomatoes: Cucumber (aphids) and tomatoes (Mildew, White flies)

Example: Soil preparation, application of plastic cover and start a cycle with 2 months of zucchini - 2 months tomato - 2 months zucchini - 2 months tomato. Take off the plastic (and throw it), soil tillage, soil amendments and soil rest = **FALLOW PERIOD** for 2 months.

SOIL TILLAGE : After the field harvest, he goes through the plot with a rototiller to reintegrate the organic matter in the soil. Then, he applies the **HEN DROPPINGS + CALCIMER + PATENTKALI** on the fields with a shovel and a wheelbarrow. He applies the plastic cover on top and leaves the soil to rest for 2 months. He can then make the holes in the plastic and plant.

SOIL AMENDMENTS & FERTILISATION:

- Calcimer and Patentkali applied on tomatoes and zucchini. Dosis: one pinch per foot applied by hand => if fruit become black it is a sign of lack of calcium.
- Hen droppings applied with the shovel approximately on the fields.

CROP DESTRUCTION POST HARVEST: First he takes off the plastic, then he pulls out the plants and he leaves the soil (fallow land) for 2 months. Before tilling with the rototiller, he goes through the plot with the field cultivator to take out partially the weeds. Finally he can till with the rototiller (only 15 cm depth approx.) as he does not want to destroy the deeper soil layers that have an important content of worms (observation from the farmer).

PLANT MULTIPLICATION: Selection of cuttings for multiplication of French Marigold flowers and the tomatoes. This allows to save time because the cuttings, if well chosen, will grow quicker than sowing a new seed and it is economical, as he does not have to buy new seeds!

SOIL ANALYSIS: no official analysis but observation of the soil quality and content by implementing trials on field.

Pest management

SPATIAL FARM ARRANGEMENTS:

- Farm is on two levels, the inferior level, next to the river = often stagnation of water —> installation of cucumber (more resistant to excess water). Zucchini = extremely sensitive to excess water.
- Separation of plots and rows with French Marigold that attract white flies.
- Separation of fields with Vetiver. Delimitation of plots and protection against wind that can destroy zucchini plantations even if it is at the ground level
- Plot size and length of rows: Rather small units to improve the motivation when working
- Papaya: Planted on raised beds to avoid water stagnation (very sensitive to excess water)

WEED MANAGEMENT: Mechanically with the brush cutter between the rows + application of plastic cover

PEST MANAGEMENT:

- Zucchini Yellow Mosaic Virus (ZYMV) —> Preventive application of Limocide when zucchini are 4 weeks old. Variety F1 Tenor has a better resistance to the virus.
- Mosaic Virus on the papaya —> pull out the tree and isolate it to destroy it (burn it)!
- White flies on tomatoes —> French Marigold flowers planted all around the fields
- Mildew on tomatoes —> before natural fungicide (coal application) but too time consuming, today application of Calcimer applied today.
- Aphids on cucumbers —> sow different varieties to limit the dispersion of attacks. Two different varieties of cucumber per row, in order to fight against pests and diseases.

Organic?

At first, what motivated him to grow organic was discussions with friends of him that are doctors. They explained the impacts of pesticides and herbicides on human health. Then, he learned a lot about organic farming practices with a old farmer and by visioning youtube videos. The future of farming is organic!

Brakes and levers to the new management practices

The farmer puts in place many trials to always find new resistant varieties or new combinations of crops. He is observant and takes time to note his experiences, in order to be able to do them again.

Future project

He deposited a demand to the DAG antenna in Raiatea, in order to obtain 3 ha of state land and start an organic production of noni, vanilla, papaya, corossol, mango, caramboles (many fruits) and vegetables. Goal: target the market on Bora Bora with many hotels + build a partnership with local guides, to have touristic visits on his farm and to valorise the exotic fruits that are unknown by many tourists. As the owner of the land in Tahiti is coming back, he has to leave anyways. His demand is strongly supported by local agents, so his project should be realised !

FARM 10_ MOOREA ISLAND

OWNERSHIP

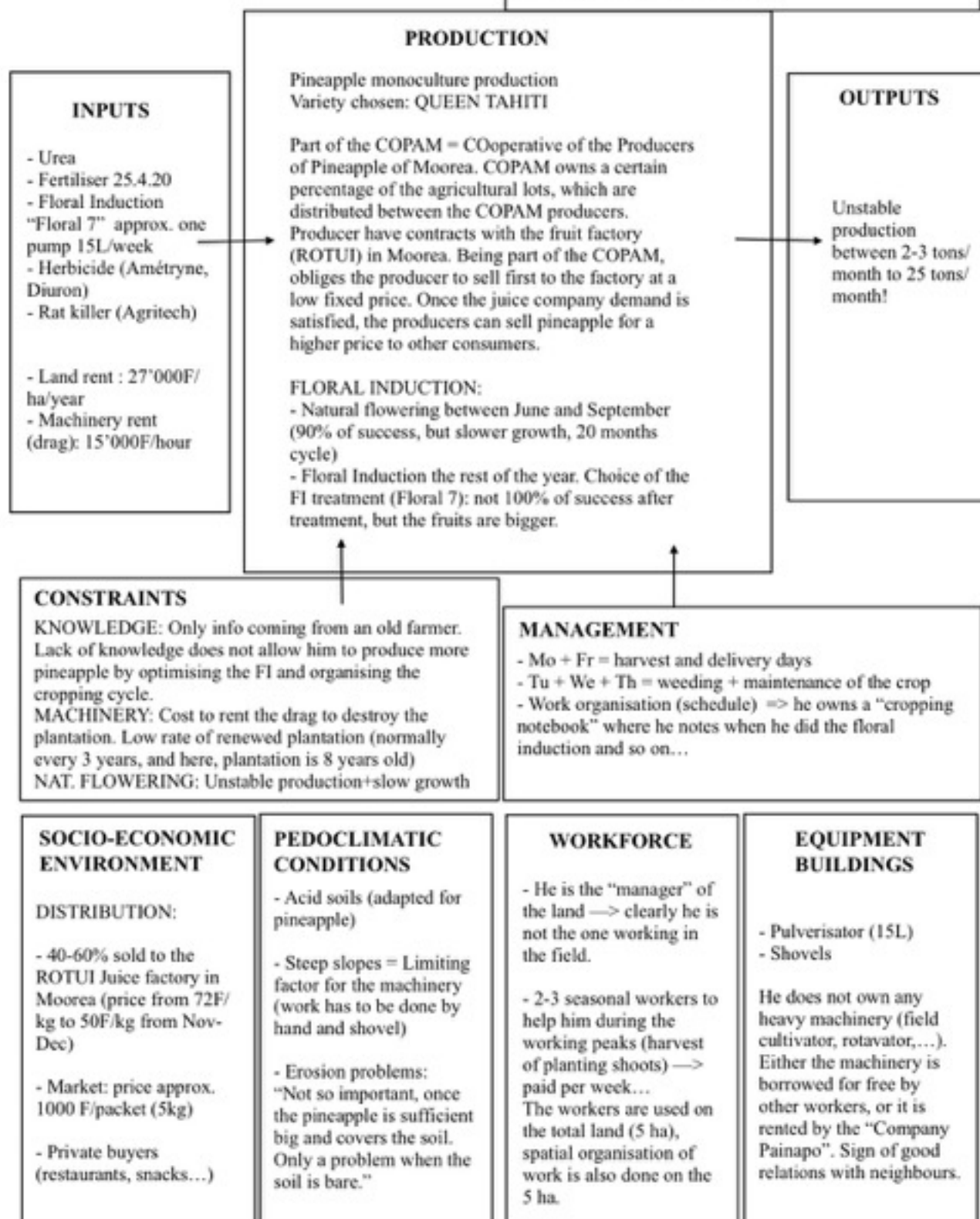
- 1 ha (9300 m²) of rented state land (9 years contract)
- 4 ha (divided in different sectors)

OBJECTIVES

- Maintain the actual system

HISTORY

From a young age, the farmer was helping out on the family farm (pineapple production). When he was 17, his father asked for him to stop school to help on the farm, and that is how the farmer started learning the skills (for the Floral Induction - FI). He officially took over the farm in 1995 and since then he is farming there. His second daughter, studying at the agricultural school in Opanohu, will perhaps take over.



FARM 10_ MOOREA ISLAND

Soil management

SELECTION OF THE GENETIC MATERIAL (3 options: the shoot, the bulbils, the crown). After harvest the pineapple, they are careful not to destroy the rest of the plant, as they will collect the shoots, that will be stored in bags and directly planted in the soil, when needed. The shoots are stored in a cool place for a maximum duration of one month.

- BULBILS are chosen as big as possible (it will give bigger fruits).
- SHOOTS are chosen only when the plantation is young. Then they favour the collection of the bulbils.

TILLING: After removing the pineapple crops, he goes through the field with a field cultivator, going to a depth of approximately 30-40cm (a friend lends him the machine). Goal= aerate soil. Then he leaves the soil to rest for one month approx. (FALLOW) which gives him time to collect the bulbils on another field. Then he makes the raised beds either by hand or with a tractor (if somebody lends it to him). Finally, he organises the work with 3 workers: one makes the raised bed, the other, makes the holes (4 lines of pineapple per row), the last worker, plants the reject in the hole. As the work is very tiring, he tries to do everything with the TRACTOR, except when the slope is too important.

FERTILISATION: He applies urea 2 months after plantation, once he observes the growth of roots from the bulbils. After flowering, he applies complete fertiliser 25-4-20 to help build the fruit (potassium). He applies it by hand from a bucket (bags of 20kg), throws it on the top of the crop and between them if possible. Important consumption: "300-400 kg of fertiliser per field".

SOIL EROSION MANAGEMENT => the rows are not perpendicular to the slope. He organised the rows to facilitate access with the tractor from the road. He does not believe erosion is a major problem on his fields, rather he sees the direction of the rows as a good way of evacuating the rainfall (as pineapple needs drained soil). The farmer tries to maintain the field to a certain height, compared to the alley, to favour water evacuation on the alley (road as a water evacuation channel).

DESTRUCTION OF THE PLOT: he rents a drag (15'000F/hour) and he pushes all the organic matter from the pineapple on the sides of the plots, and leaves it there to decompose naturally. He only destroyed the plantation 2 times since 1995, which means that his plantation was approx 8 years old, which is a lot (normally 3 years and then renewed). He explains that to destroy one plot (1 ha approx) it would take 10hours, which represents 150'000F to rent the drag. Therefore, it is economically challenging to renew the plantation, so the farmer prefers to accept lower yields and a more unpredictable production on old plantations.

Pest management

WEED MANAGEMENT: Chemical management. Weeds that covers the pineapple and take all the sunlight. It also makes it more difficult to apply the fertiliser and to apply the Floral Induction treatment.

