Anthesis of Philippine teak – mass flowering episode triggered by climate change?
Species response under climatic uncertainty
By Anacleto M. Caringal

Figure 1. "To fall or not to fall? The promise of rain is held up by heaven over the mountain range of Lobo-San Juan, Luzon Island, Philippines. Delayed monsoon in recent years, is better than ever in this part of the southeast Asian archipelago where mountain forests such as the endemic Philippine teak (Tectona philippinensis) and their regenerants are being desiccated into extinction (Text and photo: Anacleto M. Caringal, Batangas State University).

One intense summer day of April 2000, I observed from a nearby shore numerous defoliated medium-sized trees at the peak and along the slope of a low coralline hill in Sawang, Lobo Batangas. These leafless individuals, amazingly were still living. During the latter part of May, mass flowering of the same trees was observed in various villages in the Lobo Mountains, which encouraged me to conduct an inventory based on the solitary canopies bearing the mass inflorescence visible even from some kilometers away. In July, the white-purple inflorescence becomes pale-brown and begins to fall by August. By September the crowns are no longer prominently visible as fresh foliage is fully developed.

These trees in fragmented distribution up to 300 meters altitude in Lobo-San Juan Mountains (LSJM), form a century-old botanical treasure: Philippine teak (Figure 2 *Tectona philippinensis*), numbering as few as 4,300 specimens in the wild. It serves as protection forest along mountain gorges or relief that is susceptible to landslides and soil erosion. It also stabilizes the coralline hills along the sandy shores and harbors wild orchids (*Trichoglottis sp.*) and wild *Cycas*, including rare Philippine birds and mammals.

As far as the carbon value of Philippine teak is concerned, approximately 103.5 tC is locked in the stand and is valued at USD517.5 at USD 5/tC or Philippine peso (PhP) 28,462.5 based on the valuation made by Dr. Merlyn N. Rivera, a forest economist at the Ecosystems Research and Development Bureau (ERDB) – Department of Environment and Natural Resources (DENR), Philippines. But such market value is yet to be established. Nevertheless, just like any tree, it provides other services such as carbon sequestration, water holding capacity and nutrient cycling.

Figure 2. Phenotypic expression of Philippine teak (Tectona philippinensis Benth. & Hook. f., Verbenaceae) as influenced by climatic vicissitudes in Lobo-San Juan Mountains (LSJM): (a) deciduous mother tree during summer (March-April); (b) mass flowering episode observed in 2000 (May-July) on the arrival of monsoon; (c) anthesis – purple blooms are seeds of life; (d) mass fruiting (mast) at mid-August; (e) matured pale-brownish drupes about to fall (August); and (f) teaklet – wild germinant burst in the forest floor after almost a year of dormancy

Institutional appreciation

The first phenological study on Philippine teak was conducted in 1991 in Lobo by the Philippine's Protected Area and Wildlife Bureau (PAWB) and was reported by Forester Imelda C. Pangga of the ASEAN Regional Center for Biodiversity Conservation (ARCBC) during the 2001 National Summit on Philippine Teak that was sponsored by the National Museum – Botany Division and Happy Earth Organization. Since then, no report has been made on the flowering of Philippine teak. Although flowering may have occurred since 1991, it may not have been observed. Philippine teak's importance was only recognized in 2001 by the local and national agencies such as the municipal governments of Lobo and San Juan and the Batangas State University (BSU).

Mass flowering in response to climatic vicissitude

The Philippines' Weather Bureau (PAGASA) reports that the coastal province of Batangas, Luzon Island does not get a very pronounced maximum rain period, with a short dry season lasting only from one to three months. Under Thornthwaite, Moh and Schmidt's classification, however, the regional macroclimate is classified as Type D where the condition is generally dry. Rain is not evenly distributed with at most, six dry months. The normal microclimatic condition of Lobo-San Juan Mountains (LSJM), however, is pronounced having two seasons: dry (November-April) and wet (May-October).

Prior to the mass flowering in 2000, Philippine teak trees have been observed to shed in April or even earlier. On the onset of the monsoon (May-June), flower buds and new leaves start to develop and the species would be in bloom. The observed mass flowering and fruiting of Philippine teak which was not observed prominently during the previous years may be due to the after effects of the El Niño phenomenon in the Philippines during 1997-1998.

