Linking the Vulnerability and Risk Assessment for Climate Resilient design/adaptation planning of MGNREGS activities in Keonjhar District, Odisha

This paper focuses on linking climate change vulnerability and risk to climate resilient design/adaptation planning under the ICRG – It identifies the systematic process of identification of climate resilient design/adaptation plan by analysing the gaps towards climate proofing of MGNREGA activities for building climate resilience in the Saharpada block of Keonjhar district.

Background and rationale

India is one of the countries where rural populations directly depend on climate sensitive sectors (agriculture, forests and water) and natural resources (such as water, biodiversity, mangroves, coastal zones, grasslands) for their subsistence and livelihoods. It is particularly vulnerable to climate change owing to its geographic diversity, stronger dependence on agriculture, increasing exploitation of natural resources coupled with population growth and socio-economic challenges. The key environmental and climate change induced challenges in India are increasingly becoming sharper and have increased over the past two decades. Climate change will also cause increased frequency of extreme events such as floods, and droughts. These in turn will impact food and water security.

India, in order to meet the challenges of climate change consistent with provisions of the United Nations Framework Convention on Climate Change (UNFCCC), Paris Agreement and Sustainable Development Goals (SDGs); initiated action by preparing National Action Plan on Climate Change (NAPCC) in 2008 including 8 National Missions and National Determined Contribution (NDCs) in 2015. It also adopted decentralized governance through State Action Plans on Climate Change (SAPCC). In addition, many centrally supported schemes to mitigate and adapt to the Climate Change, contribute for compliance of the provisions envisaged in NDCs.

The Government of Odisha had prepared the SAPCC in line with the objectives of the National Missions under NAPCC and considering the State specific circumstances. The activities outlined in the SAPCC have been implemented together with the on-going schemes of the State and Central Sponsored Schemes. However, due to inadequate financial, capacity and coordination at various levels, the desired outputs could not be achieved. In the meanwhile, the national government has asked states to enhance the scope of ambition to meet the requirement of NDCs and SDGs.

Rural infrastructure that is well planned and constructed can reduce the impact of droughts and floods by ensuring good irrigation and help restore the natural resource base. The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) – the world's largest government funded social protection program invests nearly $8 billion annually in constructing rural infrastructure, while ensuring a 100-day wage guarantee to nearly 40 million households. However, the infrastructure being built is of low quality and inadequately linked to poor peoples' livelihoods. An investment focusing on building appropriate and good quality infrastructure, generating evidence to fine tune the Schedule and guidelines, and enhancing technical capacity is the need of the hour.

Infrastructure for Climate Resilient Growth (ICRG), a bi-lateral cooperation programme between the Ministry of Rural Development (MoRD), GoI and the UK's Department for International Development (DFID), aimed to improve the uptake of services delivered by the MGNREGS scheme through systematically considering climate change in its planning and implementation and consequently supporting resilience of groups of society that are most vulnerable to climate change. Specifically, it aimed to strengthen the quality and productivity of infrastructure built under MGNREGS to support resilient livelihoods through ground water recharge, micro-irrigation, soil and water conservation and plantation. The sheer scale of MGNREGS provides an excellent platform to inclusively deliver climate resilience benefits at scale in India and generate evidence to contribute to the global evidence base on climate, social protection and poverty reduction linkages and role of infrastructure. The ICRG programme had followed a systematic approach for mainstreaming climate change in planning and design of MGNREGS.

While the government departments understand at a broad level that climate change will enhance the vulnerabilities, this understanding is not yet based on scientific tools such as climate change projections, risk maps, vulnerability studies and not been considered while planning for MGNREGS for building the climate resilience and adaptation to climate change impacts. Hence, understandably, the methodology by which climate actions need to be identified and implemented across different sectors is also absent and a confirmed knowledge gap. The ICRG programme has followed a systematic approach for detailed risk and vulnerability analysis of the sectors by considering current climate vulnerability and then juxtaposing the additional risks that future climate change projections can cause. This is an innovative approach followed under ICRG for climate resilient planning and design of MGNREGS infrastructure. Based on climate risk management framework, adaptation gaps were identified in the existing activities under MGNREGS. The adaptation gaps identified led to the design of the climate resilient activities. Detailed Project Reports (DPRs) were prepared on each of the climate resilient activities, for pilot implementation by the state government using MGNREGS funds.

