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Coconut Risk Management and Mitigation Manual for the Pacific Region

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2. DROUGHT

By R. Bourdeix, N. Tuivavalagi, M. Cook and M. Ghanem

Description

The risk is that severe or extended drought may greatly reduce the yield of coconut plantations, or even kill the coconut palms

Although the Pacific Ocean is by far the largest single body of water globally, water can be a scarce resource in the Pacific Islands. Some small island states in the Pacific have freshwater supply problems that are among the world's most critical. Freshwater resources are often classified as either 'conventional' or 'non-conventional'. The conventional 'naturally occurring water resources' require a relatively low level of technology: rainwater collected and stored, groundwater and surface water, and substitution of water (such as the use of coconuts during droughts). The non-conventional 'water resources involving a higher level of technology' include the use of seawater or brackish groundwater, desalination, water importation by ships or pipelines, treated wastewater, and substitution of water.

The coconut palm generally grows well where annual rainfall is between 1300 and 2500 mm or more. An average monthly precipitation of 150 mm is usually considered ideal in zones where irrigation is not practiced. A prolonged dry season lasting for up to four months may adversely affect the palms.

Occurrence and severity

The harvesting and storage of freshwater have numerous constraints, such as small land area, porous atoll geology, pressures of human settlements, conflicts over traditional resource rights, capacity limitations, frequent droughts and inundation by the sea during storms.

Recent droughts associated with El Niño severely impacted both high as well as low islands. They put a lot of strain on agricultural production and depleted rainfall collection supplies and the freshwater lenses and perched aquifers on many atolls in the Pacific. For example, in 1998, Federated states of Micronesia declared a national emergency because 40 atolls ran out of water; Fiji recorded one of the most severe droughts in history, and its sugar cane production declined by more than half. In recent interviews conducted on an island in Kiribati, farmers cited drought as a major cause of the drop in coconut yield.

The coconut needs about 44 months to develop from inflorescence primordia initiation through to fruit maturity. As a result, serious drought affects coconut yield not only during the drought period but also in the following three years by constraining the development of female flowers.

Mitigation and adaptation

During severe droughts or natural disasters small islands often rely on coconuts for drinking. Elders breed some coconut varieties specifically for water and water transportation (niu vai). Such varieties are particularly useful in small corals atolls with no fresh water. When elders wanted to colonize such an island, they first went only to plant coconut palms. Six to seven years later, when the coconuts palms start to produce drink and food, they returned to set up the island.

Farmers should manage the plantations so that not all palms are the same age, and include different palm varieties. Plant other crops between the palms. If something occurs, such diversity may protect you. All palms and crops will not be affected in the same way. Share observations with other farmers and scientists.

Apply chlorine (e.g., sodium chloride in the form of sea salt) if the plantation is located more than 500 m from the sea. Whilst chlorine is generally abundant near the coast, there are many sub-coastal and inland areas where the leaching action of intense rainfall has reduced chlorine availability to the point where it limits coconut growth. Chlorine regulates water balance by controlling stomatal closure and improving osmoregulation capacity under water stress. In India and Sri Lanka, when plantations are far from the sea, planters apply sea salt in coconut groves and when planting a new seedling. Such salt application improves the development of inflorescence, the number of female flowers and nut yield.

Plate 5. Coconut palms dying from drought in Marquesas Islands.

Use drip irrigation. About 80% of the world's irrigated area is under surface irrigation methods, which have a use efficiency of 30- 50% only. Drip irrigation was introduced in the early 1970s and its use for coconut cultivation has strongly increased in Brazil and India. Drip irrigation is an efficient method of providing water directly to the root zone, minimizing conventional losses such as deep percolation, runoff and soil erosion. Unlike surface irrigation, drip irrigation is more suitable and economical if it is introduced in water scarce areas with undulating topography, shallow and sandy soils and for widely spaced high value crops. It also permits the utilization of fertilizers, pesticides and other water-soluble chemicals (organic or not) along with irrigation water, resulting in higher profit and better yields and quality of product. Irrigated farming results in significant investments to be amortized.

In Kiribati, growers/households utilize local hand pumps (Marakei and Tamana pumps) and solar water pumps to collect ground water for washing, bathing, and some crop watering. In Nauru, water tanks are used to harvest rainwater and help water supply during droughts; brackish water is also used for irrigation.

When feasible, an option is to set up a system of canals like those in Ratchaburi Thailand (Aromatic Green Dwarf cultivation) and Malaysia (Matag hybrids).

Adopting an adapted high density multi cropping planting system and/or adapted cover crop may help retain moisture and increase the profitability of a possible irrigation.

