Developmental Strategies and its Impact on an Island's Ecosystem and Bio-diversity: A Geographical Appraisal on Little Andaman Island, Andaman Archipelago, India

Saswati Roy
Senior Research Fellow, UGC
Visva Bharati Central University
Santiniketan, India

Little Andaman Island of the Andaman archipelago with its rainforests is the homeland of the Onge tribal community sustaining with their Eco-scape knowledge. Several developmental strategies were introduced within this island for profitable returns. Initially, dense forest was cleared for rehabilitating excess mainland population. Sequentially timber harvesting, construction of dams, quarrying activities, exotic red oil palm plantation and many more came up which are sufficient to harm the island's physical environment and also hampered the Onge's socio-cultural perspective. This ultimately resulted not only in deteriorating the island carrying capacity but deviating from the actual norms of human rights.

Keywords: Island ecosystem, Onge tribe, Eco-scape knowledge, Development strategies, Deteriorating physical and social aspects, Island carrying capacity

Introduction

Islands display considerable ranges of scale, resource availability, economic opportunities and levels of development. Despite such wide distribution and variations, islands everywhere are subject to the impact of a common range of constraints imposed of their insularity. Such constraints – remoteness, smallness, isolation, peripherality, etc. – can also affect, singly or together, certain mainland areas, but they are more notable in their effect on the islands. But the impacts of insularity on small islands are much more drastic as compared to the larger ones or mainland. This shock is seen much more on one of the most important resources i.e. the aboriginal communities sustaining in such small islands for ages together with their traditional wisdoms.

Little Andaman Island: Homeland of the Onge community

Little Andaman Island is the fifth largest island of the Andaman and Nicobar archipelago and is the southernmost island of the Andaman District. The little Andaman Island was originally inhabited by the ethnic Onge (a Palaeolithic Negroid tribe) community. This island continued to be known as *Chetty Andaman* till 1858. The modern name of Little Andaman appeared for the first time in the map of Port Blair in 1790 (Basu, 1990).

