



Status of Child and Maternal Nutrition in the Coastal Regions of India

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The nutritional status of children and women is a robust indicator of the well-being of society. The food habits of people are governed by the prevailing agricultural production systems which in turn govern the nutrient availability through food sources (Ghosh *et al.*, 2019; Wadhawan and Kaur, 2019). Malnutrition is an outcome of the imbalance of protein, energy and micronutrient deficiencies and it continues to be a major health concern in developing countries. The Sustainable Development Goals (SDG) of the United Nations has given a call to “end all forms of malnutrition by 2030 including achieving by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age” (Target 2.2). In 2022, an estimated 22.3% (148.1 million) of children under five years of age were stunted and 6.8% (45 million) were wasted globally (WHO, 2023). These figures are quite alarming in India. and about 36% of children in India below the age of five are stunted, 19% are wasted, 32% are underweight and an alarming 57% of women are anaemic. In the case of women, 19% of them are underweight in the reproductive age. About 57% of them in general and 52% of pregnant women are anaemic (IIPS, 2021). These conditions will have serious adverse effects on their future pregnancies with serious repercussions on the development of society as well as the country. Malnutrition increases expenditure on health care, decreases productivity and dampens economic growth, which results in a vicious cycle of poverty and ill health (Mukherji *et al.*, 2010; Siddiqui *et al.*, 2020).

The Indian coastline of 7516.6 km is distributed among nine states and four union territories (UTs) bordering the Bay of Bengal, the Arabian Sea and the Indian Ocean (SAC, 2012). The coastal environment plays a vital role in our national economy by virtue of its resources, productive habitats and rich biodiversity. As per the Census 2011, nearly 16% (18.8 crores) of the country's population reside in the coastal districts and about 4.4 lakh people reside in the Island territories

(GoI, 2011). The coastal regions have access to open seas and offshore fishing is an important livelihood activity of people residing there. The harvests from the seas and the culture fisheries make an important component of the diets of the people. Therefore, it is assumed that the coastal regions will have better nutritional outcomes which may not always be true given the specific socio-economic and environmental dynamics of coastal areas. Keeping these in mind, this study was undertaken to study how the incidence of malnutrition among children and women is distributed along the coastline of India and suggest policy interventions to address these issues. It also aimed to identify the most vulnerable districts where the prevalence of undernutrition is highest which could be taken up by the development agencies to address this question on a priority basis.

The measure of people's well-being in India is done through periodic National Family Health Survey (NFHS) which is conducted by the Ministry of Health and Family Welfare. Until now, five such surveys have been conducted *viz.*, NFHS-4 (2015-16), NFHS-3 (2005-06), NFHS-2 (1998-99) and NFHS-1 (1992-93). The data for the present study was accessed from the NFHS-5 Survey 2019-20 (NFHS-5) which provides information on population, health, and nutrition for country state/UT and districts (IIPS, 2021). The survey report encompasses data collected from 636699 households consisting of 724115 women and 101839 men. The report included data on 131 indicators for States/UTs and 104 indicators for 707 districts of India on various health and nutrition-related issues. Of these, three indicators for child nutrition (stunting, wasting and underweight) and two for maternal nutrition (body mass index and anaemia) were taken for analysing the spatial distribution of the indicators of malnutrition in the districts situated along the coastline of India. Moreover, all the districts along the coastline were ranked based on their relative performance and the five best and worst districts for each of the indicators have been reported

in this paper. For visualization and understanding the pattern of distribution of the various indicators, thematic maps for each of the indicators were created using open-source GIS software QGIS 3.22.9.

There are nine coastal states and four Union Territories situated along the coastline of India. These states and UTs have two hundred twenty-one districts among them. Of these 221 districts, 75 are situated along the coastline of India (Fig. 1). The status of child and maternal nutrition of coastal states and coastal districts of India is presented in Table 1. The difference in the value of indicators between the average of the state and the coastal districts is given in Table 2. The distribution of child under nutrition in the coastal districts has been depicted in Fig. 2. Malnutrition has several forms which include under nutrition (wasting, stunting and underweight), inadequate vitamins or minerals, overweight, obesity, and the resulting diet-related non-communicable diseases (WHO, 2021). In this study, three indicators of child nutrition and two for maternal nutrition were analysed.

