

VANUATU

MISSION D'ASSISTANCE TECHNIQUE - IAC

Filière arboriculture fruitière : Stratégie et actions de développement,

Conseils aux techniciens et aux producteurs



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SUMMARY

1. SOME REMINDERS ABOUT VANUATU

- 1.1. Geographical situation**
- 1.2. Principal climatic characteristics**
- 1.3. The soils**
- 1.4. Population**

2. SITUATION OF FRUIT PRODUCTION IN VANUATU

3. MAIN CONSTRAINTS LIMITING FRUIT TREE CULTIVATION IN VANUATU

- 3.1. Natural environmental factors**
- 3.2. Low production of planting material**
- 3.3. Technical constraints**

4. PROPOSALS FOR DEVELOPMENT OF FRUIT PRODUCTION IN VANUATU

- 4.1. Plant material propagation and production**
- 4.2. Demonstrative orchards**
- 4.3. Assistance to improve the traditional farming systems**
- 4.4. Investigation about existing planting material**

5. FUTURE PROSPECTS - CONCLUSION

- 5.1. Practical basic workplan**
- 5.2. Human resources - recommendations**
- 5.3. Conclusion**

REFERENCES

APPENDIX

SOME REMINDERS ABOUT VANUATU

1.1. Geographical situation

Vanuatu, an archipelago consisting of 13 principal islands and 60 secondary islands, spreads from the 13th to the 21st parallel south and covers an area of 12,050 km² in the Pacific Ocean.

The capital, Port-Vila, located on Efate island, is 530 km north-east of Nouméa, New Caledonia.

1.2. Principal climatic characteristics (Atlas Quantin)

The climate of the archipelago is tropical, characterized by an average annual rainfall of 1,600 to 3,000 mm and an average temperature of 23°C to 26°C. Nevertheless, it is important to note the significant variations in the midst of the archipelago from one year to the next, due to the north-south gradient.

On the other hand, each island has three distinct weather areas, corresponding to the effects of trade winds and altitude.

- Zone #1, predominant to the windward, on low altitude side, is subjected to a regularly warm and wet climate of equatorial type.
- Zone #2, on the leeward side, is affected by a tropical climate with a short dry season.
- Zone #3, located on summits, has a cooler and constantly humid climate.

The amplitude of the stated main and local variations has a natural influence on the choice of the fruit tree species and the cultivation systems which will be proposed.

1.3. The soils (Atlas Quantin)

The soils of the archipelago are, for the most part, extremely fertile. About 40 % (average) of the surfaces are suitable for cultivation (65 % to 78 % in Efate, 22 % to 52 % in Erromango, 10 % to 30 % in Anatom - Futuna).

The main islands (Santo, Malekula, and Efate) are widely made up of soils little changed by erosion, saturated at low altitude and covered by forest or dense vegetation. The coastal zone covered with coconut plantations (cattle breeding area too) is on calcareous brown soils derived from coral deposits. Smallholder farmers' gardens are mainly located in dense and fertile alluvial plains.

1.4. Population

Vanuatu population is 234,000 (2009), with a large proportion of young people: over 33 % of the population is aged under 15 years.

The main part of the people (over 75 %) lives in rural areas where cropping the Melanesian garden is the main activity (cassava, yam, taro, sweet potato, banana, kava), in association

with vegetable crops and fruit trees (papaya, pummelo, grapefruit, lemon, avocados, soursop, breadfruit, nangae, naus), as well as nut trees (nangai, navele) and spices vanilla and pepper, that can be traded in Port Vila and Luganville markets (the main centres of activities). Commercial crops are grown according to agro climatic areas (i.e. coconut, cocoa in the northern region, and coffee, in the south). The rate of population living in the urban areas reaches 25 %.

The total population is growing at a rate of 1.5 % annually, projecting 300,000 inhabitants in 2025. Another projection at a growth rate of 2.6 % annually makes Vanuatu reach to 420,000 inhabitants in 2029 (http://fr.wikipedia.org/wiki/D%C3%A9mographie_du_Vanuatu).

Tourism sector is becoming more attractive, ranging 49,000 visitors in 2002 to 101,000 tourists in 2009 (167,000 in 2007), two-thirds of them coming from Australia (ISEE NC, 2010), and 166.000 tourists en 2007 (81.000 air flight, 86.000 boat cruise) (Boudart *et al.*).

2. SITUATION OF FRUIT PRODUCTION IN VANUATU

The main part of fruit tree production in Vanuatu comes from family gardens / smallholders and is, in fact, mostly considered as a product of “picking”.

The production periods of the principal fruit tree species are described in the following table.

Production calendar of the principal fruit tree species in Vanuatu (Fullerton *et al.*).

Month	1	2	3	4	5	6	7	8	9	10	11	12
Pineapple												
Tropical raspberry												
Mango												
Citrus :												
Orange												
Pummelo												
Lime												
Papaya												
Avocado												
Passion fruit												
Guava												
Banana (dessert, cooking)												
Soursop												
Breadfruit												
Carambola												
Custard apple												

