Report on
the mission in Samoa
of a CIRAD Coconut Breeder
from February 12th to 20th 2001

Editing of two catalogues of coconut cultivars: Samoa contribution

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1. Introduction

The International Coconut Genetic Network (COGENT) and the Centre for International Cooperation in Agricultural Research for Development (CIRAD), have initiated the development of two catalogues: the Catalogue of Conserved Coconut Germplasm and the Catalogue of Farmers' Coconut Varieties. The former will contain textual and pictorial description of coconut varieties conserved in genebanks of COGENT member countries, while the latter will describe coconut varieties that are identified in farmers' fields and not yet transferred in genebanks.

The idea of making these fully-illustrated catalogues as printed materials was approved in the 2000 COGENT Steering Committee meeting held in Bangkok, Thailand. COGENT and CIRAD are collaborating with COGENT members countries to develop and publish these two high-quality catalogues.

The objective of this effort is not only to illustrate as many referenced varieties as possible, but also to provide comprehensive information (pictures and text) to help stakeholders identify and select the appropriate coconut varieties either for their breeding work or replanting programme. The information in the catalogues will be presented to make them attractive and understandable to the general public. Each variety will be described using one-page picture plate and one-page text.

2. Activities conducted in Samoa

The main objective of the mission was to collect information –pictures and text- for the future edition of the two Cogent catalogues of coconut germplasm. At our arrival, nothing was done on catalogue projects due to the drastic changes in the Samoan research team:

- E. Siaosi, agronomist in charge of the PRAS Surveys, has resigned in February 2000 and is now working overseas.
- K. Puono, project leader, is now working with the Quarantine division, we meet him but he is no more involved in Coconut research.
- O. Tilialo, former research officer in charge of Olomanu seed garden, passed away in January 2001.

The new researchers involved in Coconut activities are now Valerie Tuia, Senior research officer (vstuia@yahoo.com), and Valentino Leafi, field assistant in charge of Coconut based inter-cropping studies. At our arrival, they had little knowledge about Coconut germplasm and needed to be trained.

A big work of standardisation was done to detect duplicates and fit the Samoan coconut cultivar names with international standards (See Table 1). The data in CGRD was not improved, due to lack of time. Anyway, this was not the objective of the mission and will have to be done later by Samoan researchers.

We spent some very useful time making literature review in the national Library of Samoa. Literature review was conducted in order to better understand and re-trace the history of numerous coconut surveys and selections conducted in the past throughout Samoa. It appears that many coconut varieties names have been registered in the past mainly by Parham (1972) and Chistophersen (1935) - and that the PRAS surveys were under-documented from the beginning of the study. Result of this review will be included as historical section of each cultivar description.

It appears that many developments or research programs were conducted in Samoa in the past. Annex 1 give an incomplete overview of these programmes. It should be very useful, both for COGENT and the CIRAD Coconut programme, to constitute such a folder for each and every coconut producing countries (if not already done).

Table 2 gives the list of cultivars to be described by Samoa in the catalogues of conserved germplasm and farmers varieties. 13 accessions existing in Samoa at least will be described in the catalogues. Some of them will be described using plates provided by R. Bourdeix or other countries. We spent time in Samoan's fields, gardens and seed garden making observations and pictures of coconut varieties. It seems that there is significant variability among a special type of Dwarf coconut palm, which could be described as "Compact Dwarf". These coconut palms are characterized by a wider trunk than that of the Malayan type dwarfs, starting with a marked basal bulb, and very slow vertical growth. They generally have short leaves with broad leaflets, and bunches and inflorescences with short peduncles. The spikelets at the end of the inflorescence are generally shorter than the others, giving the inflorescence the general shape of a cone. They have previously been described in the literature as a single variety called "niu leka" in Fiji and Tonga, and "niu le'a" in Samoa.

Table 3 gives the references of pictures made in Samoa during R. Bourdeix Mission. About 150 pictures of coconut germplasm were taken; the techniques for making good coconut pictures were taught. **The cultivar description text will have to be completed by V. Tuia. The final version will have to be sent in Malaysia, Cogent Office, before the 10 of March 2001.**

List of germplasm from Western Samoa referenced in the CGRD Database versus 1999:

- CIB SMT Samoan Tall Samatau (SMOT01) 1964
- IND101 Samoan Tall (SMOT) 24081981 24081981
- IND102 Samoan Yellow Dwarf (SYD) 24081981 24081981
- IND103 Samoan Tall Alao (SMOT02) 24081981 24081981
- WS001 Samoan Tall (SMOT)
- WS002 Niu Vai Tall (NVIT)
- WS003 Niu Kafa Tall (NKFT)
- WS004 Samoan Tall Samatau (SMOT01)
- WS008 Samoan Green Dwarf (SGD)
- YSI SMOT Samoan Tall (SMOT) 1912 1912
- VT NJA R1 Samoan Yellow Dwarf (SYD) 041984
- VT NJA R2 Samoan Yellow Dwarf (SYD) 031994