Stunting is a manifestation of chronic under nutrition which causes irreversible physical and mental damage to children. It is defined as the percentage of children, aged

0 to 59 months, whose height for age is below minus two standard deviations (moderate and severe stunting) and minus three standard deviations (severe stunting) from the median of the WHO Child Growth Standards. The immediate and underlying causative factors of stunting include inadequate infant and childcare practices, poor hygiene and food insecurity among the poorest households. There is an inseparable connection of stunting in children to maternal nutrition and hence, is often determined in the womb of a mother. Stunting in children (below 5 years) was found to be higher than the national average (35.5) in Gujarat (39.0) and Dadra and Nagar Haveli and Daman and Diu (DNHDD,39.4) (Table 1).

On the other hand, in the coastal districts of Karnataka, Odisha, DNHDD and Gujarat, there was a considerably lower incidence of stunting compared to the respective state average which was lower by 4.2 to 9.5% (Table 2). When only coastal districts were considered, it was observed that among the coastal districts, stunting was higher than the national average (27.6) in West Bengal (31.6), Maharashtra (33.7), DNHDD (32.0), Gujarat (34.8) and Lakshadweep (32.0) and it was lower in rest of the states/UTs (Table 1).

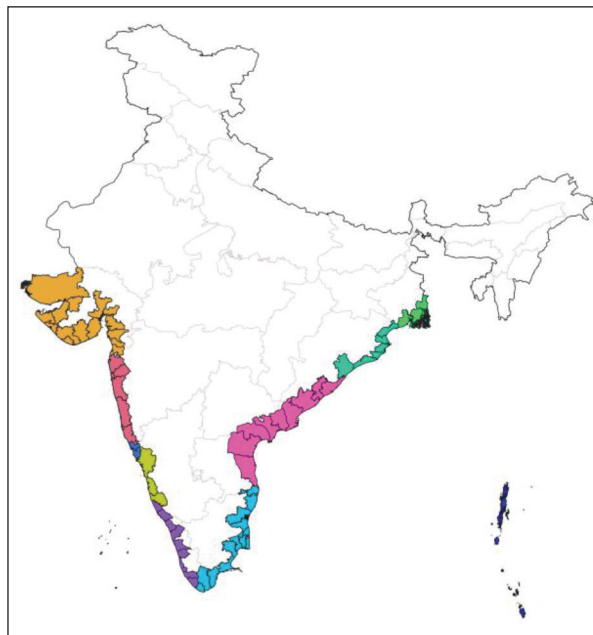


Fig.1. Location districts and states along the coast of India (Map not to scale)

Table 1. Status of child and maternal nutrition in Coastal states and coastal districts of India

State/ UT	Coastal states				Coastal districts only							
	No of districts	Percent children/women			No of districts	Percent children/women			Low BMI	Anaemia		
		Stunting	Wasting	Under weight		Low BMI	Anaemia	Stunting			Wasting	Under-weight
West Bengal	20	33.8	20.3	32.2	14.8	71.7	3	31.6	16.7	28.8	11	65.8
Odisha	30	31.0	18.1	29.7	20.8	64.4	6	22.7	11.4	18.4	17.7	60.7
Andhra Pradesh	30	31.2	16.1	29.6	14.8	59.0	9	27.4	16.0	25.8	13.1	61.1
Puducherry	4	20.0	12.4	15.3	9.0	55.5	2	21.3	13.5	16.4	10.4	55.6
Tamil Nadu	32	25.0	14.6	22.0	12.6	53.6	13	23.1	14.3	20.8	13.6	56.4
Kerala	14	23.4	15.8	19.7	10.1	36.5	9	21.6	15.4	18.8	9.6	35.2
Karnataka	30	35.4	19.5	32.9	17.2	47.8	3	25.9	23.3	26.9	18.3	43.6
Goa	14	25.8	19.1	24.0	13.8	38.9	2	26.3	19.6	23.4	13.8	38.8
Maharashtra	13	35.2	25.6	36.1	20.8	54.5	7	33.7	22.3	31.1	20.0	50.1
DNHDD**	36	39.4	21.6	38.7	25.1	62.6	2	32	21.3	28.9	19.4	55.6
Gujarat	33	39.0	25.1	39.7	25.2	65.1	15	34.8	23.7	34.7	22.4	58.5
Lakshadweep	32	32.0	17.4	25.8	8.0	26.0	1	32	17.4	25.8	8.0	25.8
A&N Islands*	3	22.5	16.0	23.7	9.4	57.6	3	22.5	16.0	23.7	9.4	57.5
India	707	35.5	19.3	32.1	18.7	57.2	75	27.6	18	25.8	15.6	53.4