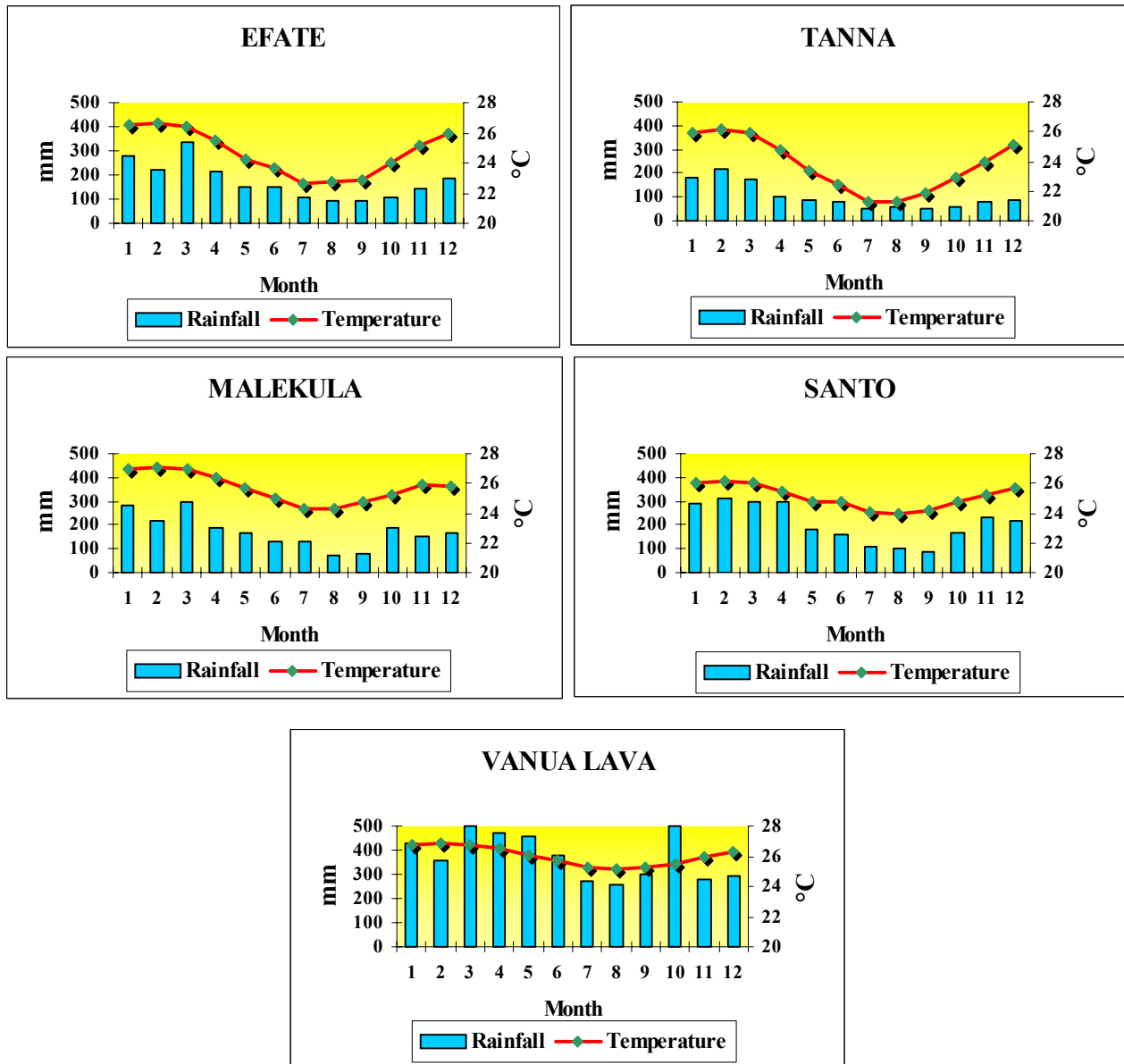
This table shows that, excluding cyclonic disturbances:

- There is a quasi-regular supply of soursops, bananas, papayas, pummelos, limes and pineapples, but intermittent and seasonal for guavas, mangoes, avocados, orange, carambola, custard apple, breadfruit and raspberry.
- Generally, the quality of papayas, pummelos, small limes and pineapples produced is good. On the other hand, the quality of bananas has to be improved. At least, the productivity appears to vary according to the different crops.
- No appropriate packaging is used.
- There is also a weak organisation for supplying markets (collection, processing and transport), and even a no production in some islands.

3. MAIN CONSTRAINTS LIMITING FRUIT TREE CULTIVATION IN VANUATU

Due to the length of the study (5 days), it is difficult to understand, in depth, the overall factors leading to the low development of fruit crops in Vanuatu. Nevertheless, with experience, it is possible to distinguish some factors in which it would be more or less easy to act.

3.1. Natural environmental factors (Fullerton et al.).



The climate and soils are globally highly favourable for most of the tropical fruit crops, but some weaknesses must be noticed.

- A strong irregularity in the quantity and the distribution of rain could necessitate irrigation due to insufficient rainfall. The lack of irrigation is sometimes responsible of

low productivity. On the other hand, areas subjected (or not) to trade winds or altitude can be especially dedicated to a fruit crop particularly adapted to the local situation (citrus in cool conditions for natural coloration, high juice and sugar contents; mango in dry areas during the flowering and fruiting season).

- The soils have an alkaline trend and are rich in active lime. It could lead to blockages of magnesium, iron, manganese, etc. with, consequently, physiological growth anomalies (see tables below). These alkaline soils can make pineapple plants more sensitive to Phytophthora and can influence the choice of rootstocks for some perennial species. But the overall situation is highly favourable for tropical fruit crops.