Herbicide treatments : Ametryne, Diuron applied at the beginning of the cropping cycle, before there are any fruits!
No use of plastic cover because the farmer does not own the machinery to apply the plastic

PEST MANAGEMENT:

- Rats and mice: Preparation of a mixture with bread+mackerel+ rat killer product from Agritech
- Insects: Not a big problem with insects, only ants, but it does not represent an important loss on the production.

Observations: impacts of climate change —> seasonality impacted (?)

Normal Pineapple production (if no Floral Induction):

- Natural flowering takes place between June - July (when the temperatures are lower)
- Peak production comes between November-December.

This year, the peak of production came in January with 251 t of pineapple harvested counting all the producers in the COPAM, whereas the average production is around 50t.

Floral Induction: approximately one pump per week (15L) distributed on the 5 ha, in order to distribute the harvest. No FI -> except between June and September when there is Natural Flowering (cold season induces flowering).

Opinion about organic?

The farmer is interested in organic farming if he can obtain organic fertiliser, organic herbicide and organic floral induction product (substitution approach)! He clearly does not question his system, he just sees the opportunity to sell his pineapple to a higher price (300F/kg!). However at the moment, the organic products are very expensive, especially the organic herbicide and the consumers are maybe not ready to pay the pineapple 6 times the price of conventional pineapple.

FARM II MOOREA ISLAND

OWNERSHIP

- 5 ha of rented state land in Moorea (9 years contract)

OBJECTIVES

- HEALTH: products that won't destroy your body and nature
=> "REASONED AGRICULTURE"
- BUSINESS ORIENTED: reduction of inputs to decrease production price - find new markets - readapt constantly

HISTORY

The farmer's grand-parents arrived from China to Polynesia to work in the plantations of cotton and sugar cane. His parents also worked in agriculture, so he learned a lot from his family and was shocked by the doses of pesticides applied. He has been farming for 35 years! He is a hard worker and he is disappointed when seeing how "weak" the young generations are in terms of mental. He did not find anybody to take over his farm yet.

INPUTS

FREE:

- Pork slurry (from Opunohu)
- Water from river

BOUGHT:

- Herbicide
- Calcimer
- Liquid rat killer (3000F/L)
- Net from New Zealand (13'000F)
- Seeds
- Insecticide
- Biodegradable plastic (70'000F/1200m)

PRODUCTION

Fruit production (approx 2.5ha):

- Mandarines ("Potoru" rare variety from Tahaa'a)
- Oranges
- Grapefruit
- Papaya (Waimanalo variety from Hawai'i)
- Watermelon (greenhouse to avoid excess water)
- Corossol
- Avocado

Vegetable production (approx 2.5ha):

- Sweet potato (attacked by rats)
- Cucumber
- Cabbage (attacked by Putella caterpillar)
- Beans (agritech F1 variety & old variety from his grand father —> allows to collect seeds!)
- Curcuma
- Ginger
- Green onion

Herbs: Mint, basil

OUTPUTS

What pays him off
= citrus production
+ sweet potato

=> He possesses important quantity of machinery which shows that he must earn sufficient income from farming.

CONSTRAINTS

- WORKERS: impossible to rely on his workers -> economical loss and forces him to change system
- LAND ACCESS: difficult to access to a lot of land (political matters), perceived as an "intruder" on Raiatea island...
- CLIMATE CHANGE: suffering from unpredictable rainfall—> difficult management for vegetable production
- BIG RETAILERS: avoids to sell to them —> returns on merchandise

MANAGEMENT

- Mo + Th = harvest
- Tu + Fr = Deliveries
=> extremely innovative farmer, open minded, finding solutions and trying to get as much knowledge as possible. Travels to see how they farm elsewhere (Taiwan, Hawaii, Japan...) and potential seeks new markets as well!

SOCIO-ECONOMIC ENVIRONMENT

Distribution:

- Stall on the road = most convenient (direct selling)
- Hotels and restaurants
- Shops/Markets
- School canteen (only Papaya)

SEEKING MARKETS:

—> sold 600 kg of potatoes for the Tuamotu (for 600F/kg!)
—> is producing MAPE for the Japanese market
—> produce coco as there will be a growing demand (price today: 80F/coco)

PEDOCLIMATIC CONDITIONS

More or less flat lands + Rocky land => but he keeps them to drain the soil!

Climate change -> since 2010 the seasons are not clear anymore, which makes it very difficult for vegetable farming especially => reason why he invested into a greenhouse (300'000F).

Rainfall = major challenge for vegetable farming.

WORKFORCE

At the moment the farmer is spending 2 weeks in Moorea and 3 weeks in Raiatea to work. His wife is dealing with the paperwork and she stays constantly in Moorea to check the workers (3 workers 100%).

The farmer's cousin is paid to sell on the road (small stall with authorisation) every day in Moorea. He works every day and does not want to go on pension! Passionate!

EQUIPMENT BUILDINGS

He owns all the machinery:

- Manure spreader
- Girobroyeur (cut grass)
- Plow with soc
- 2 greenhouses
- irrigation system rotative sprinkler + drop irrigation in the greenhouse
- Japanese seccator (collect oranges...)

FARM 11_MOOREA ISLAND

Soil management

CROP ROTATION: the farmer always alternates between crops on the fields (he organises himself depending on the plots that are free), but there is no fixed rotation. For example, alternation between sweet potato and Papaya field.
Only fixed rotation: Pakchoi - Salad - Cabbage

FALLOW PERIOD : He does have fallow periods of minimum 3 to 5 months but he says that the best would be to leave the land one year and have trees on it, and then, cut everything and reintegrate the OM in the soil. But he does not have enough land to do that!

SOIL TILLAGE:

1) Rotary slasher

2) Spread SOIL AMENDMENTS: Pork slurry applied 2 times/year + calcimer (to counter balance the acidic pH). He applies approximately 1ton of calcimer for 1 ha of land (dose defined by various trials). Calcimer is expensive, but it is something vital for the soil and necessary for the growth of the vegetables. He explains that applying the liquid slurry is not so practical as it goes everywhere, in comparison to dried hen droppings that can be applied as fertiliser, locally!

3) Soil tillage with a soc plow to a depth of 30-40cm to avoid to disturb the nematodes.

MANAGEMENT OF WIND EROSION:

- Trees planted in the corners, to optimise land use and play the role of a wind shift
- Greenhouses placed perpendicular to the direction of the dominant wind.

IRRIGATION: access to the river water for free, price for fuel only to pump water

SOIL ANALYSIS: he tries to do a soil analysis every year and on ever plot to know the pH and apply the necessary amount calcimer. pH is the only thing he cannot observe with his eyes, that's why he needs to pay for an analysis.

Pest management

SPATIAL FARM ARRANGEMENT:

- Soil gradient from rocky and low fertility (fruit production zone) to less rocky and more fertile (vegetable zone)
- Mandarines placed close to the river as they consume important quantities of water.
- Papaya installed on rocky plots to ensure a good drainage of water
- Cucumber-zucchini-watermelon (cucurbits family) => placed in far away locations to protect them from crossing diseases
- Leave grass (amaranth) => attraction of insects, source of food and pollination
- Important diversity and spatial repartition of the crops all around the farm to ensure minimal production

PEST MANAGEMENT: Use of chemical pesticide only when really needed

- Citrus: he cuts the grass between the trees rows and burns it (once/month approx.) => Smoke = natural insect repellent. He chose resistant varieties of citrus to avoid to treat them. No phytophthora. He does not PRUNE the citrus trees to avoid theft, as there are very big needles on the branches and fruit are produced higher on the tree and makes it more challenging to steal.
- Cucumber: thrips + white flies => obligation to treat chemically !
- Cabbage: 2 treatments/crop cycle against the *Putella Xylostella* (caterpillar) - Consumes important quantities of slurry (cabbage is grown on the most fertile soil)
- Lemon tree: once per year application of lime directly on the trunk (prevents fungus diseases)
- Beans: attacks from mites+thrips+aphids+leaf miner => treatment before flowering. In addition he leaves the grass grow in the inter-row (insects feed on grass/amaranth) and he weeds by hand at the base of the beans to decrease competition for nutrients.
- Rat killer: mixture of fish, grated coconut and rat killer applied once per month for the sweet potato field!

WEED MANAGEMENT: less biodegradable plastic used because of the price and he says that these weeds = free compost at the end! He just has to ensure that they do not compete too much with the main crop (management with the brush cutter).

Why not organic?

"Organic is a lie as the slurry is not coming from an organic farm."

