Human Impact Assessment of Fani: A HEALS Approach

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Abstract

Purpose: The extremely severe cyclonic storm Fani (pronounced Foni) crossed the coast of Odisha on 3 May 2019 and disrupted the lives and livelihoods of more than 1.65 crore (16.5 million) people across 14 districts of the state. There was an urgent need to estimate the extent of damage and losses and also assess the needs of the affected areas. This paper captures the impact on the affected populace.

Design/methodology/approach: As poverty and development are multi-dimensional, so are the impacts on humans in a disaster situation. A Fani Impact Index based on proportion of population affection and views of experts is used as a starting point. Subsequently, a HEALS index across five dimensions (Health, Education, Agri-livelihood, Living standards, and Shelter/Safe housing) estimates the pre- and post-disaster scenario across districts. Besides, pre- and post-disaster income poverty is indirectly computed from earlier household-level data by adjusting for growth, distribution, and population. Field visits and stakeholder interactions also helped in understanding risk and resilience.

Findings: Fani impact was extreme in Puri and least in Anugul. Post-disaster, the decline in HEALS index was 60% for Puri, just above 20% in Jagatsinghpur, in the range of 15-20% for the districts of Khurda, Nayagarh, Kendrapara, and Cuttack. Fani also led to an increase in income poverty, which reversed the gains in reduction of poverty made in the last seven years.

Originality/value: The originality of this study comes from three grounds. First, new methods to gauge impact, evaluate decline through the HEALS index that is novel and can be used in case of any disaster situation, and compute income-poverty indirectly without household data. Second, the study uses both quantitative and qualitative methods to assess the impacts. Third, it provides eight-fold path to build back better, which should be read along with the ten policy suggestions in a companion paper on macroeconomic impact and revival.

Keywords – Cyclonic disaster, Fani Impact Index, HEALS, Income poverty, Risk and resilience

JEL Codes: C18, H12, I15, I25, I31, I32

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1. Introduction

The extremely severe cyclonic storm Fani (pronounced Foni) crossed the coast of Odisha on 3 May 2019 and disrupted the lives and livelihoods of 1,65,30,900 people across 18,388 villages and 51 local bodies, located in 159 blocks of 14 districts (State Emergency Operation Centre (SEOC), 2019c). The cyclone's impact was assessed as being extreme in the district of Puri and minimal in the district of Angul.

Fani, true to its etymological meaning (the hood of a snake), kept changing course and direction; this made preparations prior to its landfall difficult. However, the Government of Odisha left no stone unturned and took the necessary steps to evacuate more than 15 lakh (1.5 million) people and provided them with basic facilities at shelter points (SEOC, 2019c). Drawing upon the lessons of the Super Cyclone 1999 (with near 10,000 fatalities and where only 1.5 lakh people could be evacuated (Kalsi, 2006)), the state government successfully achieved greater disaster preparedness over the last two decades with better capability in technology, institutions, human skills, and coordination. In spite of these efforts, 64 lives were lost across the state of which 39 were lost in Puri, the district with the maximum impact (Special Relief Commissioner Office, 2019a).

At the outset, to provide context to the analysis we also construct Fani Impact Index using an average of two components: proportion of population affected and a summary of the view of experts in a 0-4 scale. This provides us with a working knowledge of the impact across the 14 affected districts. We also provide some basic background information on human development, economic, and social aspects for the state as a whole, and also for the 14 affected districts and create the platform for subsequent analysis.

Our exercise on five dimensions (Health, Education, Agri-livelihood, Living standards, and Shelter or Safe housing, HEALS) provides a district-specific understanding before and after Fani to analyse impact among these dimensions independently and collectively. The paper also looks into risk and resilience through the lens of HEALS by drawing from our field insights, but in doing so it also keeps in mind all the other cross-cutting human impact requirements—gender, social group, and economic vulnerability among others.

The paper also suggests a new method of computing income poverty before and after Fani by adjusting for growth, distribution, and population. In doing so, it seeks to examine whether increase in income poverty on account of Fani undermine the progress in reduction of poverty in recent times.

Finally, to build back better, the paper provides a set of eight-fold path to pre-empt the transient impacts from becoming chronic. These should be read in conjunction with policy suggestions for the companion paper on macroeconomic impact and revival (Mishra and Gaurav 2020).

2. Methodology

The human impact of Fani has been substantive for its geographical spread across 14 districts and among multiple sectors. We have tried to compute this in the following manner.

After providing a pre-disaster context, to obtain a quick first impression we compute a Fani Impact Index, φ, using an average of two components: the proportion of population affected and the view of experts. The index lies between 0–1, where 0 is technically not feasible, and hence, $0 < \varphi \leq 1$. Hence,

the lower end of the interval is excluded in each of the five interval classes of the index: minimal (0–0.2); subdued (0.2–0.4); moderate (0.4–0.6); severe (0.6–0.8); and extreme (0.8–1.0). The proportion of people affected was normalised to lie between 0–1, which itself depended on the number of people affected, as provided by the government, and estimated population of the district for 2019 (Mishra et. al 2019). To arrive at the view of experts, an anonymised response solicited from those involved in the DLNA exercise. Their responses indicated the impact of Fani across districts as 'extremely high', 'very high', 'moderately high', 'slightly high', and 'not high at all', and were given values of 4, 3, 2, 1, and 0, respectively. The aggregate value from all respondents was normalised to lie between 0–1, which is the view of experts. In addition, we also provide some information on damage and loss on account of Fani.

Second, the human impact was assessed through the lens of five dimensions—health, education, agri-livelihood, living standards, and shelter/safe housing, which we refer to as HEALS. An index was prepared for each of these dimensions, and also for the combined five dimensions, which we referred to as the HEALS Index. The health component of the index, $\hbar$, is calculated on the basis of what level of health infrastructure in terms of district headquarter hospital, community health centres, primary health centres, and sub-centres were in place against the normative requirement of such hospitals based on the population and terrain of the district. From the data on the damage to the hospital buildings issued by Government of Odisha, we calculated the fall in the $\hbar$ index. The education index, e, was calculated on the basis of net enrolment. We estimate the fall of enrolment on the basis of extent of damage to the school building which was estimated on the basis of number of school damaged and the compensation sought by different districts. The agri-livelihood index, a is computed by considering work participation rate. The fall in the work participation rate is estimated by reducing the workers by number of affected fishermen and farmers. In the absence of data of affected farmers, the same is estimated from the proportion of land area that got affected because of the cyclone. The living conditions index, ℓ, was a composite indicator of access to electricity, water, sanitation, and cooking facility. The loss in living standards was estimated by assuming 100% loss for those whose houses have completely or severely damaged and 50% loss for those whose houses are damaged partially. The safe housing or shelter index, s, was computed by giving different weights to types of houses (homeless=0, katcha=0.25, semi-pucca=0.5, and pucca=1). All aggregations, within across dimensions, are carried out using displaced ideal method where score is computed as normalized value of additive inverse of Euclidean distance from ideal, which is based on the notion that the closer one is to the ideal situation, i.e., a score of 1 in every normalized dimension, then the better it is, Mishra and Nathan (2018).

Third, the paper provides incidence of income poor before and after Fani, computed by Mishra and Hari (2019). This takes decomposition of poverty change from Mishra (2015) having growth, inequality (changes in distribution) and population effects as constitutive component, $P_2 - P_1 = g + i + n$. In particular, Mishra and Hari (2019) take incidence of poverty at an early date, P_1, and along with it growth, g, inequality (or differential growth across sub-groups), i, and population, n, effects to compute poverty at a later date, P_2, and then apply this to estimate income poor before and after Fani.