Soil analysis at Tagabe Research Station

	Average values	Found values	Comment	Targeted values
Grain size distribution (%)				
Clay (<2µm)		27.07		
Fine loam (2µm<FL<20µm)		16.58		
Coarse loam (20µm<CL<50µm)		17.16		
Fine sand (50µm<FS<200µm)		30.4		
Coarse sand (200µm<CS<2000µm)		8.18		
Water pH	5.5 – 6.5	6.4		
Organic matter (%)	3 – 5	2.07	Low	3
Carbon (%)	20 – 30	12.01	Low	20
Phosphorus available (Truog, ppm P2O5)		31	Low	120
Exchangeable base				
calcium (meq Ca ²⁺ /100g)	80 – 90 % C.E.C.	13.43	High	11.4
magnesium (meq Mg ²⁺ /100g)	8 – 10 % C.E.C.	1.88	Excess	1.3
sodium (meq Na ⁺ /100g)	< 1 % C.E.C.	0.29	Possible problems	0.14
potassium (meq K ⁺ /100g)	2 – 5 % C.E.C.	0.3	Medium	0.7
Exchange capacity (C.E.C., meq/100g)		13.61	Medium	
Field capacity / 10cm of soil (mm)	15 mm / 10 cm	10.6		

Soil analysis at Vanuatu Organics Ltd (Montmartre/Lololima area)

	Average values	Found values	Comment	Targeted values
Grain size distribution (%)				
Clay (<2µm)		n.a.		
Fine loam (2µm<FL<20µm)		n.a.		
Coarse loam (20µm<CL<50µm)		n.a.		
Fine sand (50µm<FS<200µm)		n.a.		
Coarse sand (200µm<CS<2000µm)		n.a.		
Water pH	5.5 – 6.5	5.9		
Organic matter (%)	3 – 5	7.4	High	3
Carbon (%)	20 – 30	n.a.		20
Phosphorus (Olsen, ppm P2O5)		18	Low	
Exchangeable base				
calcium (meq Ca ²⁺ /100g)	80 – 90 % C.E.C.	19.6	High	28.6
magnesium (meq Mg ²⁺ /100g)	8 – 10 % C.E.C.	4.49	Excess	3.4
sodium (meq Na ⁺ /100g)	< 1 % C.E.C.	0.2	OK	0.3
potassium (meq K ⁺ /100g)	2 – 5 % C.E.C.	1.18	Medium	1.7
Exchange capacity (C.E.C., meq/100g)		34	High	
Field capacity / 10cm of soil (mm)	15 mm / 10 cm	n.a.		
n.a.: not available				

- Frequent and sometimes violent cyclones between the end of December and April are responsible of serious damages to fruit crops, especially for trees.
- There is a parasitical threat, but not yet serious, due to a close relation with stable traditional crop systems (no use of pesticides).

However, an exceptional vigilance has to be taken for some diseases such as:

- black leaf streak disease of bananas,
- Phytophthora of pineapples,
- psorosis, greening, Tristeza of citrus trees,
- anthracnosis of mango trees,
- virus diseases of papaya trees,

and for some pests such as:

- banana weevil borer (omnipresent),
- citrus scales and mites,
- fruit piercing moth,
- fruit flies.

Smallholders in Vanuatu are not used to fight against these pests and diseases with appropriate pesticides.

A detailed enquiry has to be made in order to verify the presence or absence of serious pests and diseases, as well as their vectors which could, in an intensive system or in the case of an introduction of selected varieties, become prohibitive. These constraints are **Tristeza, Greening, Citrus canker, Mango bacterial black spot, Fruit flies**, etc. Statements according to the identifications of pests and diseases have to be recorded in the Pest List Database of Vanuatu (management / coordination by the Pacific Community for all Pacific countries), with the assistance of the Applied Entomology Laboratory of Pocquereux Fruit Research Station, if needed.

3.2. Fruit material

Tagabe Research Station is able to provide fruit plants from its budwood orchard and nursery, with some citrus and avocado cultivars, or on collaboration with Pocquereux Fruit Research Station for new introductions, as we are used with for years. These old collections are close to Bauerfield airport. In order to avoid possible introduction of new pests and/or diseases from abroad, that could contaminate the material to supply, it is considered the setting up of new fruit trees collections that could take place on the site of the new Chamber of Agriculture (15mn from Port Vila), far from the airport, and in Santo (VARTC).

Many fruit trees have been recorded in Vanuatu, and different species, of alimentary and commercial interest, located in some private collections, could be available for propagation, but are not yet commercialised in relation with needs.

On the other hand, the important local resource is not very well known (excepting breadfruit) and has to be prospected and characterised for transfer towards fruit growers (fruit diversification).

It is necessary to introduce a new range of known plant material including cultivars in perfect sanitary statement, in order to improve the production, further more if exportation or processing is targeted.

An effort has to be done in order to promote private nurseries among the archipelago in relation with assistance for propagation techniques that are not yet mastered. For example, the traditional efficient way to propagate citrus by air-layering is already used, despite of the risk of diffusion of viral diseases.

A work plan, which does not exist at the moment, has to be established with extension services in order to coordinate the supplying of high quality fruit trees, from the nursery to the fruit grower, including development of local resources.

3.3. Technical constraints

The major part of the fruit production comes from traditional farming system linked to peculiar practices and local customs of Melanesian society.

These traditions have to be taken into consideration because intensification of fruit production leads to make choices and compromises to develop cash crops by developing more intensive tree farming systems.

Besides these considerations, it is important to underline that there is a huge lack of technical training in horticultural practices: even if a team of four technicians provides extension services in Efate, dedicated to fruit crops, they cannot be relayed in other islands because it seems that there is no technician specialized in fruit crops. A considerable effort in training has to be done in relation with the access to means and knowledge for fruit plant propagation and orchard management.

The implementation of a development and research project for support would lead to eliminate these limiting factors and could technically consist in:

- Introducing and studying the behaviour of producing plant material which would satisfy the needs already identified,
- Prospecting and characterising local fruit resource for further supply to fruit growers (plants) and consumers (fruits),
- Creating plant propagation structures (nurseries),
- Training for trainers and smallholders / farmers.