*Andaman and Nicobar Islands; ** Dadra and Nagar Haveli & Daman and Diu

Table 2. Prevalence of child and maternal nutrition in coastal districts as compared to the state average

State/ UT	Stunting	Wasting	Under weight	Low BMI	Anaemia
West Bengal	-2.2	-3.6	-3.4	-3.8	-5.9
Odisha	-8.3	-6.7	-11.3	-3.1	-3.7
Andhra Pradesh	-3.8	-0.1	-3.8	-1.7	2.1
Puducherry	1.3	1.1	1.1	1.4	0.1
Tamil Nadu	-1.9	-0.3	-1.2	1	2.8
Kerala	-1.8	-0.4	-0.9	-0.5	-1.3
Karnataka	-9.5	3.8	-6	1.1	-4.2
Goa	0.5	0.5	-0.6	0	-0.1
Maharashtra	-1.5	-3.3	-5	-0.8	-4.4
Dadra NHDD	-7.4	-0.3	-9.8	-5.7	-7
Gujarat	-4.2	-1.4	-5	-2.8	-6.6
Lakshadweep	0	0	0	0	-0.2
A&N Islands	0	0	0	0	-0.1
India	-7.9	-1.3	-6.3	-3.1	-3.8

-ve value indicates better performance, value sare in percent

The socio-cultural practices and food availability lead to better nourishment of children in coastal areas. The difference in magnitude of the underlying causative factors and the difference in food consumption patterns requires detailed studies to understand the cause of the difference. Ansary and Rath (2021) have reported a better performance of child nutrition indicators in the coastal districts of Odisha which was attributed to household-level characteristics, access to safe drinking water and increased latrine coverage. Improved sanitation and clean surroundings reduce the chance of catching infections and falling ill which translates into better nutritional outcomes.

Wasting is the most immediate, visible and life-threatening form of malnutrition. Children with wasting are too thin and their immune systems are weak, leaving them prone to developmental delays, disease and death. The underlying causative factors for wasting are similar to that of stunting. From the data collated in NFHS-5, it was observed that wasting in children was more than the national average (19.3) in the state/UT of Maharashtra (25.6), Gujarat (25.1), DNHDD (21.6), West Bengal (20.4) and Karnataka (19.5). The coastal districts in five states/UTs had a higher incidence of wasting than the national average (18.0). When the coastal districts within

the states/UTs were compared, it was observed that the incidence of wasting was lower as compared to the state average in Odisha, West Bengal, Maharashtra and Gujarat but higher in the coastal districts of Karnataka and Puducherry.

Similarly, when the state average was considered, the incidence of underweight children was more than the national average (32.1) in five coastal states/UT (Gujarat, DNHDD, Maharashtra, West Bengal and Karnataka) and the coastal districts of these states also had a higher incidence of underweight children as compared to the average of the coastal districts (25.8). Almost all coastal districts had a lower incidence of underweight children as compared to their state average (Table 1). Geographical location, ethnicity of the population, mother's education, monthly per capita food and non-food expenditure, per capita calorie intake, wealth score etc. need to be correlated with the child health indicators to understand the pattern of child undernutrition in the coastal and non-coastal districts of India (Khan and Mohanty, 2021).

Nutritional status of reproductive-aged women gives an indication of the future maternal and child health. Two important indicators which give the nutritional

well-being of women are Body Mass Index (BMI) and prevalence of anaemia. BMI is defined as the weight in kilograms divided by the square of the height in metres (kg m^{-2}). In the four states/UT (Gujarat, DNHDD, Maharashtra and Odisha) the BMI among adult women was worse than the national average (18.7) (Table 1 and Fig. 3a). The increased prevalence of underweight could result from consuming fewer calories and less nutritious foods. This could be attributed to the lower purchasing power and the lack of awareness on balanced nutrition. There are several other underlying factors which include socioeconomic status, religion, caste, food consumption patterns, etc., (Al Kibria *et al.*, 2019). The effect of dietary diversity in terms of possible increased consumption of animal proteins on the anthropometric characteristics warrants a detailed study to understand the pattern in the coastal districts.