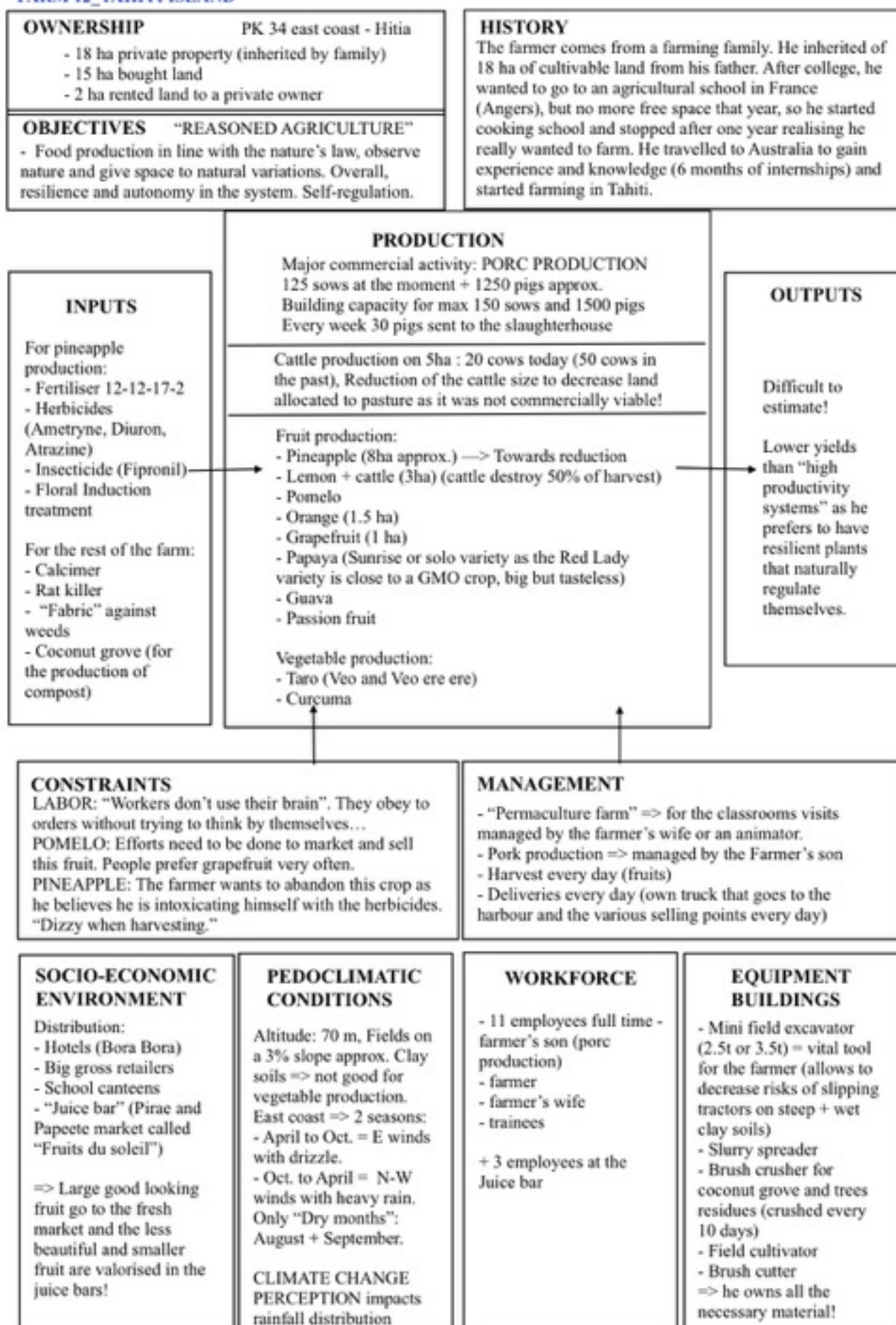
Project for farm in Moorea

Plant coconut trees (hybrid variety from Cook islands) to valorise them as "coco water". This variety has a sweet taste, a large size and a lot of flesh. He is also conscious that the production of coconut will decrease as the coconut plantations are not sufficiently renewed and therefore, the price of coconut will start to increase.

Project for farm in Raiatea

He is the only producer that uses the hen droppings on Raiatea, which allows him to avoid buying fertilisers.

FARM 12_TAHITI ISLAND



FARM 12 TAHITI ISLAND

Soil management

SOIL AMENDMENTS: All the fields are covered with PORK SLURRY (only applied between July and October to avoid risk of "chocolate bays") and COMPOST, both made on farm. LIME is also brought during tillage.

- COMPOST: coconut grove (from the coconut water put in bottle by the farmer's son) + "big residues" collected after sifting the manure from the pork production. Compost applied generously around the trees and before planting them and in the pits for the taro.

- LOGS OF WOOD: The farmer builds 50 cm raised beds with the mini excavator (they will lose height with time). Bury logs of wood in the pits + apply compost as the basis of fertilisation! The farmer does not do anything then during the crop cycle. He leaves the nature to decompose the wood/coconut grove/compost.

TILLING: Only during the cold season (between May and November approx.) when there is rather drizzle, to avoid risks of soil erosion (fine clay particules). He goes through the plot with a field cultivator (depth of 50cm) to aerate the soil and integrate compost + lime (calcimer) in the soil. Then he builds his raised beds with the mini excavator (50 cm height) and he takes great attention to make the raised beds following the topographic curve line.

IRRIGATION: No need to irrigate (only critical months= Aug. and Sept.) => Mulch material to protect from water loss by cutting vetiver (once per month) or applying coconut grove or any branches/organic material cut from the fruit trees. All the organic matter is used for something on the farm site.

COVER CROP: Arachis Pinto, a legume, sown as a green cover on the citrus plots. It allows to capture nitrogen and to control the weeds at the same time. The legume is cut every month approx with the brush cutter, and plays the role of mulch. It does not grow too big and does not uptake nitrogen which is perfect for the growth of the fruit trees.

SOIL ANALYSIS: The last one had been done a long time ago and indicated a lack of potassium (however the farmer does not change anything to improve that). The soil is improving with the constant slurry and compost spread, however there is a lack of potassium applied.

WATER EROSION MANAGEMENT: raised beds built in the direction of the curve lines to avoid that rainfall creates rivers of soil flushed avoid down the slope (KEYLINE DESIGN).

Pest management

FARM SPATIAL ARRANGEMENT:

- Lemon+Cattle (3ha): loss of 50% of the production of lemon (eaten by cattle) but allows to valorise more land.
- Intercropping system between papaya and taro to optimise land use, and create a "drained space" for papaya and a "humid and shade" pit for taro.
- Follow the altitudinal curves to build the raised beds => limit soil erosion by water flow (chocolate bays)

WEED MANAGEMENT:

- Green manure cover of Arachis pinto (legume) that does not leave space for other weeds (if it covers well)!
- Curcuma grown at the base of the fruit tree to avoid weeds to make too much competition (still at a trial stage). Only negative point: requires a lot of compost (demanding crop) and you need to elevate the crop.
- "Anti grass fabric" => better than the plastic! Allows water infiltration and ≠ destroyed as quickly → re-usable!

PEST MANAGEMENT:

- No treatments applied at all on the crops except the pineapple! Even on sooty mold
- Fipronil used against the "Fire Ant" that is will become increasingly problematic in Tahiti
- Rat killer => otherwise you lose a lot of your production !
- Herbicides (Amétryne, Diurion, Atrazine) use for pineapple: very hard to manage weeds organically ...Desire to replace completely pineapple by pomelo during the following years as farmer is tired of intoxicating himself.

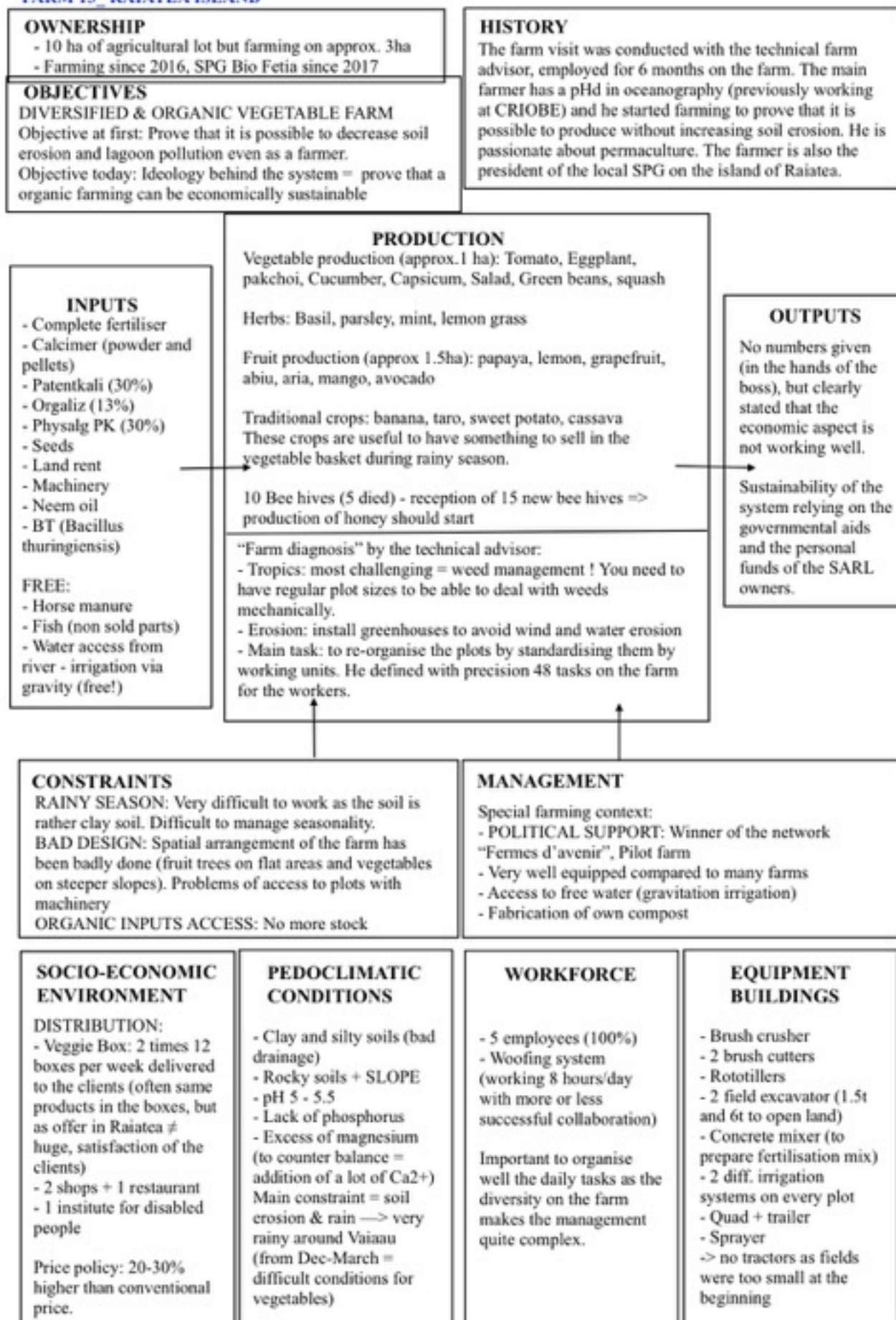
Why not organic?

The farmer does not like the fact that some believe only in organic production. For some specific crops that people eat (pineapple and some vegetables), it is impossible to grow organic! And there are 2 types of OF farmers that he dislikes, the ones that only do it for the economic benefits and the ones that do it, without having any knowledge about it. He is far from that and is not just oriented towards maximum productivity and profits.

Source of knowledge and philosophy

The farmer is observing a lot what happens in the field. He started planting logs in pits as he observed that the biggest citrus tree was next to a rotting log of wood. His philosophy is to accept the constraints and to work hand in hand with them, by finding which crops will grow well in the local context. He never treats minerally (except for pineapple) because he believes that with time, the system will auto-regulate itself. He is not trying to push for the yields. He is more turned towards a self sufficient system.

FARM 13_ RAIATEA ISLAND



FARM 13_ RAIATEA ISLAND

Soil management

CROP ROTATION: No fixed rotation for the moment (re-organisation of the system). Desire to rotate between fruit-leaf and root vegetables between plots of a certain surface (total farm divided in 24 units = 24 "soles"). Example: 3 cycles of leaf vegetables on 1 sole and 1 cycle of root vegetable on another sole, and inversion.

SOIL TILLAGE: No harrower with cutters at the moment so he tills the soil very superficially with a field cultivator at a depth of approx. 15cm. It allows to take out some of the rocks. The rototiller is used to make the raised beds. A lot of time currently is spent on opening new plots (secondary forest destruction).

FALLOW PERIOD: not possible for the moment as there are too many seedlings ready to plant in comparison with the fields ready to sown. Plus economic stress.