The team also makes use of field visits and interactions with other stakeholders for dimension-specific understanding of risk and resilience. We also provide a set of eight-fold path for a way forward. These

should be read in conjunction with the policy suggestions in the companion paper on macroeconomic impact (Mishra and Gaurav, 2020). This exercise, like its companion paper, was also part of the DLNA DLNA exercise of Government of Odisha et al (2019) with a time deadline, but at the same time was dependent on other thematic/sectoral teams to build on, which added to the time constraints and in addressing it provides important lessons.

3. Pre-disaster context

On the human development front, Odisha is a modestly performing state. Odisha performs below India's average on the Human Development Index (HDI) and its three dimensions—health, education, and income—which are proxies for a long and healthy life, knowledge, and ability to achieve a decent standard of living, respectively (Table 1).

Odisha contributes 3.1% of India's Net Value Added (NVA), though population-wise its share is 3.4%. This is reflected in the state's per capita net income, which is 71.8% of an average Indian. In terms of characteristics of economy, Odisha being a mineral-rich state, the contribution of the industry sector to the entire economy is approximately one-third, whereas the corresponding figure for the national economy is nine percentage points less. Odisha has a greater incidence of poverty (i.e., in terms of head-count ratio) than India's average by at least ten percentage points. Odisha has a larger proportion of multi-dimensional poor (MDP) compared to national level, however the average deprivations among MDP in Odisha is at a similar level as that of national average.

In terms of certain social indicators such as sex-ratio, institutional birth rate, and proportion of anaemic children amongst those under five years, Odisha is better-off. However, in certain other indicators such as improved sanitation, use of clean fuel for cooking, stunted children, women with more than 10 years of schooling, women married before 18 years of age, and women with below normal body mass index (BMI), Odisha is worse off than the national average.

Table 2 highlights some socio-economic indicators for the 14 affected districts. There is substantial variation across districts (last column, Table 2). In three of the four household-level factors (electricity, improved sanitation, and clean cooking fuel), Khurda scores the highest and Mayurbhanj the lowest. For improved drinking water in households, Bhadrak scores the best and Dhenkanal the least; the difference between the two is 40.6 percentage points, which is among the highest across all indicators reported. For institutional deliveries, Puri is the highest scorer and Keonjhar the least—with healthcare infrastructure taking a hit in Puri on account of Fani, this could have an adverse impact in the short to medium term.

Percentage of women with more than 10 years of schooling is highest in Khurda and lowest in Nayagarh. The district of Nayagarh also has the lowest number of girls per thousand boys (child sex ratio). In terms of sex ratio of the general population (females per thousand males), 10 out of 14 districts have more females than males (Angul has the lowest sex ratio). As against this, the child sex ratio is adverse (less than 1) in 12 of the 14 districts. Except for Dhenkanal, all the other 13 districts have a child sex ratio that is lower than the overall sex ratio for the state. Even if one imposes a stricter criterion taking a sex ratio of 952 females per 1000 males as a benchmark, seven of the 14 districts would still fall below this. The poor sex ratio among children should be a matter of concern in terms of access to healthcare for the girl child in a post-Fani scenario, when the healthcare infrastructure itself needs revival.

Across all the three child nourishment indicators (stunting, wasting, and underweight) Cuttack is the best performer with the lowest incidence. Keonjhar reports the highest incidence of stunting and underweight children while Angul reports the highest incidence of wasting across affected districts.

Table 1: Selected Socio-Economic Indicators of Odisha and India

Indicator	Odisha	India
HDI, 2017[a]	0.599	0.639
Life expectancy at birth (years), 2017[a]	68.2	68.8
Expected years of schooling (years), 2017[a]	11.9	12.3
Mean years of schooling (years), 2017[a]	5.6	6.4
Net State Value Added (NSVA) (Odisha)/Net Value Added (NVA) (India), 2011–12 constant price (INR lakh crore), 2017-18[b]	3.29	105.17
Share of Agriculture in NSVA (Odisha)/Gross Value Added (GVA) (India) (%), 2017–18[b]	15.10	14.82
Share of Industry in NSVA (Odisha)/GVA (India) (%), 2017–18[b]	32.24	23.47
Share of Services in NSVA (Odisha)/GVA (India) (%), 2017–18[b]	52.66	61.71
Per capita Net State Domestic Product (NSDP) (Odisha)/Net National Income (NNI) (India) at current prices, INR '00, 2017–18[b]	80.991	112.835
Proportion of people below poverty line (BPL) (%), 2011–12[b]	32.59	21.92
Proportion of people BPL rural (%), 2011–12[b]	35.69	25.70
Multi-dimensional poor (MDP) (%), 2015–16[c]	35.5	27.5
Average deprivation of MDP (%), 2015–16[c]	43.3	43.9
Multi-dimensional Poverty Index (MPI), 2015–16[c]	0.154	0.121
Population (crore), 2011[d]	4.2	121.1
Sex ratio (female per 1000 male), 2011[d]	979	940
Child sex ratio (female per 1000 males in 0–6 years), 2011[d]	941	919
Literacy rate (%), 2011[d]	73.45	74.04
Female literacy rate (%), 2011[d]	64.36	65.46
Rural literacy rate (%), 2011[d]	70.78	68.91
Households with improved drinking water resource (%), 2015–16[e]	88.8	89.9
Households with improved sanitation facility (%), 2015–16[e]	29.4	48.4
Households with clean fuel for cooking (%), 2015–16[e]	19.2	43.8
Households with access to electricity (%), 2015–16[e]	85.5	88.2
Women with 10 or more years of schooling (%), 2015–16[e]	26.7	35.7
Women aged 20–24 years married before 18 (%), 2015-16[e]	21.3	26.8
Women aged 15–19 years, mothers or pregnant (%), 2015–16[e]	7.6	7.9
Institutional birth rate (%), 2015–16[e]	85.4	78.9
Children under 5: stunted (%), 2015–16[e]	34.1	38.4
Children under 5: wasted (%), 2015–16[e]	20.4	21.0
Children under 5: underweight (%), 2015–16[e]	34.4	35.7
Children aged 6–59 months: anaemic (%), 2015–16[e]	44.6	58.4
All women aged 15–49 years: anaemic (%), 2015–16[e]	51	53
Women with Body Mass Index (BMI) below normal (%), 2015–16[e]	26.4	22.9

Sources: (a) Subnational Human Development Index, 2017, Global Data Lab; (b) *Handbook on Statistics of Indian Economy*, 2018, Reserve Bank of India (including real time data); (c) Alkire, Oldiges and Kanagaratnam (2018); (d) Census 2011; (e) National Family Health Survey, 2015–16 (NFHS-4), International Institute for Population Sciences.

Table 2: Selected Socio-Economic indicators in 14 Fani-affected Districts of Odisha