The prevalence of anaemia among adult women was observed to be alarmingly high in West Bengal (71.7), Gujarat (65.1), Odisha (64.3), DNHDD (62.6) and Andhra Pradesh (59.0). Six coastal states/UTs had a higher incidence of anaemia than the national average (57.0). In general, the prevalence of anaemia was lower in coastal districts as compared to the state/UT average (Table 1 and Fig. 3b). In India, over half of the iron deficiency anaemia (IDA) burden can be attributed to dietary causes. IDA have nutritional, physiological, pathological and (or) socioeconomic aetiologies. For instance, diet diversity has been inversely associated with the prevalence of mild anaemia among non-pregnant women of reproductive age in rural India (Jin *et al.*, 2022). Vegetarianism and non-vegetarianism also can have varied effects on the manifestation of IDA among women. Meat-based heme-iron has a much higher absorption (up to 35%) when compared to plant-based non-heme iron (2-10%). However, in Indian diets, up to 95% of the total daily iron intake is through non-heme iron. The absorption of iron taken through diets is hindered by various intrinsic factors. Loss of balance between bodily requirements, intake and absorption through such limiting diets may make an individual vulnerable to iron deficiency anaemia. However well-balanced vegetarian diets with iron coming from different sources have comparable effects

on the haemoglobin content. Hence, mass awareness about well-balanced nutrition is important to reduce the incidence of anaemia (Bhatnagar and Padilla-Zakour, 2021).

The five districts each of which had the best and worst indicators of child and maternal undernutrition are given in Table 3. The highest incidence (in per cent) of stunting was in Gir Somnath (44.4) and the lowest in Jagatsinghpur (13.2); wasting was highest in Dakshin Kannada (30.5) and lowest in Kendrapara (7.9) and underweight children were highest in Anand (46.6) and lowest in Jagatsinghpur (11.0). A higher incidence of low BMI among women was observed in Anand (32) and the lowest in Kanyakumari (5.9). The prevalence of anaemia among women was highest in Valsad (75.7) and lowest in Lakshadweep (25.8). The distribution of child and maternal undernutrition shows a clear regional pattern with a higher incidence of malnutrition along the West Coast (Figs. 2 and 3). The causative factors for this regional pattern of malnutrition among children and women need further investigation correlating with the socio-economic factors along with the dietary pattern in the region.

The burden of malnutrition among children and women can be addressed by adopting a multipronged strategy involving direct interventions to meet the immediate challenges together with long-term sustainable solutions which encompasses creating awareness among the population through educational aids for behavioural change, improving dietary habits, etc. Several initiatives have been taken by the government in this direction like Anganwadi Services, Scheme for Adolescent Girls and Pradhan Mantri Matru Vandana Yojana (PMMVY) under the Umbrella Integrated Child Development Services (ICDS) Scheme. The POSHAN Abhiyaan launched in 2018 aims to reduce malnutrition in the country in a phased manner, through a life cycle approach, by adopting a synergised and result-oriented approach. The implementation of these schemes through continuous monitoring should be prioritized so that the prevalence of malnutrition is reduced quickly for a healthy India.

The coastal states/UTs generally have better nutritional outcomes among children and women as