Use mulching or place leaves and husks around the palm trunk. Plant in a flat basin bordered by pineapples, as done in India. In this country, husk and coir pith incorporation into sandy soils increased the yield from 42- 152 nuts per palm per year.

Actions to undertake

Reinforce coconut breeding programs. It is feasible to create drought tolerant varieties, as adaptive anatomical and biochemical features are well known. They include leaflets with upper epidermal waxy cuticle two times thicker than the lower epidermis, thicker cuticular edges, xylem tracheids with thick lignification, etc. The stem girth of tall coconut decreases between dawn and midday before increasing again during the afternoon, suggesting stem organized control of water transport, allowing response to drought stress.

Preserve the traditional coconut varieties created by elders for water consumption. Specifically, the best varieties will be recovered from specific locations: the low coral islands without any sweet water available in the soil.

The distribution of access rights to water must be unanimously recognized to not give rise to controversies. Otherwise, quarrels can degenerate into a huge waste of time and effort. The maintenance of perimeters (scrubbing of canals, planning of plots, repair of bunds, etc.) is often a cause of conflicts.

Water control does not protect farmers from all biological hazards. Predatory and devastating animals can also live in irrigated areas. Sometimes the availability of water in a dry zone can attract parasites or cause them to spread.

Concerning environmental effects caused by technical changes, the control of risks, sometimes not easily noticeable in the short term, involves the gradual implementation of forecasting models.

Explore the potential of using organic materials (including mulch, compost and charcoal/biochar) as water storage materials for coconut palm roots. These materials may also capture and store water from mists and dew during a drought.

In India, Government agencies provide significant sums of money in the form of subsidies to farmers for installing micro-irrigation methods including drip irrigation. This kind of policy could be useful in well-chosen places within Pacific countries.

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3. FLOODING, KING TIDES AND LANDSLIDES

By N. Tuivavalagi, V. Mataora, and K. Viliami

Description

The risk is that degradation of coconut land could be exacerbated by climate change and hazards such as flooding, king tides, salt intrusion, coastal erosion, sea spray, and increased landslides. Flooding and other hazards may reduce coconut growth and yields. In some extreme situations, palms may be uprooted and killed by erosion and water excess.

Coconut grows on a wide range of light, medium and heavy soils below 600 m; however, it does not tolerate waterlogged clayey soils or laterite soils with a shallow rock layer or hardpan. A soil pH of 5.5 to 7.0 would be ideal for coconut, but it could tolerate acid soils down to pH 4.5 and alkaline soils up to pH 8.2. Coconut also tolerates saline and infertile soil and grows quite well close to beaches, even on shallow soils of coralline atolls.

Occurrence and severity

Poorly-drained soil is unsuitable for coconut planting and seedlings in waterlogged condition would invite skipper butterfly attack and root grub incidence. When roots are covered by water for more than two or three days, they start to rot, and the palms die or become unproductive.

Inland erosion and landslides will become severe in areas that will have increased rainfall due to climate change. Inland erosion will be particularly serious where soil and crop management is poor. Landslides occur more often in areas where vulnerable volcanic soils are subjected to increased and prolonged rainfall.

Increased wind forces linked to climate change exacerbate coastal erosion and increased sea spray. In the Cook Islands, islands where the reefs are close to shore increasingly suffer such erosion.

Inland flooding will be more prevalent in areas that will experience more rainfall. More frequent king tides will result more in areas that will experience more coastal flooding. Coastal flooding will also bring in salt to areas that may include coconut plantings. Saltwater intrusion has been observed in atolls in Federated States of Micronesia including a case (Pingelap) in which salt water enters a plantation from underground sources. Experiences in Kiribati tend to show that saltwater intrusion may happen laterally under the soil surface during high tides.

Mitigation and adaptation

Coconut palm is one of the most tolerant species to protect coastal areas against flooding, the king tides and tsunamis. The dense root mat of coconuts helps hold the ground surface layers. It can be associated with *Casuarina* trees. In Samoa, for instance, people plant a first rank of *Casuarina* on the beach border, and immediately behind one or two rows of coconut palms. Mangrove also help to mitigate king tides and tsunamis. It is more appropriate than *Casuarina* in areas they are native as mangroves have other benefits (e.g., nurseries for fish and marine invertebrates).

Inland flooding: In Ba, Nadi, Rewa and other areas of Fiji, one of the strategies employed is to keep the rivers 'clean' by dredging them so that water flows easily and results in less flooding damage. Communities should also ensure that logs are not clogging their rivers and streams.