IMPACT OF THE TROPICAL CYCLONE OCKHI ON RUBBER CULTIVATION IN KANYAKUMARI AND VULNERABILITY OF RUBBER PLANTATIONS IN CYCLONE PRONE AREAS

James Jacob and B. Pradeep

Rubber Research Institute of India, Rubber Board, Kottayam- 686 009, Kerala, India

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Tropical cyclone Ockhi that came close to Kanyakumari district in Tamil Nadu state of India on 30 November 2017 destroyed close to half a millioin rubber trees in the district even though the eye of the storm did not make a landfall there. The scale of the destruction was unpercedented in the nealy 120 year history of rubber cultivation in India. More than 900 smallholdings lost about 1,78,000 trees and the large estates in the district lost another 2,83,000 rubber trees. The affected smallholdings lost an average of 61 per cent of the trees. A few medium sized estates also lost more than 50 per cent of the trees. More than 95 per cent of the loss was due to uprooting. Mature and yielding trees and trees planted in lowlying fields were more vulnerable to uprooting. No loss of trees was reported from adjacent Kerala, except for some loss in Punalur region, about 100 kms North of the most affecetd areas in Kanyakumari district. Potential threats to rubber cultivation in India and other countries from severe tropical cyclones in the context of global warming are also discussed.

Key words: Global warming, Kanyakumari, Ockhi, Rubber cultivation, Tropical cyclone

INTRODUCTION

Kanyakumari is a traditional rubber growing region in South Western India where productivity is very high. The district has not experienced any major tropical cyclones until a severe tropical cyclone, Ockhi came close to and on 30 November 2017. Several non-traditional rubber growing tracts along the Eastern coast and North Eastern Region of India has witnessed far more number of tropical storms than the Western coast of India where most of the rubber plantations exist. Studies show that continued warming of the oceans due to global warming may lead to more violent tropical storms in the Eastern Indian coast and many parts of the Asia-Pacific regions (Shenoi *et al.*, 2014, Mei and Xie, 2016; IPCC, 2014; Knutson *et al.*, 2010; Mendelsohn *et al.*, 2012) which produce more than 90 per cent of global supply of natural rubber. Rubber being a perennial tree crop with an economic life of nearly 30 years, it is not feasible to replant if the plantations are destroyed by frequent cyclones. There are no clones that can survive heavy wind lash. Neither can windbelts protect rubber trees from severe storms. There has

Correspondence: James Jacob (E-mail: james@rubberboard.org.in)

been an almost indiscriminate expansion of rubber cultivation in recent years in many parts of the world. Occurence of Ockhi in Kanyakumari district raises some serious questions about the feasibility of expanding rubber cultivation in cyclone prone regions.

Metereological history of Ockhi

India Meteorological Department (IMD) identified a low pressure depression area in the Indian Ocean, West of Sri Lanka and South of Kanyakumari on 29 November 2017 morning (IMD, 2017) which was reported in the online edition of Business Line (Business Line, 2017) the same day. By the next day morning it intensified into a severe cyclonic storm named Ockhi and came close to Kanyakumari in the Southern tip of Indian mainland before moving off the land in a westward direction towards Lakshwadeep Islands. It picked up more momentum on its path and eventually acquired a wind speed qualifying of an extremely severe cyclonic storm on 2 December 2017 (Fig. 1). The strom made landfall in Lakshwadeep Islands where it left a trail of massive destructions before moving northward towards Gujarat coast and by 5 December 2017, Ockhi lost its stream. Moving from South West of Sri Lanka over the Indian Ocean and the Arabian Sea to Gujarat coast without making a landfall on mainland of India, Ockhi had a life of less than six days.

Destruction to rubber plantations

At 1:54 pm IST on 30 November 2017, the National Polar-orbiting Partnership (Suomi-NPP) satellite of the US National Oceanic and