Table 1. Updating of cultivar names in Samoa

Old Cultivar name	International Cultivar Name and abbreviation	Acces-ion number	Remarks from V. Tuia and R. Bourdeix
Niu Afa	Niu Kafa Tall Samoa	WS003	New population name
Niu Ati Red Dwarf	Tahiti Red Dwarf (TRD)		Ati means husk can be removed with teeth. The young husk is not sweet and cannot be chewed (tasted). Niu ati will be retained as local name or synonym.
Niu Ini-Ini	No Name		Recorded in Savai Island by Cited by Christophersen (1935). May be Niu Tea, Malayan Red Dwarf but not sure, description is closer to Samoan Yellow Dwarf. "Tea" means orange according to V. Tuia.
Niu Kogau, Niu Tau'ave and Niu Sasave	Samoan Tall Spicata (SMOT02)		Was collected in an island from American Samoa. "Kogau" will be retained as local name or synonym. See also Christophersen, 1935.
Niu La'ita	Samoan Yellow Dwarf		See Niu Laaika. Said by Christophersen (1935) to be a dwarf with numerous small fruits of a light yellowish-brown colour. Husk of the young fruits can be chewed, but is not very sweet.
Niu Laaika	Samoan Yellow Dwarf		Recorded in the PRAS survey made by E. Siaosi in Falelima village (Savai Island). No more indication. May be the form identified as La'ita by Christophersen (1935). Husk of the young fruits can be chewed, but is not very sweet.
Niu Le'a Dwarf (big fruits)	Niu Leka Dwarf (NLAD)		
Niu Le'a Dwarf (Small fruits)	Niu Leka Dwarf Samoa (NLAD02)		New population name
Niu Lega	No Name		Recorded in the PRAS survey made by E. Siaosi in Vaovai village (Upolu Island). No more indication.
Niu Mea	No Name		Recorded in the PRAS survey made by E. Siaosi in Vaovai village (Upolu Island). According to Christophersen (1935), this do not mean a special variety but only "Brown Coconut".
Niu Piu	No Name		Recorded in the PRAS survey made by E. Siaosi in Vaovai village (Upolu Island). No more indication. May be not coconut but Betel Nut according to V. Tuia, personal comm. 2001. Described as the Pacific Island fan-palm, Prichardia pacifica Seems. By Parham, 1972.
Niu Tau	No Name		Recorded in the PRAS survey made by E. Siaosi in Vaovai village (Upolu Island). No more indication.
Niu Tauaga or Tauanga	No Name		Recorded in the PRAS survey made by E. Siaosi in Vaovai village (Upolu Island). Also cited by Parham, 1972 as a form used for fibres but different from the Niu Afa.
Niu Taulua Sami	No Name		Cited by Christophersen (1935). Not available in PRAS Survey.
Niu Tea or Malayan Red Dwarf	Malayan Red Dwarf		No change. Niu Tea as synonym.
Niu Tetea	No Name		Cited by Christophersen (1935). May be Niu Tea, Malayan Red Dwarf but not sure, description is closer to Samoan Yellow Dwarf. "Tea" means orange

			according to V. Tuia.
Niu Tongau	Samoa Tall Sweet husk		Cited by Christophersen (1935). Not available in Samoa according to K. Puono. To be located.
Niu Vai	Niu Vai Tall Samoa	WS002	New population name.
Rennell Tall	Rennell Island Tall (RIT)		
Samatau Tall	Samoan Tall Samatau (SMOT01)	WS004	Germplasm Bank. Name Given by CIB (1964)
Samoa Green Dwarf	Samoa Green Dwarf	WS008	No change. Not really available in Samoa collection (mix of many types), better in Vanuatu.
Samoan Tall (SMOT)	Samoan Tall (SMOT)	WS001	No Change - Solomon, 1912
Malayan Yellow Dwarf	Samoan Yellow Dwarf	IND102, VT NJA R1	Comparison in Vanuatu show clearly the difference between No change

Table 2. Twelve cultivars available in Samoa to be described in the catalogues

Cultivar Name	Con-served Germ-plasm	Farmers varieties	Proposed authors of the form	Proposed action in Samoa	Remarks from V. Tuia and R. Bourdeix
1. Niu Kafa Tall Samoa	C	F	V. Tuia, O. Tiliao and R. Bourdeix	Text writing and pictures	
2. Niu Leka Dwarf Samoa (NLAD02)	C	F	V. Tuia, A. Peters and R. Bourdeix	Text writing and pictures	Little fruits, both Green and Brown.
3. Niu Vai Tall Samoa	C	F	V. Tuia, A. Peters and R. Bourdeix	Text writing and pictures	
4. Samoa Yellow Dwarf		F	V. Tuia, R. Bourdeix and J.P. Labouisse	Text writing and at least one picture	Use picture from R. Bourdeix from Vanuatu
5. Samoan Tall (SMOT)	C		V. Tuia, K. Pouono and R. Bourdeix	Text writing and pictures	
6. Samoan Tall Samatau (SMOT01)		F	V. Tuia, T. Petelo and K. Pouono.	Text writing and pictures	
7. Samoan Tall Siufaga Savai (SMOT03)		F	V. Tuia, R. Bourdeix and V. Leafi	Text writing and pictures	If possible, make 12 fruits and 3 husked nuts pictures (long fruited palms).
8. Samoan Tall Spicata (SMOT02) Kogau	C		V. Tuia, R. Bourdeix and T. Petelo	Text writing and pictures	
9. Malayan Red Dwarf				None	Use picture and text from R. Bourdeix
10. Tahiti Red Dwarf (TRD) Niu Ati				None	Use picture and text from R. Bourdeix
11. Rennell Island Tall (RIT)				None	Use picture and text from R. Bourdeix. Heterogeneous population in Samoa
12. Niu Leka Dwarf (NLAD)				None	Use picture and text from R. Bourdeix.
Samoa Green Dwarf					Only a few palms available in Samoan collection, discarded

Table 3 : References of pictures for Samoan cultivars and forms to be described in the catalogues