SOIL AMENDMENTS:

- Compost preparation: dried grass + chopped wood + horse manure + lactic bacteria (maceration). The compost is mixed every 10 days approximately (depending on time available). Every time the compost is mixed => adds some nitrogen via the fish fertiliser to boost the compost and to maintain the inner temperature between 55°C and 65°C. The compost is ready for use after 3 months. Compost applied at the base of the trees (papaya) and covered with wood pellets, to avoid erosion and evaporation of nitrogen. Application every time the farmers sows a new plant (with the quad and trailer) along the plantation line on the seed bed.

FERTILISER: He makes his personal mixture of fertiliser between Orgaliz(N), Physalg (PK), Patentkali (K). The standard mixture is adapted depending on the crop. At the moment, there is no more physalg in stock in Tahiti, so he replaced his mixture by a complete fertiliser called Plantin (3-8-9 + 3 MgO).

=> optimisation of the use of fertilisers - analysis of the compost use as well

IRRIGATION: 3 types of irrigation systems (1) irrigation drop by drop (tomato) (2) mister (for salad, pakchoi, basil) (3) rotative sprinkler depending on the crop! Regulated with an alarm system, very practical.

MANAGEMENT OF WATER EROSION: Mulching system (coconut grove or wood pellets) and "terrace system"

Pest management

SPATIAL FARM ARRANGEMENT: Very badly done! No agronomic logic behind the spatial configuration which makes it difficult today to improve. Fruit trees installed on the flat plots and vegetable farming applied on the slopes.

PEST MANAGEMENT: Organic treatments applied preventively for the moment once/week with a sprayer, before being able to have a more systematic observation of the farming system. If it rains, they stop and have to wait for sunshine to continue treating.

- Organic fungicide: Sulfur, "bordeaux mixture", copper.

- Organic insecticide: Neem oil (against insects and mites) and BT Bacillus Thuringiensis against caterpillars (cabbage, green beans)

- Pheromone traps against fruit flies (works very well)

- Adapted irrigation: adapted to avoid diseases (drop by drop for tomato to avoid humidity and risks of Mildew)

WEED MANAGEMENT:

- Mechanical (by hand or with a brush cutter)

- Mulching system everywhere against weeds, but it is not the case for the moment! For fruit trees only: mulch system used to manage the weeds = by applying wood pellets (from the secondary forest destruction). The wood also brings nutrients in the soil. Other mulch material: coconut grove (used under tomatoes)

NURSERY: Substrate used to make the seedlings is made from the compost that is filtered to keep only the very fine particles that are mixed to white sand (improving drainage)

SEEDS: the seeds bought are sometimes treated against the TYLC, and F1 varieties are used (it is tolerated even though he is in organic because there is no access to other types of seeds!). That means he cannot always re-use the seeds.

Projects for the improvement of the system

Installation of many greenhouses to fight against the rain + desire to have programmable irrigation under greenhouses, to control the water availability.

Apply mulching system everywhere to fight against 3 types of erosion (by sun, by water, by wind).

Seedlings preparation plans + rotation plans + cropping plan + education (definition of 48 tasks to conduct on the farm)=> there is a need to educate the workers for them to do qualified work.

Main constraints?

- Cover the charges, workers wages and pay back to the bank for the grant. But at the moment, no money is left after having paid the workers. If some of the associates of the SARL did not have the funds, they could not continue with the activity. **ECONOMIC SUSTAINABILITY ??**

FARM 14_RAIATEA ISLAND

OWNERSHIP

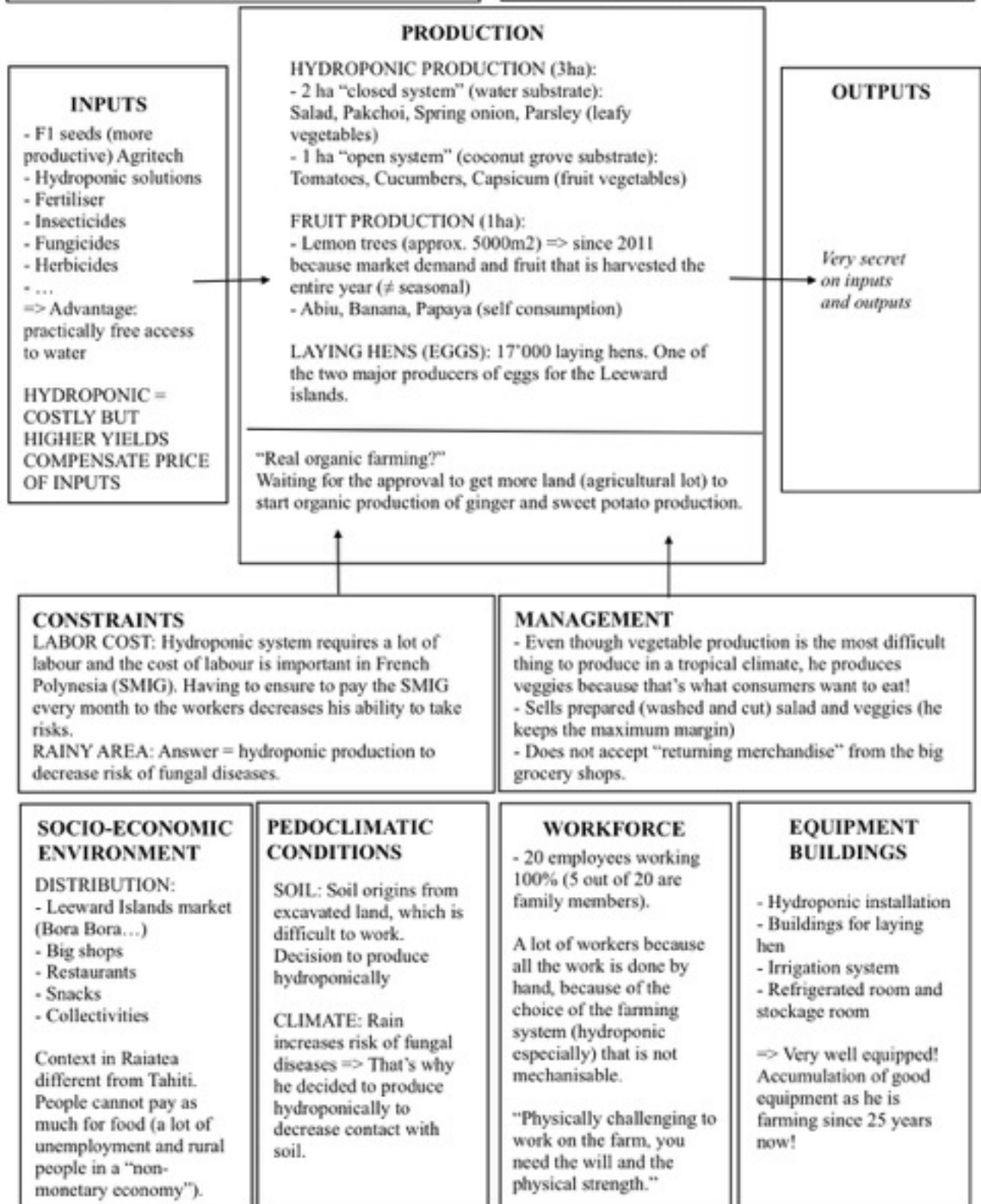
- 5 ha of cultivated land (30 ha of private property but land going up to the mountain = steep)
- Opoa PK25 east coast

OBJECTIVES

- Market oriented: For that reason vegetable production
- Oriented towards yields and productivity
- Organic demand at the moment = challenge for him to potentially start organic production

HISTORY

The farmer comes from a farmer family from Tahiti (learned by doing). He had the opportunity of buying land from a farmer and that's what brought him to Raiatea, where he is installed since 25 years. Started farming partly in field and in hydroponic, and then shifted to only **HYDROPONIC PRODUCTION** as the yields were higher. Today, interested in producing sweet potato and ginger organically.



FARM 14_RAIATEA ISLAND

Soil management

FERTILISATION:

- Hydroponic section: secret mix applied in the irrigation tubes constantly (but no treatments added inside otherwise a chemical reaction could take place in the tubes!)

SOIL AMENDMENTS:

- Lemon trees: Hen droppings applied every 6 months at the base of the tree.

SOIL ANALYSIS: only done at the beginning as he installed himself in a hydroponic system

Pest management

PEST MANAGEMENT

- LEMON PRODUCTION: No treatments applied on the lemon. No issues with Phytophthora for the moment. He does not want to label the lemon "organic" as the hen droppings applied to fertilise are not organic!, but technically he is managing the lemon trees organically.

- HYDROPONIC SECTION: treatments applied rather in a curative way in the hydroponic section. Major threats: (1) Cercosporiosis (on salad), (2) Thrips, miner flies, insects (on cucumber, capsicum...) (3) Mildew (on tomato, cucumber)

WEED MANAGEMENT

- LEMON PRODUCTION: Management of cover with brush cutter

- HYDROPONIC SECTION: He leaves grass once he harvested the major part of the cucumber for example to leave space to insects and potential auxiliaries

Source of knowledge?

Knowledge comes partly from the experience and observation of his family farming, but also from travels to New Zealand and Australia to get more sources of knowledge and techniques.

=> The farmer though was very doubtful to communicate his economic data or the details on his system (seeds...) . He is a very rational market oriented farmer.

Opinion about organic farmers/farming?