In this context, this paper focuses on linking climate change vulnerability and risk to climate resilient design/adaptation planning under ICRG – it identifies the systematic process of identification of climate resilient design/adaptation plan by analysing the gaps towards climate proofing of MGNREGA activities for building climate resilience in the Saharpada block of Keonjhar district, Odisha.

State's Scenario

Odisha has 480 kilometres of coastline stretching from West Bengal to Andhra Pradesh and is a hotbed of climatic events. Odisha is India's eighth largest state, comprising 4.7 percent of India's land mass, 3.37 percent of its population (some 42 million people), and over 5 percent of its poor. Although poverty levels fell from 57 percent in 2004/05 to around 33 percent in 2011/12 (Government of Odisha 2014), the proportion of poor in Odisha remains well above the national average of around 22 percent. High poverty level, high percentage of indigenous communities with high natural resource dependency make the state extremely vulnerable to climate change. According to the Odisha State Disaster Management Authority (OSDMA), for 95 of the last 105 years, Odisha has been affected by disasters triggered by heat waves, cyclones, droughts, and floods. Since 1965, these calamities have become more frequent and widespread. Natural calamities have seriously affected household income and set back the state's economy. Odisha is susceptible to cyclones and drought, and its 480 kilometers of coastline also make its coastal communities and infrastructure vulnerable to the rising sea level. Many of the districts of the state are also affected by heat waves. The rural poor in Odisha depend mostly on agriculture and forest resources (especially the scheduled castes and tribes).

Climate vulnerability of Odisha

The SAPCC 2018-23 highlights the current and future vulnerabilities of Odisha under different scenarios based on scientific assessments. It also summarizes some major climatic events and their impacts as well as exposure to such events that are likely to happen in future. Rainfall patterns in Odisha have been more erratic since the 1960s, with below-normal rainfall across all districts being recorded for most years. The "normal" 120 days of monsoon rain has shrunk to 60-70 days, and unusual spikes in rainfall, with torrential rainfall of over 200-250 millimetres/day, are more frequent during the monsoon, frequently resulting in floods. This situation has had a strong influence on agriculture, especially during rabi season, because of the reduced residual moisture. By 2100, the mean annual temperature globally is projected to increase by one to five degrees Celsius (24.5°C in 1970 to 28.5°C in 2080), depending on the A2 scenario in IPCC AR5 and location. Coastal Odisha will remain relatively less warm than the rest of the state, even though it clearly breaches the 2°C barrier. North-western, western, and southwestern Odisha show the highest rise in temperature. This temperature rise is certainly at an unsustainable level, assuming the current challenges of global warming are not mitigated. This factor will have an increasingly larger impact on terrestrial and marine ecosystems. According to the costal vulnerability index (CVI) study by the Indian National Centre for

Ocean Information Services (INCOIS), vulnerability, loss and damage from sea level rise, coastal geomorphology, tidal range, and elevation in the area of Odisha coastline varied from "low" in about 76 kilometres of the coastal stretch of Odisha state, covering parts of Ganjam, Chilika, southern Puri, and Kendrapara, and to "medium" in about 297 kilometres, covering northern Ganjam, Chilka, central Puri, Jagatsinghpur, Kendrapara, southern Bhadrak, and northern Balasore, to "high" in about 107 kilometres, covering northern Puri, parts of Jagatsinghpur, Kendrapara, northern and southern Bhadrak, and southern Balasore.

Keonjhar: Observed Impacts of Climate Variability

Keonjhar is known as one of the minerals producing districts of Odisha with vast deposits of iron, manganese and chromium ores. The district has 13 blocks with a population of 18,01,733 (2011 census). There are approximately 55 tribal communities in the district, the largest group belonging to Juangs. The Scheduled Tribes of the district constitute 44.5% of the total population whereas the Scheduled Castes constitute 11.62%. Around 80% of population earns their livelihood through traditional agriculture.

Saharpada block, one of the ICRG intervention blocks where the demonstration of Climate Resilient Works (CRWs) and linking them to livelihoods through convergence proved to be the best coping strategy for the communities to manage climate change. Saharpada is one of the 13 blocks of Keonjhar district and has 20-gram panchayats, 139 villages and a total of 19,939 households. The total geographical area of the block is 413.7 sq.km, out of which the net sown area is 0.11 %, 14.73 % forest area and 5 % net irrigated area. According to 2011 census, the total population of the block is 88,314 out of which the average percentage of SC population is 7.88 % and ST population is 58.3 %. About 58.7 % households are classified as vulnerable. These include women headed households, differently able, other PVTG groups, small marginal farmers and migrants.

