

SHELTER BELTS AGAINST STORMS AND CYCLONES ON THE COAST

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The Sea-Coast is characterised by sand beaches and sand dunes whatever be the character or composition of the soil on the Coast. The uninterrupted breeze across the sea and the rhythmic tidal waves continuously pile up sand along the coast in the form of almost a continuous ridge which is a natural tidal bank containing the sea within its bounds at all normal times.

However, the storms and tempests that frequently rage in the sea and hit the coast line lift the sand from the ridges and dunes and blow them inland. This results in the sand drift which covers several thousands of hectares all along the coast at present, and which threatens to engulf several thousands of hectares of fertile cultivated lands all along the east coast in Andhra Pradesh.

Nature tries to assert itself and as a result *Spinifex squarrosus*, *Cyperus rotundus*, *Ipomea biloba* and *Pandanus odoratissimus* grow on the sands and bind the sand particles together to stabilize the drifting sands. *Calamus* species grow wherever water collects in the sheltered niches on the leeward side of the sand ridge or embankment.

Along the east coast from Nellore in Andhra Pradesh to Tinnevely in Tamil Nadu the dry evergreen forest occurs under intense heat and humidity and the influence of the South-west and North-east monsoons. This forest ameliorates the climate, protects the coastal agriculture and supplies fuel and pasture to the cattle. From Nellore to Srikakulam in the north, the coast is interspersed with estuaries of several rivers mightiest amongst which are the Godavari and Krishna. Rich and extensive Mangrove forests occurred in the past in the estuary of the Krishna around Bandar or Machilipatnam and in the estuary of the Godavari around Kakinada in East Godavari District. mangrove forests can persist in situations where salt water of the sea and the fresh water of the rivers alternate with each other. As the rivers deposit the silt when they are in spate the salt water cannot reach the vegetation and the raised mud flats gradually get desalinated by fresh waters of the river and rain. The Mangrove forests gradually give place to general vegetation and *Thespisia* and *Prosopis* Pioneer the colonisation of estuarine tract elevated by the process of silting.

The moment Mangrove forest starts disappearing, the raised mud flats are banded and flooded with river water by the enterprising Delta farmers to leach the Salinity and the addition of gypsum hasten the process. Thus the dry evergreen forests and the estuarine forests have been gradually dwindling and the natural shelter belt on the east coast has almost disappeared.

When most of the garden lands of Coconuts, Mango and Sapota of Srikakulam Coast growing by a very apt name of 'Udyanam' were threatened by the invasion of sand dunes of the sea coast, the Forest Department commenced planting *Casuarina* *Cashew* and *Acacia auriculiformis* at Srikurman in 1974 and achieved in a small way commendable success in stemming the sand drift. The District Collector, Srikakulam, a foresighted Administrator took the courageous step of handing over all the Government lands along the Coast to the Forest Department in 1974-75.

Utilizing the special funds provided under Six Point Formula for the development of backward regions of the State the Forest Department have so far raised a thirty km long shelter belt of *Casuarina* interspersed with *Acacia auriculiformis* planted at 1.5 m × 1.5 mt. in seventy rows between 1974-75 and 1977-78 at a cost of Rs 15 lakhs.

Without giving the tag of 'Shelter belts' the Forest Department has been planting *Casuarina* all along the coast from Visakhapatnam to Nellore since 1920. *Eucalyptus* and *Cashew* plantations raised as 'Block' plantation on the leeward side of *Casuarina* plantation belt since 1958-59 provided the reinforcement necessary and supplied the demands for fuel and small timber. Sriharikota island in Pulicat lake famed for the extensive and remunerative *Casuarina* plantations which used to supply the fuel needs of Madras City is now under the control of 'SHAR' Project but serves the purpose of a shelter belt as tree growth is zealously protected.

The total Coast line of Andhra Pradesh from Srikakulam to Nellore District is about 1000 km long and the length of the Reserve Forest belt facing the sea is 204 km. The length of the R.F. covered mostly by *Casuarina* plantations is 103 km and the length of the forest belt which can be planted as a shelter belt 32.14 km.