4. PROPOSALS FOR DEVELOPMENT OF FRUIT PRODUCTION IN VANUATU

Objectives to be reached in the next years:

- To improve food security through increase of fruit production and supply (increase of the local consumption when rural populations are far from the markets),
- To reach self-sufficiency of fresh fruits (substitution of the imports of fresh fruits),
- To produce fruits targeting local processing and value addition for both domestic and export markets: purees, juices, dehydrated fruits, ice-creams / sorbets, jams, dried nuts,
- To produce targeting “niche export markets” (processed fruits and nuts for New Caledonian market, Tahiti limes for New-Zealand, essential aromatic oils for global export),
- dried nuts could be certified organic crops such as some spices (labelled vanilla, chillies, pepper, ginger),
- To develop *ad hoc* quarantine protocols between Vanuatu and New Caledonia for the introduction of planting material and export of fruit (to NC).

These objectives will be reached if some conditions are realized:

- To disseminate high quality planting material over the whole archipelago, where environmental factors are favourable, and in accordance to local needs,
- To establish demonstrative orchards in the main islands allowing farmers to evaluate the feasibility of their investment project and the adaptability of fruit crops to their farming system,
- Immediately, to improve growers’ cultivation techniques: grafting of low quality mango trees, pruning techniques, maintenance of fertility by composting, mulching...
- To train officers in Vanuatu and New Caledonia.

4.1. Plant material propagation and production

Pocquereux Research Station - I.A.C. New Caledonia has developed and evaluated a wide range of collections of species and cultivars answering to the demands of producing countries, giving at the same time all the sanitary guarantees requested (citrus seeds from Pocquereux were sent to Tagabe Research Station in 1999). It is highly recommended to introduce some high quality cultivars in order to improve quality of fruits and increase the length of production such as:

Citrus

- Orange cv. Washington Navel (early fruiting), blond oranges (season), Late Valencia (late season),
- Mandarin cv. hybrid A68, Imperial (early), Ponkan, Cravo, Federici (season), Lebon, Tankan, C54-4 (late season), Fortune, Kara (very late),
- Hybrids for juices: tangelo Seminole, tangelo Pearl, tangor Ortanique,
- Grapefruit cv. Henderson,
- Diversification for processing (aromas, essential oils, liquors, marmalades, ornamental): kumquat, limequat, cedrat, combava, calamondin, bergamot, bigarade (bitter orange).

Citrus rootstocks

- Conventional: Troyer Citrange, Trifoliolate orange,
- Dwarfing : *Poncirus trifoliata* var. Flying Dragon,
- Calcareous conditions: Rough Lemon, Rangpur Lime.

Mango cv. Nam Doc Mai, Keitt.

Avocado (in fruiting order from February to September, to be fitted with Vanuatuan climate):

- Pernod, floral group A,
- Choquette floral group A,
- Hall, floral group A,
- Fuerte, floral group B,
- Hass, floral group A,
- Nishikawa, floral group B,
- Anaheim , floral group A,
- Reed, floral group A,

Longan cv. Homestead, Kohala, Biew Kiew

Diversification fruits

- Custard Apple cv. Atemoya,
- Carambolas: wide range of sweet cultivars,
- Guavas: wide range of cultivars to propagate with cuttings,
- Pecan nut,
- Pithaya.

The nursery in Tagabe Research Station is able to receive and propagate these fruit trees, but extension services have to think about the opportunity to establish new structures such as the Chamber of Agriculture, far from Bauerfield airport (biosecurity) and VARTC (Santo).

The first step consists in introducing a few numbers of carefully selected cultivars, increasing the length of the production season and adapted to pests and diseases constraints. These cultivars have to be grafted on suitable rootstocks.

The second step consists in developing a nursery activity by smallholders / farmers in the several islands in order to diversify their production and to supply fruit growers with high quality fruit trees. These nurseries will have the ability to deliver fruit plants to nearby producers. They can also become “relay nurseries” for other remote islands.

Linked with this workplan, nut trees have to be taken into consideration (potential “niche market”, free sanitary statement because processed to dried nuts).

Improvement of the knowledge of local fruit resource is needed (setting up and evaluation of collections of local species and cultivars, improving propagation techniques such as grafting, cuttings, air-layering, in order to reduce the length before first production from seedling trees). These fruit tree species are (not exhaustive):

- Avocado, *Persea americana* (lauraceae),
- Mango, *Mangifera indica* (anacardiaceae),
- Rambutan, *Nephelium lappaceum* (sapindaceae),
- Nangae, Dawa, *Pometia pinnata* (sapindaceae),
- Mangosteen, *Garcinia mangostana* (clusiaceae)
- Star apple, caimitier, *Chrysophyllum cainito* (sapotaceae),
- Custard apple, *Annona squamosa* (annonaceae),
- Navele, *Barringtonia edulis* (lecythidaceae),
- Nangaï, *Canarium indicum* (burseraceae),
- Naus, pomme cythère, *Spondias dulcis* (anacardiaceae),
- Nakatambol, *Dracontomelon vitiense* (anacardiaceae),

The objectives of this prospecting would be collecting, preserving and better valorising the national genetic patrimony, knowing that this scheme is already going on with root crops and breadfruit.

4.2. Demonstrative orchards

The aim of establishing demonstrative orchards in collaboration with smallholders’ farmers is to convince the producer of the feasibility and the profitability of fruit crops. These plots could be of variable size, but small plots are easier to follow-up and could allow the smallholder to choose the most suitable for him:

- orchard established with existing coconut trees,
- orchard established in association with forest species, either in reforestation or existing forests,

- orchard established in association with food crops allowing the smallholder quick harvest and/or return while waiting for income of fruit trees,
- monospecific and semi-intensive orchard established on the outskirts of urban areas (i.e. Port Vila, Efate island) in order to supply urban markets (and export).