According to the Climate Modelling Study done under the ICRG programme by the Indian Institute of Science, Bengaluru, the mean rainfall of Saharpada block between the month of June to September over a period of 30 years (1984-2014) is 1180 mm and its coefficient variation is 22.3%. According to the 30 years historical data, the highest rainfall (mm) received in a day is 265 mm and the number of years with normal sowing rain pattern is 4-years whereas across 24 years, the rainfall pattern was abrupt and erratic. Saharpada block has suffered mild drought in the last 30 years. The Climate Modelling Study projects that the percentage change in number of rainy days (2021-2050) will be 30.4 % and the projected coefficient of variation of the rainfall will be 18.7 for the period 2021-2050.

Climate Change Scenario of the block

Historical (1984-2014)	
Historical mean maximum temperature	38°C
Highest temperature recorded	45°C
Change in mean maximum temperature	0.73°C
Mean JJAS rainfall in mm	1180
Coefficient of variation (CV) in %	22.25
Total number of rainy days for 30 years	2542
Average number of rainy days/year	85
Number of years with normal sowing rains	4
Number of years with abnormal sowing rainfall	26
Number of years with mild drought condition	11
Projected (2021-2050)	
Change in temperature relative to historical by 2035	0.26°C
Mean JJAS rainfall in mm	1400
Coefficient of variation (CV) in %	18.7
Total number of rainy days	3651
Average number of rainy days/year	122
% Change in number in rainy days	30.4

Vulnerability and associated risks

Saharpada block in Keonjhar district has a moderately undulating topography with few small sized hillocks/hills mostly covered with tress and stone blocks. Only 15 % of the total geographical area of the block is under forest. Due to undulating topography, red sandy soil, and slope from north to south, there are places in the southern part of the block where soil erosion is severe due to surface runoff that have formed gullies up to 2m deep. Most of the runoff water generated in the small hills and uplands flows through these agricultural lands and hence there is loss of soil nutrition.

As per the Vulnerability Assessment done under the ICRG programme, it is found that the composite vulnerability of the Block is high (H). As per the Climate Modelling Study, the block will receive 217 mm (18%) more mean monsoon (JJAS) rainfall than historical mean monsoon rainfall of 1180 mm in the climate change scenario (next 30 years 2021 to 2050). The block has faced 11 years of mild drought, 3 years moderate and once severe drought out of 30-year period (1984-2014). The coefficient of variation (CV) of average monsoon rainfall both historical and predicted is 22.35% and 18.7% respectively. This means the projected monsoon CV is decreasing than of the historical CV. Though there are no high differences in CV of rainfall between historical and predicted, however predicted rainfall analysis shows that the block will receive only 18% more average monsoon (JJAS) rainfall in future. It means, the total mean monsoon rainfall will be intense in the future and there are possibilities of more flash floods in the monsoon season, thus chances of more crop loss or damages in kharif. Hence flood management, ground water recharge and water harvesting works were undertaken. As soil erosion is high in some places and total irrigated area is also less, more work on soil conservation (that also controls flash floods), works along with creation of irrigation facilities for both the Kharif and Rabi season was undertaken, so that total productivity of the block can be maintained or increased.

Climate vulnerability			Vulnerability scenario			
Time period/Type of exposure	**2021-2050**	**1984-2014**	**Parameter**	**Poverty**	**Marginal**	**Aggregate**
Drought (JJAS rainfall, coefficient of variation %)	**18.7 (L)**	**22.4 (L)**	Net irrigated area	**M**	**H**	
Flood (no. of rainfall events >100 mm/day)	**11 (L)**	**34 (M)**	Ground water	**L**	**M**	**H**
Average number of rainy days/year (>2.5 mm rainfall/day)	**122**	**85**	Forest cover	**M**	**H**	

Vulnerabilities

Parameter	Poverty	Marginal	Aggregate
Net irrigated area	**M**	**H**	
Groundwater availability	**L**	**M**	**H**
Forest cover	**M**	**H**	

Saharpada block of Keonjhar district is a classic example of demonstration of climate resilient works and enhancing the resilience of communities. The area had issues of soil erosion, low water retention, poor soil quality and high silt deposition thus affecting the agriculture productivity. Based on the vulnerabilities and associated risks, prescribed contour or earthen bunds, trenches as well as plantations and vegetative measures were identified as the most relevant works to mitigate the issues. The site selected had 16 hectares of large barren and cultivable waste land prone to severe soil erosion. There were no proper irrigation facilities and the crop fields near the lowland catchment areas (Kachinjoda and Baitarani rivers) were getting damaged during high intensity rain. Since some places had high soil erosion and less total irrigated area, works on soil conservation along with gully control measures, creation of irrigation facilities for both Kharif and Rabi season were taken up-to increase the productivity of the farmers.