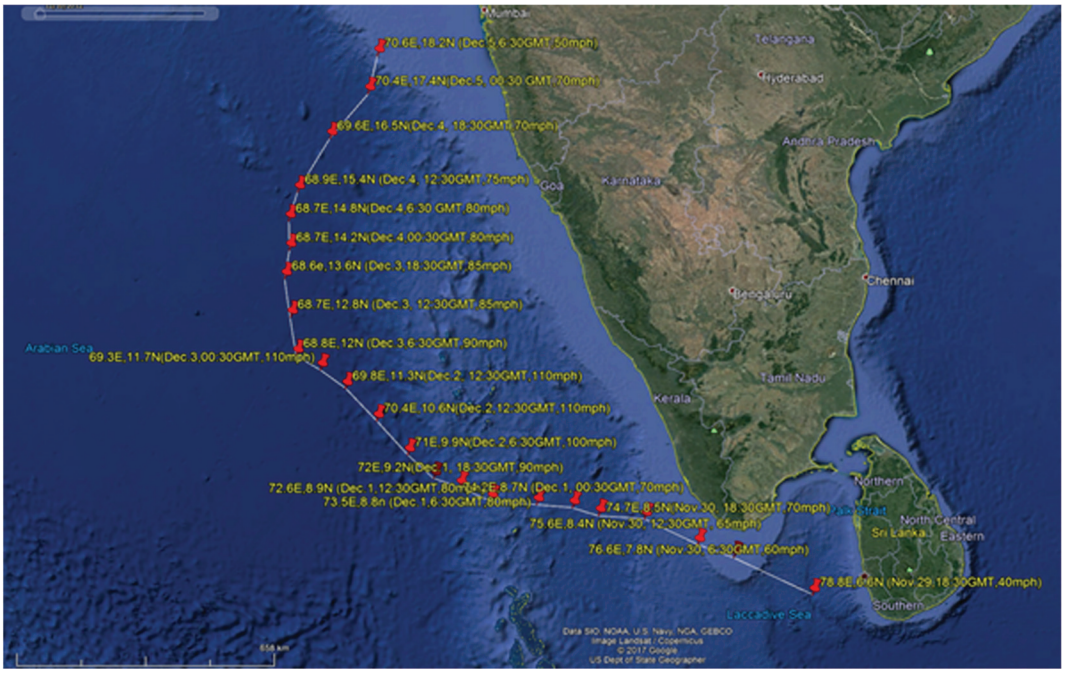

Fig. 1. Path of tropical cyclone Ockhi from 29 November to 5 December 2017 plotted based on the tracking data available in https://www.wunderground.com/hurricane/indian-ocean/2017/tropical-cyclone-ockhi

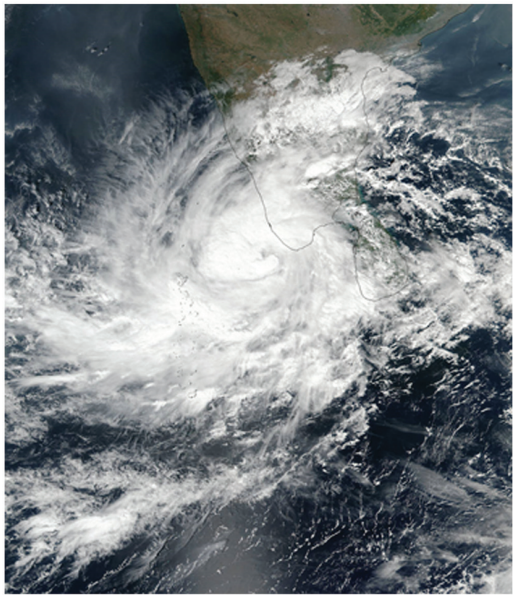

Fig. 2. Eye of tropical cyclone Ockhi moving westward away from Kanyakumari pictured at 1:54 pm IST on 30 November by NASA. (https://www.nasa.gov/feature/goddard/2017/ockhi-northern-indian-ocean).

Atmospheric Administration pictured Ockhi South-West of Kanyakumari in the Indian Ocean not very far off from the mainland (Fig. 2). Kanyakumari district, a major rubber growing area is the closest region on mainland of India to which Ockhi came near (Fig. 2). In the morning hours of 30 November 2017, Ockhi left a trail of severe destruction along the rubber growing tracts of Kanyakumari district even as it moved away from the coast without making a full impact landfall on Indian mainland (Fig. 1 and 2).

Tamil Nadu has a total of nearly 21,000 ha of natural rubber plantation spread in three taluks of Kanyakumari district, namely Kalkulam, Vilavancode and Thovala; Agesthewaram is the only other taluk in this district where no rubber is grown (Fig. 3). Kanyakumari is also the region where rubber productiviy is the highest in India. Yields close to 2.5 to 3 tonnes ha^{-1} $year^{-1}$ are recorded in some of the well maintained estates in the region; thanks to the congenial weather conditions, particularly the well distributed rain fall. This is the first time in the more than 120 year history of rubber cultivation in this district or anywhere else in India a tropical cyclone of this severity has struck destroying several lakhs of rubber trees.