4.3. Assistance for the improvement of the traditional crop systems

The development of fruit crops in Vanuatu and the establishment of nurseries as well as demonstrative plots and orchards is linked to the training of officers.

Priority should be given to training and technical assistance to nurserymen / growers (propagation techniques, nursery management, plot maintenance, including pruning, pest & diseases...). The existing structure in Pocquereux Research Station can provide this kind of training, but also Tagabe Research Station.

These nurseries should be able to produce plants within 12 and 18 months after decision made and establishment.

At the same time, officers in charge (including farmers, women...) trained in Vanuatu or in Pocquereux Research Station will have to assist producers in improving their traditional cropping systems by providing assistance in:

- Planting trees sourced from the new nurseries (plantation techniques, density of trees, pruning, even irrigation...),
- Fertilization techniques (manure, compost, mulch made from crops wasted products) allowing fertility maintenance as well as better soil preservation,
- Fruit crops protection by a wise and rational use of some pesticides or traps (pineapple Phytophthora, citrus scales and mites, mango anthracnosis, banana weevil borer and fruit flies...),
- Floral induction application on pineapples in order to produce all year long,
- Grafting adult mango trees when the quality and yield are low.

Extension officers specialized in fruit crops should coordinate and supervise actions implemented in the islands (budwood, rootstocks, material, input orders, delivery in the archipelago, assessment of demonstrative orchards, juice analysis, technical information, database, statistics...).

4.4. Quarantine recommendations

The development of fruit crops requires the knowledge of the parasitic risk. It is therefore recommended to proceed to an updated investigation on existing pests and diseases in the archipelago (that will be also suitable to evaluate the economic impact of the damages caused on fruit crops). Such survey will be used by upgrading the Pest List Database managed by the Pacific Community, in order to lighten procedures between our two quarantines departments.

Following a meeting held with Vanuatuan Quarantine Officers at Tagabe, a list of fruit species (and so on, cultivars) of interest for Vanuatu to be introduced from New Caledonia has been transmitted to DAVAR – SIVAP for fitting protocols with phytosanitary requirements.

4.5. Investigation about existing planting material

Following preliminary investigations, we noticed that a quite wide range of fruit species is already grown on Efate and Santo (i.e. André Pilecki & François Japiot have already identified “collection” of fruit trees that could be of interest (Teouma, Rentapao, VARTC). It is required to investigate in depth and compile information about: location, farmer, species, varieties, production, quality... in order to elaborate a plan for propagation. Developing production of high quality planting material from existing local plantations and fruit trees should be prioritized for two main reasons: reduction of costs and risk (import).

5. FUTURE PROSPECTS - CONCLUSION

Following this preliminary assessment of the fruit sector on Efate Island, the next step is to prepare a “Fruit Sector Development Program” (FSDP) for the next ten years; for that purpose, a survey (or at least an estimate) of the market/consumption is required. Then, it will be possible to plan the production of fruit plants (species and quantity) such as citrus, mango, avocado, rambutan (also have a look on longan), guava, passion fruit, custard apples (and hybrids), carambola, dessert and cooking bananas, etc.

The aim of the FSDP is to integrate fruit cultivation as part of the farming systems. The resources required for the Program can be listed as follows:

=> **3 nurseries/collection centres** for the production and dissemination of planting material, as well as demonstrative/training purpose:

- Tagabe Research Station, as the main existing nursery and collection, should be upgraded: new species, varieties, maintenance... in order to supply more planting material on the one hand, and be used as a training facility, on the other
- Chamber of Agriculture and VARTC, as new collection/nursery for the dissemination of planting material: budwood / seed production (plants supplying and assistance to private nurseries).
 - Basic laboratory equipment: binoculars, refractometer...
 - Documentation: books, booklets, leaflet, DVD...
 - Agricultural and horticultural equipment: set of tools, backpack sprayers...
 - Inputs: fertilizers, pesticides...
 - as well as all necessary means to carry out missions, including equipment and operating costs.

=> **Technical Human Resources**, for that purpose a huge training plan must be developed for the officers, lead-farmers and farmers in general, targeting plant production, orchard and trees management.

=> Pilot operation for value adding/preservation, it is also necessary to develop and/or facilitate the establishment of pilot processing facilities (purees, dehydrated fruits, essential oils), as well as fruits for juices, jams, sorbets and dried products. These processed products should progressively satisfy tourist demand, substitute a part of imports, and open export perspectives. Specific studies will be necessary to develop this activity in Vanuatu.

A work plan and a logical framework should be prepared, including feasibility study and financial analysis for promotion purpose to investors interested in fruit development in Vanuatu.

5.1. Practical basic workplan

In relation with the observation of fruit market in New Caledonia, reasonably projected consumption objectives for the next ten years could be:

Per annum, whole Vanuatu (in comparison with New Caledonian consumption):

- 5,000 tons of fruits,
- 7,000 tons of cooking bananas and breadfruit.