Name of the District	Total coast line km	Length of R.F. or Forest km	Length of R.F. covered by plantations km	Balance forest length available for plantations
Srikakulam	160	9	9	23
Visakhapatnam	160	8	8	—
East Godavari	161	6	6	—
		+64 Mada	+64 Mada	
West Godavari	31	—	—	—
Krishna	116	32	—	—
Guntur	52	44.60	43.40	1.20
Prakasam	117	25.50	25.50	—
Nellore	168	15.04	10.92	4.12
	965	204	103	32

Shelter belt planting on a massive scale was done in Andhra Pradesh (in the erstwhile Madras State) along the eastern bank of the Hagari between 1946 and 1953 to prevent the sand drift from the wide sand bed of the dry river and protect the agricultural fields and villages which were over-run by the moving sands and dunes. Because of aridity of the locality and the clayey soils obtaining, *Prosopis* was planted and the villages were saved. Now these continuous shelter belts worked on Simple coppice system provide feed for cattle and small timber to local population and give revenue to the State.

In the arid Districts of Andhra Pradesh, shelter belt planting is being done along the river Penna in Anantapur and Cuddapah and along the River Cheyyer at Attirala in Cuddapah since 1953. The species chosen are *Sisau*, *Eucalyptus* and *Tecoma*. This work is being continued under D.P.A.P, in these dry tracts and the results have been very satisfactory. The sand drift is arrested, the dunes are stabilised and the soil has improved due to the leaf and root decay.

However, in raising these shelter belts not much scientific study was made and "aerodynamics" was not studied. Investigations made into these aspects by Foresters have led to the following conclusions.

- (i) Sheltered zone on leeward side (before incident flow is re-established) extends to approximately 15 to 30 times the height of the belt.
- (ii) A dense belt provides greater shelter immediately to leeward but the sheltered distance is less, compared to a more permeable belt. A moderately permeable belt is the best.
- (iii) Porosity is apparently important in the effectiveness of shelter belt and proper selection of tree species is necessary. Porosity especially near the ground level is desirable.
- (iv) A shelter belt is mainly a function of height and permeability. The width influences the general micro-climate but not the reduction in wind velocity.
- (v) A belt which rises and falls abruptly on windward and leeward sides is said to be more effective. Smaller trees and shrubs should occupy the interspaces between the tall trees.
- (vi) The depth of the shelter belt or barrier should normally be 10 times the height of the shelter belt.

When the killer cyclone hit the east coast on the 19th November, 1977 and destroyed the villages, fields, groves and took a heavy toll of human and animal life, there were reports in the Press that in stretches where the Forest Deptt. had raised *Casuarina* and other Plantations along the Coast, the fury of the rolling waves and the bellowing storm were, to some extent, arrested and the loss of life and property was considerably less. Dr. K.L. Rao and other Technocrats issued statements that the Forest Department should plant continuous

shelter belts all along the Andhra Coast from Srikakulam to Nellore as one of the methods of Cyclone or Storm proofing of the Coastal villages.

Inspection of Cyclone damage and the enquiry with the fisherman living right on the sea front, at Nizampatnam in Guntur District and several other places along the Coast confirmed the belief that the *Casuarina* plantations existing along the Coast did reduce the velocity of winds and the fury of the waves. In the tree less Bandar Port area where even the stunted Mangrove forest is cleared for fuel by the town's population, the boats and the smaller ships moored in the waters were carried in the high tides and thrown on the land. But at Nizampatnam and elsewhere where shelter belts and dwarf Mangroves exist, the fishing boats were caught and held secure between the trees of the shelter belt plantations of *Casuarina*. Of course, the *Casuarina* poles snapped in the middle and it may be necessary to harvest these tree belts and replant them as early as possible.

Whether or not such unprecedented cyclones as occurred on the fateful evening of the 19th November, 1977 can be effectively tamed by the tree belts along the Coast, the severity of oft occurring tempests and storms causing considerable damage to the lives and property of the Coastal population can certainly be contained and reduced by the shelter belt planting now contemplated.

There are no forests worth the name along the east coast and the fertile plains of the coast irrigated by the Godavari and the Krishna have attracted the concentration of dense populations. The numerous towns and villages require fuel and small timber and any shelter belt planting and the "Block planting" that is made possible on the leeward of the shelter belt should take this aspect into consideration.