Proposed Cultivar Name	12 fruits	3 husked Fruits	Whole palm	Bunch	Inflores-cence	Round picture	Other picture	Remarks
Samoan Tall (SMOT)	RB17 22A	RB18 07A	RB18 14A	RB18 15A	n.a.	RB18 23A	-	
Samoan Tall Samatau (SMOT01)	VT01 12A	RB18 05A	VT01 10A	VT01 08A	VT05A	RB19 08A (!)	-	
Niu Vai Tall Samoa	RB17 19A	RB18 09A	VT01 22A	VT01 15A	VT01 20A	RB18 17A		
Niu Kafa Tall Samoa	RB17 13A and 17A	RB18 03A	RB16 28A	RB17 33A	RB16 05A	RB17 35A		
Rennell Island Tall (RIT)								
Niu Leka Dwarf (NLAD)								
Niu Leka Dwarf Samoa (NLAD02) little fruit	RB17 27A	RB18 10A	RB16 24A	RB16 31A or RB19 34A	RB19 32A	VT01 02A or RB19 35 A	RB19 20A	
Tahiti Red Dwarf (TRD) Niu Ati								
Samoa Green Dwarf								
Samoa Yellow Dwarf						RB19 11A		
Malayan Red Dwarf								
Samoan Tall Spicata (SMOT02) Kogau	RB17 26A	RB18 12A	VT01 28A	VT01 24A	RB16 09A	RB16 02A		
Samoan Tall Siufaga Savai (SMOT03)			RB19 07A	RB19 30A	RB19 23A	RB19 24A	RB19 26A	Find more indications about project and origin
Hybrid MRD x RIT				RB15 09A				

3. Exportation and importation of Coconut germplasm from/to Samoa

Queen Emma who brought Samoan types to Kokopo (E.N.B.P) late last century (18 Th.) made the first recorded coconut introductions from Samoa to Papua New Guinea. See **Robson**, RW, ***Queen Emma***, Brisbane, Robt. Brown, 1994, p. 153. p. 201-203

- According to Gangolly et al (1957), Hamilton and Grange (1937) recorded seven varieties of dwarf palms in Samoa, which were subsequently planted at Buitenzorg (now Bogor botanical garden, Java, Indonesia). See Hamilton W.M. and Grange, L. I. (1937) Report on the soils and Agriculture of Western Samoa. Dept. Sci. and Industrial Res. Report made for Samoan Administration on New Zealand Reparation Estates, Sept. 1937. The original paper of Hamilton was not read by us, and it will be useful to find it.
- From the Solomon Island Joint Coconut Research Scheme, review of breeding programme 1971-1974: Samoan Tall and FMS (Federated Malayan States) said to be introduced in Solomon Island before the first world war (1912).
- Malayan Tall Coconuts were introduced in 1932 at Vailele plantation, 3 miles east by road from Apia, Upolu Island, (Anonymous, 1952). At least 315 palms from this introduction were obtained in second generation and planted again in 1952.

4. Varieties and forms of the coconut palm as described by Parham, 1972

NIU (R"588) Cocos nucifera Linn., (palmae)

Tall, monoecious palm, without spines; trunk ringed with broad leaf-scars, often curved and leaning, up to 30m high or more; leaves 3-6m long, short and stourly peerioled, pinnate' pinnae numerous, linear, 50-70cm long, 5cm wide, acuminate at apex, shining, dark-green; inflorescence arising from leaf-axils; spathe boat-shaped, more or less woody; spadix with numerous branches; staminode flowers 1-1.;2cm long, pistillate flowers 2.5cm across; fruit ovoid or ellipsoid, bluntly 3-angled, 20-30cm long, the fibrous husk 2-4cm thick; seed with hollow endosperm about 1cm thick, filled with clear liquid; cultivated and semi-wild; a plant with many uses, trunks and timber for building and bridges, leaves for baskets, fans and thatch, fruits for drinking, for culinary purposes, for copra and oil; many varieties, some introduced, are grown. Coconut palm. The following varieties are listed, mainly by Christophersen (1935,38)

- AFA: Large, long and narrow fruits with thick husk, favoured for making sinnet ('afa);
- ALAVA: fruits light green;
- 'INI'INI: fruits small, with thin shell and heavy kernel; a Savaii name recorded by Reinecke;
- LA'ITA: small palm with large clusters of numerous light yellowish-brown fruit, favoured for a fresh beverage; ornamental;
- LE'A: dwarf palm, with heavy butt and bole, and dense crown and large fruits; indigenous and introduced; dwarf coconut, Malayan dwarf, Fiji hybrid dwarf;
- TAUAGA: fruits oblong, with almost parallel sides, fibres used as strainers for coconut milk (lolo);
- TAUAVE: probably a distinct species, see NIU TAUAVE;

- TAULUA SAMI: small fruits, the shells strung in pairs and used to carry salt-water for making palusami (taro-leaf with coconut milk);
- TETEA: fruit ovate, medium-sized, in sub-mature stage, light-green to almost white; a distinct variety, rare; white coconut;
- VAI: fruits large and round, the shells being valued as water bottles;
- TOGAU: fruit with juicy husk, sweet and edible together with the shell and kernel, in the sub-mature stage.

The stages in development of the fruits of the coconut are determined by tapping with the knuckle, each stage having a descriptive name:

NIU TAU'AVE (C'38) and **NIU SASAVE**

Diplothemium henryaanum F. B. H. Brown (Palmae) Palm, to 10-15m high; leaves pinnate, glaucous or pale beneath; spadix simple, spicate, 100cm long, spathes 2; only female flowers seen, these crowded in spirals, bracteate, sessile; fruits few, 2-3 in each spadix, irregularly ovoid, obliquely symmetrical, about 16cm diameter, 26-28cm long, with a curved terminal beak; husk thin, nut about 12-14cm across; plant very similar in size and general appearance, to Cocos nucifera; but differing in the thick unbranched spadix, spirally-arranged flowers and the double spathe; rare in Samoa. So-called female coconut palm.

5. References from Parham, 1972

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YUNKER, T. G. 1945: Plants of the Manua Islands, Bull. Bernice P. Bishop Mus. 184.

6. Varieties and forms of the coconut palm described by CHRISTOPHERSEN, 1935

Cocos nucifera Linnaeus: Sp. Pl., p. 1188, 17853.

