GIFT DISCUSSION PAPER SERIES

2024

7/2024

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This article can be cited as Rju Mohan A & Aswathy Rachel Varughese, Ecological Federalism and Disaster Fund Allocation Criteria in India: Call for a Revisit, GIFT Discussion Paper 07/2024, *Gulati Institute of Finance and Taxation*, *Thiruvananthapuram, India.*

Ecological Federalism and Disaster Fund Allocation Criteria in India: Call for a Revisit

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Acknowledgment

The authors express their sincere gratitude to the reviewers for their invaluable comments and suggestions, which have greatly contributed to the improvement of this paper. We extend special thanks to Shri K. M. Chandrashekhar, Former Cabinet Secretary and Distinguished Professor at GIFT, for his critical input during the presentation of this paper at GIFT. We also acknowledge Prof. K. N. Harilal, Chairman of the 7th State Finance Commission, for his valuable remarks that have enhanced this work during the presentation at GIFT. We also express our gratitude to Prof. M. Govinda Rao, Member of the 14th Finance Commission and Distinguished Professor of GIFT, for his encouragement and comments during the paper presentation. Besides, we are grateful to Prof. K. J. Joseph, Director of GIFT, for his critical comments that have significantly improved the manuscript. Lastly, we thank all faculty members of GIFT for their constructive feedback and comments.

Abstract

The present study critically examines the disaster response financing mechanism within India's fiscal federal framework. It identifies significant deficiencies in both the criteria and methodology for the State Disaster Response Fund (SDRF) allocation. The methodology currently used by the Finance Commission deviates from the established principles of disaster risk theory. The parameters for fund distribution—population, geographical area, and Below Poverty Line population disproportionately disadvantage states that have effectively managed demographic and poverty reduction efforts, inadvertently penalizing high-performing states. These parameters are largely irrelevant to the specific needs of disaster response funding. Furthermore, the existing measure of vulnerability, which predominantly focuses on poverty, fails to adequately reflect the vulnerability to specific natural disasters. The study proposes revised parameters for fund allocation, including population density and specific geographical features such as wetlands, hilly areas, and coastal length. It also advocates for the replacement of the poverty-based vulnerability measure with a comprehensive disaster vulnerability index.

Keywords: Ecological federalism; finance commission; Disaster response funding; vulnerability

1. Introduction

The escalating risks of environmental degradation and climate change necessitate fiscal interventions to implement effective mitigation, adaptation, and resilience measures. Considering the quality of the environment being a "local" public good, and aligning with the "principle of subsidiarity" or Oates theorem (suggesting local governments closer to citizens are more efficient in public service provisioning than higher tiers of government), fiscal decentralisation emerges as a key driver for fiscal interventions that promote ecological conservation, efficiency and equality in the economy (Chakraborty, 2021; Kaur et. al., 2021).

Ecological fiscal federal transfers (EFTs) represent a critical financial mechanism to promote sustainable development and environmental conservation along the lines of fiscal decentralisation. This system involves reallocating funds from national to sub-national governments based on ecological criteria. Dasgupta and Srikanth (2021) emphasize that well-designed transfers can enhance ecological values and support climate goals. By directing funds to states essential for their contributions to climate mitigation, India can incentivize states to adopt greener policies and practices that would ultimately leading to a reduction in greenhouse gas emissions. By incentivizing states to maintain and improve their ecological health, these transfers can also help mitigate issues such as deforestation, pollution, and loss of biodiversity. Sankar (2009) highlights that fiscal transfers not only

support environmental sustainability but also build capabilities in local bodies, which are crucial for effective ecological management.