Indicators	Puri	Khu-rda	Cut-tack	Ken-dra-para	Jaj-pur	Jagat-sing-hpur	Bha-drak	Gan-jam	Bala-sore	Naya-garh	Ma-yur-bhanj	Dhe-nka-nal	Keon-jhar	Angul	Gap |Max-Min|
Households, electricity (%)[a]	95.0	96.4	91.6	92.4	93.2	92.9	87.2	89.4	88.7	93.4	73.9	88.7	75.0	87.4	22.5
Households, improved sanitation facility (%)[a]	40.1	47.0	38.8	25.6	30.7	30.8	23.0	40.7	37.3	31.6	18.1	33.3	20.5	35.6	28.9
Households, clean cooking fuel (%)[a]	19.9	46.2	31.0	13.8	15.9	12.8	10.7	34.5	14.2	21.0	9.5	21.0	16.4	21.4	36.7
Households, improved drinking water (%)[a]	95.0	84.6	91.1	98.8	87.8	96.9	99.4	90.3	97.7	80.2	81.5	58.8	85.4	77.2	40.6
Institutional births (%)[a]	97.8	85.1	94.7	94.2	94.0	97.6	87.7	91.5	91.9	92.5	85.6	90.1	72.7	90.3	25.1
Women, 10+ years of schooling (%)[a]	30.4	38.3	32.3	30.3	35.0	38.2	30.4	22.2	31.1	21.9	23.6	33.5	28.1	27.6	16.4
Sex ratio (females/1000 males)[a]	996	980	992	1129	1020	1070	1074	1111	1089	1009	1032	1026	1065	935	194
Under 5 years, sex ratio (females/1000 males)[a]	922	965	987	1007	725	929	875	801	969	725	983	1044	851	879	319
Children under 5 years, stunted (%)[a]	16.1	24.7	15.3	26.9	30.3	19.5	34.9	28.9	33.2	28.0	43.5	26.1	44.6	31.8	29.3
Children under 5 years, wasted (%)[a]	12.1	13.8	9.1	12.3	16.5	12.6	15.3	16.4	18.0	17.5	17.2	19.0	19.0	21.6	12.5
Children under 5 years, underweight (%)[a]	17.2	20.3	17.1	24.1	30.0	16.5	28.2	21.3	33.7	25.4	43.8	29.2	44.3	35.3	27.8
Children 6–59 months, anaemic (%)[a]	29.2	19.0	18.9	28.7	30.0	23.4	22.7	37.4	28.6	26.5	34.5	39.4	32.7	37.4	20.5
Women 15–49 years, anaemic (%)[a]	44.3	45.3	37.8	42.3	43.3	35.8	43.5	41.3	41.1	39.8	42.4	39.4	40.5	44.0	9.5
Women 15–19 years, mother or pregnant (%)[a]	2.9	8.1	0.9	3.1	2.3	1.2	3.3	10.0	11.8	15.9	16.1	7.3	15.0	9.9	15.2
Women 20–24 years, married <18 years (%)[a]	8.3	18.1	17.6	12.2	8.5	9.7	6.2	29.8	25.9	31.3	35.0	25.4	28.1	22.0	28.8
Women, BMI below normal (%)[a]	15.5	15.4	19.2	24.3	28.4	17.3	30.3	21.5	25.4	16.4	31.6	25.6	28.9	21.8	16.2
MDP (%), 2015–16[b]	15.3	17.4	16.4	27.2	25.0	16.7	35.2	23.6	30.5	24.5	51.0	37.4	45.7	31.3	35.7
Average deprivation of MDP (%), 2015–16[b]	37.6	41.5	40.2	39.4	41.3	38.2	39.2	43.6	40.8	41.6	44.6	42.1	47.0	41.4	9.4
MPI, 2015–16[b]	0.058	0.072	0.066	0.107	0.103	0.064	0.138	0.103	0.124	0.102	0.227	0.157	0.215	0.129	0.169

Source and Notes: (a) National Family Health Survey, 2015–16 (NFHS-4), International Institute for Population Sciences. (b) Alkire, Oldiges and Kanagaratnam (2018). The districts have been arranged as per our Fani Impact Iindex (most to least impact), as indicated in Figure 1. The first eight indicators are for attainment (higher values are better) and the subsequent indicators are for shortfall indicators (lower values are better). Across the 14 districts, the district with the best performance (maximum in attainment indicators and minimum in shortfall indicators) is highlighted with a lighter shade in the background and the district that has the least performance (minimum in attainment indicators and maximum in shortfall indicators) is indicated in red font.

Incidence of anaemia among children is the lowest in Khurda, and the highest in Dhenkanal (which is also the district with the poorest access to improved drinking water facility among households). It is intriguing that Khurda with lowest incidence of childhood anaemia reports the highest incidence of anaemia among adult women.

Cuttack has the lowest proportion of women in the 15–19 year age-group, who are either mothers or are pregnant. Bhadrak reports the lowest proportion of women in the 20–24 year age-group, who were married before 18 years of age. Khurda reports lowest proportion of women with a BMI that is below normal.

In all these three women-specific shortfall indicators, Mayurbhanj reports the most adverse figures wherein it may be reiterated that this is also the district where proportion of households with access to electricity, sanitation, and clean cooking fuel is the lowest.

From among the 14 affected districts, Puri has the least deprivation in terms of proportion of MDP, average deprivation of MDP and MPI. Given the impact of Fani, Puri is not likely to be the same. At the other extreme, with highest deprivation, are Mayurbhan in MDP and MPI and Keonjhar in average deprivation of MDP.

4. Fani Impact: a first impression

In terms of human impact, to begin with, a Fani Impact Index was computed and the 14 districts classified into five groups—Extreme (Puri); Severe (Khurda, Cuttack and Kendrapara); Moderate (Jajpur and Jagatsinghpur); Subdued (Bhadrak, Ganjam, Balasore and Nayagarh); and Minimal (Mayurbhanj, Dehenkanal, Keonjhar and Angul)—as shown in Figure 1.

Figure 1: Fani Impact Index across 14 Affected Districts
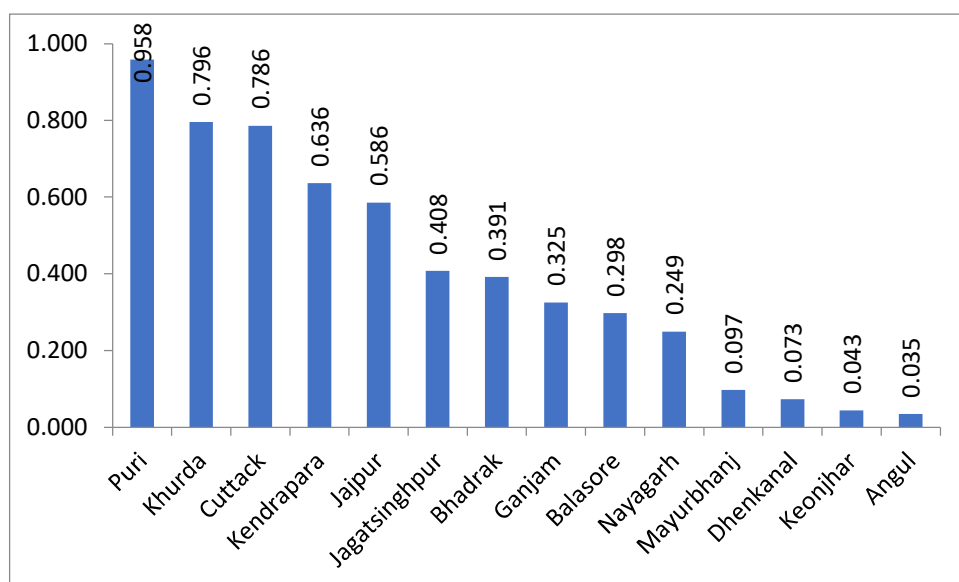
Source: Authors' calculation using the view of experts and proportion of affected population

Compared to the super cyclone of 1999, there was greater preparedness. This, however, could not entirely limit damages and losses (computed at INR 24,176 crore, that is, around USD 3.5 billion) and the adverse impact on livelihood. A total of 88 lakh (8.8 million) livestock were affected:

- 24.4 lakh or 2.4 million large ruminants

- 10 lakh (1 million) small ruminants

- 53.7 lakh (5.4 million) birds.

From among the affected livestock, 53.3 lakh (5.4 million) perished. The case fatality per 1000 affected stood at: 1.4 for large ruminants, 2.9 for small ruminants, and 999 for birds (SEOC, 2019a). These losses have severely constrained the livelihoods of many engaged in rearing livestock.

More than 32 lakh (3.2 million) fruit and nut trees were either uprooted or severely damaged, including more than 10 lakh (1 million) coconut trees, 14 lakh (1.4 million) cashew nut trees, and close to 47,000 mango trees. Overall, 3.2 lakh (0.32 million) farmers—approximately 16% of the total farmers in Odisha, and 44% of the farmers of the 14 affected districts—were adversely affected. The cyclone damaged 1.82 crore (18.2 million) hectare (ha) of crop area that included 30% sown summer paddy, 12% sown mung and 11% perennial fruits (SEOC, 2019b). Last but not the least, 1.5 lakh (0.15 million) members of the traditional fishing community have been severely affected and do not have an alternate source of livelihood.