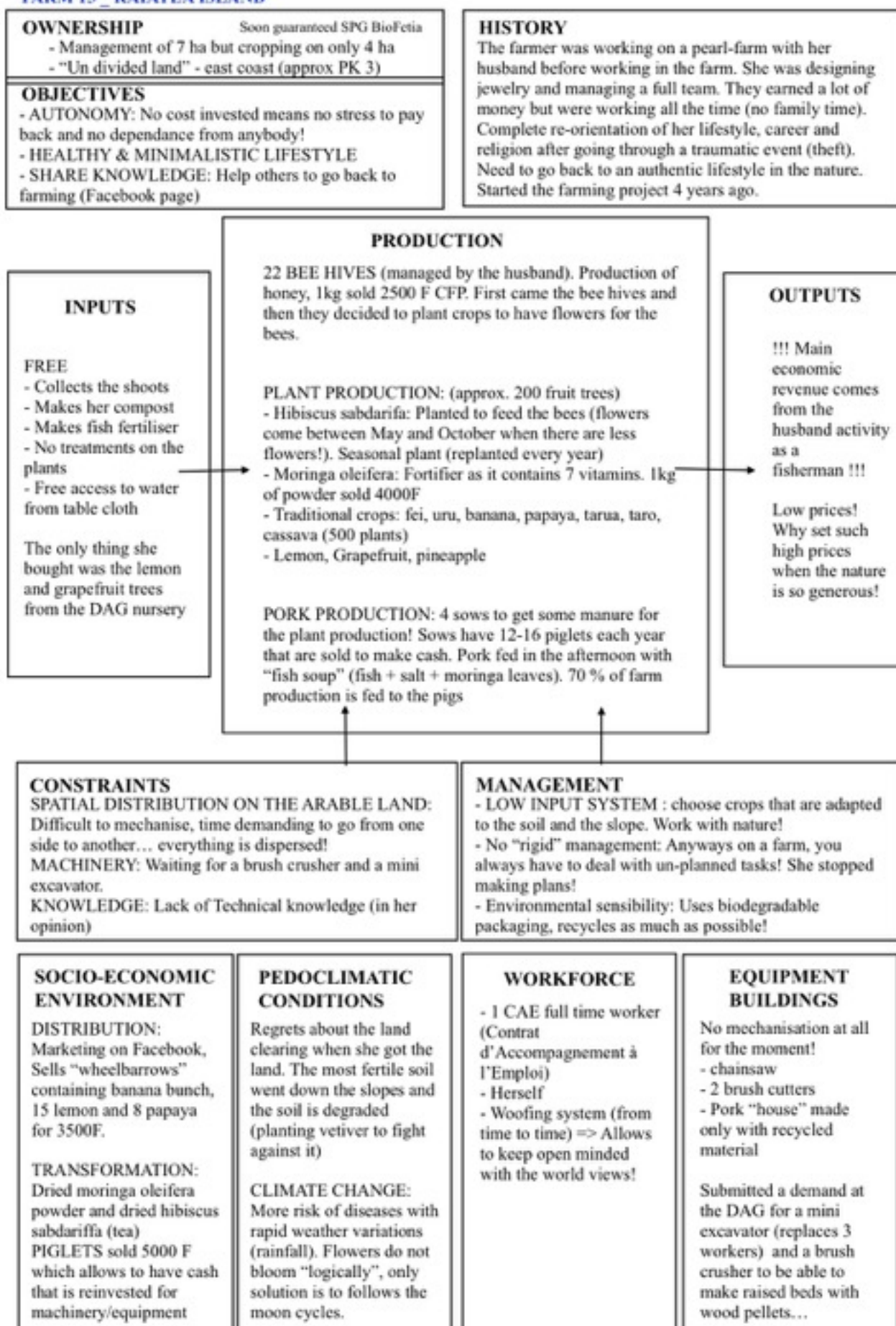
"As a farmer, I have to make by farm run as a business and I cannot afford to take risks. Furthermore, I believe the organic farmers nowadays in French Polynesia are lying. They do not know how a plant functions and they do not feed the plant in an appropriate way. They sometimes only give them compost and omit to feed them with potassium, oligo-elements and magnesium for example. The taste of these organic products is not good (sour taste of fruits for example showing the lack of potassium). What irritates me the most, is that they don't spend any money to buy the sufficient inputs that the plant needs to grow well, but they sell the organic products 3 to 4 times more expensive than my products!"

=> His objective would be to produce organically in a "proper" manner AND to be able to sell it to a price that is affordable for all. He does not want to produce vegetables only accessible to certain social classes.

New project?

He is waiting for the attribution of an agricultural lot (state lot) of 3 ha in the commune of Faoa. The land is relatively flat, which allows him to mechanise the plot. He would then be able to manage the weeds via mechanisation and/or mulch (plastic cover that he would re-use a couple times). He decided to plant sweet potato and ginger on the plot as these are plants that are cultivable organically in a tropical climate in the farmers' opinion. In addition, these crops are: (1) productive, (2) have good yields, and (3) are demanded by the consumers. They also have the great advantage of being "storable" in the soil for a couple months, which allows him to harvest consequently to the consumer demand.

FARM 15 _ RAIATEA ISLAND



FARM 15 _ RAIATEA ISLAND

Soil management

TILLAGE: Minimal soil work (just digging plantation holes). She realised she was compacting her soil when she was working with a pick in the soil. She regrets the way she approached her soil when arriving on the fields wanting to flatten it. Destruction of the Falcata forest led to soil erosion issues.

FERTILISATION

- Fish fertiliser: Stopped producing it because too complex (even though free access to fish from her husband)
- Algae fertiliser

SOIL AMENDMENTS

- Compost: cut grass + cut vedelia + pork manure + branches => mixed together and left to decompose for a week. She already sees that the first mushrooms arrive after one week which is the signal that compost is ready. She starts the process of fabrication of compost every 3 months (time intensive). She applies compost overall every 3 months.
- Hen droppings from a neighbour farm (free)

MANAGEMENT OF WATER AND WIND EROSION: she made a demand at the DAG for a mini excavator to allow to better manage the water drainage on the field. At the moment, the water is flowing at a certain spot, which is often saturated. She took the opportunity to install the taro at that specific spot.

IRRIGATION: free access to table water, the most valued resource on the land. She is waiting to receive a mini excavator to better manage the water canalisation system.

MULCHING: with vetiver at the base of the fruit trees to maintain soil humidity + source of nutrients

SOIL: Issues with the soil as the destruction of the Falcata forest led to erosion problems (planting vetiver to stabilise soil where there is important erosion)

Pest management

SPATIAL FARM ARRANGEMENT: "You have to arrange the type of crop with the type of soil. Today, everybody wants to produce vegetables but it is not adapted to our land." She installed the cassava where the soil is the most fertile.

3 levels of terrasses:

- Lowest level: Avocado, mangos, lemon. Best plot in terms of fertility (all the top soil from the cut forest came on the lowest plot, rich soil)
- Middle level: Grapefruit, Pork house
- Highest level: Hibiscus Sabdariffa (plus future project to build the farmer's house). This plant attracts the aphids and for that reason it must be "isolated" on the highest plateau.

MOON CYCLES: she sows 2 days before the new moon (impossible to follow advices like planting a crop in October...).

WEED MANAGEMENT : Before she was fighting against nature and then she realised that the weeds were working the soil for her (aeration). So she decreased time spent on weeding.

PEST MANAGEMENT: Rarely treats! She chose her entire system in order to plant only crops that do not require few treatments! She also has the impression that the more she spends time on the plants, the more problems they have! If she had to start from scratch, she would not have chosen to plant grapefruit for example.

- Sooty mold on the lemon and grapefruit trees, but when she treated (organic product) she did not see any improvement.
- Algae: collected from the sea after heavy wind (algae float on the water), she leaves the algae bags in the shade for one week and they compost. She then applies them on the plants that are attacked by the cochineal, as the salt kills the ants, that attract the aphids that attract the cochineal.

Information Inspired by a woman producing in Tahiti -> "Aroma Ohi bien-être et santé" that prepares juices with medicinal plants. Uses internet to get information! Often looks what is happening in Martinique and Reunion (as the nature is similar). Knowledge is easy to access today. Often visits the DAG to get some information.

Why Organic?

Even though using conventional products to treat is tempting (facility) she knows it destroys the soil fertility on the long run.

Main constraints of the management:

There are tons of plants growing around in French Polynesia, but impossible to identify them! She is looking for an alternative to the nettle fertiliser often used in France. Which plant growing in Raiatea could be used to substitute nettle for example?

FARM 16 _ RAIATEA ISLAND

OWNERSHIP

- 3-4 Agricultural lots of approx. 1 ha in FAROA (east coast) managed by the family

OBJECTIVES

- Not oriented towards any specific objective. (Potential future project: replace pineapple with noni production)

HISTORY

The family has been renting the same agricultural lot for the last 30 years, and today the 2 children in their late 20's are going to take over the farm. The daughter just started to farm in addition on her own agricultural lot. In total they grow on approx. 4ha. None of them followed any agricultural education but rather transmitted knowledge through generations. The mother works at the commune level (external income to the farming income).

INPUTS

- Complete fertiliser 12-12-17
 - Herbicide: Credit
 - Land rent: 10'000F/ha/year
 - Compost (from Avera commune) 10'000F a truck = lasts 4 months approx.
 - Fuel

FREE

- Shoots, seeds and cuttings collected directly on farm or EXCHANGED between farmers.

PRODUCTION

2 ha taro monoculture (Lower agricultural lot)

TARO monoculture production (non irrigated taro):
 - 3 varieties: Tuari, "Red taro", Rarotoa

FLOWER production:
 - Opuhi (red and white)
 - Auti

FRUIT production:
 - Pineapple
 - Lemon
 - Guava
 - Coconut
 - Dragon fruit
 - Star apple
 - Papaya (Hawaiï variety)

VEGETABLES & TRADITIONAL CROPS:
 - Sweet potato, 3 varieties (white, purple, orange)
 - Cassava
 - Banana
 - Ginger

1 ha polyculture (Upper agricultural lot)

OUTPUTS

TARO:
 - 50 kg/week sent to Bora Bora
 - 100 kg from time to time sold to make flour at the CAP (Agro-transformation, Raiatea)

CONSTRAINTS

KNOWLEDGE: Do not know anything about the soil, do not know the names of the weeds or diseases. Do not plan to make any changes. Self satisfied!
 MACHINERY: Would like a mini excavator! No mechanisation available on their land!!
 NEIGHBOURS: Issue concerning the land border with the neighbour.

MANAGEMENT

Mo + Th: Harvest
 Tu + We + Fr: Market sales
 Sunday = off → Church
 Every week (Monday): 500 plantation holes made for taro
 Every week (Friday): Plant the shoots collected

SOCIO-ECONOMIC ENVIRONMENT

DISTRIBUTION:
 - Uturoa market
 - On the road (farm site)
 - Delivery to shops (sometimes if extras)
 - Delivery of 100 kg of taro every week to the CAP

FLOWERS → Bora Bora and Tahiti market (high demand at the moment and stable price = reliable source of income)

PEDOCLIMATIC CONDITIONS

Different conditions on the two lot locations:
 ⇒ UPPER LOT = dry soil, sandy ≠ good for vegetables! → flowers, fruits, sweet potatoes...
 ⇒ LOWER LOT = hydromorphic land, saturated in water (in the plain) → Taro field

CLIMATE CHANGE PERCEPTION: Fresher winters & very rainy episodes between Nov.-Dec.

WORKFORCE

They work with the family (Father, son, daughter, husband and sometimes mother...) - Approximately. 4-5 people 100%.

EQUIPMENT BUILDINGS

- Crow bar (for taro holes)
 - Brush cutter
 - Rototiller
 - Shovels
 - Rotative sprinklers
 - Sprayers

FREE water access: If no more water from the river, they have to use the drinkable water (very expensive) but does not happen often.

FARM 16 RAIATEA ISLAND

Soil management

CROP ROTATION: no specific rotation. Designation of plots for certain crops and they maintain this way.