In the Indian context, ecological federal transfers take the route of tax devolution and Finance Commission (FC) grants. Disaster risk financing through FC grants has been in place since the Second Finance Commission, later, it was replaced with a Calamity Relief Fund and a National Calamity Contingency Fund (NCCF) as well as National Disaster Relief Fund (NDRF). Those fund allocations followed an expenditure-based criterion, considering only the past expenditure incurred by the states for disaster responses. However, the 15th FC deviated from this approach and adopted a comprehensive methodology with population, area and disaster risk scores for determining the states' share. However, the current mechanism of determining state government shares in the State Disaster Response Fund (SDRF) has significant flaws, particularly in its criteria and methodology. Therefore, the present study critically examines the existing criteria and methodology for the disaster response funding in India. In the wake of submitting inputs for the 16th FC – memorandum of the state of Kerala, the study suggests alternative criteria to overcome the flaws in the previous and current approaches.

2. History of Disaster Financing through Finance Commission Grants

Disaster financing in India was first introduced by the Second Finance Commission. It implemented a 'Margin Money Scheme' for disaster relief by incorporating a margin in each state's annual revenue calculations (Sharma, 2023). This approach allowed states to accumulate substantial funds for potential natural calamities. The Commission advised states to establish separate funds and annually deposit the calculated amounts. This framework remained largely unchanged from the Third to the Eighth Finance Commissions, with only minor modifications to the disaster funding recommendations.

The Margin Money Scheme allowed states to incorporate a financial buffer in their annual revenue calculations for potential disaster-related expenses. Finance Commissions advised states to allocate this calculated amount to a dedicated fund. The central government supplemented these funds through grants and loans. When a state's disaster expenses exceeded its margin fund, the Union provided additional support. During natural calamities, the Centre covered 75 percent of the expenditure, with 67 percent as loans and 33 percent as grants. States were responsible for the remaining 25 percent, sourced from their own funds or third-party loans. These central loans were offered on favourable terms. However, subsequent Finance Commissions phased out this loan-based approach.

The Ninth Finance Commission introduced a significant change by recommending the establishment of the Calamity Relief Fund (CRF), granting states more autonomy in fund utilization compared to previous schemes. The Tenth FC expanded funding to include "calamities of rare severity," though this term remained undefined due to India's diverse geography, demographics, and hazard profiles, necessitating case-by-case evaluation. The Eleventh FC noted that the CRF had become inadequate to address the states' growing needs in response to increasing natural calamities. Subsequently, the Twelfth FC maintained both the CRF and National Calamity Contingency Fund (NCCF) while broadening the range of calamities covered under these programs.

The Disaster Management Act of 2005 mandated the establishment of the State Disaster Response Fund (SDRF) and National Disaster Response Fund (NDRF). The Thirteenth Finance Commission recommended transitioning from the Calamity Relief Fund (CRF) and National Calamity Contingency Fund (NCCF) to these new funds, which was implemented by the Fourteenth Finance Commission. The Fifteenth Finance Commission also consolidated the CRF into the SDRF and adopted an expenditure-based approach for fund allocation, using the average disaster response spending from the previous seven years as the basis for state-level distributions.

3. Current Methodology

The Fifteenth Finance Commission (FC) (2021-22 to 2025-26) revised the methodology for determining state shares in the SDRF. Unlike previous FCs that relied solely on past expenditure for disaster relief fund allocation, the 15th FC considered population, area, average past expenditure, and the Disaster Risk Index (DRI). The DRI assessed hazard probabilities, such as cyclones, landslides, floods, and earthquakes, alongside vulnerability, which is based on the population below the poverty line. Under this framework population and area have a weight of 15 percent each while the average of past expenditure was given a weight of 70 percent. Even in the revised methodology past expenditure is considerably represented. Third important variable for fund allocation is the risk profile of the state which is captured through a Disaster Risk Index (DRI). It includes the probability of hazards and vulnerability, thus arriving at composite score. The hazards mainly focus on the probability of events such as landslides, flood, earthquakes, drought and other natural calamities. For the calculation of DRI, hazards have the highest score of 70 while vulnerability has 30. The vulnerability measure considers the population below the poverty line (BPL). The hazard scoring system employs three tiers: fifteen, ten, and five points, correlating with the highest to lowest probability of natural disaster occurrence (Table 1). An additional uniform score of ten is assigned to all states for rare, unforeseen disasters, bringing the

total hazard score to 70. The BPL population, determined using the Tendulkar Committee's calorie-intake methodology, forms the basis for vulnerability scoring. As shown in Table 1 the states with less than 13 percent poverty receive 10 points, those between 13-26 percent get 20 points, and states exceeding 26 percent BPL population are assigned 30 points. This system aims to quantify both disaster risk and socioeconomic vulnerability in fund allocation decisions.