5. Impact on Health, Education and Agri-Livelihoods

In recent times, the multidimensional poverty index has been used as a basis to evaluate the outcome of certain sustainable development goals (Alkire and Jahan, 2018). However, the application of that tool is based on availability of individual household-level data. Notwithstanding that, and as also espoused in the human development index, HDI, the importance of health, education and living standards are acknowledged.

Under normal circumstances, while not dismissing the importance of livelihoods and housing, they seem to be subsumed within living standards. In disaster situations like Fani, we believe that livelihoods are also an important and independent aspect.

In this section, we develop a health index, h, largely denoting access that is particularly important immediately after disaster strikes, an education index, e, focusing largely on elementary/primary schools with the assumption that during crisis schools not only provide shelter but also a space for sharing and caring, and are of the opinion that school vacations, if any, need to be minimum during the immediate post-Fani period), and finally an agri-livelihoods index, a, as agriculture is an important provider of employment, across the 14 Fani-affected districts. The degree of change in all three indices across all 14 districts can be seen in Table 3.

The h Index is a measure of access to public health facilities prior to and post-Fani, which is aggregated through the displaced ideal method across facilities. It considers the existing population norms for sub-centres, primary health centres, community health centres and the existence of a district headquarters hospital as ideal. Post-Fani, the index captures reduced access on account of damage to

facilities. For district headquarter hospitals, the damage is also adjusted with cost per bed benchmarked to the district with maximum damage per bed.

The maximum impact on health access has been in Puri, the change in the h Index being −82.8%.[3] The change was 60.5% in Nayagarh, −60.3% in Kendrapara, −59.0% in Jagatsinghpur, −57.7% in Khurda, −47.2 in Cuttack, and −42.9 in Bhadrak, which were with higher absolute values than the average for the affected districts at −41.1%. Impact on access to health was negligible in Ganjam and Angul.

Table 3: Health, Education and Agri-Livelihood Indices Pre- and Post-Fani across Affected Districts

Districts	h Index			e Index			a Index		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Puri	0.794	0.137	-0.657	0.870	0.116	-0.754	0.366	0.294	-0.072
Khurda	0.547	0.231	-0.316	0.901	0.709	-0.193	0.352	0.344	-0.008
Cuttack	0.687	0.363	-0.324	0.891	0.725	-0.165	0.357	0.340	-0.017
Kendrapara	0.728	0.289	-0.439	0.896	0.858	-0.038	0.324	0.317	-0.007
Jajpur	0.736	0.471	-0.265	0.888	0.733	-0.155	0.302	0.291	-0.011
Jagatsinghpur	0.886	0.363	-0.523	0.884	0.694	-0.191	0.355	0.298	-0.057
Bhadrak	0.637	0.364	-0.273	0.905	0.826	-0.079	0.311	0.307	-0.004
Ganjam	0.732	0.732	0.000	0.893	0.805	-0.087	0.426	0.425	0.000
Balasore	0.696	0.460	-0.236	0.938	0.839	-0.099	0.402	0.402	0.000
Nayagarh	0.897	0.355	-0.543	0.872	0.672	-0.200	0.357	0.357	0.000
Mayurbhanj	0.857	0.686	-0.171	0.971	0.953	-0.018	0.486	0.486	0.000
Dhenkanal	0.769	0.470	-0.300	0.911	0.822	-0.089	0.365	0.364	-0.001
Keonjhar	0.834	0.671	-0.163	0.969	0.966	-0.002	0.425	0.425	0.000
Angul	0.681	0.681	0.000	0.957	0.948	-0.009	0.413	0.413	0.000
All Fani districts	0.757	0.446	-0.312	0.914	0.780	-0.134	0.382	0.371	-0.011

Sources and Notes: Authors' calculation based on information available in *Rural Health Statistics 2018*, Ministry of Health and Family Welfare, Government of India, *Status of Elementary and Secondary Education in Odisha 2017-18*, Odisha Primary Education Programme Authority, and Census 2011 for pre-Fani scenario and data obtained through DLNA for post-Fani scenario. The h Index looks into availability across public health facilities, the e Index is focused on elementary/primary schools, the a Index is in essence the worker population ratio.

The e Index measures access to elementary/primary schools through net enrolment ratio. Post-Fani, the index captures the possibility of reduced access on account of damage, which is also benchmarked to the district with the maximum damage per school.[4] The change in the e Index was −86.7% in Puri, −23.0% in Nayagarh, −21.6% in Jagatsinghpur, −21.4% in Khurda, −18.6% in Cuttack, and −17.5% in Jajpur, which were with higher absolute values than the average for the affected districts at −14.7%.

Agri-livelihood measured in terms of the worker–population ratio (as per the Census 2011) was taken separately for rural and urban areas and then adjusted to population shares as per extrapolated population values. Post-Fani, the a Index captures those affected among fishermen and crop farmers. It is indicative and could be an underestimation, as many other workers who lost their livelihood would not have been captured. The change in the a Index was −19.7% in Puri, −16.0% in Jagatsinghpur, −4.7%

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[3] Change expressed in % is {[(Change in index value)/Pre-Fani index value]*100.
[4] The damage per school in Puri is greater than 15 times the other districts. We take the log of damages per district for computing the ratio, which in essence recognises that damages will have a diminishing marginal impact.

in Cuttack, and −3.6% in Jajpur, which were with higher absolute values than the average for the affected districts at −2.9%. There was no adverse impact on agri-livelihood in Keonjhar.

6. Impact on Living Standards and Housing

This section focuses on the living standards index, ℓ, which aggregates access to the household amenities of electricity, sanitation, water and cooking fuel. Its calculation uses displaced ideal method.

For the pre-Fani scenario, district-level aggregate attainments on these household amenities are taken from NFHS-4. Post Fani, the adverse impact on household amenities are considered as 100% for completely and severely damaged and 50% for partially damaged houses.[5]

The fall in living standards index has been the greatest in Puri. The change at the combined level for Puri stands at −42.0% (−42.6% for rural and −39.9% for urban). The change in Khurda is −6.3% and that in Cuttack is −3.3%. The decline in living standards in Kendrapara (−0.1%), which had a higher Fani Impact Index, is lower than that of many other districts. There are six districts (Bhadrak, Ganjam, Balasore, Nayagarh, Mayurbhanj, and Keonjhar), where the adverse impact was negligible, and finally, there was no adverse impact in Angul.

Table 4: Living Standards Index, Pre- and Post-Fani, across Affected Districts

Districts	ℓ Index, Rural			ℓ Index, Urban			ℓ Index, Combined		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Puri	0.465	0.267	-0.198	0.682	0.410	-0.272	0.500	0.290	-0.210
Khurda	0.432	0.392	-0.040	0.766	0.728	-0.037	0.618	0.579	-0.039
Cuttack	0.451	0.432	-0.019	0.769	0.754	-0.015	0.538	0.520	-0.018
Kendrapara	0.423	0.423	-0.001	0.548	0.547	-0.001	0.430	0.429	-0.001
Jajpur	0.437	0.429	-0.007	0.558	0.555	-0.003	0.451	0.444	-0.007
Jagatsinghpur	0.430	0.427	-0.003	0.516	0.509	-0.007	0.442	0.439	-0.004
Bhadrak	0.384	0.384	0.000	0.553	0.553	0.000	0.408	0.408	0.000
Ganjam	0.472	0.472	0.000	0.780	0.780	0.000	0.555	0.555	0.000
Balasore	0.429	0.429	0.000	0.753	0.753	0.000	0.467	0.467	0.000
Nayagarh	0.448	0.447	0.000	0.597	0.597	0.000	0.468	0.468	0.000
Mayurbhanj	0.342	0.342	0.000	0.667	0.667	0.000	0.370	0.370	0.000
Dhenkanal	0.385	0.382	-0.002	0.939	0.936	-0.003	0.443	0.441	-0.002
Keonjhar	0.351	0.351	0.000	0.719	0.719	0.000	0.408	0.408	0.000
Angul	0.434	0.434	0.000	0.673	0.673	0.000	0.477	0.477	0.000
All Fani districts	0.423	0.410	-0.013	0.728	0.703	-0.025	0.483	0.467	-0.015

Source and Notes: The ℓ Index aggregates by using the displaced ideal method the household-level amenities on access to electricity, sanitation, clean cooking fuel, and water from NFHS-4 for the pre-Fani scenario. Post-Fani loss of access to household amenities is considered at 100% for completely and severely damaged houses and at 50% for partially damaged houses.