Of the three rubber growing taluks in the district, Kalkulam and Thovala taluks took the brunt of Ockhi in terms of the number of rubber trees lost. As per data available, more than 461,000 rubber trees from more than 900 smallholdings and some of the large estates were destroyed in Kanyakumari district (Table 1). In these smallholdings, on an average 61 per cent of the trees have been lost. A few large estates lost as many as 50 per cent of the trees.

Nature of damage in more than 95 per cent of the cases was complete uprooting of the trees and in the rest it was breaking of the main trunk or branch snap. Almost all the uprooted trees were mature trees and they fell in an East-West direction which was roughly the direction of the wind. Immature plants were found bent or with the main stem broken in some cases. It appeared that trees planted in low lying areas, which were likely paddy fields in past were more prone to uprooting.

Table 1. **Number of rubber trees lost due to tropical cyclone Ockhi in Kanyakumari district**

Holdings	No. of trees lost
Large holdings	2,83,000
Small/marginal holdings	1,78,000
Total	4,61,000

(Data provided by Regional Office of Rubber Board, Kanyakumari district)

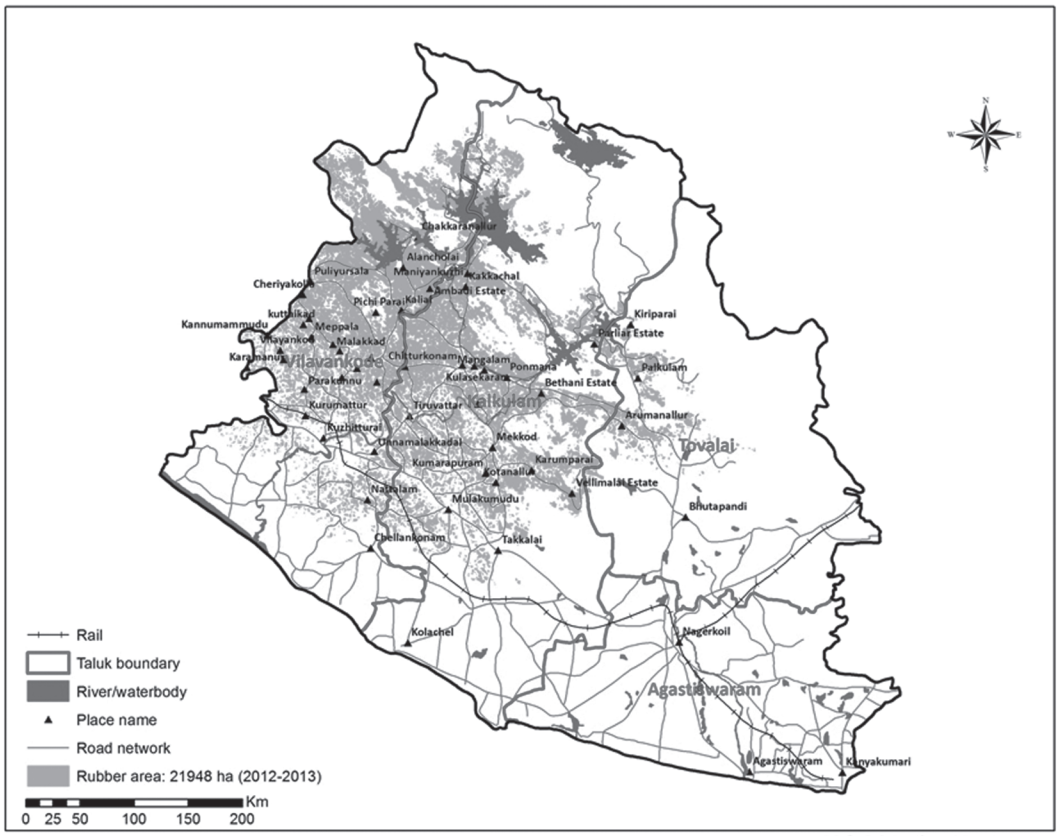

Fig. 3. Distribution of rubber plantations in Kanyakumari district.

Eye witnesses said that high velocity wind started by around 6.30 AM on 30 November 2017 in the Keeripara and Paraliyar regions of Thovala taluk where it lasted for about two hours with only short lulls. In more than 40 places one to two kilometers apart, hundereds of trees could be seen completely uprooted contiguously leaving a large gap in the rubber canopy. But adjacent to these gaps created by the uprooted trees were standing trees with little damage. This indicates that Ockhi came with very strong gusts and where they hit the ground, there was near complete uprooting of rubber trees. In additon to this, lesser number of trees were found uprooted throughout the rubber plantations in the region following no specific pattern. About 10-15 kilometers away from Keeripara in the interior areas of the Kothayar region close to the Western ghats, strong winds occurred between 7.30 AM and noon in four or five short spells of around 15 minutes, indicating the power of the cyclone declined as it moved over the land. Trees were uprooted everywhere in Kothayar in a random manner, but the scale of destruction was not so widespread as in the other two regions. The high speed winds stopped by noon.