Table 1: Summary of the Scoring Scheme for DRI

Disasters	High	Medium	Low
Floods	15.00	10.00	5.00
Drought	15.00	10.00	5.00
Cyclone	15.00	10.00	5.00
Earthquake	15.00	10.00	5.00
Others		10.00	

Scoring System	Poverty
Low - 10.00	Below 13%
Medium - 20.00	Between 13% and 26%
High - 30.00	Between 26% and 40%

Source: 15th Finance Commission Report, 2020.

4. Estimation of SDRF Share of States

After fixing the parameters, for the calculation of shares, 70 percent of the weight is assigned to the past expenditure. 15 percent of weights each has been allotted for population and geographical area. Hence a score is arrived at

$$W = Expenditure_{70} + Area_{15} + Population_{15} \quad (1)$$

Once W is calculated, this score is multiplied with the respective DRIs of the states to get a score of Y,

$$Y = W * DRI \quad (2)$$

The final score is Z in equation (3) which is the base value of a state.

$$Z = Y + W \quad (3)$$

The base value considers 5 percent inflation and then arrive at the final figure which reflects the share of respective states in disaster funding.

In the domain of disaster management, risk is fundamentally perceived as an interaction between the likelihood of disasters and the degree of vulnerability. This interactive effect can be quantitatively assessed through the calculation of the Disaster Risk Index (DRI), wherein risk is expressed as the product of disaster probability and vulnerability, aligning with established risk theory (Blaikie et al., 1994). Contrary to this approach, the Finance Commission's DRI calculation method employs an additive model by summing disaster probability and vulnerability, which merely reflects a cumulative effect rather than a true interaction between these elements. For a more precise representation of risk that encapsulates the dynamic interplay between disaster probability and vulnerability, it is imperative to utilize a model that emphasizes their interactive effect. Employing

such an approach ensures a more accurate depiction and understanding of potential risks.

Table 2: DRI Scores of the States

States	Hazard (H)	Vulnerability (I)	Total
Andhra Pradesh	55	10	0.65
Arunachal Pradesh	40	30	0.70
Assam	40	30	0.70
Bihar	50	30	0.80
Chhattisgarh	25	30	0.55
Goa	25	10	0.35
Gujarat	60	20	0.80
Haryana	35	10	0.45
Himachal Pradesh	35	10	0.45
Jharkhand	30	30	0.60
Karnataka	40	20	0.60
Kerala	45	10	0.55
Madhya Pradesh	30	30	0.60
Maharashtra	50	20	0.70
Manipur	30	30	0.60
Meghalaya	30	10	0.40
Mizoram	30	20	0.50
Nagaland	30	20	0.50
Odisha	60	30	0.90
Punjab	35	10	0.45
Rajasthan	35	20	0.55
Sikkim	30	10	0.40
Tamil Nadu	45	10	0.55
Telangana	35	10	0.45
Tripura	40	20	0.60
Uttar Pradesh	45	30	0.75
Uttarakhand	40	50	0.50
West Bengal	55	20	0.75

Source: 15th Finance Commission Report, 2020.

Table 2 shows the composite DRI scores for states as calculated in the 15th Finance Commission by combining Hazard and Vulnerability with a weight of 70 and 30 respectively.