El Niño was first heard of in 1892 by a scientist named Camilo Carillo from fishermen in Port Paita of Peru who kept on talking about the "Corriente del Niño" or "Current of the (Christ) Child". Evidently, the fisher folk were referring to the warm water that occurred around Christmas, the date celebrated worldwide as the birth of Jesus, causing a sharp increase in fish catches. But the abundant catches lasted only briefly because subsequently the fish population declined sharply. El Niño is associated with extreme climatic variability characterized by weather disturbances or unexpected climatic changes such as absence of rains during the rainy season, or the occurrence of violent storms during the dry season. In other words, this global climatic abnormality can cause extremes: either prolonging the dry season or causing drought or excessive rainfall in short periods that can lead to widespread flooding in low-lying areas. In the past, Indonesia's 80,000-ha forest fire and North Korea's famine were manifestations of El Niño's presence in the Asia-Pacific Region. In the Philippines, its signals are a very low water table, a delayed onset of the rainy season, an early onset of the dry season, weak monsoon activity and fewer tropical cyclones (Diokno, 1997).

Flowering of Philippine teak may start normally during the onset of the rainy season (May-June) but the usual extreme and extended summer caused by El Niño may bring a delay in the flowering and mass flowering may be driven also by the effect of such phenomenon.

Elsewhere in Southeast Asia

Mass flowering and the subsequent mass fruiting (mast) which is observed and reported in other tropical countries such as Thailand, Malaysia and Indonesia, is ascertained to be the direct effect of such climatic abnormality which is highly associated with temperature, water stress, sunshine values, and canopy position (Ashton, et.al 1998). The major El Niño events of 1951, 1953, 1957, 1968, 1976-1977 and 1982-1983 were accompanied by heavy mass flowering in many areas of Peninsular Malaysia and East Borneo in some species of rain forest canopies particularly the Dipterocarpaceous (Bauan and Evasco, 1995; Ashton, et.al 1998). According to Lisa M. Curran, assistant professor of tropical ecology at the University of Michigan, more than 50 different species of Bornean dipterocarp trees synchronize their bursts of reproduction to brief, intense periods and she ascertained the episode by the arrival of the El Niño. Curran and her research colleagues documented a rare reproductive strategy called masting. Four masting episodes were recorded during El Niño years from 1986-1999.

Opportunity for restoration of Philippine teak population

Fruit maturity of Philippine teak is observed during the rainy season (July-August). Rain causes the matured drupes to fall on the ground. Further observation shows that the drupes remain dormant on the forest floor for almost a year and on the onset of another year's monsoon, the seeds burst from dormancy. During this event, hundreds of wild germinants (Figure 2f Teaklet) 3.5 – 6.0cm long can be isolated and transplanted to a temporary nursery in order to save them from the desiccating effects of summer**.** After three years, the nursery adapted germinants (seedlings) can be adopted by the local community or can be re-introduced to the original habitat.

The local microclimatic regime in LSJM in the last four years has never been worse for both agroecological and natural forest landscapes due to the prolongevity of the summer which makes it difficult to maintain optimum environmental conditions for the species' survival. In fact, mountain farmers' rain-dependent fruiting of sugar apples (*Annona squamosa*), one of their main sources of income has been delayed in the last four years (2004-2007) due to the holdup of rains that then lasted for three to four months. This observation may indicate that this part of the Philippine archipelago is highly vulnerable to climatic abnormality. Normally, the monsoon comes in early May with the highest rainfall in the months of July to October (ERDB, 2004). Despite this, the mass flowering observed in Philippine teak once the monsoon arrives can be advantageous for the species' perpetuation at least in

its natural distribution. But to what extent? Teaklets are desiccated every summer under their leafless mother trees and they are gone forever. Their chances of survival are as small as they are.

The cheapest way of forest restoration is through assisted and natural regeneration. The success of this can be affected by many factors such as climatic change that drives the frequency of flowering and hence abundance of fruits and seeds. Most of the time, only small numbers of the trees flower sporadically in any population. In the case of Philippine teak, almost every aging individual (8-27m high and up to 80cm in diameter) has been observed in mass flowering. This episode probably will not occur annually and therefore, efforts to preserve the young population of Philippine teak trees are recommended. Philippine teak has been highlighted since 1998 by the International Union for the Conservation of Nature (IUCN) for being vulnerable to extinction.

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