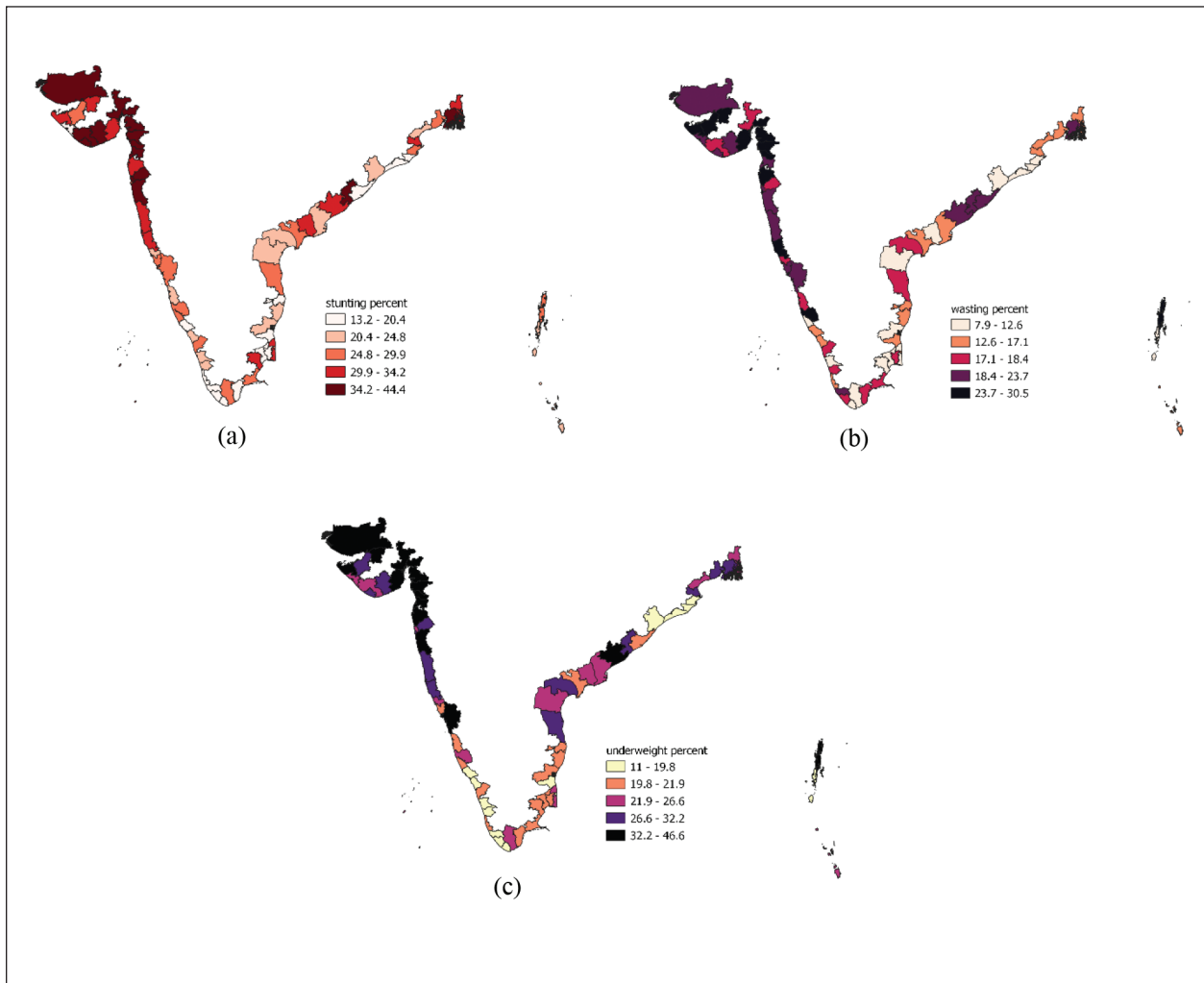


Fig. 2. Prevalence of (a) stunting, (b) wasting and (c) underweight among children in the coastal districts of India (Map not to scale)