SOIL TILLAGE

- Taro field: not accessible with the rototiller! Only worked with the SHOVEL! No tillage!
- Upper field: superficial work with the rototiller (max 10-15 cm)

MANAGEMENT OF WIND & WATER EROSION: Does not seem to be problematic for the farmers. The upper lot shows important crop diversity and a good combination of shrubs and trees that form wind brakes.

FERTILISATION:

- Chemical : 12-12-17 - no details on when they apply it.
- Organic: Fish fertiliser: the father makes it (secret) they use the left overs from the fish they eat. No details

SOIL AMENDMENTS:

- Compost bought from the commune of Avera → Applied after they plant the crops.

FALLOW PERIOD:

- Taro: one cycle last approx 8-10 months. SO they leave the land covered with grass (fallow) for 2-4 months and start again. The commelina nudiflora is a "good" fallow cover. Before planting taro again they apply the CREDIT herbicide and then directly make new holes (distance between holes = "big step") with the crow bar.
- Non managed "fallow land" on the other plots, just a couple of weeks to periods of 2 months at its maximum.

SOIL ANALYSIS

Never did a soil analysis and the farmer has the incapacity to describe the soil, except that it was drying very quickly on the upper plot and that it is difficult to work on the lower plot.

SHOOTS and SEEDS: collected and re-planted directly

Pest management

SPATIAL FARM ARRANGEMENT:

- Land optimisation: Aui in the borders to use space.
- Opportunism: A lot of the plants produce shoots, and that's how they decide on the spacial configuration. If a shoot starts rooting, they leave it there. "Nature decides where it wants to grow".

PEST MANAGEMENT

- Lemon: clearly attacked by the sooty mold → nothing done against it. The farmer says the product against sooty mold is expensive, and they do not know anything about its use/effectivity...
- Taro: no treatments at all → no visible traces of diseases or pests.
- Opuhi: the opuhi attacked by BBTV is cut. Apparently no transmission to the healthy opuhi. They preventively have to take good care of the flowers and take out all the weeds to avoid BBTV outbreaks.

WEED MANAGEMENT

- Chemical before planting the new crop: spray a total weed killer → CREDIT
- Mechanical after planting: weed by hand, with a knife or with the brush cutter (depending on the plant)

Problem statements

- "Taro sometimes rots in the soil" => no hypothesis explaining this.
- In the past, they tried to grow vegetables (salads, green beans, eggplant...), and it did not work well. Why?

Opinion about organic

"It is good to promote a healthier production method, for our sons and our daughters but sometimes I get irritated. In organic farming, you have to sleep next to your plants! It is easy for politicians to promote organic, when they are not the ones working in the fields. Everything is extremely time consuming in organic!"

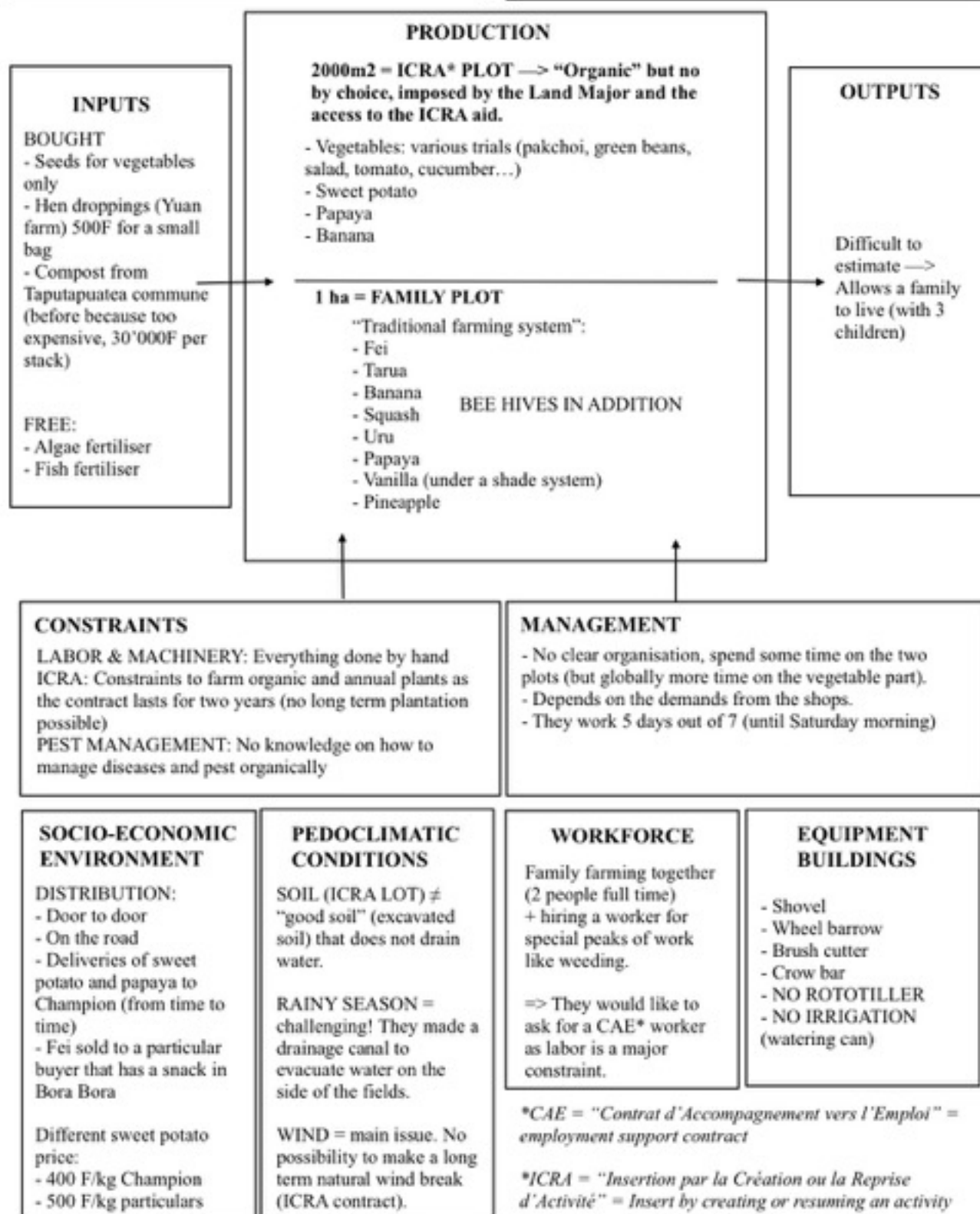
FARM 17_ RAIATEA ISLAND

OWNERSHIP PK 40 east coast
 - 2000 m2 approx. land contract for 2 years "ICRA"
 = aid from the state to start a business "Insertion par la
 Création ou la Reprise d'Activité"
 - 1 ha approx. private family land

OBJECTIVES
 - Produce noni instead of vegetables → less work,
 harvest every 2 months, and they do not manage
 technically vegetables!

HISTORY

The couple of farmers come from a farming background.
 They never followed any education but learned by doing
 and seeing. They have got access to land via a "ICRA"
 land thanks to the land Mayor, that set up the demand for
 them. However, they were imposed to produce
 organically to access the ICRA plot, when they are not
 really capable technically, being traditional farmers that
 have very little education.



FARM 17 _ RAIATEA ISLAND

Soil management

CROP ROTATION: They try to inverse between sweet potato and the other vegetable they produce, but without following any clear rotation.

SOIL TILLAGE: After harvest, they weed by hand to take out the residues of organic matter. Usually they add some algae fertiliser on the soil (only the vegetables fields) and they mix everything with a shovel as they do not possess a rototiller = very superficial tillage. They leave the soil with the algae a couple days "to leave time to the salty algae to decompose". And then they make new mounds and they sow by hand on the mounds.

FERTILISATION

- Algae fertiliser: they fetch algae from the ocean and place them in a barrel with water, left closed for a week (fermentation) —> Application approx 2 times per month (very strong —> "When you mix it with water, it makes bubbles, and you see it can burn the plants if the doses is too important")

- Fish fertiliser: fish bones kept from their own consumption that are left to ferment in a barrel (no indication of time length and procedure)

SOIL AMENDMENTS

- Hen droppings: they put the droppings in a barrel with water to allow dilution (kept for 3 days) and then they use the mixture to water the vegetables (except the sweet potato/papaya/banana) once per week (they water in the evening).

- Compost -> not bought anymore => it was too expensive.

FALLOW PERIOD: Apparently, they leave one month of fallow to allow the land to rest a little. Destruction of the field with the brush cutter, then they usually burn the weeds on the side, and reintegrate the coal on the fields ("sort of compost" as says the mother) => USE OF FIRE

SOIL: No knowledge about the soil quality/acidity only a qualitative understanding: "difficult to work when wet and rocky."

IRRIGATION: No irrigation system -> takes a lot of time to water with a watering can

Pest management

SPATIAL FARM ARRANGEMENT

No special arrangement —> No guarantee of land tenure = clear brake. They were saying that they would have liked to make a noni tree wind break alley to protect the papaya from wind destruction...

PEST MANAGEMENT

They do not treat chemically as it is not allowed on this area by the major, but not knowing the alternative treatments options, they do not do anything. Therefore, they have many problems to manage the insects on their plot. The first year, they were able to harvest, but very quickly, at the second or third harvest => all the production was attacked by insects. They did not manage their system well because do not have the knowledge to produce vegetables organically. The fertilisation may have also been inappropriate, the choice of varieties as well. The farmer explained he buys the seeds at the shop not knowing at all which ones he chooses. They do not have any clear rotation system, neither a specific fallow period. Bad management of the weeds (risks of getting germination of weeds everywhere). Pressure on the soil was too big after a first year of vegetable farming therefore, at the second year, no vegetables are growing anymore.

WEED MANAGEMENT

They told me they leave some grass between the vegetable mounds to "feed" the insects and avoid that they all attack the cultivated crops, but during the visit I did not see any grass.