Priority Actions

Considering the uncertainty due to vulnerability of climate change the likely gaps were groundwater availability, land management and soil fertility, irrigated area, low forest cover. These were bridged by proposing and under-taking additional activities as adaptation actions under the MGNREGA. Considering the vulnerability scenario, exposure to long term climate change and the field assessment, land development, Loose Boulder Check Dam (LBCD) and farm pond were demonstrated on pilot basis to address the above-mentioned issues. The structures created in the area were linked to livelihoods by leveraging resources from various schemes and programmes.

The following MGNREGA works were undertaken to reduce vulnerabilities and enhance climate resilience of the communities in the block, which is summarized in the following table:

Climate Impact Area	Action	Type of Intervention
Address net irrigated area	contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water-logged areas, diversion weir, link drains, deepening and repair of flood channels etc.	Demonstration on pilot basis and policy mainstreaming
Low groundwater availability	recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain, chaur renovation etc.	Demonstration and policy mainstreaming
Low forest cover	grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, drainage, diversion weir etc.	Demonstration and policy mainstreaming

Impact Assessment

The impact of implementing the above priority actions under the ICRG programme led to a total of 13.5 hectares of barren and cultivable waste land being converted to productive land. A total fund of Rs. 54.83 lakhs have been leveraged through ITDA (Integrated Tribal Development Agency) & OAIC (Odisha Agro Industries Corporation) excluding MGNREGA investment of Rs. 6.1 lakhs, benefitting a total of 44 households directly. Along with creating a favorable platform to get investment for seeds, fertilizers and farm inputs through ITDA and 5 mini lift irrigation points through OAIC under Jalanidhi Scheme, the trainings provided by the ICRG team to the community made the Badabil village in this block a classic example for the district and the State. Project Director, DRDA of Keonjhar district issued directives to Block Development Officers (BDOs) for scaling up similar interventions and approach in their block for larger benefit of the communities.

Improved cropping intensity, enhanced income through improved production system and durable and productive MGNREGA assets helped the communities' dependent on them across whole landscapes to cope better with climate change and extreme weather events. This has helped in fully utilizing the available resources and meets the need of every household/village/habitat.

Economic Impacts

- Convergence with ITDA converted 13.5 hectares of cultivable waste land to productive land with intensive integration of farm-based livelihoods giving livelihood security to 44 families directly.
- The cropping area of the farmers rose from 5 acres to 33 acres in Kharif season and from 5 acres to 18 acres in Rabi season.
- Supplement of agricultural farm equipment worth around Rs. 6 lakhs and seeds, fertilizers and pesticides inputs worth more than Rs 15 lakh from ITDA led to an increase in vegetable production in the village.
- 15 farmers adopted a 3rd crop at the Badabil work site by cultivating vegetables and earning more than Rs. 10,000/- each.
- 80 farmers cultivated potato during Rabi 2018 and 400 quintals of potato were harvested in that season.
- The field bunding resulted in reduction of soil erosion.

Social Impacts

- Continuous trainings and meetings held in the village empowered women to take part in the decision making and increased mobilization to public places such as engagement with stake holders.
- Linkage with various line departments such as ITDA and OAIC enhanced the income of the farmers and helped them to think of livelihood opportunities throughout the year.
- 10 progressive women farmers from the village presented their successful journey of taking up climate resilient works to cope with the climate vulnerability at a workshop organized by ICAR-CIWA, Bhubaneswar.

Environmental Impacts

- Heavy run-off of water and soil erosion from upland to the Nala checked.
- The direct run-off of rainwater to the Nala is managed thus helping in recharging of the ground water.
- Soil quality and the moisture content of the soil is enhanced.
- Over bund cultivation adopted by farmers led to strengthening of bunds.