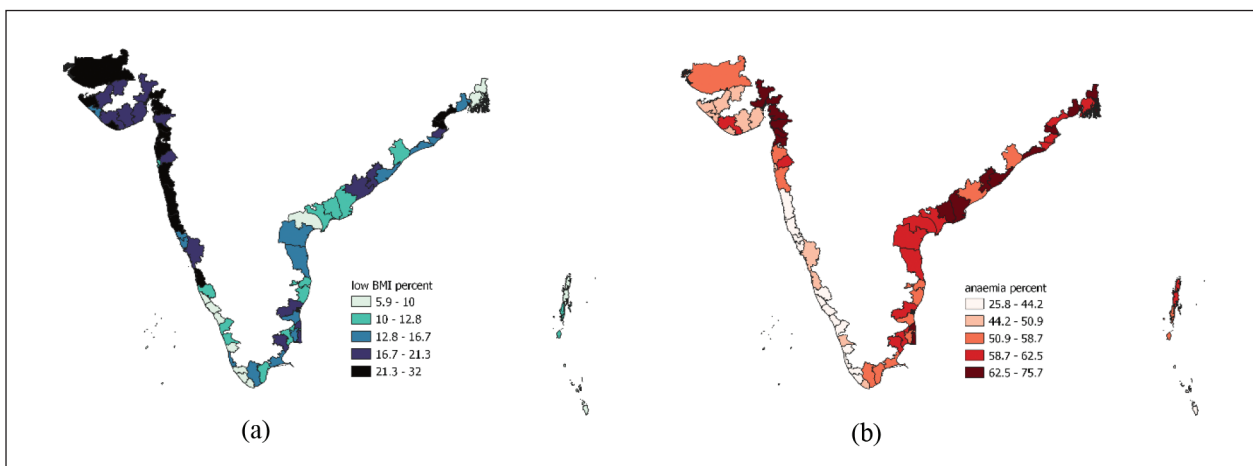


Fig. 3. Prevalence of (a) low BMI and (b) anaemia among women in the coastal districts of India (Map not to scale)

Table 3. Five best and worst performing coastal districts for child and maternal undernutrition

Rank	Stunting	Wasting	Underweight	Low BMI	Anaemia
Worst performing districts					
1.	Gir Somnath (44.4)	Dakshina Kannada (30.5)	Anand (46.6)	Anand (32)	Valsad (75.7)
2.	Bharauch (40.9)	Bhavnagar (29.6)	Bharauch (45.5)	Bharauch (30.3)	Bharauch (71.8)
3.	Thane (40.8)	Navsari (29)	Navsari (43.6)	Kachchh (28.1)	Purba Medinipur (70.4)
4.	Anand (38.4)	Anand (28.6)	North & Middle Andaman (42.8)	Palghar (27.9)	Surat (69)
5.	Valsad (37.8)	Sindhudurg (27.7)	Bhavnagar (39.5)	Ratnagiri (25.8)	Navsari (68.7)
Best performing districts					
1.	Jagatsinghapur (13.2)	Kendrapara (7.9)	Jagatsinghapur (11)	Kanniya-kumari (5.9)	Lakshadweep (25.8)
2.	Puri (13.8)	Thanjavur (8.3)	Puri (11.3)	North 24 Parganas (6.5)	Kozhikode (29.8)
3.	Kollam (15.5)	Prakasam (8.7)	Puducherry (13.1)	Thiruvanantha- puram (6.6)	Ernakulam (31.7)
4.	Puducherry (17)	Puri (8.9)	Kanniyakumari (14.5)	Chennai (7.4)	Alappuzha (31.9)
5.	Kanniyakumari (17.3)	Pudukkottai (9.5)	Thiruvanantha- puram (15.2)	Ernakulam (8)	Thiruvanantha- puram (33)

compared to the national average in all the indicators which were studied, even though there are several areas of concern as few of them have higher incidences of malnutrition as compared to the national average. Among the coastal states/UTs, the districts situated along the coasts are better off than their respective state/UT average. A clear regional pattern in the prevalence of child and maternal undernutrition has emerged from this study eschewed towards the west coast. It is generally perceived that coastal regions with an abundant supply of fish and marine produce may be having a positive outcome on nutritional status. Still there are some districts where nutritional status is poor. Such districts need priority attention from the development agencies to overcome this malaise. There is also a need to understand the causative factors of

the higher incidence as governed by socio-economic factors together with the prevalent dietary habits of the population. A multipronged approach is needed to overcome the burden of malnutrition which includes immediate dietary interventions, providing nutritional supplements, complementary feeding, etc. together with long-term solutions which include behavioural change through nutritional counselling and improving the economic status of the people enabling them to access quality foods. This also calls for strengthening the institutional mechanisms like Aanganwadi centres and primary health care infrastructure in rural areas for a long-term sustainable solution.

CONFLICTS OF INTEREST

The authors report no conflicts of interest.

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*Corresponding author: E-mail: anil.ciwa@gmail.com

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ANIL KUMAR*, TANUJA, S., D.N. SARANGI
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