In Tunisia, Foresters have tried mixed species coniferous trees planted for production of timber and forage, while raising shelter belts. In Egypt *Casuarina* is planted around farm lands to protect the farms from the sand drift and to provide much needed fuel and small timber. In Sudan, *Eucalyptus camaldunensis* and Neem are planted according to the available soils both for shelter and income.

Therefore, there is nothing wrong and in fact, it is necessary to confine the protective and production functions in raising coastal shelter belts on a massive scale for the benefit of the masses.

The length of the Coast line is 965 km and the length covered by Forests is only 204 km. The balance length is covered by private and the Government lands which may have to be acquired at considerable cost and trouble. The District Collectors have enthusiastically agreed to transfer Government lands to the Forest Department for raising shelter belts and help the Forest Department in acquiring private lands.

To ascertain these details, to estimate the total length of the shelter belt that can be raised, to ascertain the soil types that exist under the sands and to calculate the estuaries or creeks that cannot be planted up, three Working Plan Parties existing in Coastal Districts are being deployed. Two special parties to survey the coastal belt in the

districts of Krishna, Guntur, Prakasam and Nellore are being arranged with the concurrence of the Government and the work will soon start in right earnest.

Meanwhile, the technique of shelter belt planting combining the protective and production functions and the aerodynamics, saltation, suspension and surface creep of the coastal sands needs to be perfected.

Planting *Casuarina* at 1.5 m × 1.5 m may not permit permeability probably an interval of 2 mt in the rows along the coast line and 3 mt between the rows may ensure permeability and growing space for the shelter belt, incidentally reducing the costs per unit area.

Planting of short trees or shrubs in the front row facing the sea, followed by 20 or more rows of *Casuarina* and another 20 rows of *Cashew* at wider espacement would achieve the multiple purpose of the shelter belt. Orissa Forest Department is reported to have raised 11,400 ha of shelter belt planting on the coast mixing *Casuarina* and *Cashew* judiciously.

Construction of an effective palisade of *Pandanus odoratissimus* at the commencement of planting, and growing *Ipomea pescapae* or *I. biloba* on the windward side to bind the sand and fix the dunes would constitute the preliminary operations.

This massive programme that will be undertaken by the Forest Department to benefit the masses on the Coast would bring the Foresters living in Jungleisolation into direct contact with the people. Here is the opportunity for the Foresters to practice Social Forestry on an unprecedented scale. Here is the chance for the Forest Department to improve their image in the public. Let us seize this opportunity and serve the people.

SUMMARY

The characteristics sand dune formation and the nature's assertive activity to stabilize the drifting sands and dunes are in evidence along the sea coast. Mangrove forests at estuaries and dry evergreen forests along the coast contain the storms and protect the fields from invading sands. But the constantly rising mud flats cause the disappearance of estuarine forests and the man's need and greed result in the degradation of dry evergreen forests.

Some protection from drifting coastal sands is afforded to the cultivation by the plantations of *Casuarina* raised on a small scale. Only about 10% of the coast length in Andhra Pradesh is thus covered by Forest plantations. To arrest sand drift from dry river beds in the hinter lands, wind belt plantations of *Prosopis* were raised in forties and fifties.

The principles and aerodynamics of 'Shelter belts' are discussed and the damage caused by the 'Killer' Cyclone of East Coast in November, 1977 is indicated, the need to raise a green belt of trees along the coast to minimise damage by the cyclones is emphasized and the technique of planting suggested.

भूकवत और वात्याचक्रों के विरुद्ध सागरतट पर रक्षि मेवलाएं बनाना

लेखक सी०वी० कोंडा रेड्डी

सारांश

विशिष्ट प्रकार के रेत टीलों का बनना और प्रयोदी रेत और टीलों को दृढ़ बनाने के लिए प्रकृति की निश्चयी क्रिया सागरतटों पर देखने में आती है। खाड़ी के वायुशक्ति वन और समुद्र तट के शुष्क सदाहरित वन तूफानों को रोकते हैं और बढ़ती हुई रेत से खेतों की रक्षा करते हैं। किन्तु कीचड़ का तल निरन्तर ऊंचा उठते रहने से खाड़ी के वन विलुप्त हो जाते हैं तथा मानव की आवश्यकताएं और जालव शुष्क सदाहरित वनों का विनाश कर रहे हैं।