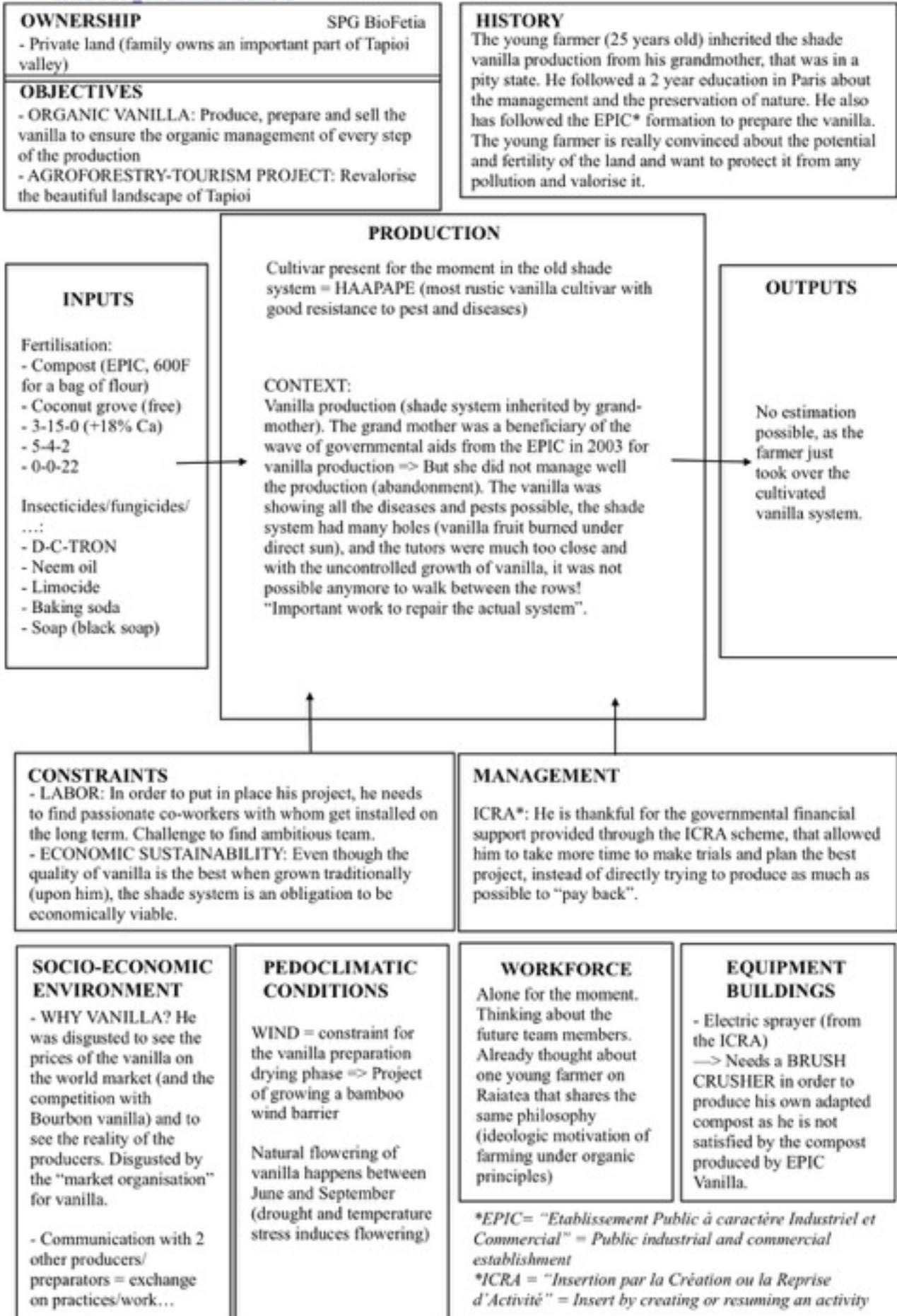
Problem statement

Clear lack of knowledge to produce vegetables organically without any machinery and knowledge about vegetable farming. The knowledge they have was inherited by their farmer parents but often they are not able to explain why they do a certain practice.

Main constraints of the new management

Clear lack of knowledge about farming. We can see that they have heard of the "organic concepts" from the discourse of the Land Mayor and so on, but they do not technically manage these concepts. Therefore, the system cannot work! In comparison, the field that is managed traditionally seems much more "organic".

FARM 18 RAIATEA ISLAND



FARM 18 _ RAIATEA ISLAND

Soil management

FERTILISATION: Organic

- 3-15-0 (+18% Ca) : applied just before the flowering in June normally (need of potassium)
 - 5-4-2 "Down to earth": applied when the buds appear (approx. in March)
 - 0-0-22: Phosphate needed to make fruits → applied after he married the flowers (July usually) to give power to the fruit. Slow assimilation of this fertiliser.
- Important that the vanilla is in direct contact with the soil, as the vanilla gets its fertility by the activity of a mycorrhizae. Without any contact with the soil, there will not be enough bacteria activity → no nutrients.

SOIL AMENDMENTS: compost applied from EPIC VANILLA

GREEN COVER

Clover naturally took place in the shade system, he has just been selecting it since 1.5 years by weeding all the other plants. He believes it is a good plant to add nitrogen stock and to decrease temperature change at the foot of the plant (apparently vanilla likes stable temperatures).

Pest management

Preventive approach → he sprays Neem oil only 2 times per month during flowering period (June→Sept.) and Limocide only once per month.

- D-C-TRON: Product that improves the fixation of the other products on the plant
- NEEM OIL: Insect repellent → makes a shiny layer on the leaf (not authorised under organic regulation in EU, VS the other organic regulations in the world)
- LIMOCIDE: Management of caterpillars and cochineals
- BAKING SODA: Induces a variation in the acidity of the environment which troubles fungus attacks. Applied usually after an important rainfall to avoid the development of fungi. Not systematically applied.
- BLACK SOAP: To fight against cochineal and to fix better the baking soda on the plant

Future project 1 : agroforestry and agrotourism

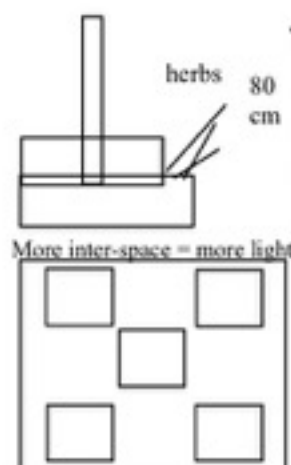
Mixed farming system: Small animals (rabbits, quails) and fruit tree of all types to make an "edible forest" ecosystem. Sell the fruit on the farm site directly (to make the most value out of it). The co-workers should be working half time on the farm and half time somewhere else (to maintain passion and to ensure that they do not rely solely on farming income).

"Agrotourism": People are already hiking up the Tapioi trail. Potentially, deviate the hikers from their route to attract them on the farm site and make visits, education signs and sell farm products. Create touristic circuits for the Cruise tourists. Leave the circuit open for the local. It must stay accessible to all.

Future project 2 : vanilla production → 6 units of 280 m² with two liana per tutor

First of all, the farmer wants to improve his technical skills by training on the old shade vanilla he inherited. He will need approx. 3 years to become more productive in this shade system. Seeks the AB label Bio Eco Cert as it is the most constraining (the best).

- Installation of the vanilla on natural tutors (colon made of coconut grove) → studies showing particulars of concrete in the vanilla growing on concrete tutors.
- Personal square pro vanilla tutor to improve the management, optimise surface use, and decrease the risk of disease contamination (follows the recommendations given by a CIRAD study in the 2000's). Renew the tutor every 15 years (so install 6 shade systems, one every year to be able to manage to renew them one after the other).
- Display: First compartment, aromatic plants playing the role of a 100% natural insect repellent (Rosmarin, Sage, Lemon grass and Pepper) and will also absorb partly the humus (avoid a too rich environment and the proliferation of mushrooms). Second compartment = compost compartment.
- 3 Cultivars per shade system: Tahiti (from Huahine), Haapape, a local vanilla from Tahaa'a island. Connection between the vanilla and the soil to increase the mycorrhizaa activity.
- Compost: coconut grove + crushed Falcata → it is a legume and apparently wood pellets contain nitrogen
- Cover = clover grass or Alfalfa
- Fertilisation & amendments: algae fertiliser, fish fertiliser and self made compost



FARM 19_TAHAA'A ISLAND

OWNERSHIP

- Renting 4 agricultural lots of 1 ha
- Coconut field managed by a community (Fenua feti'i)

OBJECTIVES

- MARKET ORIENTED: he wants to make some money (hard worker). "Organic does not allow to make money."
- AGROTRANSFORMATION: to add value to products and be able to store them (boat trips + year long)

HISTORY

The farmer comes from a farming background, but he did not follow any agricultural education. He took over land with his father and then he decided to follow a 6 months education for adults (CFPPA*) given by the DAG in 2005 and at the same time he asked for access to an agricultural lot. He obtained his lot in 2006 and now, he farms on 4 lots which shows his progression. Today, he has the desire to get into agro-transformation.

INPUTS

- Complete fertiliser 12-12-17
- Organic insecticide "Summer oil" (white oil type parafine)
- Herbicide (Glyphosate)
- Rent for machinery (mini excavator)
- Rent for land

PRODUCTION

FRUIT AND VEGETABLE PRODUCTION

- Papaya (solo and red lady)
- Ginger ("chinese variety")
- Lemon (Taporo Tahiti)
- Orange (Valencia)
- Mandarine (Potoru variety from Tahaa)
- Squash → came naturally

TRADITIONAL CROPS:

- Banana (Hamo-Rio variety = hybrid variety that is productive and has a good tolerance to transport, does not ripe too quickly, so it is an advantage as he exports to Tahiti)
- Uru (variety MAFALA coming from Wallis producing out of season = advantage and gluten-free, 100F/kg, supports well the boat transport)
- Coconut (hybrid dwarf variety)
- Ape → came naturally

COPRAH production:

Approx. income = 50'000F every 3 months
Managed by the community that makes shifts to harvest the coconut (called FENUA FETI'I = "non divided" land)

OUTPUTS

Important volumes in the future when all the trees will be producing as he just started planting them!

2 tons/week papaya for the first 3 years (then you have to replant a new Papaya "tree")

CONSTRAINTS

LABOR not sufficient workers (avoid paying wages) for all the hand labor that has to be done (little machinery)
MACHINERY he wants to achieve a mini excavator to make hole more easily for the fruit trees...
CREDITS difficult to get some financial help with the banks as they do not trust the farmers!
NON DIVIDED LAND problems on the island of Tahaa'a regarding the management of coconut...

MANAGEMENT

- Tuesday and Thursday = deliveries to the cargo for Tahiti
- Other days: harvest/weed/plant
- The farmer's wife is getting ready to take over with the agrotransformation
- Washing structure at the farmer's house
- Constantly renewing his system: planting new trees to maintain a similar volume of production all the time

SOCIO-ECONOMIC ENVIRONMENT

DISTRIBUTION:
- Comptoir Cecile in Tahiti
Challenging to work with them as they want regularity and volumes but constant demand
- Gross retailers (Tahiti)
- Sells to Cruise Boats
- Agricultural Fairs
- On the road

Problems of jealousy with the neighbour farmers as he has achieved the right to farm on 4 lots on some of them would like the same

PEDOCLIMATIC CONDITIONS

- SOIL: The soil in the valley is fertile, there is no issues with stagnating water as there is also some rocks (which is good for the citrus, reason why he chose this plant family)

- RAIN: Jan-Feb-Mar = rainy season & heavy winds that destroy the Papaya fields. He tries to make natural wind barriers.