Table 3: SDRF Allocation for the States during 15th Finance Commission

States	Total SDRF allocated	Centre's Share
Andhra Pradesh	6591.20	4943.40
Arunachal Pradesh	1228.80	1105.92
Assam	3793.60	3414.24
Bihar	8345.60	6259.20
Chhattisgarh	2546.40	1909.80
Goa	66.40	49.80
Gujarat	7802.40	5851.80
Haryana	2895.20	2171.40
Himachal Pradesh	2006.40	1504.80
Jharkhand	3345.60	2509.20
Karnataka	4659.20	3494.40
Kerala	1852.80	1389.60
Madhya Pradesh	10728.80	8046.60
Maharashtra	18989.60	14242.20
Manipur	208.00	187.20
Meghalaya	322.40	241.80
Mizoram	229.60	206.64
Nagaland	203.20	182.88
Odisha	9455.20	7091.40
Punjab	2918.40	2188.80
Rajasthan	8730.40	6547.80
Sikkim	248.00	223.20
Tamil Nadu	6012.80	4509.60
Telangana	2648.00	1986.00
Tripura	336.00	302.40
Uttar Pradesh	11396.80	8547.60
Uttarakhand	4601.60	4141.44
West Bengal	5960.00	5364.00
All states	128122.40	98613.12

Source: 15th Finance Commission Report, 2020.

Note: Centre's share here refers to 75% and 90% of the total SDRF allocation for general and special category states respectively.

As shown in Table 3, the 15th Finance Commission allocated a total of Rs. 1,28,122 crores for the SDRF. Under this allocation, for general category states, 75 percent of the fund will be shared by the Union government, with the remaining 25 percent allocated by the state government. Special category states, however, will have a different allocation ratio, with 90 percent of the fund shared by the Union and 10 percent by the state government. Based on current criteria, Maharashtra, Uttar Pradesh, Madhya Pradesh, Odisha, and Rajasthan top the list of recipients for the SDRF, while the North-Eastern states, Kerala, Himachal Pradesh, Chhattisgarh, and Telangana receive the least.

5. Problems in the Allocation Criteria

Despite this comprehensive approach, the inappropriate parameters for SDRF fund allocation have resulted in significant fiscal discrimination against certain states. The current framework's inclusion of population, geographical area and BPL population criteria results in those states receiving a higher share of SDRF funds which may not be necessarily high-risk category in terms of hazards and exposure to natural disasters. Hence, it turns out to be highly unfair.

a. Population Criterion Penalises States Successful in Population Control

Using the 2011 census population as a key factor has been contentious, penalizing states like those in South India that have successfully implemented population control measures. These states have voiced discontent, arguing that the population criterion unfairly reduces their share of federal resources. In tax devolution, this concern was addressed by incorporating demographic performance alongside population weight. While population is a need-based criterion for resource allocation and ensuring larger populations receive adequate resources, the SDRF fund allocation should focus on risk and vulnerability rather than sheer population size.

b. Geographical Area Does Not Accurately Reflect Disaster Vulnerability

Using geographical area as a criterion for SDRF fund allocation is flawed. Natural disasters impact specific geographical divisions like hilly regions, wetlands, and coastal areas more than others. Simply using the geographical size of a state does not address the unique risks posed by cyclones, earthquakes, floods, and landslides. While geographical area is relevant for general resource allocation, it falls short in addressing the specific needs of natural disaster relief. Geographically larger states receive more funds even if they face less risk or vulnerability, leading to unfair

distribution. In the current SDRF framework, both area and population have a 15 percent weight each. However, this approach does not accurately reflect the needs of states with higher disaster risk. To ensure fairness and effectiveness, the allocation criteria should prioritize factors directly related to disaster risk and vulnerability rather than relying on population and area alone.

This study prioritized coastal regions in our climate impact assessment by assigning them a 7 percent weight due to their heightened vulnerability to adverse climatic events. Coastal regions frequently encounter cyclones, rising sea levels, coastal erosion, and saltwater intrusion, all of which endanger millions of lives by displacing communities and threatening agriculture, freshwater resources, and infrastructure. The Indian western and eastern coastal plains constitute approximately 7 percent of the nation's land area but are home to about 17 percent of the population, equating to nearly 211.93 million people across 640 districts, including states such as Kerala, Tamil Nadu, and Odisha that are acutely susceptible to climate change.