छोटे परिमाण पर लगाए गए कंजुआरिना रोपवनों से तट के अपवाही रेत के प्रति खेतों को कुछ सुरक्षा मिल जाती है। आंध्र प्रदेश में वन विभाग के ऐसे रोपवन समुद्र तट की पूरी लंबाई के केवल लगभग 10 प्रतिशत भाग पर लगे हुए हैं। मूखते हुए नदी पाट से उड़कर आने वाला रेत पृष्ठ देश में पहुंचना रोकने के लिए चालिसे और पचासे दशक में प्रोसोपिस के वात रक्षि रोपवन लगाए गए थे।

प्रस्तुत लेख में रक्षि मेखलाओं के सिद्धान्तों और वायु गतिकी का विवेचन किया गया है तथा नवम्बर 1977 में पूर्वी समुद्र तट के संहारक वात्याचक्र में पहुंची क्षति बताते हुए ऐसे वात्याचक्रों से होने वाली हानि रोकने के लिए पूरे तट के किनारे-किनारे हरी वृक्ष मेवला लगाने की आवश्यकता पर बल दिया गया है तथा उसे लगाने की रीति सुझाई गई है।

Schutzmäntel gegen die Stürme und Zyklone auf die Küsten

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ZUSAMMENFASSUNG

Die merkmale sanddüne Bildung und anmassende Tätigkeit der Natur den treibende Strad und Dünen zu etablieren sind die Seeküste entlang augenscheinlich. Mangrove Wälder auf Mündungen und trocken immergrünere Wälder die Küste entlang enthalten die Stürme und schützen die Felder gegen den eindringende Strand. Aber die immersteigende Schlammebenen verursachen das Verschwinden der mündunge Wälder, und der Mangel und die Gierigkeit des Mannes entsteht sich nach Degradation der trockenere immergrünere Wälder.

Ein Schütz gegen den treibende Strand ist zur Bebauung bei den *Casuarina* Pflanzungen, im kleiner Maßstabe gewachsen, bestritten. Nur etwa 10% der Küstelänge im Andhra Pradesh ist bei forsten Pflanzungen so gedeckt. Zu aufhalten den Sandtrieb aus trocken en Flußbetten in Rückeländer waren windmantele Pflanzungen der *Prosopis* in vierzig und fünfzig Jahren gepflanzt.

Die Grundsätze und Luftdynamik der Schutzmäntel werden diskutiert, und der Schaden beim 'totschläger' Zyklon der Ostküste im November 1977 ist angezeigt, und der Mangel einen grüne Mantel der Bäumen, die Küste entlang zu erheben, den Schaden bei den Zyklonen zu verringern, ist betont, und die Technik der Pflanzung suggeriert.

Zone-limite du peuplement contre les tempêtes et les cyclone,
le long des bords de la mer

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Résumé

La formation caractéristique des monticules saplonneux et l'activité pérennitaire de la nature de stabiliser les sables et les dunes sont en évidence le long des bords de la mer. Les forêts de mangliers dans l'embouchure des fleuves et les forêts sèches toujours vertes le long de la côte contiennent les tempêtes et empêche l'invasion des terrains per table. D'autre part l'élévation sans cesse de plage de vase provoque la disparition des forêts dans l'embouchure des fleuves et les exigences et l'avidité de l'homme mement à la dégradation des forêts sèches toujours vertes. Plantation de *Casuarina* par petites-surfaces offre un per de protection contre le sable mouvant. Seulement 10% due bord de la mer de l'Andhra Pradesh est auisi couvert de peuplements forestiers. Pour arrêter le mouvement de sable du lit see des rivières, se situent dans l'arrière-pays, on a planté *pro cpiis* dans les années quarantes et cuiquantes, en forme de ceinture des arbres de protection contre le vent.

Les principes et aérodynamique de 'Shelter Belt' ont été discutés et le dégât occasionné par le 'Killer' cyclone qui an menacé la, Côte orientale en Novembre 1977, indiqué. On a appuyé sur la nécessité de créer une ceinture d'arbres le long de la côte, pour reduire au minimum les d'égâts dus aux cyclones. Ou a également proposé la technique sylvicole, à adopter, pour la création des peuplements.

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