- SLOPE: Important slope on one of the agricultural lots = challenge for tractor

WORKFORCE

Approx.: 3 workers full time
→ 1 CAE + him + sometimes his wife + sometimes daily workers during working peaks (to plant or to weed)

EQUIPMENT BUILDINGS

- No irrigation available
- Crow bar
- Sprayer (for glyphosate)
- Brush cutter

DEMAND FOR AID:
- Field excavator (10t)
- Transformation units for coconut oil, make "fruit puree", jams in order to distribute to school canteens.

*CFPPA = "Centre de Formation Professionnel et de Promotion Agricole" = Training and Agricultural Promotion center

FARM 19_ TAHAA'A ISLAND

Soil management

FERTILISATION

The only fertilisation he uses is complete fertiliser applied only once in the life cycle of a crop at the moment of plantation. That means he digs a hole for the fruit tree and applies the fertiliser at the bottom. He says that "the soil is sufficiently fertile to ensure enough nutrients for the plant after plantation." Complete fertiliser is expensive, which is an extra reason to avoid using too much of it.

SOIL ANALYSIS

He says that the analysis of the colour says enough about the quality of the soil: "if it is red it means it contains a lot of clay. If it is black, it means it is rich." The rocks in the soil are good for the growth of citrus plants, that's why he decided to grow oranges, mandarines and lemons. Approx. 170 lemon trees planted!

PLANT REPRODUCTION

By layering especially rather than with cuttings as it saves time! He selects the best productive papaya tree and he layers it to plant it on another field. Grafted trees take more time to grow, so he prefers layering.

IRRIGATION: No irrigation available => forces to choose adapted crops

Pest management

FARM SPATIAL ORGANISATION

The agricultural lot the most exposed to wind (closest to the shore) has a special spatial disposition: sugar cane in the front (not too much attacked by the crabs). He wanted to put taro but too much damages by crabs. Then he installed coconut trees around the plot as a wind barrier and in the middle of the lot he installed lemon trees.

On one of the agricultural lots consists of a steep slope => he installed a ginger plantation on this agricultural lot as ginger does not need so much water (draining plot).

PEST MANAGEMENT: Organic management

- Fruit flies: harvest the papaya fruit BEFORE it is too ripe (then it is attacked by the fruit flies). And as he sells to boats, it is better to harvest when the fruits starts to show yellowish colours.
- Mosaic, Gomose, Sooty mold: "Leave the nature ! It will resorb naturally! The tree will fight on its own."
- Varieties: he chooses varieties that show a certain rusticity —> locally adapted
- "Summer oil" used on lemon trees —> mineral oil allowed in organic farming in the Pacific. Depending on the doses used it inhibits the growth of insect eggs, it allows to destroy the sooty mold and finally it allows to fix better other products (fixator agent)

WEED MANAGEMENT

- Chemical: Glyphosate sprayed once per month everywhere between the trees/crops. It is sprayed rather early in the morning when there is no wind and it depends on the weather (avoid spraying if it will rain). The farmer explains it is better to do it often when the grass is still short. Otherwise, it forces you to lift the sprayer higher and that is when there are risks of breathing glyphosate if the wind comes in at the same time. To protect the workers health, it is better to apply glyphosate when grass is short. After spraying on a plot, avoid to enter the plot for the next 5 days. He tries not to use too much of it, because it is also very expensive!
 - Mechanical: Brush cutter or by hand directly around the crop/tree (papaya tree or ginger).
- Weeding of the ginger = 100% by hand —> for that reason he needs to employ extra workers.

Opinion about organic

"Organic farming is good for one self, but you cannot earn some money farming like that. I farm organically for my small vegetable plot using hen droppings, but for my farm production, I prefer first to make some money and then we will see, maybe I could invest in a better system (machinery needed, more expensive products...)."

His future project

- AGRO-TRANSFORMATION: Transform his products, as it enables him to manage the surplus (1/10th of the production that is lost today). Make mashed puree and sell to tourists visiting Tahaa'a and school canteens.
- PRODUCE COCONUT OIL: Once the coconut trees will become big enough and start producing, he will stop producing papaya on the same plot. Papaya allowed to have a source of revenue for the first 3 years of growth of the coconut trees. Then he wants to make some extra virgin coconut oil and to sell the coconut water. The project should take place in approx. 2 years!



FARM 20 _ RAIATEA ISLAND

OWNERSHIP

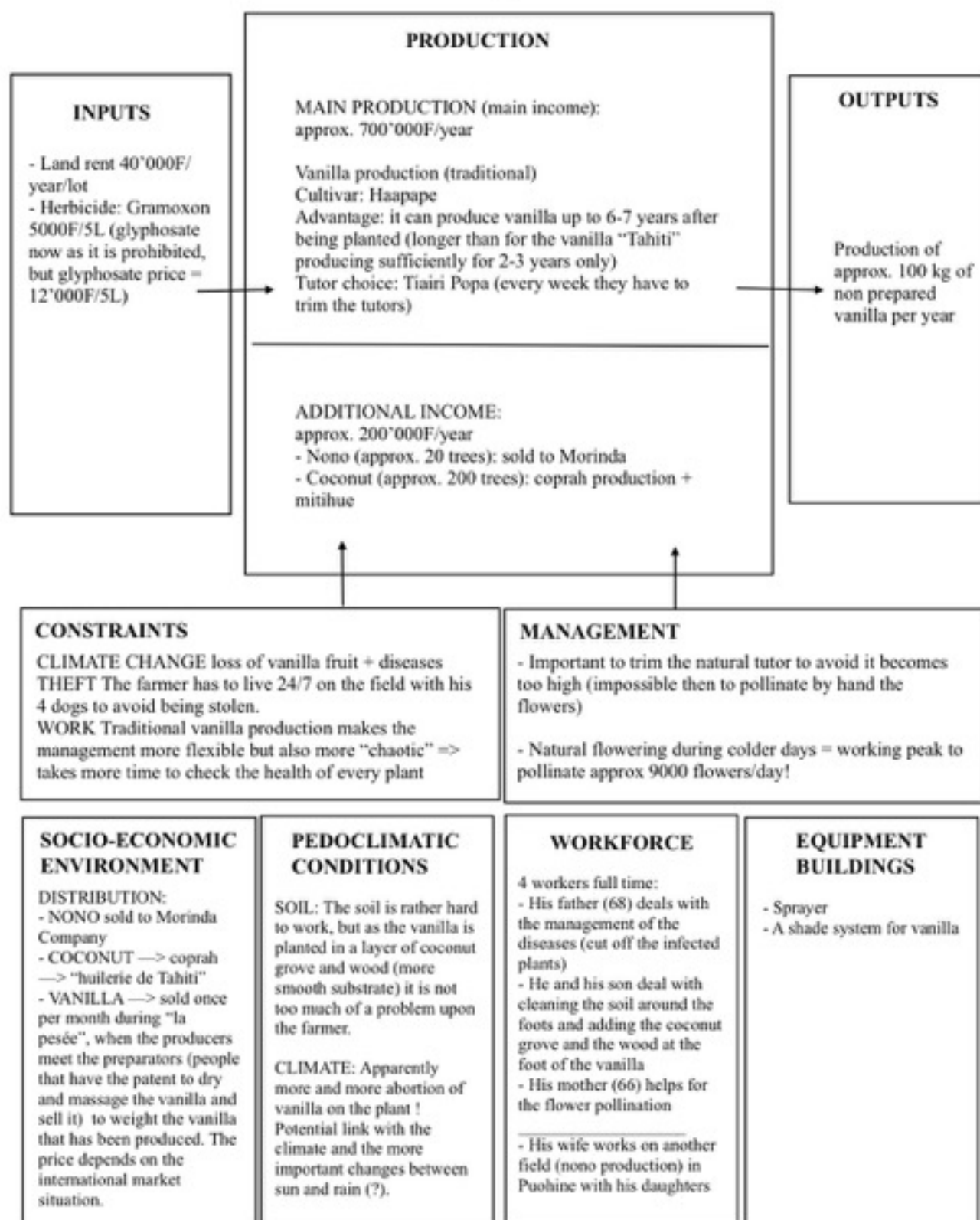
- Renting 2 agricultural lots (4 ha in total) in Faaroa

OBJECTIVES

- PASSION of vanilla transmitted from father to son
- GO ORGANIC: produce, prepare the vanilla and sell it to France under the organic French label

HISTORY

The farmer is farming with his parents, traditional vanilla producers. He will take over the production once they are gone. They have the real passion of vanilla. The three children of the farmer also work on the farm site and they are thinking of doing the education to become preparators ("Onas") and sell the vanilla themselves!



FARM 20 _ RAIATEA ISLAND

Soil management

SOIL AMENDMENTS

Only coconut grove (coming from their own production) and wood (any type). Sufficient to feed the vanilla! "If you use some mineral fertilisers, it can burn the plant as it is too strong."

SOIL ANALYSIS

No soil analysis. Qualitative description: The soil is red and rather hard to work with (not more indication given about the soil), but the vanilla is taking root in the coconut grove and chopped wood, which is a much better substrate for vanilla to grow on.

He will have to renew the 5 year old plots in 2 years approx. (Haapape variety)

5 years old
2000 plants

1.5 years old
3000 plants
no diseases yet!

5 years old
2000 plants

Pest management

PEST MANAGEMENT

- No chemical treatments used! Diseases will naturally be dealt with the balance of nature. At the beginning of the production, he was treating the vanilla but he did not see any results, especially for the main problem of the loss of the fruit (fruit abortion).
- Traditional way of cultivating vanilla: The father of the farmer produces vanilla in the shade system and in the traditional system. He prefers the traditional cultivation as it allows to have more flexibility of management of the system. The trimming of the tutor can adapt to a very local need of more shade/sun and if one liana is sick, you can much more easily react as everything is "removable" in comparison to a shade system with concrete tutors. The contamination of disease is more rapid under a shade system.
- Bird and mosquito management: He ties blue plastic bags in different locations. The noise of plastic when there is wind distracts the birds. He wants to try to put CDs as well around the plot.

WEED MANAGEMENT

Chemical management => They use the rests of Gramoxon to weed in the alley (weed by hand in direct proximity to the plant), but once they finished the bottle they will buy glyphosate. They prefer using Gramoxon as the price is much lower (but the use of Gramoxon is prohibited today).

Future project

The farmer will take over the totality of the vanilla production once his father is too old. He still has to learn all the secrets from his father that has been producing vanilla for the past 50 years! Real passion about it. He wants his two daughters to subscribe to the EPIC education to become a "patented" vanilla preparator. In that way, they will be able to prepare their own vanilla and to export it directly to France, as the farmer's brother lives in France (works in the army). As they produce their vanilla under organic ways except for the management of weeds in the alleys, he would like to sell it under the organic label.