Tau: cultivated, Luma, male flower, young fruit, January 10, 1922, Garber no.703. Savaii: cultivated, Manase, fruit, August 24, 1931, nos. 3611 and 3612; cultivated, Salailua, fruit, October 1931, mos 3614, 3615, and 3616; cultivated, Foailuga-Fogasavaii, altitude 25 meters, fruit, October 1931, no. 3613; cultivated, Tanga, fruit, October 6, 1931, no. 3617. Native name, niu. The coconut palm is everywhere in cultivation, copra being the principal export article of the islands. Several distinct forms are to be found:

Ini'ini: fruits are said to be small with thin shell, heavy endosperm, and very little or no juice. The meat is usually taken out entire and dried without being cut.

La'ita: a relatively small tree with clusters of numerous, small fruits of a light yellowish-brown colour. The juice is sweet so that the fruit are favoured for drinking purposes, but on account of their size they are seldom, if ever, used for copra. Specimen no. 3614.

Niu 'afa: Large, relatively long narrow fruits the husk of which is favored for the making of sennit ('afa). One fruit measured in the submature stage (niu sami) at Manase was 32cm long and broad. Specimen no. 3612

Niu alava: The fruits are said to be of a very light green colour.

Niu le'a: The dwarf coconut palm, with stocky stem and a dense crown of heavy, stiff leaves not graciously arching like the common form. It starts to bear at an early age.

Niu tauanga: Fruits oblong with almost parallel sides (one mature specimen 28 by 16.5cm). The fibre of the husk is used for making strainers for coconut cream. Specimen no. 3615.

Niu tauave: A very distinct form, the fruits being borne sessile directly on the rachis of the branchless spadix. The fruiting spadix is drooping. The fruits ae short and relatively broad (one mature specimen 21 by 16cm). The nut is flattened at the apex. Specimen no. 3613.

Niu tau lua sami: The fruits are smaller than those of niu vai, used as water bottles in pairs for carrying salt water for palusami.

Niu tetea: Fruits in the submature stage (niu sami) are light yellowish green to almost white. Form of fruit ovate (one specimen 25.5 by 16cm). Specimen no. 3616.

Niu vai: The fruits are large and rounded, the nus being used for water bottle. One submature fruit in Manase was 25.5cm long and 22.5 cm broad. Specimen no. 3611.

Tongau: In the submature stage (niu sami) the lower part of the nuts, husk, shell and meat is edible, in taste and consistency much like the "heat" of the tree. The upper part of the nut is sweeter, the husk being fibrous. The mature nuts, when allowed to become so, are used for copra. Specimen no. 3617.

Niu and niu ui: These names are used or the brown and green colour forms respectively, but do not, as I was informed, apply to any particular form. That is niu vai, for instance, may occur as niu mea (brown) and niu ui (green).

The various stages of ripeness in the coconut are recognised by definite name. Aile (aile) I the earliest stage when the fruit is beginning to form. In mua sui (mua sui) the fruit is bigger, but no soft meat (aano) is as yet formed. In the niu mamata stage the nut contains soft meat and is filled with liquid. In the niu sami stage the meat is partly ripened nut filled with liquid. Popo is the ripe stage, meat fully developed, nut only partly filled with liquid.

The coconut palm is used for variety of purposes. The leaves furnish material for mats, baskets, brooms (midrib of leaflets). The wood is used for thatch rafters (aso), walking sticks, canoes (?). The husk of certain varieties is used for sennit, strainers and for sandals. The shell is used for cups and water bottles, playing discs (lafonga), for fire where strong heat is desire, and for charcoal (charcoal irons). The meat of the nut is used for a variety of food preparations, the dried meat (copra) being the only important native produce and source of income.

7. Extracts from the book by Fox and Cumberland (1962).

Fox J. W. and Cumberland K. B. (1962) Western Samoa, Land Life and Agriculture in Tropical Polynesia. Whitcombe and Tombs LTD eds, Christchurch, New Zealand.

GERMAN RULE AND ECONOMIC DEVELOPMENT

This necessary framework of stable government was created in 1900 by the Germans who at once forcefully affirmed the position of the kaiser and of Governor Solf, and skilfully grafted Samoan institutions into the new system by the diplomatic acceptance of native custom.

LAND, LIFE AND AGRICULTURE TO MID-CENTURY

While the government thus protected Samoan land, it had no intention of permitting that land to remain completely idle. Solf was hopeful that peace, combined with the influence of government and missions, would evoke native energies; but in addition, legislation was framed to stimulate production. Native producers were protected against false weights and measures, the existing poll tax was confirmed and- more significantly - enforce, and on 31 August 1900 Solf promulgated the ordinance that every Samoan landholder must henceforth plant fifty coconut palms annually.

WESTERN SAMOA

Meanwhile a new menace invaded the coconut plantations. In 1907 Preuss described as the only coconut-producer free from the rhinoceros beetle, but ironically enough this was introduced the very next year with rubber 'stumps' from Ceylon. Two critical years passed before the beetle was detected near Apia, and by 1912 it had spread around the shores of Up0lu and invaded Savaii and wilting fronds and dying palms marked its progress.

Again, the government and planters acted with determination. An educational campaign was launched and Samoans were rewarded for the number brought in to the collection stations-until mounting expenses and evidence of 'beetle-framing' forced a change for policy. Thereafter, task days were appointed for beetle searching, plantations were cleared of the rotten and empty husks used by the beetle for breeding, and female beetles were tempted into strategically-placed tumu, or breeding-pits where their offspring were periodically scalded. Various experts - Fredericks, Gehrman and doane - were consulted and a virulent fungus discovered and place in the tumu. The beetles were reduced, but by 1914, heavily infested. The threat was checked, but was still latent.