Human casualities on the land were fortunately very few even in those areas where thousands of rubber trees were

uprooted. Based on the number of trees lost, it is easy to estimate that the area lost is only around 2000 ha or so which constitutes about 10 per cent of the total rubber area in Kanyakumari region. The presence of fully and partially damaged trees scattered in the plantations adversely affects the land productivity in the region and economic viability of these holdings. Complete replanting can be taken up only in those holdings that lost most of the trees. Even if only some trees are lost, it is impossible to do gap filling in mature holdings. Partially damaged holdings will remain a liability for the farmer until the next replanting.

Ockhi also struck rubber holdings in Punalur region of Kerala lying more than 100 kms North of Kanyakumari district. The loss in that region was only a few thousand trees. Apart from Kanyakumari district, Punalur is the only other place where Ockhi destroyed rubber trees.

Histroy of occurrence of tropical cyclones along the Eastern and Western coasts of India

Coastal regions along the Arabian Sea (West coast) do not experience as many major tropical cyclones as the Bay of Bengal coast (East coast). This is because the Arabian Sea is relatively colder than the Bay of Bengal (Shenoi *et al*., 2004) and hence is less congenial for the formation and intensification of cyclones. East coastal districts especially in the states of Odisha and Andhra Pradesh are more vulnerable to cyclones than those on the Western coast and coastal regions of Gujarat state are highly vulnerable (Mohapatra *et al*., 2012). Between 1891 and 2002, the Eastern coastal districts were hit by a total of 308 tropical cyclones out of which 98 were in Odisha and 79 were in Andhra Pradesh (ncrmp.gov.in). During the same period, Western coastal districts experienced only 48 cyclones and out of this 28 were in the coastal districts of Gujarat. Kerala and Karnataka coasts had only three and two cyclonic storms, respectively.

Caution for rubber cultivation in cyclone-prone areas

Rubber cultivation is expanding in India along several non-traditional areas such as the North Eastern Region and the Eastern and Western coastal states. Odisha state on the Eastern coast (Krishan, 2014) and Tripura state (unpublished reports) in North Eastern Region of India regularly experience tropical cyclones and as many as 5-10 per cent trees can be lost if severe cyclones strike rubber holdings which is devastating for smallholders. In Tripura, major tropical cyclones with a wind speed ranging from 100 to 140 km h^{-1} occurred in 1986, 1994, 2003, 2004 and 2007 usually during the months of April/May and loss of trees ranged from three to 12 per cent in the affecetd holdings (Unpublished reports). Mature and yielding trees were more vulnerable to damage than young trees in Tripura as was noticed in Kanyakumari.

Global warming may make cyclones more severe in the years ahead. It is expected that oceans will continue to get warmer and it will cause more extreme weather events to occur, including intense and violent tropical storms (IPCC, 2014; Knutson *et al*., 2010; Mendelsohn *et al*., 2012). The Eastern coastal districts of India which are already vulnerable to tropical cyclones are likely to become more so in future. Warming of oceans may result in marked increase in the severity of tropical cyclonic storms on the Eastern coast of India (Mishra, 2014). It is not easy to develop wind tolerant high yielding clones that can withstand the onslaught of severe tropical cyclones. Planting windbelts around a rubber plantation can at best give

some protection against moderate winds, but not violent cyclones. Therefore, it is necessary that we take a more prudent and cautious approach towards large scale expansion of rubber cultivation in regions that are already known to be highly cyclone-prone.

Wakeup call for rubber growing countries in South and South East Asia

Tropical storms are common in China, India, Sri Lanka and most of the South East Asian countries from where comes more than 90 per cent of world's natural rubber. Occasionally, they have caused massive destruction to rubber plantations in China, Myanmar, Philippines, Vietnam and Thailand. The severe tropical cyclone, Nargis wiped out large stretches of rubber holdings in Myanmar in May, 2008 (Lateef, 2009). Recently, there has been large scale expansion of rubber cultivation in Myanmar, a country that had as many as 18 major tropical cyclones in the past 25 years. Hainan islands form the heartland of rubber cultivation in China and this region is particularly vulnerable to tropical cyclones (Shihna, 1984; Yanshi *et al.*, 2011; Zhang *et al.*, 2016). Cyclones are a major problem in North Sumatra, Indonesia and the tree stand is greatly reduced particularly in areas affected by white root disease (IRRDB, 2013). They are a concern in several other countries like Sri Lanka (Silva and Silva, 1971). Some plantations in Indonesia and Guatemala practice canopy pruning to reduce tree height and thus reduce wind damage, but this has not been very effective (Personal communication from Mr. Carlos Nájera, Gremial de Huleros, Guatemala and Dr. Thomas Wijaya, Indonesian Rubber Research Institute, Indonesia).