Further, hilly terrains and wetlands were each given a 4 percent weight due to their exposure to distinct climate challenges. Hilly and mountainous regions comprise roughly 16.2 percent of India's land area, encompassing the northern Himalayas and the Eastern and Western Ghats, which face significant climatic challenges like

glacial retreat, erratic rainfall patterns, landslides, and flash floods. These challenges notably affect ecosystems and biodiversity in states such as Himachal Pradesh, Uttarakhand, Jammu and Kashmir. Collectively, these areas account for approximately 3.64 percent of India's population or around 44.06 million individuals as recorded in 2011.

Wetlands, which cover about 4.86 percent of India's geographical area amounting to 15.26 million hectares, are biologically enriched yet highly sensitive environments vulnerable to sea-level rise and frequent flooding that heighten salinity levels impacting ecosystem functionality and community livelihoods. A higher weighting is allocated to wetlands in acknowledgment of India's robust commitment to their conservation with India recognized for safeguarding 49 Ramsar sites covering an expanse of 10,93,636 hectares—the largest in South Asia.

Desert regions, which occupy approximately 10% of the nation's land area and account for about 5% of its population, remain an important geographical area worthy of study, though they are not included in our current analysis. These regions are characterized by sparse populations due to limited water resources and challenging living conditions. However, they are increasingly afflicted by intensifying droughts, extreme heat waves, and water scarcity. These issues exacerbate desertification, lead to declining groundwater levels, and adversely affect food security and local

ecosystems. Going by the land area and related inhabitants, the study takes into account disaster vulnerability in areas such as coastal lands, wetlands and hilly terrain.

c. Past Expenditure

Despite there being a departure from the previous methodology, the current mechanism also heavily relies on the average expenditure on relief measures from the past seven years, which accounts for 70 percent of the allocation criteria. This predominant focus on historical expenditure means that states with higher past expenditures receive more funds, regardless of their current risk and vulnerability to natural disasters. This approach can perpetuate inequalities, as it doesn't necessarily address the actual needs or future risks faced by different states. To create a more balanced and fair allocation system, it would be beneficial to consider current and projected risks and vulnerabilities alongside past expenditures.

6. Concerns with Disaster Risk Index Calculation

In the domain of disaster management, risk is fundamentally perceived as an interaction between the likelihood of disasters and the degree of vulnerability. This interactive effect can be quantitatively assessed through the calculation of the Disaster Risk Index (DRI), wherein risk is expressed as the product of disaster probability and vulnerability, aligning with established risk

theory (Blaikie et al., 1994). Contrary to this approach, the Finance Commission's DRI calculation method employs an additive model by summing disaster probability and vulnerability, which merely reflects a cumulative effect rather than a true interaction between these elements. For a more precise representation of risk that encapsulates the dynamic interplay between disaster probability and vulnerability, it is imperative to utilize a model that emphasizes their interactive effect. Employing such an approach ensures a more accurate depiction and understanding of potential risks.

Currently, the DRI is a composite score derived from hazard and vulnerability scores. The hazard score, out of 70, is based on the probability of frequent natural disasters in India, with states classified as high, medium, or low risk. The vulnerability score, out of 30, is based on the population Below Poverty Line (BPL), which is a rudimentary measure of vulnerability.

The current DRI formula while providing a starting point, overlooks crucial theoretical aspects of disaster risk. A clear contextual understanding of the two concepts, hazard and vulnerability is in order here.