Nevertheless, the German achievement in checking pests and diseases and maintaining a prosperous economy was remarkable. Under the guidance of European and Samoan officials coconut planters had extended and optimists (at least) claimed a perceptible increase in the economic response. Plantation production had boomed. By 1913, 26,000 acres were cultivated by Europeans, and 141 'planters' were reported in the census, though scarcely more than thirty can have deserved the name. Some 13,000 acres were under coconut palms, and copra production had increased by fully fifty per cent. The cultivation of cacao had flourished. By 1913 Europeans owned 9,000 acres, and by 1914 more than a thousand tons were exported. Rubber, mainly Hevea, covered 2,900 acres, and exports had risen from less than two tons in 1911 to forty-one by 1914. The imperial grants which had marked the first eight years of German rule were no longer needed. Samoan had become a self-supporting colony.

LAND, LIFE AND AGRICULTURE TO MID-CENTURY

The status of the larger plantations was gradually resolve. At first these properties were opened to long-term leases, but offers were considered inadequate, and it was finally decided to maintain the four major coconut plantations-Vailele, Vaitele, Mulifanua and Magia-as undivided Crown estates, and their operation was placed in the lands of a board which included the Administrator. In 1926, to eliminate confusion with 'Crown lands,' and to emphasise their distinctive status as dominion property, the title 'New Zealand reparations Estates' was adopted and subsequently confirmed by the legal overruling of a German attempt to reassert rights to these 'unliquidated' properties.

EFFECTS OF CLOPES AND CLIMATE

At Fagaloa Bay, for example, mature coconuts grow on slopes of more than thirty per cent, while on the slopes above Saluafata Harbour, young palms have been planted on slopes of over sixty per cent. In Savaii there has been no need to establish gardens on steep slopes, except in Matavai, a small village with a restricted area of land.

THE VILLAGE AND ITS AGRICULTURE

Drought also affects coconut production. It has been observed, particularly in north-western Savaii where the likelihood of periods of moisture deficiency I high, that the yield of nuts is decreased and many nuts drop before reaching maturity.[25] Furthermore, long periods of dry weather will result in reduced yields the following year. Even in normal years the drier months from August to

[24] During dry periods taro plantings continue as the mature roots are harvested. The tops planted at these times have an exceptionally low survival rate, with the result that further inroads are made into the banana crop for food.

[25] L. curry: 'the Physical Geography of Western Samoa', N. Z. Geographer, Vol. 11, No. 1, 1955, p.42

* See R. G. Ward: 'The banana Industry in Western Samoa,', Economic Geography, Vol. 35, No. 2, 1959, pp.123-137-Editorial Note.

THE COCONUT ZONE

While taro and bananas are the main subsistence crops in the pattern of village agriculture in Western Samoa, coconuts provided the main cash crop, although they have an equally significant non-commercial role-as food, drink and building material. Probably thirty-five per cent of the coconut crop is used to satisfy these local requirements. Coconuts are already by far the most ext4ensively grown crop, occupying alone and in various combinations about fifty-five to sixty percent of the village land. Production from village land alone accounts for four-fifths of the copra exported; and in 1956 copra provided forty-eight per cent of the total cash income received by Samoan villagers from the sale of agricultural produce[30].

The coconut zone commences immediately behind the village, and within it are many small plots the size of which reflects both the smaller clearings of bygone days and the later subdivision (Figs. 33 and 34). Within this zone nearly all the village coconuts are grown. Although the intensity of cultivation ad the total number of palms grown varies from village to village, the characteristics of coconut areas have much in common. Palms are irregularly spaced and are

[30] In 1956 Samoan villagers received $728,513 for the three main cash crops. Copra returned $350,000, cacao $252,450 and bananas $126,063. Of the total exports from all sources, Samoan gardens supplied eighty per cent of the copra, more than fifty per cent of the cacao, and ninety-five percent for the bananas. On 31 December 1957 a nine-year contract to supply copra to the United Kingdom Ministry of food expired. A new contract was signed to supply Unilever Ltd with 11,000 tons in 1958 at prices based on those paid for Philippine Island copra.

frequently too close to each other. Densities of more than a hundred palms an acre are usual.

A serious problem is that the majority of palms are betw43en forty and sixty years old[31] - eighty years old in some cases - and well past their peak of production. In the last forty years new planting has not offset the decline in production of the aged palms. There are only small patches of newer plantings, the majority age structure, and before this is achieved there is likely to be an extended period of declining coconut production.

The position does not go entirely unheeded. The necessity for continued planting and the removal of old palms is slowly becoming recognised. It is reflected in the numerous small areas of young palms at Satalo, Siuniu, Fusi (Saluafata) and Saanapu in Upolu and at Fusi (Safotulafai) and Satoalepai in Savaii. However, there is no general enthusiasm for systematic replanting. This situation has arisen despite an official policy aimed at ensuring continuity of planting which may be traced from the German legislation requiring each man to plant fifty nuts a year. One reason for the lack of enthusiasm is the competition offered by cacao, the importance of which, both really and economically, has increased since the end of World War II. Expansion has been largely at the expense of new plantings of coconuts, and it must be admitted that the lead was given by European planters whose function in the economy is totally different from that of the Samoan cultivator.

Apart from commercial considerations, more subsistence is threatened. The demand for coconuts as food increases yearly, and with the increased food demands of a growing population a much smaller amount of copra will be available in future for export. In view of the imminent independence of Western Samoa and the absolute necessity of increasing overseas income as well as local food supplies, the slow rate of coconut planting must be looked upon as a serious problem.

On the major commercial plantations weeds and scrub are controlled by the grazing of cattle and by the hand weeding go young palms. The coconut zone of village lands, by contrast, is characterised by a tangled mass of undergrowth in which large numbers of fallen nuts are lost.