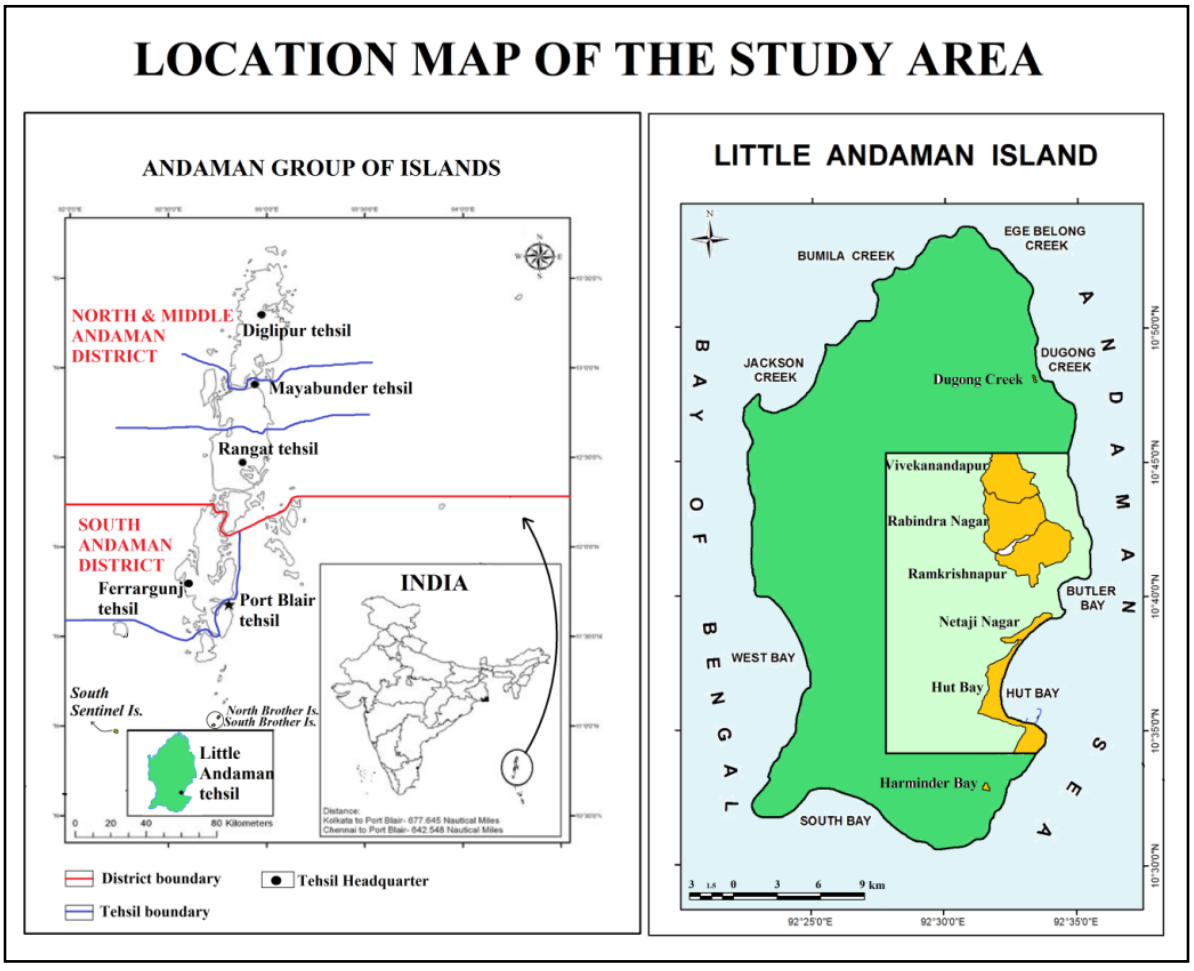

Figure 1: Little Andaman Island

Geographically, the Little Andaman Island is situated between 10°30' to 10°54' north latitude and 92°21' to 92°37' east longitude. Hut Bay is the administrative centre of this island which is about 140 km from Port Blair, the capital town of the Union Territory. This island covers an area of 732.8 square km with an elongated shape and spreads in north-south direction. Maximum length of the island is about 40 km and the maximum width is 25 km (Pandien, 2011 to 2021).

Developmental Strategies and its Impact on the Island's Ecosystem and Bio-diversity

Given that there will be some effect on the environment from any development; the expression 'environmentally sustainable development' must imply a level of compatibility between the two. The degree of impact on any locality will depend on the nature and scale of the development and the activities it may generate. Its significance will depend on the extent of the area affected and the sensitivity of its ecology to the development process (Dalal-Clayton, 1994).

The islands of Andaman and Nicobar are ecologically and socio-culturally very fragile. The developmental activities in these islands must be undertaken strictly keeping this in mind. In Little Andaman Island like that of the other islands of this archipelago the tragedy however is that most of the developmental activities undertaken in the past (as well as those which are proposed), have been (or are likely to be) mostly destructive from the ecological and social point of view (Sekhsaria, 2003).

The impacts of the various induced phenomena on the physical and social environmental aspects of this tiny Little Andaman Island are dealt in this paper. The paper is divided into two major parts –

1.1 Impact on the geo-physical environment

1.2 Impact on the social environment

1.1 Impact on the Geo-Physical Environment

Little Andaman Island's geo-physical environment mainly comprises of huge stretches of coastline, sandy beaches, coral reefs, evergreen rainforest and some perennial streams. With an area of 732.8 square km and a fragile tropical ecosystem, the development within this island should be cautiously undertaken. The development strategies already taken up within this island have a wide impact on its physical environment which is detailed below.

1.1.1 Impact of rehabilitation and resettlement within the forest area

The entire Little Andaman Island was initially declared as 'Tribal Reserve' in 1957 which was subsequently constituted into 'Reserve Forest' during 1963. The forests of this island remained practically untouched and undisturbed until 1964 when some forest areas were cleared under a rehabilitation scheme to resettle refugees from East Pakistan (now Bangladesh) and repatriates from Ceylon (now Sri Lanka) and Burma (now Myanmar). This continued till early-1970s (Pandien, 2011 to 2021). The refugees and repatriates were re-settled along a thin strip of land on the eastern coast of the island in 5 villages (vide figure 1) at Hut Bay, Netaji Nagar, Rabindranagar, Ramkrishnapur, Vivekanandapur (Bose, 1994). Each refugee family

was handed over with some 5 acres of land that were derived by clearing the tropical rainforest which had once been the hunting grounds of the Onge. Not only that, those lands were planted with coconut and betel nut trees which were alien amidst the rainforest lands. At present these rehabilitated population have not only outnumbered the indigenous population but are gradually encroaching upon the reserved forest lands.

1.1.2 Impact of timber harvesting

Timber extraction began on the island in 1970. This was carried out in the name of Andaman Canopy Lifting Shelterwood System and was recognised of being a scientific system of forestry. In 1972 about 20,000 hectares (roughly 30 %) of the island was denotified from its tribal reserve status. In 1974, assessment was done for the timber productivity of the forests of Little Andaman Island. In 1975, the Little Andaman Forest Division was created for intensive management and exploitation of the forests. Figure 1 shows the unusual rectangular shaped forest map. This is because being a virgin forest a rectangular shape was marked for commercial exploitation.

The most damning critique of forestry operations on the islands as a whole was contained in a 1983 report from the Department of Environment, Government of India in which environmental scientists argued that the basic assumption of scientific forestry underlying the Andaman Canopy Lifting Shelterwood System was absolutely wrong. This forestry system they pointed out was leading to a preponderance of deciduous elements in the evergreen system that would eventually destroy the whole island ecosystem (ANIFPDCL, 2013).

