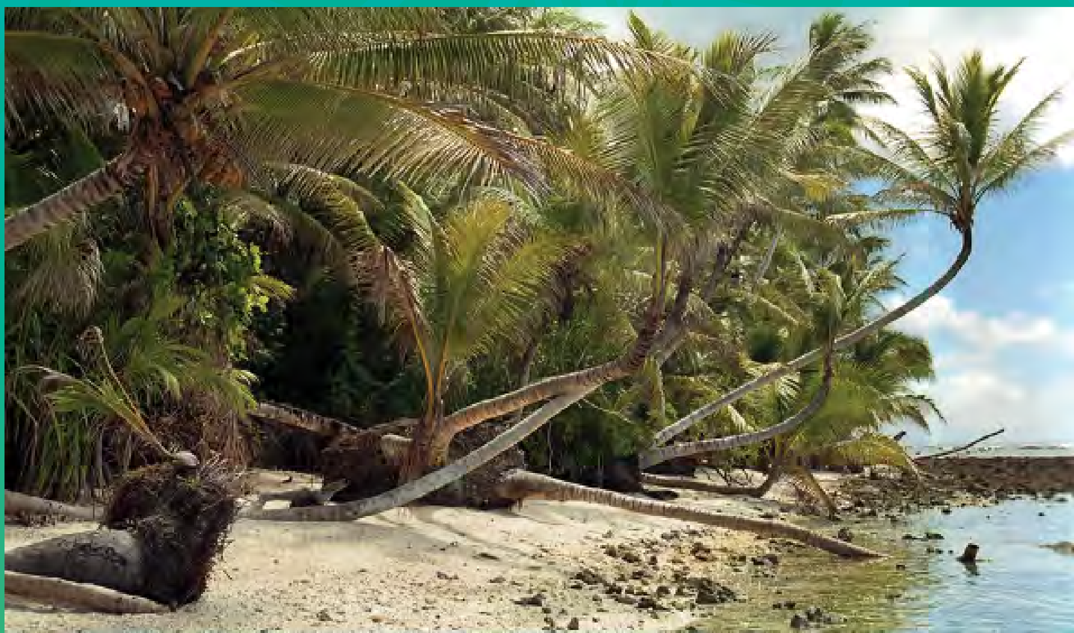
Coconut Risk Management and Mitigation Manual for the Pacific Region



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4. TEMPERATURE AND OTHER CLIMATE HAZARDS

By M. Ghanem, C. S. Ranasinghe and R. Bourdeix

Description

In addition to cyclones, tsunamis, drought and flooding, countries in the Pacific are affected by frequent natural hazards of smaller magnitude. The risk is that the increasing frequency of extremely hot days, unexpected cold periods, sea-level rise, and king tides may negatively affect coconut production.

Occurrence and severity

Climate change is affecting Pacific life in significant and complex ways. Impacts vary across the region, depending on the socio-cultural and economic context and the geology and ecology of islands. The Pacific islands face the highest disaster risk, in per capita terms, globally. Three main sources quantifying risk in the region are: EMDAT, Desinventar, and PCRAFI. A study conducted in 2016 analysed these sources (Noy & Edmonds, 2016). It concluded they all underestimate the risks, especially for atoll nations. This study cited these important trends concerning natural hazards due to climate change: increasing frequency of extremely hot days, sea-level rise, and other oceanic environmental and ecological changes.

Some low-lying atoll islands around the world could disappear due to climate change and sea level rise, leading to mass migration and threatening the existence of several island nations. Countries such as Kiribati and Tuvalu are often positioned as frontline victims of climate change that must anticipate the future uninhabitability of their homelands. Climate change is expected to generate and amplify human mobility. Some Pacific Islands are widely viewed as likely sites of climate-related migration, displacement, and resettlement. For instance, the Fiji government has identified 830 climate vulnerable communities that require relocation, of which 48 are in urgent need of relocation, intending to support their move via government funding and assistance from development partners.

Smaller magnitude climate variation affects crops at different life stages. At adult stages, temperature stress mainly affects fruit setting, causing significant reductions in resulting bunches. Low fruit setting can be due to reduced quality of pollen and button nuts (female flowers), low number of button nuts and /or impaired pollination process. Pollen germination is the most temperature sensitive process of fruit set in coconut. The optimum temperature for pollen germination is 28- 29°C. When the temperatures of coconut growing areas rise above the critical temperature of 33- 34°C or fall below 12°C, pollen germination and the pollination process are impaired, and fruit set reduced.