The hazard dimension of the Disaster Risk Index (DRI) appears to consider only the technocratic perspective of hazard, whether natural or anthropogenic in their singular context. An objective approach should consider socio-natural hazards, associated with

the combined dynamics of both natural and anthropogenic factors in their socio-political context (Burton et al. 2005). Moreover, factors like frequency, intensity, and spatial distribution of hazards are crucial for understanding disaster risk (UNISDR, 2009).

Coming to vulnerability, the DRI does not adequately account for a region's vulnerability, which refers to the susceptibility of communities to the impact of hazards. There are different ways of understanding vulnerability. One perspective, offered by Bohle et al. (1994), sees it as a complex social situation with many layers and influences. These influences include the resources available to people (political, economic, and institutional) depending on where they live and the times they live in. Another way to think about it, as Blaikie et al. (2004) suggest, is to focus on the characteristics of individuals or communities that affect their ability to handle the impacts of natural disasters. These characteristics influence how well they can anticipate, deal with, resist, and bounce back from such events.

For a more robust DRI which is in line with the theoretical considerations and thereby gives a more holistic picture of disaster risk, the Disaster Risk Index (DRI) should integrate hazard, vulnerability, and capacity assessments (UNISDR, 2009). That is, disaster risk is not static. Climate change, for instance, can alter hazard patterns. Therefore, the DRI should be adaptable to incorporate evolving risks (Jodha, 2012). As already indicated in

the context of hazard, the DRI also needs to incorporate social factors that exacerbate vulnerability. This requires using a more comprehensive vulnerability index that has been constructed for states in India like the Disaster Score Card prepared for States and Union Territories (NDMA, 2018) which nevertheless, needs to be updated. Also, instead of considering disaster risk in terms of probability of disasters only and vulnerability separately, the comprehensive, traditional risk measure in terms of probability of disasters times vulnerability degree can be considered.

In this light, using the BPL population alone as a measure of vulnerability is problematic. That is, vulnerability is not a representation of only (income) poverty. It is now a generally accepted fact that poverty is multi-dimensional. Vulnerability should therefore, consider exposure to hazards and the population's capacity to adapt and be resilient. However, the current method unfairly penalizes states that have successfully reduced poverty, such as those in South India. As a result, there is a mismatch between hazard scores and vulnerability measures. For example, states like Odisha, Gujarat, West Bengal, Andhra Pradesh, Bihar, Maharashtra, Uttar Pradesh, Kerala, Tamil Nadu, and Arunachal Pradesh have high hazard scores. However, incorporating below poverty level populations as the primary vulnerability measure lowers the overall scores of states like Andhra Pradesh, Kerala, and Tamil Nadu. Consequently, these

states rank low in the overall DRI and receive less SDRF funding, despite being high or medium hazard states.

7. How to Address the Methodological Issues in Disaster Fund Allocation?

a. Population Density is a Better Indicator

To better address disaster risk, incorporating population density as a criterion would be more effective. Densely populated areas face higher risks, casualties, and losses during natural disasters. Adjusting the allocation to reflect this would ensure a more equitable distribution of funds, aligning resources with actual needs and vulnerabilities. Instead of considering population and area separately, a combined measure of population density, which is a recognised vulnerability dimension (Birkmann et al., 2006) and a higher risk factor, must be accounted for. Assigning a weight of 15 percent to population density would better address the high-risk factor for the population.

b. Geographical Sub-divisions

For ecological fiscal transfers, instead of considering only the geographical area, geographical sub-divisions more prone to natural disasters, such as hilly areas, wetlands, and coastal lines, need to be incorporated. Mere consideration of geographical area is irrelevant in the context of setting up disaster funding criteria. Natural disasters impact specific geographical divisions like hilly

regions, wetlands, and coastal areas more than others. Instead of simply considering the area, the allocation criteria need to consider the proportion of wetlands, hilly regions and the length of coastal lines. Incorporating these sub-divisions with a weight of 15 percent would significantly represent states which are prone to the natural disasters.

c. Replacing Poverty Vulnerability with a Composite Score

Replacing the below poverty line population with a composite vulnerability score is essential. Composite index of National Disaster Management Authority (NDMA) would provide a more accurate picture. It considers unsafe buildings, social infrastructure, physical infrastructure, net cropped area, livestock population, industries, vulnerable women, children, disabled and aged population, rural- urban population, deforestation, depletion of mangroves and water stress. Inclusion of a composite vulnerability index will considerably represent those states which are really vulnerable to natural disasters, rather than merely taking the poverty vulnerability.