1.1.3 Impact of Red Oil Palm (ROP) plantations under the ANIFPDCL

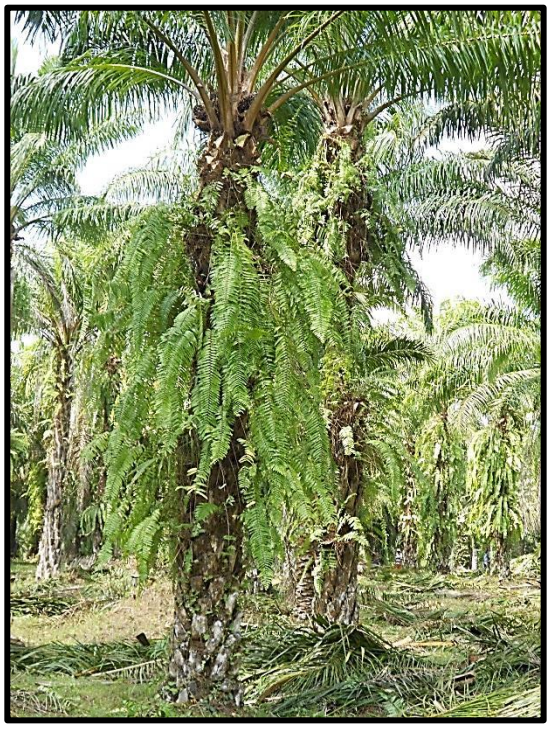

Plate 1: Epiphytes and climbers are seen affecting the ROP plantation

The Andaman and Nicobar Islands Forests and Plantation Development Corporation Ltd. (ANIFPDCL) was established in 1977 for logging, marketing and raising plantations. This saw harvestable forests getting leased out to this corporation. The ANIFPDCL took over some 19,600 hectares of forest for timber harvesting. New planting operations began in 1980-81 and the Corporation subsequently raised 1593 hectares of plantations until 1985-86. Red Oil Palm (ROP) plantations were raised to produce crude palm oil, while 21 hectares were allotted for spices, 12 hectares for coconut and 5 hectares for cashew (Sekhsaria, 2003).

Even as the company was in the process of expanding its ROP plantations to over 2400 hectares, there was a sudden shift in government policy and there was a ban imposed on further expansion in 1986

(35th Annual Report 2011-2012, ANIFPDCL).
However, by then, the exotic red oil palms brought into the island had wreaked havoc. The special attention bestowed on the exotic species through the use of fertilizers, pesticides and other chemical inputs resulted in a long term impact on the island's ecological balance.

Plate 2: Unmanaged and improperly maintained ROP plantation of Little Andaman Island

The optimum productive age of a ROP is 30-35 years. Hence, there was a decline noticed in productivity since 2015. Besides, mismanagement and improper maintenance had caused the trees to be infected by pests (vide plates 1 and 2). Exotic pests like the field rats, rhinoceros beetle and nettle caterpillars are seen to infect the endemic forest. Hence, the Forest department has finally decided to return the planted area back to natural forest once again. The plantation site is seen littered here - a typical picture of wasteful exploitation (Kharti, 2002).

Although the ROPs grew well, endemic vegetation completely disappeared leaving the soil completely exposed, since evergreen vegetation never returns. The site also saw a red oil palm factory constructed to extract red palm oil for exporting in the mainland. Most of the untreated effluents from the mill are seen to be dumped on the perennial streams contaminating the natural water resource (Kharti, 2002).

Firstly, clearing the endemic forest followed by growing exotic plantations and ultimately surrendering to the natural environment after realising the error. So, it is evident that the policies undertaken within the endemic forests came up with trial and error putting the biodiversity hotspot at stake.

1.1.4 Impact of jetty and breakwater

Jetties generally have a negative impact on the hydrodynamic regime of coastal morphology. Construction of jetties in the marine environment also results in persistent impacts on marine communities (benthic in-fauna) where the benthic fauna's characteristics changes which is ecologically less desirable (Iskander et al, 2006).

Similar, such an impact could be visualized in case of the Hut bay jetty cum breakwater (vide figure 2) in Little Andaman Island as well. Although it is an ardent need for the island's development but it had been very unscientific. The Reinforced Cement Concrete (RCC) approach jetty built at Hut Bay in Little Andaman Island is 32 m wide and 240 m long (Rai et al, 2006) built during 1965 in order to avail the rehabilitated population within this island. Further in order to prevent this jetty from the coastal erosion and storm surges a 1200m long breakwater was also constructed. It is assessed that about 1 km north of the Hut Bay jetty and 2 km further south of the island from this jetty is fully covered by dead coral rocks. The

maximum percentage of dead coral was found around the jetty at Hut Bay, the island's main town. The relative abundance of live coral here was reported to be only about 12% (Swarnakumar et al., 2008).