The table below shows the number of plants required to reach the 5.000 tons of (diversified) fruits (current production is not included in this table):

	Production (t)	Yield (t/ha)	Area (ha)	Plants /ha	Total plants required
FRUITS					
Orange (1)	1,000	20	50 (4)	200	10,000 (5)
Mandarin (1)	500	20	25 (4)	200	5,000 (5)
Lime (export) (1)	500	20	25 (4)	200	5,000 (5)
Other citrus (1) (2)	60	20	3 (4)	200	600 (5)
Mango	200	10	20	150	3,000
Avocado	200	10	20	150	3,000
Pineapple	500	25	20	35,000	700,000
Dessert banana (3)	2,000	20	100	2,000	200,000
Passion fruit	200	10	20	670	13,400
TOTAL FRUITS	5,160		283		940,000
Cooking banana (3)	4,000	20	200	1,800	360,000
Breadfruit	3,000	30	100	200	20,000
TOTAL	12,160		583		1,320,000
(1) priority is given to Flying Dragon rootstock in order to enhance quality and yield of citrus					
(2) the objective is to develop new products (value addition) through processing (essential oils): combava, bergamot, cedrat, bitter orange (bigarade), finger lime, kumquat and frozen / pre-cooked processed: breadfruit (Export market)					
(3) using the in-vivo technique to propagate hundreds of plants					
(4) using conventional rootstock					
(5) depending on the use of rootstock : Troyer Citrange, Trifoliolate orange, Flying Dragon (dwarfing rootstock), Rangpur lime or Rough lemon in calcareous condition					

The production of plants should be developed at the DARD-Tagabé Station and new centres (VCA & VARTC), as well as private nurseries, including smallholder farmers. For that, consistent and regular assistance from extension services and punctual expertise missions from Pocquereux Fruit Research Station – IAC – New Caledonia is required.

Actual budwood and seedling orchards have to be managed at Tagabe (fertilization, pruning) for planting material supply (citrus, avocados), and also re-planted far from the airport with introduction of renovated and new species, cultivars and rootstocks (1 ha – 2 ha for collection / budwood / seedling orchard).

Main nurseries have to be equipped accordingly (2,000 m² for each at least) to be able to produce hundreds of woody plants and in-vivo banana plants. Smaller structures could be developed by smallholder in remote islands (far from Port-Vila or Luganville markets). Each

site and stakeholder should be financially and technically assisted according to the specifications described in the work plan.

5.2. Human resources recommendations

Implementing such a program requires officers highly specialised in tropical fruit crop propagation and orchard management:

- 1 tropical fruit crops agronomist in charge of the overall program implementation, monitoring and evaluation (based on Efate),
- 3 extension officers to take care of collections and nursery in Efate, and also assisting fruit growers in the South of the archipelago,
- 2 extension officers to take care of collections and nursery in Santo / Malekula, also assisting fruit growers in the North of the archipelago,

The main mission of the staff would be to train fruit growers (from “nucleus farms” and/or villages) and supply planting material.

5.3. Conclusion

Pocquereux Fruit Research Station – IAC, which undertook this expertise, is particularly opened to all new requests from the Government of Vanuatu, especially the DARD, the Chamber of Agriculture, VARTC and other stakeholders of the private sector for:

- More information/explanations about issues and topics developed in this document,
- Welcoming fruit growers, nursery agents, extension services officers for further training according to tropical fruit crops issues in New Caledonia,
- Introducing selected planting material in Vanuatu,
- Providing technical support to fruit growers and assisting all along the implementation of the FSDP.

We have noted the request of Mr. Ruben Bakeo Markward, Director of DARD who proposes to strengthen the cooperation between Pocquereux Fruit Research Station – IAC – NC by proposing the signature of a Memorandum of Understanding between the Department of Agriculture and Rural Development and the Institut de Recherche néoCalédonien, which will be the next step to achieve further collaboration.

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Zacharie LEMERRE DESPREZ
La Foa, August 2011.

APPENDIX 1

GOVERNMENT OF THE
REPUBLIC OF VANUATU
MINISTRY OF AGRICULTURE,
QUARANTINE, FORESTRY
AND FISHERIES
Private Mail Bag 9039
Port Vila, Vanuatu
Tel: 23406, Fax 26498
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GOUVERNEMENT DE LA
REPUBLIC DE VANUATU
MINISTERE DE L'AGRICULTURE
DE LA QUARANTAINE, DES FORÊTS
ET DES PECHES
Sac Postal Privé 9039
Port Vila, Vanuatu
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Date: 5 juillet 2011

De: Monsieur Jeffrey Wilfred, Directeur Général, Ministère de l'Agriculture, de l'Elevage, de la Quarantaine, de la Forêt et des Pêches (MAEQFP)

A: Monsieur Laurent Lhuillier, Directeur, Institut Agronomique néoCaledonien (IAC), Nouvelle-Calédonie

Objet: Coopération IAC/MAEQFP

Monsieur le Directeur,

Suite à la mission réalisée par votre équipe de Pocquereux, je souhaiterais désormais envisager avec vous la suite que nos deux institutions pourraient donner à cette première étape, sachant que nous souhaiterions nous inscrire dans une coopération durable avec l'IAC.

Tout d'abord, je tiens à souligner l'excellent travail d'expertise et de formation qui a été réalisé par MM Zacharie Lemerre-Desprez et Patrick Lecrun. Il s'agit d'une première étape essentielle qui nous permet désormais d'envisager la poursuite du développement de la filière fruit de manière cohérente et soutenue. Compte-tenu des compétences et de l'expérience de l'IAC en la matière, votre institution apparaît comme un partenaire privilégié du Ministère de l'Agriculture et, par extension, de la Chambre d'Agriculture ainsi que l'ensemble des partenaires de la filière concernée.

Pour cela, je vous propose d'élaborer une lettre d'intention (*Memorandum of Understanding*) définissant un cadre de travail et de coopération qui précisera les termes de références de notre collaboration d'une part, ainsi que les rôles et responsabilités de nos institutions, d'autre part.