8. Empirical Estimation with the Proposed Revision in the Methodology

Following are the underlying assumptions of the proposed revision in the methodology:

1. It maintains the 70 percent weight given to the average expenditure on disaster relief measures over the past seven years, aligning with the previous approach.
2. Instead of considering population and area separately, the new methodology combines these factors by using population density per square kilometre, assigning it a weight of 15 percent. This change aims to better reflect the potential impact of disasters on densely populated areas.
3. The revision recognizes that geographical subdivisions are more relevant to disaster risk than overall state size. Consequently, it incorporates the share of wetlands and hilly areas, each weighted at 4 percent, and the length of coastal lines, weighted at 7 percent. These weights are assigned based on the likelihood of specific disasters (such as earthquakes, floods, droughts, and cyclones) affecting these terrains.
4. The proposed revision in the methodology includes a revision in the DRI scores as well. It replaces the current poverty-based vulnerability measure with a comprehensive vulnerability index provided by the National Disaster Management Authority (NDMA). While maintaining the 10, 20, and 30 scoring system for low, medium, and high vulnerability levels respectively, this change shifts the focus from poverty vulnerability to

a more holistic assessment of disaster vulnerability. This adjustment aims to more accurately reflect each state's susceptibility to natural disasters rather than its economic conditions alone.

Table 4: Revised DRI Scores and Change in the Ranking

States	H	I	Total	New rank	Old Rank
Gujarat	60	30	0.90	1	3
Andhra Pradesh	55	30	0.85	2	9
West Bengal	55	30	0.85	3	5
Bihar	50	30	0.80	4	2
Maharashtra	50	30	0.80	5	8
Odisha	60	20	0.80	6	1
Tamil Nadu	45	30	0.75	7	18
Uttar Pradesh	45	30	0.75	8	4
Karnataka	40	30	0.70	9	11
Kerala	**45**	**20**	**0.65**	**10**	**16**
Rajasthan	35	30	0.65	11	17
Assam	40	20	0.60	12	7
Madhya Pradesh	30	30	0.60	13	12
Uttarakhand	40	20	0.60	14	21
Haryana	35	20	0.55	15	22
Himachal Pradesh	35	20	0.55	16	23
Punjab	35	20	0.55	17	24
Telangana	35	20	0.55	18	25
Arunachal Pradesh	40	10	0.50	19	6
Jharkhand	30	20	0.50	20	10
Tripura	40	10	0.50	21	14
Chhattisgarh	25	20	0.45	22	15
Manipur	30	10	0.40	23	13
Meghalaya	30	10	0.40	24	26
Mizoram	30	10	0.40	25	19
NAgaland	30	10	0.40	26	20
Sikkim	30	10	0.40	27	27
Goa	25	10	0.35	28	28

Source: Authors' own calculation based on data from NDMA's

Disaster Score Card for States and Union Territories of India, 2018.

Based on the revised score and parameters shown in Table 4, the revised share entitled for the states as SDRF grants is given below (Table 5).