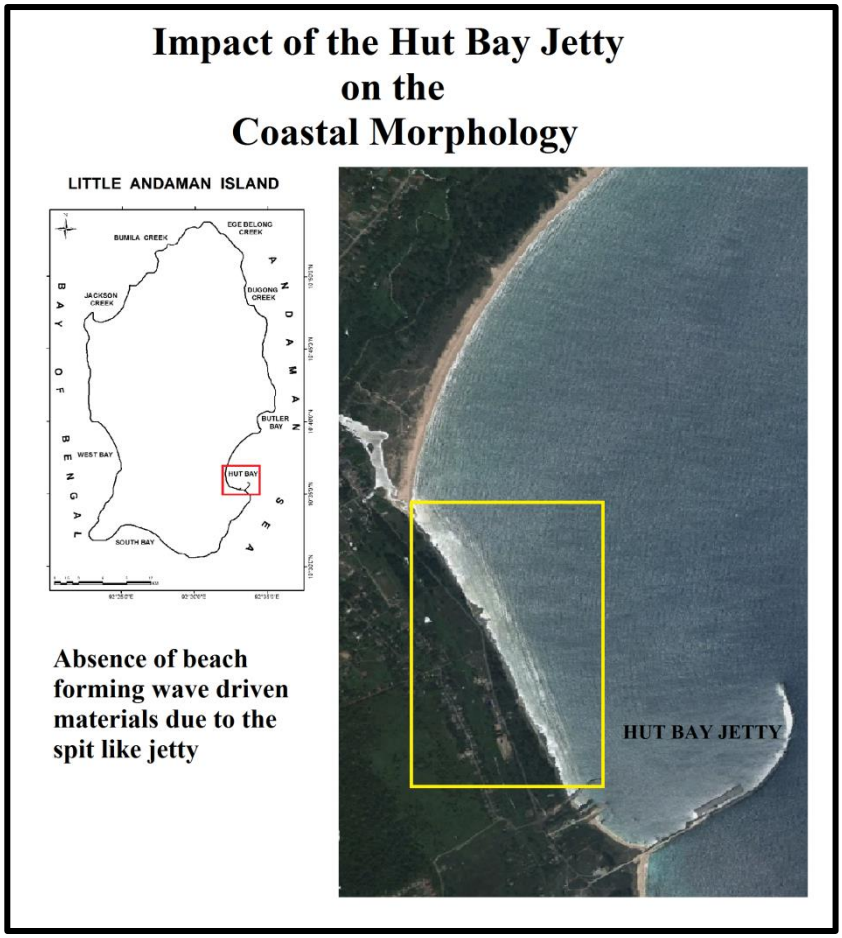

Figure 2: Impact of the Hut Bay jetty on the Coastal Morphology

This jetty is the only source of easy and cheap transport with the other parts of the archipelago. Even being the southern-most island of the South Andaman district, all the heavy cargo and commuter ships come and berth in this jetty. Soil erosion is high and the sea water is dark and muddy, preventing light penetration and affecting the growth of corals. Mud accumulation on the sea bed is found to be very high and silt accumulation is also seen on the corals themselves (Sekhsaria, 2002). The south of the Hut Bay jetty region is fully dominated by dense seaweed vegetation with higher diversity. There are live corals along the seaward side of the reef flat (Swarnakumar et al., 2008). This assessment can easily determine the negative impact within the coastal ecosystem of the jetty and the breakwater constructed for the jetty's protection.

Eventually it is also assessed that the microorganisms that thrive on the pillars of the breakwater and jetty have led to the growth of a varied benthic community that differ from the endemic coastal communities. This exotic species are the resultant of siltation, soil wash, eutrophication where the sediments wash off from the land (Sekhsaria, 2002).

1.1.5 Introduction of agriculture

After settling the refugees on the demarcated lands of the island the urgent need was to preoccupy them with cultivable lands such that they could sustain themselves in this isolated island with their traditional activity i.e. agriculture.

At present the non-tribal population of Little Andaman Island is known for commercial cultivation of vegetables, coconut, spices and areca nut. The vegetables like brinjal, lady finger, green chilli, cucurbits especially bitter gourd, bottle gourd and cucumber are grown in intensive management using chemical fertilizers, pesticides and the

products are transported to other island mainly to Port Blair in the north and Car Nicobar Island in south. Chemical fertilizers like urea and Di-Ammonium Phosphate (DAP) are applied to the vegetable crops with mean application rate of 195 and 185 kg ha^{-1} respectively, along with organic manures to the extent of 1.75MT ha^{-1} (Swarnam et al., 2015). There has been a declining production of crops mainly rice in the recent years. The rice productivity in 1975 was 1.9 tons per hectare which increased to 2.4 tons per hectare in 1985. Since then, there has been a decadal decline in the rice production with 2.1 tons per hectare in 1995; 1.7 tons per hectare in 2005 and 1.3 hectare in 2015. The excessive use of chemical fertilisers, pesticides and the over usage of soil nutrients by multiple cropping with HYV seeds might be the cause behind such a decline and is pertinent in degrading the quality of the naturally fragile calcareous soil of this tropical island. Forcibly growing of exotic species by clearing the evergreen rainforest is sure enough to worsen the situation further (Annual plan, 2015-16).

1.1.6 Impact of quarrying

There is a limestone quarry located to the south of Hut Bay. This quarry is maintained by the Andaman and Lakshwadeep Harbour Works (ALHW) and named as Andaman and Lakshwadeep Harbour Works Limestone Quarry. Limestone is quarried from a leased out area of 19.24 hectares of land. Quarrying at Hut Bay in Little Andaman includes collection and stacking of quarry products.

Plate 3: Old machineries lay astray at the ALHW quarry site

During the field study it was noticed that the blasting time of this quarry site is between 3pm to 4pm i.e. for 1 long hour blasting of stones are carried out which is absolutely not suited for such a tiny island. Not only that after visiting the quarry site it is observed that the old machineries lay astray (vide plate no. 3) and the huge excavated sites are not even filled up. As usual the excavated pits are filled up by rain water (vide plate no. 4). During heavy rain the water spills over the pits leading to eutrophication to the adjoining water bodies and leaching of minerals onto the ground water. This island bears calcareous soil in which the soil binding character is poor due to very little presence of micro nutrients and organic matter. This friability of the soil makes it pertain to a higher rate of soil erosion (Kadry, 1972). Hence, it had been absolutely injudicious to carry out unmanaged quarrying practices like this in this ecological fragile unit.