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[5] Alkire and Jahan (2018) also use these indicators in their living standards dimension while computing multdimensional poverty. They use household-level data, whereas data availability not only constrains us to use aggregate district-level data but also limits us to fewer indicators.

For estimating the exact impact on housing, we have devised a safe housing or shelter index, s, on a scale of 0–1 where 0 indicates no houses are safe or no shelter, and 1 indicates that all houses are safe or that everyone has access to reasonable shelter.[6] In devising the index, we first imputed the following safety/shelter scores: 0 (zero) for the homeless; 0.25 for a kutcha house; 0.5 for a semi-pucca house; and 1 for a pucca house. A weighted average of these safety/shelter scores, along with the share of population residing in each house, gave us the s Index.[7] The s Index, pre- and post-Fani, for affected districts is given in Table 5.

In Table 5, the maximum damage to houses is seen in Puri. Further, if one computes the change then in Puri it is −59.5% for rural, −60.2% for urban and −59.7% for both combined. The change in the s Index at the combined level, is −6.4% for Khurda (−9.4% for rural and −4.6% for urban), and −3.8% for Cuttack (−4.8% for rural and −1.4% for urban).

Table 5: Safe Housing/Shelter Index, Pre and Post-Fani, across Affected Districts

Districts	s Index, Rural			s Index, Urban			s Index, Combined		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Chang
Puri	0.688	0.279	-0.410	0.755	0.300	-0.455	0.699	0.282	-0.417
Khurda	0.724	0.656	-0.068	0.978	0.933	-0.045	0.865	0.809	-0.055
Cuttack	0.708	0.674	-0.034	0.852	0.840	-0.012	0.747	0.719	-0.028
Kendrapara	0.513	0.511	-0.002	0.820	0.819	-0.001	0.529	0.527	-0.002
Jajpur	0.648	0.632	-0.016	0.937	0.930	-0.007	0.682	0.667	-0.015
Jagatsinghpur	0.642	0.633	-0.009	0.828	0.817	-0.010	0.664	0.655	-0.009
Bhadrak	0.540	0.540	0.000	0.650	0.650	0.000	0.555	0.555	0.000
Ganjam	0.800	0.799	0.000	0.989	0.989	0.000	0.851	0.851	0.000
Balasore	0.465	0.465	0.000	0.844	0.844	0.000	0.509	0.509	0.000
Nayagarh	0.586	0.586	0.000	0.884	0.884	0.000	0.627	0.626	0.000
Mayurbhanj	0.477	0.476	-0.001	0.680	0.679	0.000	0.494	0.494	-0.001
Dhenkanal	0.623	0.619	-0.004	0.957	0.955	-0.003	0.658	0.654	-0.004
Keonjhar	0.499	0.499	0.000	0.481	0.481	0.000	0.496	0.496	0.000
Angul	0.612	0.612	0.000	0.895	0.895	0.000	0.662	0.662	0.000
All Fani Districts	0.609	0.573	-0.036	0.875	0.837	-0.038	0.662	0.625	-0.037

Source and Notes: The number of houses in 2019 was extrapolated using compound annual growth rate (CAGR) from number of houses in censuses 2001 and 2011. Assuming the house size for rural and urban areas as in 2011, a district- and region-specific (rural/urban) population was estimated and adjusted pro rata to the 2018–19 population in Mishra, Gaurav and Nathan (2019). Further, the share of homeless population was as in 2011 and the distribution of house structure (kutcha, semi-pucca, and pucca) was as per Directorate of Economics and Statistics (2017). For impact of Fani we assumed that a severely damaged house rendered its residents homeless and a partially damaged house put it one notch below—i.e. pucca to semi-pucca, semi-pucca to kutcha, and kutcha to homeless.

The decline in Jajpur at −2.1%, Jagatsinghpur at −1.3%, and Dhenkanal at −0.6% is greater than that in Kendrapara −0.3%, which in our earlier calculation had a greater Fani Impact Index. This could be

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[6] The s Index draws upon an approach followed in the computation of Youth Development Index by Rajiv Gandhi National Institute of Youth Development (2017).

[7] S Index, $S=\sum s_i w_i$; s_i is safety score for the ith category of house, and w_i is the proportion of population staying in the ith category of house.

because of resilient house structures in Kendrapara. It is said that Jagatsinghpur, which had borne the brunt of the super cyclone of 1999, and Kendrapara have developed resilient house structures. In fact, as Puri had not suffered much in 1999 or in subsequent cyclones, the house structures there were older and perhaps not as resilient. Of course, Puri bore the brunt of Fani and the maximum damage in the district was inevitable, but better house structures might have reduced the impact of the damage on the houses.

7. The Multidimensional HEALS Index

The five indices (health, education, agri-livelihoods, living standards, and safe housing as mentioned above) are aggregated using the displaced ideal method to give us a multidimensional HEALS Index (see Table 6). Compared to our Fani Impact Index (an average of proportion of affected persons and the view of experts), if we look at the change, or change (%), in HEALS, the worst affected (Puri) and the least affected (Angul) seem to maintain their positions.

Table 6: Pre- and Post-Fani HEALS Index across Affected Districts

Districts	Pre-Fani	Post-Fani	Change	Change (%)
Puri	0.599	0.220	-0.380	-63.4
Khurda	0.600	0.486	-0.114	-19.0
Cuttack	0.600	0.505	-0.095	-15.8
Kendrapara	0.533	0.445	-0.088	-16.6
Jajpur	0.559	0.495	-0.064	-11.4
Jagatsinghpur	0.584	0.466	-0.118	-20.2
Bhadrak	0.518	0.459	-0.059	-11.3
Ganjam	0.644	0.637	-0.007	-1.1
Balasore	0.558	0.510	-0.048	-8.5
Nayagarh	0.585	0.478	-0.106	-18.2
Mayurbhanj	0.567	0.549	-0.018	-3.217
Dhenkanal	0.578	0.520	-0.057	-9.9
Keonjhar	0.561	0.543	-0.018	-3.213
Angul	0.591	0.591	0.000	0.0
All Fani Districts	0.593	0.515	-0.077	-13.1

Source and Note: Authors' calculation using displaced ideal method to the five individual dimension-specific indices given in Tables 3 to 5.

The adverse impact of Fani based on change (%) in HEALS, was the highest in Puri (−63.4%), followed by Jagatsinghpur (−20.2%), Khurda (−19.0%), Nayagarh (−18.2%), Kendrapara (−16.6%), and Cuttack (−15.8%), which were with higher absolute values than the average for the affected districts at −13.1%. Under HEALS, compared to Fani Impact Index, the districts of Nayagarh and Jagatsinghpur gained ranks by seven and four positions, respectively, because these two districts had relatively higher adverse impacts in health and education, and also for agri-livelihood in the case of Jagatsinghpur, but relatively less in the case of living standards and safe housing. Since the impact was relatively less on

living standards and safe housing it affected less proportion of people and thereby leading to relatively lower scores in Fani impact index.[8]

For the districts ranked second to fourth under the Fani Impact Index change (%) under HEALS indicates that the district of Cuttack seems to have suffered relatively less impact. This could be because the adverse impacts for the district, relatively speaking, were greater in terms of living standards and housing, but not in terms of health, education, and agri-livelihood.