Coconuts are byn9 means grown only in pure stands. There-tenths of the area in palms in interplanted with equal areas of cacao and bananas; and a tenth of the total area in coconuts supports a mixture of coconuts, bananas and cacao. Pure coconut stands, however, constitute more that forty-five per cent of the land in crops (Table 15) Where coconuts are planted closely together their shade is too dense for bananas to thrive. Thus, whenever secondary crops are grown under palms, they must be spaced more widely that if they were grown in the open. In consequence yields are lower. A more serious factor, however, which limits the extent to which bananas can be interplanted with the palms of the coconut zone, is that here soils are in general the most seriously impoverished, and the older the coconuts, the poorer the soil. In Aleipata some areas have grown

TABLE 15

LAND USE: SAMPLE VILLAGE LANDS*

	UPOLU	SAVAII	WESTERN SAMOA

R. Bourdeix, mission to Samoa for catalogues of coconut cultivars, 12/02/23, 5:12 2312/P12

	Ten villages Percent occupied land	Per cent Cropland	Nine Villages Per Cent Occupied Land	Per Cent Cropland	Nineteen Villages Per Cent Occupied Land	Per Cent Cropland
Coconuts	2,090 33	46	2,478 35	47	4,568 34	46
Cacao	233 4	5	288 5	7	621 5	6
Bananas	382 6	8	101 1	2	483 4	5
Bananas-Coconuts	616 10	14	447 7	8	1,063 8	11
Bananas-Cacaos	275 4	6	868 12	16	1,143 8	12
Coconuts-Cacao	606 10	13	482 7	9	1,088 8	11
Bananas-Coconuts-Cacao	268 4	6	477 7	9	745 6	7
Taro⊕	64 1	2	92 1	2	156 1	2
Various crops with scrub	143 2	-	302 4	-	445 3	-
Grass-Scrub-Swamp ℘	1,524 24	-	1,331 19	-	2,855 21	-
Village Areas	146 2	-	158 2	-	304 2	-
Occupied Village Land	**6,347 100**	**-**	**7,124 100**	**-**	**13,471 100**	**-**

- Nineteen sample villages; areas in acres. Tiavea land is not included.

⊕ Because taro patches are usually small and scattered, and because in many cases were difficult to map at the scale used, this estimate is less reliable than for other crops.

℘ Scrub represents areas in shrubby weeds, small woody copes, scattered trees and patches of light remnant bush, all interspersed with patches of grass and weeds.

Coconuts for over sixty years and the soil is so depleted that there are places where individual banana plants will not produce more than one or two satisfactory bunches, and in some instances will not fruit at all similar conditions are found in eastern Savaii. Samoans in Aleipata believe, with good reason, that bananas cannot be grown satisfactorily under coconuts. This idea is likely to spread until the use of fertilisers makes it possible to attain reasonable results.

Coconut palms in Western Samoa are inherently poor producers,[32] possible as a result of unsatisfactory original stock, the uniformed selection of new seed,

32 Based on the maximum area in coconuts on village land - 70,000 acres - the yield of copra per acre, allowing for estimated local consumption (4,6000 tons), is approximately 650 pounds per acre. If the area of 'pure' stands of coconuts could be considered alone, and if the nuts lost were added, then the yield of coconuts per acre per annum would be considerable higher.

For comparison the following figures derived from E. J. E. Lefort: 'Economic Aspects of the Coconut Industry in the South Pacific', S. P. C. Technical Paper, No. 92, Noumea, 1956, are presented, but they must be considered with caution as in each case coconuts are grown under considerably different conditions from those of Western Samoa - annual copra production per acre is approximately 390 pounds for New Caledonia, 590 pounds for the British Solomon Islands and almost 900 pounds for Netherlands New Guinea.

R. child, in an article, 'The Coconut', in New Biology, No. 13, October 1953, p. 42, suggests that the world average is about 1,025 pounds of copra per acre. He also states that a well-cared-for estate in Ceylon yield at least double this figure, and that crops equivalent to 2,190 pounds of copra per acre are not unknown.

Undoubtedly above-average results are obtained on commercial plantations where up-to-date and proven methods are used. Moreover, all coconuts are exported as copra and estimates do not have to be made of coconuts used for subsistence purposes.

And lack of attention. A further cause of low production is the ravages of the rhinoceros beetle (*Oryctes rhinoceros),* a pest which is thought to have been introduced accidentally from Ceylon with rubber plants in the early 1900s. the beetle attacks both young and mature palms by tunnelling and boring in the young fronds and inflorescences. This causes injuries which give, in time, a ragged appearance to the fronds and which, if concentrated, may cause the affected palms to die.[33] In some places entire blocks of coconuts have been destroyed. At Saanapu, for instance, no young palms remain unaffected. The beetle feeds on a large number of forest trees, and rotting logs and decaying vegetation provid3 it with ideal breeding grounds. As beetles may always be found in the forest, coconuts near the forest edge are likely to suffer the most severe depredation.[34]

Special ordinances, revised in 1954, have long been in force in an attempt to control the beetle. They have not been applied consistently nor systematically gettable. The efficacy of anti-beetle measures varies from village to village and from aiga to aiga. New emphasis has recently been focused on beetle eradication, and it appears that recent result shave been most satisfactory and that prospects are brighter than they have been for many years. This pest, the High Commissioner for Western Samoa points out, is responsible for a loss of twenty to thirty per cent of the whole copra crop, or of $300,000 in income to the country.[35]

33 for a comprehensive account see R. A. Cumber: The Rhinoceros Beetle in Western Samoa', S. P. C. Technical Paper, No. 107, Noumea, 1957.