Plate 4: Huge excavated sites at the Hut Bay quarry filled up with rainwater

1.1.7 Impact of check dams and barrages

The Andaman Public Works Department (A.P.W.D.) under the Government of India constructed two dams at Ramkrishnapur and Vivekanandapur to meet the water demand of the increasing population (which rose to 20,409 in 2015 within the last four decades as per Census Report).

Plate 5: Hyacinth cover on the partly leaked Vivekanandapur dam

From the field visit it is observed that the Vivekanandapur dam is partly dried out. This dam site when visited in the early months of March was seen in a swampy condition with a good stretch of hyacinth cover (vide plate 5). On the other hand, the Ramkrishnapur dam stays without water all throughout the year (vide plate 6). After interrogating the officials regarding the reasons for such a situation, they attributed it to the huge porous limestone concentration of the island. The base of the Ramkrishnapur dam is so porous that it is incapable of holding water even during the heavy monsoons.

Plate 6: Fully dried out Ramkrishnapur dam

1.2 Impact on the Social Environment

In Andaman and Nicobar, the situation at present is fast galloping towards being a society removed from nature. The ecosystem people have been slowly and steadily made into refugees in their own land of our so called urban society (Giles, 2013).

The Onge belonging to the hunting and gathering group are concentrated only in Little Andaman Island sustaining for ages with their Eco-scape knowledge. Prompted partly by the changed situation in the aftermath of colonisation of Little Andaman Island and partly by the intension to do good to the Onge, the Government took the decision to settle the Onge at Dugong Creek in 1976-1977and South Bay in 1980 only. But after the tsunami of 2004 all the Onge of South Bay were shifted to the Dugong creek alone (vide Figure 3).

1.2.1 Impact on the folk spirit hood – a feeling of 'Topophilia'

The tsunami of 26th December 2004, affected the South Bay camp much more than the Dugong Creek due to its geographical location (vide figure 3). Though the Onge of South Bay was successful enough in escaping the wrath of nature with their rich oral tradition, the administration persuaded them to join the Onge of the Dugong Creek. Initially, the Onge of the South Bay showed unwillingness to settle together with the Onge of the Dugong Creek.

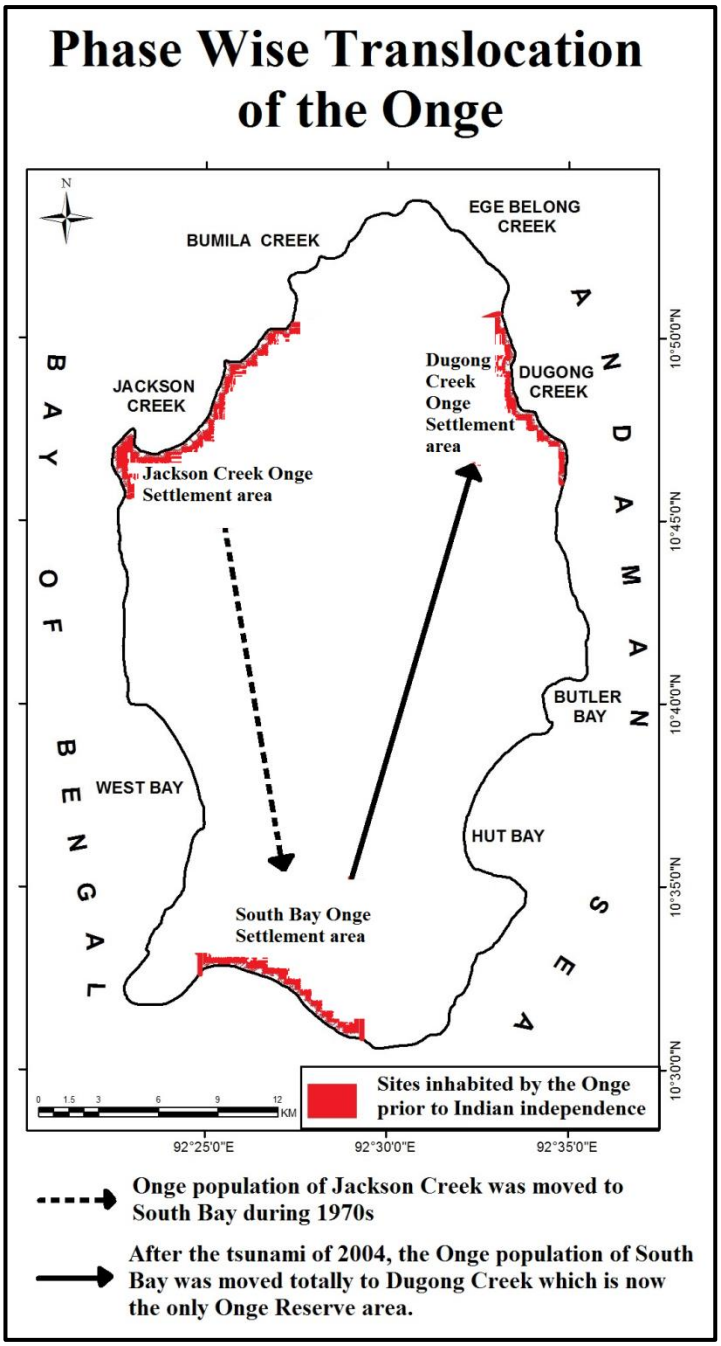

Figure 3 : Phase wise translocation of the Onge
Source: Anthropological Survey of India and modified by the researcher

On the contrary, they wanted to be resettled near South Bay due to '*Topophilia'* – attachment to their traditional habitat where the spirits of their ancestors exist. This policy posed a serious threat to the mentifacts that bear an important aspect within the Onge's folk spiritual culture which was ignored by the governance.