At the seedling stage, heat stress and high intensity of solar radiation can affect growth or cause seedling mortality due to excessive water evaporation from leaves, leaf yellowing due to reduced photosynthesis or photo-oxidative damage. In the Raiatea nursery, French Polynesia, exposure of the seednuts to strong sunlight in a low wind area resulted in internal rot and low germination rates.

Coconut palms are relatively tolerant to salinity compared to other crops. Pacific farmers point out increasingly frequent phenomena of high tidal swell and saltwater incursions from the ocean on atolls. This phenomenon is not new, but this swell sweep fallen coconuts on the strands and saltwater stays longer on the land and contributes to a high salinization of soils and the fresh-water lens on atolls, inducing a decrease in coconut production.

The cold can wreak havoc if the temperature drops to less than 6°C for a few hours. Semi-lethal temperatures range from 7- 12°C depending on the cultivar. A story was told to Dr R. Bourdeix by a former CIRAD scientist, without exact date and place. In the north of Australia, an investor had set up a large coconut plantation with an area of several tens of hectares. The palms developed very well and even started to produce. One night, a weather phenomenon that occurs only once every 10 years or more occurred. A wave of icy air came from the desert. In one night, it killed all the coconut trees on the plantation. If climate change increases the occurrence of such cold episodes, it may jeopardize larger areas.

Research conducted in Sri Lanka has shown that extremely high rainfall negatively impacts coconut productivity in dry and intermediate zones; that extremely high temperature negatively impacts productivity in dry zones; and that extreme weather does not significantly impact productivity in the wet zone of the country.

Mitigation and adaptation

A method was recently proposed to evaluate the susceptibility of islands to climate change, by using four physical and quantifiable variables: island rock-type (lithology), island shape (circularity), maximum elevation and area. These four physical variables were used to determine a dimensionless index for 1779 islands across 26 countries. This approach could help private companies and some farmers select sites for setting up new coconut plantations.

Some recent studies argue that sea level rise does not inevitably lead to coastal areas becoming uninhabitable (Esteban et al., 2019). Humans have an innate and often underestimated capacity to adapt to changes in their environment. Mapping of Funafuti island in Tuvalu from 1897 to 2013 indicates net gain in land, despite a sea level rise among the highest (t~0.30 ± 0.04 m over the past 60 years). Future reef growth can mitigate the physical impacts of sea-level rise on atoll islands, although reefs may grow too slowly to compensate for rising sea levels.

Manage your plantation so that not all the palms are the same age and grow more than one variety. 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. Sharing your observations with other farmers and scientists will facilitate the emergence of new technical solutions. If the plantation is under irrigation, with correct fertilizer application, soil moisture conservation and good agronomic practices, the palms can tolerate heat stress and perform successful pollination at higher temperatures than critical; i.e., even at about 35-36°C.

Actions to undertake

The use of tolerant varieties would be an efficient way to mitigate such temperature hazards. Outside of the Pacific region, breeders have already started to identify criteria for cold tolerance and salinity adaptation. For instance, measurement of coldness on leaves by electrical conductivity; for salinity adaptation, leaf stomatal frequency, leaf gas exchange, the quantum yield of chlorophyll fluorescence, the relative chlorophyll index, etc. Temperature response of pollen germination, female flower production, fruit set, leaf physiological parameters, and pattern of root growth can also be used to select tolerant varieties.

There is a significant potential market for cold-tolerant coconut varieties able to survive in countries with temperate climate. The first cold-hardiness studies in Hainan Island (China) indicated the existence of genetic variability. Māori tried to grow coconut palms in New Zealand many times but never succeeded due to the cold weather. Polynesians living in the Austral Islands (southern French Polynesia) also suffer greatly from scant coconut production. Because it gives any landscape a 'tropical' look, many people attempt to grow coconuts in non-tropical climates. Studies conducted in Florida shows that palms subjected to long periods of low temperature have soft, sunken, reddish areas on the trunk. These cold-damaged trunk areas are often invaded by secondary fungi and/or bacteria that cause trunk-rot and, several months later, the collapse of the entire crown. Fertilization slightly improves cold tolerance.

The possibility of carbon trading in coconut plantations can be explored for the whole coconut growing community. This will mitigate climate change and add value to coconut plantations and growers will get an additional benefit.

Strategies addressing climate change adaptation in the Pacific should include both state-based governance mechanisms combined with customary non-state institutions. Recent negotiations concerning labour mobility, unskilled and skilled, temporary and permanent, do not relate only to climate change adaptation. Mobility helps to balance labour shortages, transfer skills and generate remittances. Successful mobility also helps to adapt to climate risks.

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