Au nom du Ministère de l'Agriculture du Vanuatu, je tiens à remercier l'IAC pour cet appui technique qui constitue une étape supplémentaire dans le développement de la filière « fruits » au Vanuatu d'une part, et des relations de coopération entre nos deux institutions.

Restant à votre disposition pour préparer la prochaine étape, je vous prie d'agréer, Monsieur le Directeur, l'expression de mes salutations distinguées.


Jeffrey Wilfred

Directeur Général, MAEQFP

Copie: Ruben Bakeo Markward, Directeur, Département de l'Agriculture et du Développement Rural (DADR)

Zacharie Lemerre-Desprez, Directeur, Station Pocquereux-La Foa, IAC

François Japiot, Conseiller, MAEQFP

APPENDIX 2

FERTILISATION des PLANTS en PEPINIERE

Besoins en éléments fertilisants des plants de pépinière à partir du repiquage (g/plant) :

N	P2O5	K2O	CaO	MgO	S
12	4	12	9	4	2

Selon engrais disponibles, l'apport annuel par plant est le suivant (exemple) :

Urée	Nitrate de potasse	Nitrate de calcium	Superphosphate
7 g	25 g	35 g	9 g

(ne pas mélanger l'urée avec le nitrate de calcium. A apporter séparément, en alternance).

Exemple de programme de fertilisation annuel :

Engrais	g/plant/an	g/m²/an	g/m² 1 à 6 mois	g/m² 6 à 9 mois	g/m² > 9 mois
Urée	7	420	20	40	60
Nitrate de potasse	25	1500	60	180	200
Nitrate de calcium	35	2100	110	220	260
Superphosphate triple	9	540	30	50	70

Le premier apport se fait un mois après le repiquage.

APPENDIX 3

Quelques espèces fruitières de diversification présentes dans les collections des particuliers à Efate.

Famille	Espèce	Nom
ANACARDIACEAE	<i>Spondias dulcis</i>	Pomme cythère, naus
ANNONACEA	<i>Annona muricata</i>	Corossol
	<i>Annona squamosa</i>	Pomme-Cannelle
	<i>Annona cherimolia</i>	Chérimolier
	<i>Annona reticulata</i>	Coeur de Boeuf
BOMBACACEAE	<i>Pachira aquatica</i>	Noisetier
CLUSIACEAE	<i>Garcinia xanthochymus</i>	Faux mangoustan (PG / mangoustan)
EBENACEAE	<i>Diospyros digyna</i>	Sapote noire
FABACEAE	<i>Inocarpus fagifer</i>	Châtaignier de Tahiti, namembe, mape
LECYTHIDACEAE	<i>Bertholletia excelsa</i>	Noix du Brésil
MALPIGHIACEAE	<i>Malpighia glabra</i>	Cerise des Antilles
	<i>Malpighia puniceifolia</i>	Cerise des Antilles
MORACEAE	<i>Artocarpus heterophyllus</i>	Jacquier
	<i>Mora nigra</i>	Mûrier (cv. Hicks)
MYRTACEAE	<i>Psidium guajava</i>	Goyavier
	<i>Syzygium malaccense</i>	Pomme canaque
	<i>Eugenia uniflora</i>	Cerise de Cayenne
	<i>Psidium cattleianum</i>	Goyave de Chine Rouge
	<i>Syzygium luehmannii</i>	Lilly pilly
	<i>Syzygium jambos</i>	Pomme rose, nakavika
PROTEACEA	<i>Macadamia integrifolia</i>	Noix de macadamia
OXALIDACEAE	<i>Averrhoa carambola</i>	Carambole
	<i>Averrhoa bilimbi</i>	Bilimbi
SAPOTACEAE	<i>Manilkara zapota</i>	Sapotille
	<i>Synsepalum dulcificum</i>	Fruit miraculeux
	<i>Chrysophyllum cainito</i>	Caïmitier, star apple
	<i>Pouteria caimito</i>	Abiu, caïmito
	<i>Richardella campechiana</i>	Canistel
ROSACEAE	<i>Eriobotrya japonica</i>	Néflier du Japon, bibace
RUBIACEAE	<i>Cinchona officinalis</i>	Quinquina
RUTACEAE	<i>Citrus hystrix</i>	Combava
	<i>Microcitrus australasica</i>	Finger lime, citron caviar
	<i>Casimiroa edulis</i>	Sapote blanche
SAPINDACEAE	<i>Euphoria longan</i>	Longan
	<i>Nephelium lappaceum</i>	Ramboutan
	<i>Pometia pinnata</i>	Nangae, dawa

APPENDIX 4

Quelques exemples d'appui technique à distance et lors de la mission



Photo 1 : agrumes, porte-greffe : début de fonte de semis (attaque cryptogamique et bactérienne) observée sur substrat lourd. Le chevelu racinaire est absent. Utiliser uniquement du sable pour la germination.



Photo 2 : agrumes, porte-greffe. Plantules bonnes à repiquer. Bon développement du chevelu racinaire.



Photo 3 : agrumes, greffage. Mauvaise cicatrisation du greffon sur la plaie à cause de son mauvais positionnement. Il doit être plaqué sur un côté de la plaie, et non centré.



Photo 4 : pas d'ombrage en pépinière (climat naturellement favorable) pour la multiplication des agrumes afin d'éviter l'étiollement des plants.



Photo 5 : taille de formation sur lime de Tahiti (producteur)



Photo 6 : taille d'entretien sur limettier de Tahiti âgé de 3 ans (producteur, Pang-Pang).



Photo 7 : syrphidae, mouche jaune, auxiliaire, dont les larves mangent les pucerons et les adultes pollinisent. A ne pas confondre avec un ravageur (C. Mille).