1.2.2 Impact on the folk housing of the Onge

The houses constructed by the administration for the Onge at the Dugong Creek settlement area do not bear any structural resemblance with their indigenous temporary hut '*Korale'* or the communal hut '*Beyra'*. The floor area of the *Korale* was traditionally made with split bamboo and cane by the Onges to allow proper aeration from below so as to withstand the hot and sultry weather prevailing there. The raised floor of the pseudo *Korale* is made of hard wooden plank which prevents the air flow.

The present houses are roofed with asbestos sheet with one room and one open balcony. These all constructional menaces make these huts uncomfortable for dwelling during the daytime as these houses become too hot to stay in the hot and humid environment of the island. Earlier to avoid the scorching summer season, the Onge used to migrate deep into the forest interiors which was much cooler under the vast canopies. But now as they are within an invisible wall of the strategies they have to get along with the system. To escape from the heat the Onge have been observed raising their open and airy *Korale* near these pseudo settlements to avoid the sultry summer season. It is only during the heavy monsoon do they prefer to live in the wooden houses (Bose, 1994).

1.2.3 Impact of changing dietary habits

Generally the Onge's food items consist of both terrestrial and marine sources. Wild boar is the only terrestrial species that the Onge hunt. The other terrestrial diet comprises of Pandanus, wild roots, tubers, fruits and honey. The marine food resources comprise different kinds of fishes, turtles, crabs, shell-fish and lastly but most important, the dugongs (a sea mammal known as Sea Cow). Turtle eggs are also gathered from the shore areas and adjacent islands. It is within their folk custom that whatever the individual hunt or group gathering is they generally share zealously with the whole community. There is a well organised division of labour among the folk, as outlined by the community head, to prepare the food for the whole community. They particularly know 66 plant species of Little Andaman and out of these 24 for food, 27 for medical applications, and the leftover 15 for different useful utilization (Reddy et al., 1990).

But with the intrusion of developmental strategies, they had to adjust with the shrunk forest area. They suffered from a dearth of fruits and animals, which were their traditional food items that posed threat to their nutritional status. Under the banner of human development, this hard-working community is being supplied with grains, spices, tea, tobacco, sugar and oil through the ration system. These are absolutely alien to their diet and affected their health immensely (Rao et al., 2006).

Table no. 1: Intake of different food groups by Onge

Food group	RDA (g)	Families consuming less than RDA (%)	Average intake (g)	Deficit/Excess (in %)
Cereals and millets	460	6.67	558.20	+21.34
Pulses	40	0.00	153.49	+283.72
Green leafy vegetables	50	93.33	8.58	- 82.84
Other vegetables	60	100.00	0.00	-100.00
Roots and tubers	50	73.33	30.29	-39.42
Fats and oils	20	0.00	79.21	+296.05
Fruits	30	96.67	4.27	- 85.77
Fish	30	73.33	58.75	+95.83
Meat and poultry	30	80.00	21.91	-26.97
Milk and milk products	150	100.00	26.72	-82.19
Sugar	30	-	30.96	+3.20
Condiments and spices	-	-	0.16	-
Nuts and oil seeds	-	0	304.40	-

RDA – Recommended Dietary Allowance,
Source: Rao et al., 2006

Table 1 shows the profile of food-group consumption per CU (Consumption Unit) of all the families of Onges in the year 2006. The intakes of green leafy vegetables, other vegetables, fruits, milk and milk products were much less than the respective recommended dietary allowances (ICMR). Their average daily consumption of fats and pulses was nearly four times the recommended dietary allowance and the consumption of fish was almost double the recommended allowance. Although the average consumption of many food groups per CU in the community was above the recommended level, the consumption pattern differed from family to family. Of the families, 7% to 100% had deficient intakes of various food groups except pulses, fats and oils. The intakes of all food groups except cereals, pulses and fats were deficient in the majority of the families (Rao, et al., 2006).