The districts ranked seventh to tenth under change (%) in HEALS are Jajpur (−11.4%), Bhadrak (−11.3%), Dhenkanal (−9.9%), and Balasore (−8.5%). The case of Dhenkanal is intriguing. It could possibly have smaller areas where the impact was greater.

In the remaining districts, change (%) under HEALS is the least in Ganjam. It was relatively less adversely affected in almost all domains, barring education.

The differences in the two sets of indicators (HEALS vs Fani Impact Index) point out that our exercise under HEALS has been independent of the Fani Impact Index. Further, as it dwells into specific dimensions of damage and loss, district-specific sector-specific healing interventions become possible.

8. Impact on Poverty

The discussion on five independent indices and the aggregated HEALS provides us a comparative picture across districts. This section uses Mishra and Hari (2019) to look into the impact of Fani on the income poor by adjusting consumption expenditure information of 2011–12 with growth, distributional concerns, and change in population.

A comparison of pre-Fani (2018–19) and base year (2011–12), indicates a decrease in incidence of the income poor by −5.1 percentage points, that is −0.7 percentage points per annum (Table 16.7). What is more, this decline was greater in rural areas (−0.8 percentage points/year) compared to urban areas (−0.5 percentage points/year) and greater among the vulnerable population across social groups (−1.0 percentage points/year for Scheduled Tribes (STs), and −0.8 percentage points/year for Scheduled Castes (SCs), as also for Other Backward Classes (OBCs), as compared to −0.3 percentage points/year for Others).

As a corollary, the decline in incidence of the income poor was relatively greater in non-Fani districts, where the incidence of poverty in the base year (2011–12) was also higher. These achievements are quite impressive given the recurring disasters that the state has been exposed to—the cyclones Phailin (2013), Hudhud (2014), and Titli (2018), as also floods and droughts at regular intervals in the last seven years.

Comparison of the incidence of the income poor in the pre- with the post-Fani scenario, suggests that the entire gains in the last seven years were lost in the aftermath of Fani. The increase in the incidence of the income poor has been relatively low in the case of the STs (3.6 percentage points) as their population is relatively low in the Fani-affected districts. The increase has been the highest for SCs,

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[8] In fact, in the view of the experts, the adverse impact (ranked from worst to least) put Jagatsinghpur at fourth and Nayagarh at joint sixth.

particularly in urban areas (9.0 percentage points). In rural areas, the increase in the incidence of the income poor has been the highest for Others (7.2 percentage points).

Table 7: Incidence of Income Poor for Pre and Post-Fani Scenario in Odisha

Sub-Groups	Income Poor (%)									Change (percentage points)					
	Base, 2011-12			Pre-Fani, 2018-19			Post-Fani, May 2019			Pre-Fani minus Base			Post-Fani minus Pre-Fani		
	Rur	Urb	Com	Rur	Urb	Com	Rur	Urb	Com	Rur	Urb	Com	Rur	Urb	Com
ST	63.5	39.7	62.6	56.3	32.9	55.4	60.0	35.0	59.0	-7.2	-6.8	-7.2	3.7	2.1	3.6
SC	41.4	26.3	39.0	36.4	18.7	33.6	43.1	27.7	40.7	-5.0	-7.6	-5.5	6.7	9.0	7.1
OBC	24.2	22.1	23.9	18.2	20.0	18.4	24.0	21.4	23.7	-5.9	-2.1	-5.5	5.7	1.4	5.2
OSG	14.2	6.7	11.8	11.8	5.4	9.8	19.0	6.9	15.2	-2.4	-1.3	-2.0	7.2	1.5	5.4
CL-A	59.6	-	59.6	51.0	-	51.0	59.5	-	59.5	-8.6	-	-8.6	8.4	-	8.4
CL-NA	45.4	55.3	46.6	42.6	50.0	43.5	47.1	51.0	47.6	-2.9	-5.3	-3.2	4.5	1.0	4.1
SE-A	32.1	-	32.1	26.0	-	26.0	32.1	-	32.1	-6.2	-	-6.2	6.2	-	6.2
SE-NA	25.2	17.3	22.9	20.9	13.8	18.8	25.1	20.7	23.9	-4.3	-3.5	-4.1	4.3	6.9	5.0
RWS	12.0	8.7	10.4	9.2	5.6	7.5	11.6	5.8	8.8	-2.8	-3.1	-2.9	2.4	0.2	1.3
OOG	20.4	11.9	18.1	18.2	11.6	16.4	23.7	12.5	20.6	-2.1	-0.4	-1.7	5.4	0.9	4.2
Fani	26.4	11.2	24.1	22.7	9.6	20.8	31.7	14.8	29.2	-3.6	-1.5	-3.3	9.0	5.2	8.5
Non-Fani	51.8	27.2	47.9	43.2	21.1	39.8	43.2	21.1	39.8	-8.6	-6.1	-8.2	0.0	0.0	0.0
Odisha	35.7	17.3	32.9	30.3	14.0	27.8	36.0	17.2	33.1	-5.4	-3.3	-5.1	5.7	3.2	5.3

Sources and Notes: The estimates of the income poor are from Mishra and Hari (2019), which is based on a method in Mishra (2015). We use unit-level data of consumption expenditure from National Sample Survey (NSS) with poverty lines provided by Planning Commission (2013) that are adjusted for population estimates provided by Directorate of Economics and Statistics (2019). Distributional concerns impose a growth rate of 1.85% per annum on the bottom 50% of the population, and 1.91% on the middle 40% of the population, as per estimates by Chancel and Picketty (2017). The fall in income on account of damage and loss due to Fani across affected districts uses the Gross District Domestic Product (GDDP) provided by Mishra, Gaurav and Nathan (2019) to suggest that this would be equivalent to an income loss of 10%. For regions, Rur is Rural, Urb is Urban, and Com is Combined. Across social group, ST is Scheduled Tribe, SC is Scheduled Caste, OBC is Other Backward Classes, and OSG is Other Social Groups. Across occupational group, CL-A is Casual Labour in Agriculture, CL-NA is Casual Labour in Non-Agriculture, SE-A is Self Employed in Agriculture, SE-NA is Self Employed in Non-Agriculture, RWS is Regular Wage or Salary, and OOG is Other Occupational Groups.

Experts involved in the DLNA also provided their anonymised response on the impact of Fani on different income groups in a scale of 0–100. The average of their responses is normalised to a 0–1 scale such that, as in the Fani Impact Index (Figure 1), they are categorised into five impact groups: Minimal, Subdued, Moderate, Severe, and Extreme.

The impact by income group (Figure 2) indicates that the lower income group suffered an extreme impact (0.843), the upper income group that fell into the lower income group on account of Fani, suffered a moderate impact (0.526) and the upper income group that remained in the upper income group suffered a subdued impact (0.262).