Table 5: Revised Share Entitlements for States as SDRF

	Current		Estimated	
States	**Total SDRF allocated**	**Centre's Share**	**Total SDRF allocated**	**Centre's Share**
Andhra Pradesh	6591.20	4943.40	6988.35	5590.68
Arunachal Pradesh	1228.80	1105.92	1423.64	1138.91
Assam	3793.60	3414.24	4847.05	3877.64
Bihar	8345.60	6259.20	11762.41	9409.93
Chhattisgarh	2546.40	1909.80	3167.11	2533.69
Goa	66.40	49.80	226.97	181.58
Gujarat	7802.40	5851.80	11188.24	8950.60
Haryana	2895.20	2171.40	4235.83	3388.66
Himachal Pradesh	2006.40	1504.80	2887.99	2310.39
Jharkhand	3345.60	2509.20	4190.93	3352.74
Karnataka	4659.20	3494.40	6494.80	5195.84
Kerala	**1852.80**	**1389.60**	**2901.88**	**2321.50**
Madhya Pradesh	10728.80	8046.60	13985.01	11188.01
Maharashtra	18989.60	14242.20	26765.11	21412.09
Manipur	208.00	187.20	263.52	210.81
Meghalaya	322.40	241.80	436.08	348.86
Mizoram	229.60	206.64	352.67	282.13
Nagaland	203.20	182.88	272.75	218.20
Odisha	9455.20	7091.40	12391.26	9913.01
Punjab	2918.40	2188.80	4111.55	3289.24
Rajasthan	8730.40	6547.80	11972.17	9577.73
Sikkim	248.00	223.20	593.09	474.47

Tamil Nadu	6012.80	4509.60	8918.30	7134.64
Telangana	2648.00	1986.00	3611.26	2889.01
Tripura	336.00	302.40	511.78	409.42
Uttar Pradesh	11396.80	8547.60	15470.50	12376.40
Uttarakhand	4601.60	4141.44	6342.30	5073.84
West Bengal	5960.00	5364.00	8777.44	7021.95
All states	**128122.40**	**98613.12**	**175089.97**	**140071.98**

Source: Authors' own calculation

As per the tables 4 and 5, the total SDRF allocation will increase from Rs. 128,122.40 crore to Rs. 175,089.97 crore. High risk states like Gujarat, Andhra Pradesh and Kerala would receive more funding. Kerala's share would increase from Rs 1389.60 crore to Rs 2321.50 crore with the revisions in the methodology.

9. Conclusion

In disaster management, risk is seen as the interaction between the likelihood of disasters and vulnerability, typically measured by the Disaster Risk Index (DRI). According to established risk theory, DRI should be calculated by multiplying disaster probability and vulnerability. However, the Finance Commission uses an additive model, simply summing these factors, which does not capture their true interaction. To make the SDRF more efficient and equitable, the 16th Finance Commission should revisit the existing criteria. The penalizing performers criterion of population and area should be replaced with population density with 15 percent

weight, which better captures the risk and exposure to natural disasters.

For ecological fiscal transfers, rather than considering only the geographical area, subdivisions more prone to natural disasters—such as hilly areas, wetlands, and coastlines—should be included, with an overall weight of 15 percent. Out of this 15 percent, hilly areas and wetlands each receive a weight of 4 percent due to their disaster risk, while coastlines receive a weight of 7 percent due to the risk of flooding. For the DRI, since the BPL population is a basic measure capturing only poverty vulnerability, a composite vulnerability index from authorized agencies like NDMA or self-computed figures should be used to reflect the actual vulnerability to natural disasters.

The risk measure should be calculated as the probability of disasters times the degree of vulnerability as per the theory of risk. However, the current approach considers risk in terms of probability of disasters only and vulnerability separately which is theoretically incorrect. Failure to revise these criteria could result in states receiving disproportionate amounts, insufficient to meet their disaster response needs effectively.

If this were done, states like Gujarat, Andhra Pradesh, West Bengal, Bihar, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh, Karnataka, and Kerala would be recognized as having high DRI scores and would justifiably receive more SDRF funds.

The proposed revisions to the SDRF allocation criteria represent a significant step towards more equitable and effective disaster response funding in India. By addressing the shortcomings of the current system, the states may receive funds proportionate to their actual disaster risks and vulnerabilities. The 16th Finance Commission needs to consider these recommendations to strengthen India's disaster preparedness and response capabilities in the face of growing climate-related challenges.

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