Photo 8 : transmise après observation de chute de fruits. On observe quelques dégâts probablement dus à des frottements. La chute des fruits est provoquée par les pontes de mouches des fruits (*Bactrocera spp.*). Obligation de lutte au verger par piégeage attractif.



Photo 9 : attaque d'anthraxose (*colletotrichum gloeosporioides*) sur inflorescences de manguier. Les fleurs "coulent". Développer la culture dans des zones sèches de la floraison à la récolte.



Photo 10 : tenebrionidae à identifier (besoin d'autres spécimen) pour statuer sur son action au verger.



Photo 11 : agrumes. Attaque de chenille mineuse sur jeune plant. L'introduction de l'auxiliaire *Ageniaspis citricola* a montré d'excellents résultats en Nouvelle-Calédonie.



Photo 12 : agrumes. Attaque sévère de diverses cochenilles. L'usage d'huiles blanches / minérales (action physique d'étouffement) donne d'excellents résultats (y compris sur certains oeufs et larves) à condition de "doucher" les arbres (feuillage + bois).

APPENDIX 5

Quelques prix à la consommation en juin 2011.

Produit	Quantité	Origine	Prix – Vatu	Prix – F.XPF
Orange	1 kg	Import / magasin	580	540
Orange	8 u	Local / marché	40	37
Orange	15 u	Local / marché	50	46
Orange	1 u	Santo / marché	50	46
Oranges pelées	4 u / 604 g	? / magasin	411	382
Mandarine	1 kg	Local / magasin	295	274
Mandarine	16 u	Local / marché	300	279
Lime de Tahiti	6 u – 8 u	Local / marché	100	93
Lime de Tahiti	1 kg	Local / magasin	800	744
Citron	1 kg	Local / magasin	250	232
Pamplemousse	1 kg	Local / magasin	180	167
Pamplemousse	1 u	Local / marché	30 – 100	28 – 93
Banane à cuire	1 régime	Local / marché	1000	930
Banane à cuire	1 main	Local / marché	150	139
Banane dessert	1 main	Local / marché	150	139
Papaye	1 u	Local / marché	50 – 100	46 – 93
Papaye	1 kg	Local / magasin	220	205
Pomme cythère	6 u – 8 u	Local / marché	150	139
Corossol	1 u	Local / marché	100	93
Carambole	50 u	Local / marché	10	9
Fruit de la passion	1 u	Local / marché	20	19
Pomme verte	1 kg	Import / magasin	680	632
Pomme rouge	1 kg	Import / magasin	620	577
Poire verte	1 kg	Import / magasin	580	539
Taro	6 u – 8 u	Local / marché	700	651
Choux Kanak	1 botte	Local / marché	50 – 100	46 – 93
Arachide	1 botte	Local / marché	150	139
Potiron	1 kg	Local / magasin	300	279
Pomme de terre	1 kg	? / magasin	195	181
Oignon	1 kg	Import / magasin	190 - 320	177 – 298
Ail	1 kg	Import / magasin	790	735
Salade	10 u	Local / marché	500	465
Haricot vert	1 pochon	Local / marché	150	139
Choux de Chine	8 u – 10 u	Local / marché	200	186
Haricot mètre	1 botte	Local / marché	200	186
Choux	1 u	Local / marché	100	93
Oignon vert	1 botte	Local / marché	200	186
Brocoli	1 kg	Import / magasin	1600	1488
Concombre	1 kg	Local / magasin	250	232
Melon	1 kg	Import / magasin	1100	1023
Carotte	1 kg	Import / magasin	295	274
Sucre	1 kg	Import	149	139
Riz	25 kg	Import	3395	3157
Poulet	1 u	?	895	832
Œufs	30 u	Local / marché	800	744
Crabe de palétuvier	1 u	Local / marché	2500	2325
Bœuf rumsteak	1kg	Local / magasin	995	925
Bois à brûler	1 u	Local / marché	300	279

APPENDIX 6

Programme et personnes rencontrées lors de la mission

Date	Details of activities	Places	Staff responsible
Monday 20 June	8.30 am, Briefing with the Director of DARD and Heads of DARD	DARD Head Office	Director / DARD, James W, Francois J, Francois W, John F, Zacharie and Patrick.
	Meeting with all Technicians	DARD conference room	Francois W, John F, John W, Jean Marc.
	Visit to DARD station	Station at Tagabe	All Technicians +
Tuesday 21 June	Visit to producers and commercial nurseries	Rainbow Garden Summit Estate	All Technicians with Zacharie and Patrick
	Visit to the local producers and do the on-farm training	Glen's Farm at Rentabao Donald and Kaltong's farm at Pangpang Kaltau nursery at Epau	
Wednesday 22 June	Visit to the local producers and do the on-farm training.	Lelepa's citrus plot Kanas farm at Siviri village Gilbert farm at Paunangisu V.	All Technicians + Patrick L.
	Meet with other Dept. And people concerned.	Quarantine Dept, Supermarkets, Charlot Longwah.	Francois Japiot and Zacharie
Thursday 23 June	Field day at the Tagabe Agriculture Station, enhancing the promotion of the fruit trees production , deliver the necessary information, and do the practical demonstration on sawing of seeds, pruning, grafting , maintenance and nursery management.	DARD and Tagabe station	All Technicians and DARD staff, Francois Japiot, Zacharie and Patrick.
Friday 24 June	Meet with all DARD Technicians	8.30 am at DARD conference room	All Technicians.
	Meet with Director and James on the outcome of the training and future planning.	10.00 am at Director's office	Director, James, Zacharie, Patrick and F.Japiot.
	Meet with French Embassy.	2.00 pm	Zacharie, Patrick and F.Japiot.