34 Cumber recommends the stringent removal of breeding places and the intensification of trapping and other means of destroying beetles. He suggests the growing of taro, bananas and cacao as a buffer zone between the forest and the coconuts and increasing the number of palms per acre so that the damage of beetles will be less concentrated and a reasonable return from the palms can be expected. As a biological control measure, the Scolia wasp, was introduced in 1945, but its effect of the beetle so far is not clear. But it is interesting to note that Scolia ruficornis is being used in large numbers in Guam (Micronesian Reporter, Vol. 5, No. 1,1957, p.1) and the prospect of controlling re beetle in the Palau Islands seems reasonable. As a further experimental measure in Western Samoa, two species of elaterid beetles (*Agryphus fuscipes,* Fabr. and *Alaus speciosus*, Linn.) from Ceylon were liberated in 1955. During 1957 nematode parasites from Fiji were bred and liberated about Apia, Palauli and Solosolo. In addition, the Department of Agriculture is interested in a new insecticide which is said to give control at one-thirtieth of the cost of the 'crown' treatment now being practised (Laufasi Ola, Vol. 2, No. 4, 1957, p.6).

35 See 'Field Control of Rhinoceros Beetle', Laufasi Ola, Vol. 2, No. 5,1957, pp. 4-5. Similar calculations are

Nuts for copra are collected each week, sometimes each month. Production per tree is small and rat damage may significantly reduce the harvest. Much time is spent s4arching amid the undergrowth for fallen nuts which, when collected, are husked on the spot. The meat is then removed and the pieces packed into newly-woven coconut-leaf baskets to be carried to the village together with a few choices green drinking nuts. Some aiga bring the husked nuts

to the village for copra preparation but most Samoans see no virtue in carrying greater weights than necessary over the rough paths.

Some of the coconut meat is used to feed chickens or to provide coconut cream for use in palusami, or fai'ai, or as an accompaniment to tafolo or fa'ausi. The remainder is laid on account mats in the sun, often with a child to watch over it and to chase away wandering pigs and fowls. At the first sign of rain, it is put under cover and replaced in the sun once the shower has passed., their process continues until the coconut meat is dry and ready for sale. Copra made this way is frequently poor and greatly variable in quality, but since 1956 villages have been to build hot-air dryers in order to produce a better copra. So far, with the aid of the Department of Agriculture, more than sixty simple dryers have been built, with equal numbers in each island. Although a bonus of thirty shillings a ton is offered in Apia for good not-air dried copra, most of the harvest is sold to village traders who are reluctant to any premium pieces for fear the product will be downgraded by the Copra Board staff. This has tended, unfortunately, to discourage growers in their effort to improve quality.[36]

Finally, breadfruit trees (*Artocarpus altilis),* planted among the coconut palms and around the malae, are an important source of food in the coconut zone. During the main ripening season in December-January (and a secondary one in July-August) breadfruit are as important as taro in the Samoan diet. Little labour is involved in their harvest and the fruit may be used immediately or preserved for short periods in pits. At present a surplus exists during the main harvest season, but for many months of the year no breadfruit trees, although obviously their full potential as a source of food has not yet been exploited.[37]

Used by V. d. Stace: op. cit., p. 13, and by J. C. Gerlach in a paper, 'Some Agricultural Aspects of Western Samoa', read to the Auckland Branch of the New Zealand Geographic Society, 23 march 1954.

36 Annual Report for the year 1857, Western Samoa Department of Agriculture, Apia, 1958, p. 12. In realisation of the low level of agricultural knowledge in Western Samoa, and as part of its newly-initiated extension campaign, the Department of Agriculture, with a trained team of experts, has concentrated its efforts first on the villages of Leauvaa and Solosolo. To raise the level of coconut cultivation, instruction has been given in weed control, spacing, use of cover crops, planting, beetle control and copra drying.

37 For various methods of preserving breadfruit see Jacques Barrau: 'Drier for Preservation of Breadfruit', S. P. C. Quarterly Bulletin, Vol. 6, No. 2, 1956, p. 16; and J. L. O. Tedder: 'Breadfruit Drying in the Reef Islands', ibid, Vol. 6, No. 3, 1956, pp. 21-2

WESTERN SAMOA

German influence and direction have now been absent for nearly fifty years, the form and character of the plantations are little different from those in the decade or more of the German heyday at the beginning of the century.[4]

BEGGININGS

The products available in Samoa which first attracted the interest of trading vessels from Europe operating in the Pacific were pigs, fresh fruit and water, and pearl and tortoise shell. Taking advantage of the use of coconut oil in soap-making, missionary settlers established primitive press and persuaded Samoan villagers to extract oil from the dried flesh of surplus nuts. Oil exports began in 1842; and five years later Hanburg merchant ships first took part in

this trade. In 1857 Apia was chosen as the headquarters in the Pacific of the enterprising Hamburg firm of Johan Cesar Godeffoy and Son. From Apia it organised a fleet of small vessels to collect coconut oil from adjacent island groups, not only in Polynesia but also in Micronesia and Melanesia.

With the arrival in Samoa in 1861 of Theodore Weber, the firm's activities were vigorously expanded. He soon saw Samoa as a prospective rich and prosperous German colony. Under his direction land was taken and, to ensure regular supplies of high-grade oil for export, commercial plantations were established. Mulifanua (1865) was the first and largest. Vailele and Vaitele (Faleata) - east and west of Apia - were laid out in 1867 and the years following; Utumapu (elevated, inland and immediately south of Vailele) was established with a view to planting coffee in 1882. In this period the Germans, with exception of the missions and one New Zealander, were the only planters. They had monopolised the trade of Upolu and Savaii. In 1883 no less than 161 German vessels put in to Apia.[5]

In the process of establishing coconut plantations, cotton was the principal cash crop. Cotton was planted to shelter the young coconut palms, and meanwhile, especially during the American Civil War, its three ratoon crops every two years provided a valuable source of initial income. After seven years the cotton was cut out and cattle were grazed to keep down weeds ad to encourage pasture growth on the estates.[6]

4 With very few exceptions, the coconut palms on commercial plantations were planted under German supervision. Most are now more than seventy years old. As much as anything else this explains the steady reduction in copra production of the New Zealand Reparations Estates since it reached a peak in 1922-3. The 2,482 tons produced that year represented almost a quarter of the territory's total export. In recent years the Western Samoa Trust Estates, with a slightly reduced area under palms in bearing, have had an output of about 1,800 tons -little more than a tenth of the territory's annual export shipment. The estimated Trust Estates output of copra for the 1958-9 production year was 1,653 tons.