Table 2 Intake of various nutrients by Onge

Nutrient	RDA (g)	Families consuming less than RDA (%)	Average intake (CU day $^{-1}$)	% deficit/excess
Protein (g)	60	0.00	124.43	107.38
Fat (g)	20	0.00	215.25	+ 976.25
Energy (kcal)	2425	0.00	4864.01	+ 100.57
Calcium (mg)	400	6.67	780.68	+ 95.17
Iron (mg)	28	63.33	26.37	- 5.83
Vitamin A (mg)	600	96.67	293.09	- 51.16
Thiamine (mg)	1.2	0.00	2.14	+ 78.33
Riboflavin (mg)	1.4	36.67	1.68	+ 20.00
Niacin (mg)	16	0.00	23.23	+ 45.18
Vitamin C (mg)	40	100.00	7.08	- 82.30

RDA – Recommended Dietary Allowance; CU – consumption unit
Source: Rao et al., 2006

Average intake of various nutrients per CU is given in Table no. 2. Average consumption per CU of all nutrients, except iron, vitamin A and vitamin C, was above the recommended levels. Almost all of the families had deficient intakes of vitamin A and vitamin C, whereas 63% of families had deficient iron intake and 37% of families had deficient riboflavin intake. No family had deficient intakes of protein and fat. Their average daily fat consumption was more than 10 times the recommended daily allowance and their intakes of protein, energy and calcium almost double the recommended allowances (Rao et al., 2006). Hence, the Onge population is seen declining day by day (vide figure 4).

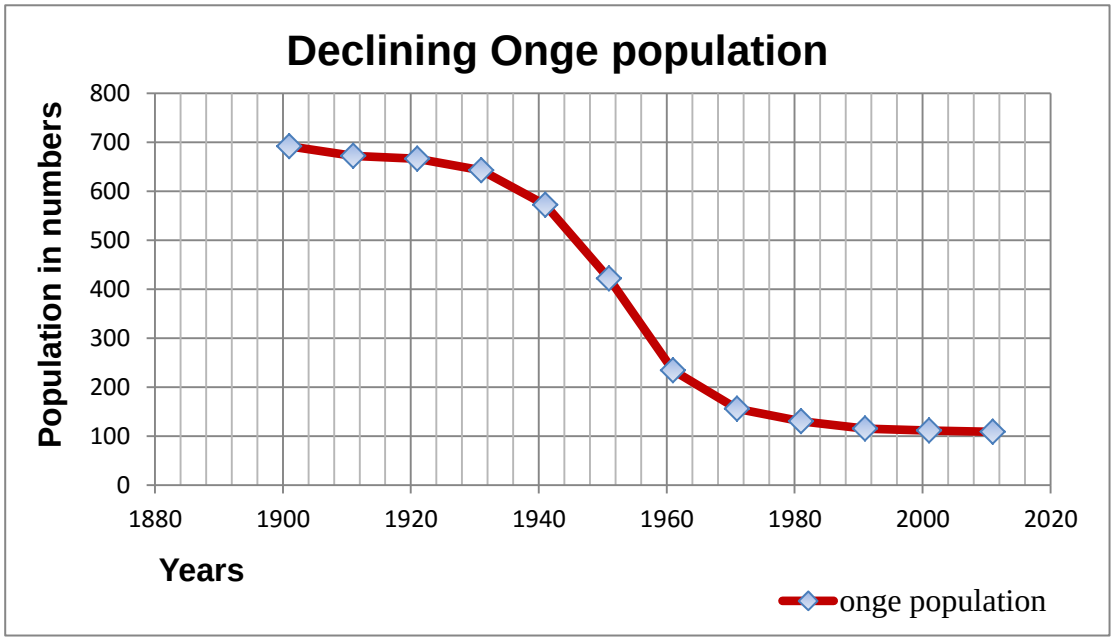

Figure 4: Declining Onge population

1.2.4 Impact on the economic culture

Government to make them globally correct introduced a tribal welfare agency named *'Andaman Janjati Vikas Samity'*, assisted by the Government of India, Ministry of Home Affairs, in March 1976 for undertaking welfare measures. In the Dugong Creek reserved area, coconut plantations are being carried out where the Onge people are employed in the farm clearance activities with a daily wage of Rs. 4 per day in the early years of 1980s. They are also being taught to separate the copra from the coconut fruit. The strategies undertaken infused the non-objecting Onge community within an alien livelihood and translated it as development (Basu, 1990).

With the introduction of a market culture, in the name of *Onge Multi-purpose Cooperative Society* they are encouraged to sell their gathered items mainly coconut, honey, resin, cane to the co-operative Society for cash (Basu, 1990). Continuous attempts were undertaken to introduce a cash economy amongst the Onge community to bring parity with the mainstream society. Ill-conceived schemes, such as - the raising of coconut plantation (in which the Onge people were made workers), poultry farming, cattle rearing and pig-breeding were introduced. All of them failed as Onge are traditionally ignorant of the domestication of birds or animals (Sekhsaria, 1999). The per capita area available to the Onge before resettlement was 4.67 km; up to 1987 the per capita area available for foraging was 1.1 km which has come down to 0.5 hectares (Bose, 1994).

After injecting this culture within their system of livelihood the government realised that it is not functioning as expected. At present this Society is engaged in distributing the rations and other daily purpose articles. Now they are planning to introduce agriculture in the new settlements which they think would be more desirable since the Onges are already familiar with the forest and soil (Gangwar, *et al*, 1984).

Conclusion

Little Andaman Island being a small tropical island is ecologically very sensitive. So any further developmental strategies should be taken up very cautiously, strictly keeping in mind the fragile ecosystem of this tiny island.