Figure 2: Fani – Impact by Income Group
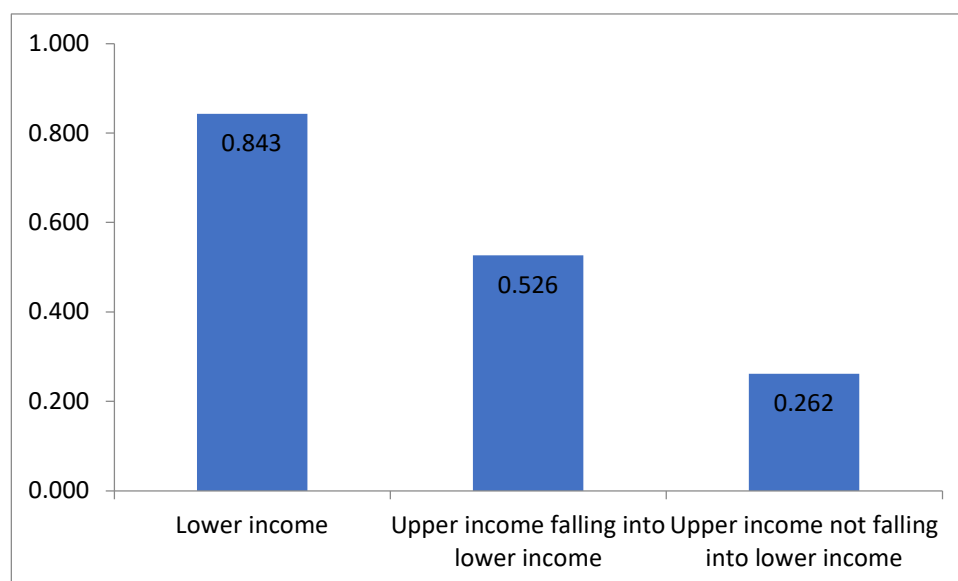
Source: Authors' calculation using the view of experts

It is possible that the increase in the income poor in the post-Fani scenario (Table 7 and Figure 2), as also the shortfall under HEALS (independently and collectively, Tables 3 to 6) are largely transient. With appropriate relief, rehabilitation, and reconstruction most of the income poor may come out of it. Otherwise, they may fall into structural poverty.[9]

9. Impact Highlighting Risk and Resilience Needs

The different risk and resilience needs identified during the discussion under the five dimensions of HEALS, also cut across gender, caste, occupational groups including small traders and business entities.

9.1 Health

Cyclone Fani has adversely affected 1,031 health centres including community health centres, primary health centres, sub-centres, and 12 medical colleges/district headquarter hospitals (Special Relief Commissioner Office, 2019b). The damage and devastation to the health centres on the one hand, and the need of emergency healthcare to treat cyclone-related injuries, and arrest risks of one or more epidemics on the other, creates a catch-22 situation for all those affected.

Interactions with victims in the worst affected district, Puri, revealed that there has been some incidence of waterborne diseases, like diarrhoea, post-disaster. People do acknowledge that medical

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[9] In fact, as Shephard et al. (2013) point out, natural disasters will be one of the important reasons for the reversal of progress against poverty. India is among those countries that have the highest exposure to such disasters and also have a high vulnerability to poverty. The study also puts in a case to consider some Indian states, including Odisha, as sub-national entities that require greater attention because of their exposure to recurring natural disasters.

care was provided promptly by the government. However, people carry the risk of infections of various kinds in post-disaster months, due to pollution of various kinds, including open defecation. Also, they are apprehensive about wild animals and snakes as certain affected localities are not far from forests.

Field interactions reveal that toilet facilities are damaged and, as a coping strategy, women have decreased their food intake to avoid defecating in the open, or to at least minimise their need to do so.

Limiting food intake at a time when physical requirement for nutrition has increased, has adverse nutritional and health implications. Their menstrual hygiene is also affected, which was depicted in a play/report (Mishra, 2019). In fact, shelter homes need to have dedicated spaces that provide privacy to women.

9.2 Education

The disaster has left at least 7,105 primary schools damaged. Incidentally, the disaster struck during school vacations. However, post-vacation there is a high risk of dropouts because of various externalities such as migration, distress, and reprioritisation of household needs. This will affect girl children and children with special needs in particular.

Apart from damage to their school buildings, students have also lost books and notebooks, which need to be replaced. Some students have expressed signs of mental and physical exhaustion. Children from the vulnerable communities and marginalised households (particularly, adolescent girls) may not only be withdrawn from schools, but also face an increased risk of child labour, trafficking, abuse, and child marriage.

It is during these times of crisis that vacations should be cancelled and schools reopened, so that children find an avenue to interact with their peers and teachers. This will reduce their physical and mental stress, and also perhaps the time can be used to come up with positive strategies to engage with their community in rebuilding lives.

Going back to school will also provide the children with at least a mid-day meal, which during such periods of crisis may be their only meal of the day. Hence, even if cyclone Fani hit during the vacation period, we consider the post-Fani period as one without access to education.

9.3 Agriculture and Livelihoods

Those dependent on agriculture and allied activities have been adversely affected. Many fruit and nut trees have been destroyed, horticulture crops, as also standing rabi crops, have been damaged. The loss of fruit and nut trees will not only result in income losses in the current year, but also in subsequent years. This does call for taking up resilient agro-ecological approa ches.

9.3.1 Those dependent on fishing

The fishing community has also suffered greatly. Their boats, nets and other fishing equipment have been destroyed and it will take them some time before they can restore these and venture again into

the sea. The women of the community, who used to sell fish or work as casual labourers, are also without jobs. Thus, both men and women of the fishing community are unable to earn a living.

9.3.2 Artisans and craftpersons

During our visit to Raghurajpur, a heritage village, it came to light that not only were paintings damaged, but their raw material had also been damaged and both art and raw material will be in short supply in the months to come. This will adversely affect their business prospects.

9.3.3 Tourism and small businesses

In Puri, which traditionally attracts a large number of tourists, the loss of livelihoods can stretch to more than even six months, which also provides time enough for new entrants to come in and replace those who may never be able to get back their source of livelihood.

Small businesses, largely comprising own account self-employed informal workers, suffered damage to their business entities and loss of income ranging from a fortnight to a couple of months.

A recent synthesis report (UNDP, 2016) that also covered Puri after the floods in 2011, pointed out that the micro and small entities were themselves resource and expertise pools and should be involved by the administration in any recovery process.

9.4 Living Standards

The living standards of the affected people saw a sudden dip in the absence of access to electricity, water, sanitation, cooking fuel, and other basic amenities. For Puri, the worst affected district, the electricity restoration took more than a month (Figure 3). Restoration of electricity was less than 5% even after two-weeks from the disaster and picked up after that. Almost a month after the disaster, that is by June 4, electricity restoration in the district is approximately two-thirds.

Access to electricity acts as not only a multiplier on the income generating activities in agriculture, industry, and services; but is also an enabler to provisioning of social amenities such as health care, water and sanitation (Birol, 2014; Nathan and Raj, 2016). Since electricity was not restored for more than a week even in the cities, water supply to the households (contingent upon power supply) was also affected. In those places where water supply source was restored in a few days, drinking water was not available at doorsteps.

Women had to walk a few kilometres thrice or even four times a day to fetch water for drinking and cooking. This was exhausting, time consuming and added to the burden of the women and girl children. As discussed earlier, under health, this also had adverse implications on their bodily integrity.

In the absence of electricity, people used kerosene lamps and candles during the night. During the day, to cope with the severe heat wave, people spent the day at shelter homes or schools (closed for vacations) and they returned home after sunset.

One of the welcome steps by the government, post disaster, was to allow the affected free access to forests to collect wood (fallen branches and uprooted trees). This has helped in two ways. The

collected wood is being used as firewood and houses have temporarily shifted to this mode of cooking to address a crisis situation. Some of the better-quality woods are being stored so that they can be used while rebuilding houses.