5 Sylvia Masterman: The Origins of International Rivalry in Samoa: 1845-1884, London, 1934, p. 66.

6 Cotton, however, continued to be grown on the large German estates as a separate crop. From Mulifanua and Vailele considerable quantities were exported during the 1800s to feed the infant textile industries of Saxony and Alsace-Lorraine.

PLANTATION AGRICULTURE

By the time coconuts on Mulifanua had reached bearing age, copra in sacks had replaced oil in barrels as the export product. Pressing was a slow, tedious, labour-demanding process and the oil produced variable and inferior in quality. In the period 1868-74 copra became the principal item in the export trade of the Pacific, and its place has not since been disputed. In Western Samoa, however, in recent years of high prices, cacao has superseded copra as the most valuable export, and hitherto most of it has come from commercial plantations.

8. Extract from ADB report on Western Samoa (1985)

Asian Development Bank (1985) Western Samoa Agriculture Sector study. Volume II. Background and sector review.

COCONUT

Until recently, copra was the main coconut product in Western Samoa. Since 1982, a coconut oil mill has been in operation to extract crude coconut oil from copra. A small amount of charcoal is made by villagers from coconut shell for domestic use only. Production of coconut is generally measured by the amount of dry copra exported. The amount of coconut and copra consumed domestically is not known with any accuracy, and various estimates exists. One such estimate is based on the assumption of an average consumption of 0.5 coconut per person per day, for all persons above 10 years of age, giving an annual average consumption of 3,864 Mt of dry copra equivalent. Other estimates are as high as two to three coconuts per person per day. The conservative consumption figure of 0.5 coconut per person per day has been generally accepted, perhaps not because it is more reliable but because of the implications of the other estimates. Uncollected coconuts which remain on the ground germinate or are eaten by rats and pigs and have been estimated at 16-25 percent. After making appropriate adjustments for domestic consumption, wastage and exports, the average annual production is estimated at about 24,000 mt. The current levels of productivity in the copra industry are low by world standards, averaging about 6000 kg per ha. This is due to several factors, including senile plantations, poor cultural practices, lack of fertilizers, failure to remove the old trees under which the new stand has been planted and failure to collect the crop on time. Many of these constraints could be removed by an effective extension service.

SMALLHOLDERS COCONUT SEEDNUTS SUPPLY SCHEME

From 1966 to 1977, the Government ran a coconut replanting scheme under which about 4.45 million seednuts were distributed to farmers. Rather than replanting, most of the seedlings were used for new plantings. These new plantings were not properly managed agronomically. It is estimated that about 21,000 ha of these areas now exist and are yielding at the rate of about 750kg copra per ha annual. This yield from fully mature young plantations is considered too low, and the benefit from the replanting scheme would appear to have been mostly lost.

FAO/UNDP HYPRID COCONUT PROJECT

A project to establish a hybrid coconut garden was started in 1977 using an area of about 16 ha. The project also provided for plant protection services, including a laboratory, insectary and plant house complex. The hybrids developed were based on Malayan Red and Yellow Dwarf mother palms crossed with Rennel Tall. The project is producing hybrid seeds that are currently being used for replanting on WSTEC lands. From 1986, the production of hybrids has been planted with local talls on three locations in controlled experiments for comparison. These are about four years old now and, although no scientific assessment has yet been completed, it is obvious from visual observation that the hybrid plants are producing almost at the rate of 50 or more nuts per palm per year as compared to no fruit set yet in the local talls

WSTEC

WSTEC has about 4,048 ha of coconut, about 971 ha of cocoa and about 128 ha of coffee. The production of these crops in 1983 was as follows: 4,057 Mt of copra, 202 Mt cocoa and 15 Mt of coffee. WSTEC has received three loans from international agencies for development work.

In December 1977, the Asian Development Bank approved a loan of US$3.0 million for rehabilitation of six WSTEC estates on Upolu. The main components of the project included the improvement of infrastructure and management practices; establishment of an agricultural research station for tree crops research; machinery for road improvement and maintenance; provision of

necessary product processing facilities for cocoa and copra; assistance for project implementation, operation and maintenance; and provision of fellowships for overseas training of local staff.

In October 1980, the Asian Development Bank approved a second loan, part of which was for WSTEC's development, consisting of replanting of 400 ha of the oldest coconut provision of fertilizer for an additional 1,518 ha of coconut, planting of 400 ha of cocoa (Amelonado) under younger coconut, application of fertilizer in about 718 ha of cocoa, upgrading of existing buildings and construction of additional structures a coconut stem utilization plant, construction of new roads and rehabilitation of existing roads, consultants and support for activities other than tree crop cultivation. The total lending for the tree crop plantation related activities was about US$4.5 million.

In 1979 the World Bank approved US$8.0 million under an IDA credit for the development of WSTEC estates in Savaii. The total cost of the project was US$20.5 million, with con-financing by the Australian Government (US$5.4 million), UNDP (US$1.7 million), the Japanese Government (US$1.4 million) and the EC Special Fund (US$0.3 million). The project consisted of investments for nurseries, imported improved planting material and field development of about 1,000 ha of coconut 5,260 ha of cocoa and about 80 ha of coffee in WSTEC estates and selected villages of Savaii, plus other activities of WSTEC not related to tree crops.