Recently, the tropical cyclones and typhoons that struck East and Southeast Asia have become stronger probably due to the effects of global warming (Mei and Xie, 2016). It cannot be said with certainty that any particular extreme weather event like the cyclones Ockhi or Nargis is a product of global climate change, but one should not miss the larger picture of more frequent occurrences of violent cyclonic storms in South and South East Asia which is a clear and loud wakeup call to rubber growing countries in this region.

REFERENCES

BusinessLine (2017). (http://www.thehindu businessline. com/news/weather-update-depression-forms-off-sri-lanka-kanyakumari-to-intensify-further/article9976160.ece) IMD 2017 (http://www.imd.gov.in)

IPCC (2014). Climate Change 2014 Synthesis Report (Eds R.K. Pachauri *et al.* Intergovernmental Panel on Climate Change. pp 2-212.

IRRDB (2013). Report of the IRRDB Agronomy workshop, Medan, 9th to 12th May, 2013.

Knutson, T.R., McBride, J.L., Chan, J., Emanuel, K., Holland, G., Landsea, C., Kossin, J.P., Srivastava, A.K. and Sugi, M. (2010). Tropical cyclones and climate change. *Nature Geoscience*, **3**: 157-163 (doi:10.1038/ngeo779).

Krishan, B. (2014). Impact of cyclones and periodic strong winds in *Hevea* plantations and screening of wind resistant clones in Odisha state. *Rubber Board Bulletin*, **32**(4): 10-15, 35-38.

Lateef, F. (2009). Cyclone Nargis and Myanmar: A wakeup call. *Journal of Emergencies Trauma Shock:* 2: 106-113. (doi:10.4103/0974-2700.50745).

Mei, W. and Xie, S.P. (2016). Intensification of land falling typhoons over the northwest Pacific since the late 1970s. *Nature Geoscience*, **9**: 753-757 (10.1038/ngeo2792).

Mendelsohn, R., Emanuel, K., Chonabayashi, S. and Bakkensen, L. (2012).The impact of climate change on global tropical cyclone damage.

Nature Climate Change, **2**: 205-209 (doi.10.1038/nclimate1357).

Mishra, A. (2014). Temperature rise and trend of cyclones over the eastern coastal region of India. *Journal of Earth Science and Climate Change*, **5**: 227. (doi: doi: 10.4172/2157-7617.1000227).

Mohapatra, M., Mandal, G.S., Bandopadhyay, B.K., Tyagi, A. and Mohanty, U.C. (2012). Classification of cyclone hazard prone districts of India. *Natural Hazards*, **63**:1601–1620. Springer. DOI 10.1007/s11069-011-9891-8.

Shenoi, S.S.C., Shankar, D. and Shetye, S.R. (2004). Why is Bay of Bengal warmer than Arabian Sea during the summer monsoon? Proceedings of the National Symposium METOC - 2004 on Emerging Trends in the Fields of Oceanography and Meteorology, Kochi, India; 5-6 Feb 2004; pp. 87-93.

Shihua, L. (1984). A preliminary study on causes of typhoon damage on rubber trees [J]. *Chinese Journal of Tropical Crops*, **1**: 007.

Silva, C.G. and De Silva, MUJ (1971). Survey of wind damage in rubber plantataions. *RRIC Bulletin*, **6**(1/2): 1-11.

Yanshi, C.H.H.Y., Jiawei, A.Z.Z.Q.Y. and Min, T.U. (2011). Wind Damage Investigation of Typhoon" Nesat" at National Rubber Tree Germplasm Resource Field Identification Nursery in 2011. *Chinese Journal of Tropical Agriculture*, **12**:1- 13.

Zhang, J., Huang, H., Che, X. and Zhang, M. (2016). Evaluation of typhoon disaster losses of Hainan Island rubber plantations. Proceedings of the 7th Annual Meeting of Risk Analysis Council of China Association for Disaster Prevention, November 4-6, 2016, Changsha, China. Pp. 251-256. (DOI: 10.2991/rac-16.2016.40)