Figure 3: Electricity Restoration in Puri District Post-Fani
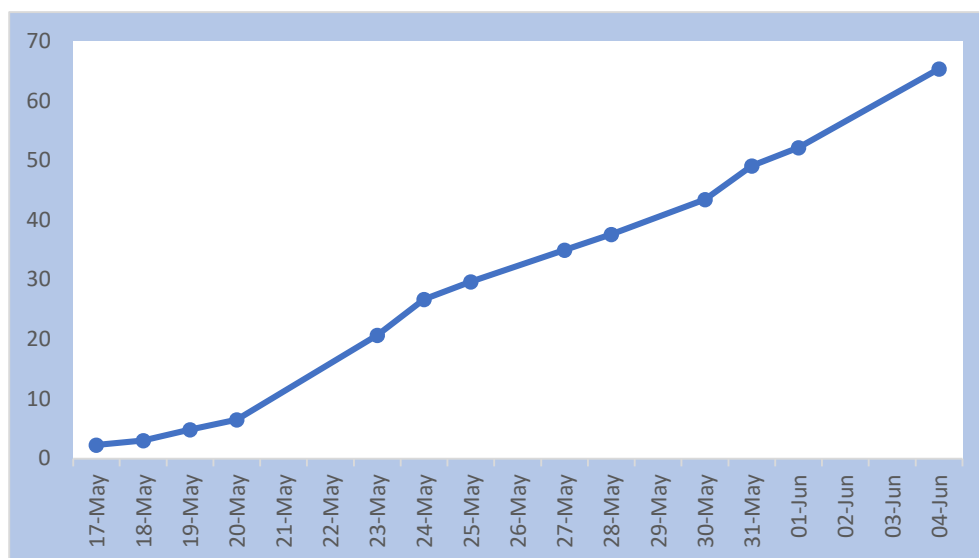
Source: Authors' calculation from Situation Reports released by Odisha State Disaster Management Authority (OSDMA)

9.5 Safe Housing or Shelter

The loss of housing has jeopardised the safety and security of the assets. Field interactions with communities reveal instances of assets being stolen in some areas by anti-social elements.

Residents pointed out that after they returned home post-disaster, they found that all their belongings buried under mounds of debris as walls had collapsed. In addition to this, to their dismay, they also found that their lockers and trunks had been broken open and valuables stolen.

The field notes also show that the households are not immediately rebuilding or repairing their houses primarily for two reasons. First, they are aware the damage assessment team is still visiting them, so an immediate repair or rebuild would underestimate the damage. Second, the cost of rebuilding has increased. For instance, the cost of straw has multiplied five times from INR 200 (USD 3) for a 100-bunch lot, to INR 1,000 (USD 15).

9.6 Relief and Exclusion

Immediately after the disaster, the government gave relief to households in terms of ration (50 kg rice) and cash (INR 2,000 or USD 29). However, two concerns noted during field visits were: (i) in some cases, the rice packets invariably weighed 10 kg less; (ii) some were excluded as they did not have some identification documents, this is a major concern.

The non-requirement of any identification documents for immediate relief has already been addressed by the administration, but it has led to some exclusion.[10] The question of exclusion also has a caste dimension. There have been reports that some social groups (particularly, the SCs) were denied access to shelter homes during Fani (Pattnaik, 2019). Such exclusions are unfortunate. Besides, the livelihood loss among these communities also needs special attention.

A study after the 1999 super cyclone (Roy, Mrutyunjaya and Selvarajan 2002) pointed out that some of the coping strategies were: migrating to other places, selling assets (land and cattle), shifting away from agriculture (because of its uncertain returns) to non-farm wage income for a regular source of earning. However, income-earning opportunities would themselves be limited.

Post disaster, with loss in avenues of income, people are taking up odd jobs such as rag picking, and waste recycling. However, opportunities here are also limited. This can lead to differences within families and within communities.

There have been reports of trafficking of children and minors, particularly girls. These need to be addressed.

10. The Way Forward

As the affected communities recover and strive to build a stronger society, we recommend the following eight-fold path.

First, the manner in which the agriculture sector is to be revived needs careful consideration. The agro-ecological approach of 'zero budget natural farming' in Andhra Pradesh has shown evidence of resilience to Cyclone Pethai, when compared with 'input-intensive cultivation practices'.[11]

It is reported that the Government of Odisha is planning a new Agricultural Policy. The government should seriously consider taking up the agro-ecological approach. In fact, it would be a logical extension of its initiatives under the Odisha Millets Mission (OMM) and would lead to convergence with the integrated farming programme and organic farming policy.

In fact, Fani suggests that the climate crisis is real and makes it imperative that the agro-ecological approach be considered as a way out. This will be good for the farmer (revive livelihood and also open up opportunities for others), good for the consumer (provide healthy and nutritious food), and is good for the planet.

Second, akin to relief being paid in cash and kind, rebuilding and reconstruction assistance can also be given in cash and kind. For instance, coconut planters need good nursery plants, which can be sourced from Kerala and other coconut producing regions of the country. In fact, rearing of fruit and nut trees in the farmers' own fields can be linked to payment of wages for a few years through the employment guarantee scheme under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), as the fruit and nut trees need to be nurtured before they can become regular sources of income.

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[10] The concerns for over-invoicing, in the absence of unidentified recipients, is an independent and important concern and needs to be addressed separately.

[11] Webinar: Growing the new Green Revolution: Zero Budget Natural Farming in Andhra Pradesh. Global Sustainability Institute. Anglia Ruskin University, UK, 25 March, 2019.

Third, the specific needs of communities must be addressed. For instance, the heritage village would immensely benefit from a greater tourist inflow post-disaster, enabling the local community to recover from the huge shock.

Similarly, different contingency plans need to be put in place for different occupations. The handicrafts sector, in addition to financial assistance, will also need a bank/storehouse that acts as a safe repository for their raw materials, which they can use to prevent future loss and also to borrow and use during times of such emergent requirement.

Fourth, community-specific, occupation-specific and location-specific requirements call for special considerations for female-headed households, widows, the differently-abled, fishing communities, SCs and STs, among others.

It also needs to be kept in mind that SCs and STs are constitutionally mandated social groups that are not only different, but each of them comprises multiple communities. Hence, their intra-community-specific requirement should also be kept in mind whilst designing any recovery and rehabilitation effort.

Fifth, public buildings such as schools and hospitals need to be built in a cyclone resistant way. For instance, Puri has approximately 2,000 primary schools. It is disappointing to note that till date these are not housed in cyclone-resistant structures. While people do seek shelter in school buildings during times of disaster, in many cases these schools and other public buildings were themselves damaged.

It is necessary that these buildings are built to be disaster-resilient and as safe structures. There is also a case to build more public buildings in disaster prone areas and to design them as places of shelter when the need arises.

Sixth, Odisha's towns and villages are known for their greenery. And human survival is contingent to the survival of plants. Hence, plantation drives are required in the affected districts. The government can develop a bank for seeds of different varieties; and in partnership with local institutions (civil society and community-based organisations (CBOs)) undertake plantation drives so as to restore the green cover on a war footing. Trees not only act as a first line of defence, but they also provide firewood and can also be a source of nutrition and perhaps the only source, during such times of crisis.

Seventh, a crisis of this proportion requires efforts from multiple quarters. The Government of Odisha alone cannot bear the burden and responsibility. International bodies, non-governmental organisations (NGOs), civil society groups, CBOs, and the people themselves need to be partners in recovery and reconstruction endeavours.

Last, but not the least, it's time that Odisha has an International Centre for Disaster Studies given the number of disasters the state has faced historically and the manner in which it has recovered despite these challenges.

The International Centre for Disaster Studies can act as a repository of knowledge on disasters and act as a collective endeavour of state, national, and international organisations. It can act as a linkage between the government, civil society, individual experts, and the public at large; and thereby strive towards a collective effort to build back better.

11. Conclusion

The paper has important methodological contribution on coming up with a Fani impact index and then with a HEALS index that helped us quantify damage after cyclone Fani in five important dimensions: health, education, agri-livelihoods, living standards, and safe housing or shelter, as also collectively. The indirect way of arriving at income poverty before and after Fani is also a methodological contribution. What is more, it shows that cyclone Fani reversed the gains of progress in poverty reduction in recent times. Field visits and interactions with stakeholder also provided us with an understanding of risk and resilience. We also provide a set of eight-fold path, as way forward, which should be read in conjunction with policy suggestions provided in the companion paper on macroeconomic impact.

As a postscript, it is heartening to note that some of the suggestions in the two papers have already been taken up by the Government of Odisha and other stakeholders. Meanwhile, the ongoing globally pandemic and public policy response to that has taken precedence. In such a scenario, the HEALS approach with some modifications, can have continued relevance.

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