The policies meant for this island was for the benefit of a pocketful of policy makers. In the name of development, the undemanding Onge community is tried in every respect to follow the footprints of the popular culture. So, it was necessary enough to leave a clump of this pristine community and recognise the Eco-scape knowledge within their folk wisdoms. Rather, the latent science within the Onges' perception of nature could be drawn out and put to use in the policy making. This synergism of the scientific folk wisdom might prove fruitful before leaping into some big mistakes.

After assessing the impacts on the various biotic and abiotic components as discussed in this paper it reveals that the injudicious developmental strategies are posing serious threat onto the ecological balance of this island ecosystem. After the geographical appraisal study done through perception and field survey, it is evident that the further population growth and associated developmental strategies should be controlled. Or else, the negative impacts as an outcome are sure to cross the carrying capacity of the island ecosystem equilibrium.

In fine the researcher would like to conclude that the unscientific trial and error within an ecologically sensitive island is absolutely injudicious. Although the exotic crop and plantations reaped a short term economic benefit but was at the cost of the irreversible ecological balance. Rather an island with its exact endemism could have been used up as a laboratory that could have reaped benefits for long term sustenance.

Reference:

Annual Plan (2015-16) Department of Agriculture, Andaman and Nicobar Islands.

35th Annual Report (2011-2012) Andaman and Nicobar Islands Forest and Plantation Development Corporation Limited (ANIFPDCL), Port Blair, pp. 3-6.

ANIFPDCL (2013). Report on survey and documentation of encroachment in leased out forest area of ANIFPDCL, Little Andaman, pp. 53-59.

Basu, B. K. (1990) *The Onge: Negrito Hunter-Gatherers of Little Andaman*, Calcutta, Seagull Books, pp.1-37.

Bose, S. (1994) The Onges of Little Andaman-The tribe in transition. *Geographical Review of India.* 56(1), 6-13.

Dalal-Clayton.B., Bass S., Sadler B., Thomson K., Sandbrook R., Robins N. and Hughes R. (1994) National Sustainable Development Strategies: Experiences and Dilemmas. Environmental Planning Issues No.6, International Institute for Environment and Development, London.

Gangwar, B., Mongia, A.D. and Singh, N.T. (1984) Calendar of agricultural operations for field crops on the Andamans, Port Blair, ICAR, P. 44.

Giles, D. (2013) Plight of ANIFPDCL employees - The inside story. *Andaman chronicle-The daily diary of the islands*, Port Blair.

Iskander, M.M., Frihy, O.E., Ansary, A.E.E., Mooty, M.M.A. and Nagy, H.M. (2006) Beach impacts of shore-parallel breakwaters backing offshore submerged ridges, Western Mediterranean Coast of Egypt. *Journal of Environmental Management* (2007). Doi:10.1016/j.jenvman,1.

Kadry, L.T. (1972) Distribution of calcareous soils in the near east region, their reclamation and landuse measures and achievements. *Calcareous soils*, FAO Soils Bulletin, The United Nations, Rome. 21, 19-20.

Pandien, C.V.C., (from 2011 to 2021) Working plan for Little Andaman Forest Division, Andaman and Nicobar Administration, Department of Environment and Forests. Vol-I.

Rai, D. C., Murty, C.V.R., Jain, S.K., Kaushik, H.B., Mondal, G., Dash, S.R., Tang A., Yashinsky, M. and Eskijian, M. (2006) The Effect of the December 2004 Great Sumatra Earthquake and Indian Ocean Tsunami on Transportation Systems in India's Andaman and Nicobar Islands. *Earthquake Spectra*, Earthquake Engineering Research Institute. 22(3), 561–579.

Rao, V.G., Sugunan, A., Murhekar, M. and Sehgal, S. (2006) Malnutrition and high childhood mortality among the Onge tribe of the Andaman and Nicobar Islands. *Public Health Nutrition*. 9(1), 19–25. DOI: 10.1079/PHN2005761.

Reddy, G. P., Sudarsen, V. and Venkatesan, D. (1990) Onge foraging system: Strategies of resource utilization. In Basu A., Sarkar J. et. al. (Eds.). *Andaman and Nicobar Islanders*, Kolkata: Indian Anthropological Society,pp 101-110.

Sekhsaria, P. (1999) A people in peril. *Frontline magazine*, The Hindu. 16(9).

Sekhsaria, P. (2002) Ecological treasures ... unlimited. The Hindu, Sunday 7th July, 2002.

Sekhsaria, P. (2003) Onge - A People in Peril. *Troubled Island*. Kalpavriksh. LEAD-India, pp. 29-34.

Swarnakumar, N.S., Sahu, M.K., Sivakumar, K. and Kannan, L. (2008) Assessment of microbial pollution in the coastal environs of the Little Andaman Island, India. *Indian Journal of Geo-Marine Sciences*. 37(2), 146-152.

Swarnam, T.P., Velmurugan, A., Sai, T.P., Jai Sankar, I., Subramani, T., Swain, S., Kundu, M.S.and Kirubasankar, R. (2015) Comparative evaluation of tribal and non-tribal farming systems in Little Andaman, India. *Journal of the Andaman Science Association*. 19(1), 53-58.

Kharti,T. C. (2002) Red Oil Palm Cultivation in Little Andaman of Bay of Bengal. *Tropics*. 12 (1), 81-83.