Department for International Development

Integrating Climate Change in the 'Samarthya' Manual

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Infrastructure for Climate Resilient Growth in India (ICRG) Programme

Submitted By:

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Chapter 2

(Suggested to be inserted as a separate chapter in the Samarthya Manual)

2.1 Looking at MGNREGA through a Climate Lens

Climate change is a real and formidable threat to lives, livelihoods, infrastructure and economies globally. It will hinder India's ability to alleviate poverty and achieve sustainable development. The adverse impacts of climate change are made far worse by widespread poverty. Hence, it is essential and urgent that climate resilience is promoted as integral to the development process. Vulnerabilities in India differ among states, districts, and blocks, and among different groups of people within the same locality, due to substantial variations in biophysical and socioeconomic conditions. Almost two-thirds of the population of India rely on agriculture as the source of their livelihoods. They are already facing a high degree of climate variability with frequent droughts and floods. **MGNREGS has the potential to make an important contribution to the climate resilience of vulnerable rural communities, if planning, design, implementation and monitoring of natural resource management works take climate change into account.** It is, therefore, imperative that MGNREGA be looked at through a climate lens in order to guide district, block, Gram Panchayat and village-level technical staff on MGNREGS works in relation to climate change.

2.2 Key Definitions of Terms in Relation to Climate Change

The following terms and definitions[1] are important to bear in mind while implementing climate adaptation and climate resilience programs.

Adaptation: "The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects".

Climate Change: Article 1 of the United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."

Exposure: "The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected".

Hazard: "The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this report, the term 'hazard' usually refers to climate-related physical events or trends or their physical impacts".

Impacts: "Effects on natural and human systems. The term impact is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change.

[1] IPCC, 2014: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf]

Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate change or hazardous climate events occurring within a specific time and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts".

Resilience: "The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation".

Risk: "The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In this report, the term 'risk' is used primarily to refer to the risks of climate-change impacts".

Vulnerability: "The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt".

2.3 Natural Resource Management Works under MGNREGS and Potential Contribution to Climate Resilience

Implementation of MGNREGS works has already contributed to reducing vulnerability to climate risks. However, there is a need to mainstream climate change in rural development programs, such as MGNREGA in order to make the climate benefits sustainable in the long run and also to address long term climate change.

Table 1 identifies the potential contribution to climate resilience of categories of output-based MGNREGA NRM works in relation to climate vulnerable areas (water, land, agriculture and forests).

Table 1: Natural Resource Management Works under MGNREGS and Climate Resilient Infrastructure Planning

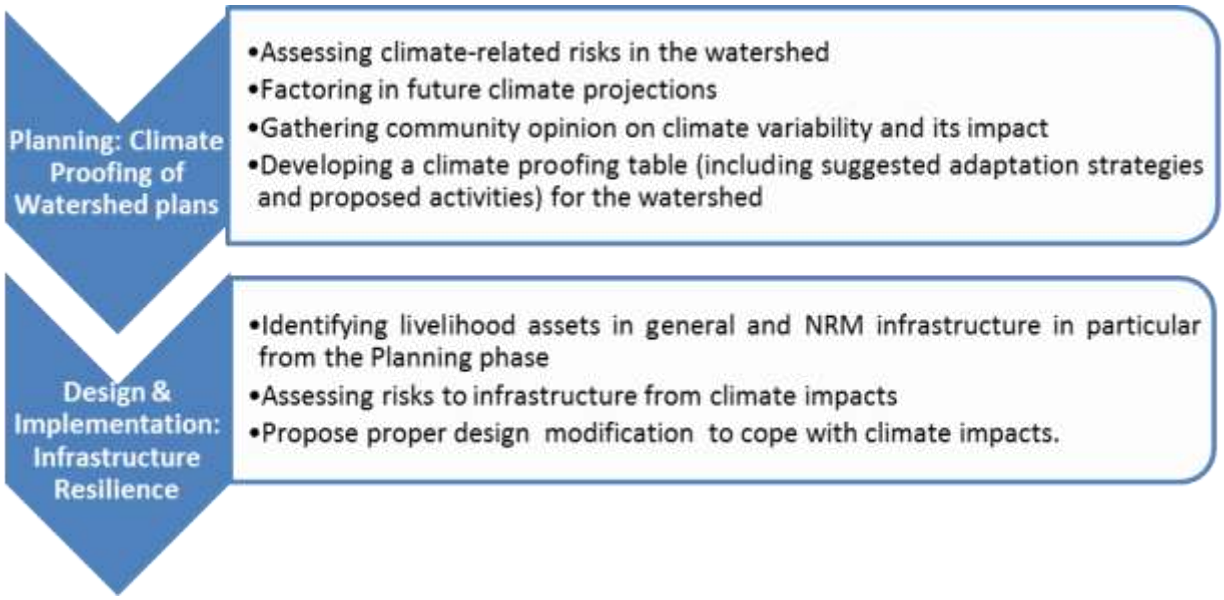
Climate Vulnerable Area	Output-based MGNREGA Work Categories	Potential Contribution to Climate Resilience
WATER	▪ Water conservation, water harvesting, recharging of ground water resources and water management ▪ Watershed management ▪ Micro and minor irrigation ▪ Renovation of traditional water bodies and flood control works	▪ Erosion control ▪ Ground water recharge ▪ Soil moisture retention ▪ Improved availability of water for irrigation ▪ Improved availability of drinking water ▪ Improvement in soil fertility and quality ▪ Improved vegetative growth and crop production

LAND	▪ Land development (both common and private lands) ▪ Land levelling, field bunding, contour bunding, terracing, graded bunding, pasture development, ▪ Flood control measures ▪ Application of silt in farm fields, coming from the de-silting of water bodies and farm ponds ▪ Drought proofing ▪ Soil improvement	▪ Improvement in soil fertility and quality ▪ Productive use of degraded lands including reclamation ▪ Erosion control ▪ Improvement in soil moisture ▪ Improved production from trees, crops and other vegetation ▪ Improved quality of cultivation fields leading to increased crop yields
AGRICULTURE	▪ Composting/Vermi-composting, vegetative mulching, ▪ Fisheries ▪ Dug wells ▪ Cattle shed	▪ Improvement in soil fertility and quality ▪ Improved availability of water for irrigation ▪ Supplemental income
FORESTS	▪ Afforestation ▪ Timber, fruit, fodder, fiber varieties of tree plantations ▪ Boundary and block plantation ▪ Agro-forestry, silvi-pasture, horticulture ▪ Pasture development ▪ Wasteland development	▪ Conservation of forests ▪ Natural regeneration of trees, shrubs and perennial grasses ▪ Improved carbon sink ▪ Improved soil moisture retention and protection ▪ Improves soil quality ▪ Improved income from non-timber forest products ▪ Improved micro-climate ▪ Ground water recharge ▪ Improved availability of water in surface water bodies

2.4 Framework and Approach for Climate Resilience in MNREGS Works

Mainstreaming of climate change requires an assessment of climate-related risks, impacts, vulnerabilities (in terms of climate sensitivities and adaptive capacities), and identification of adaptation options that promote climate resilience relevant to each sector and region. A broad approach to mainstreaming climate resilience through integrated natural resource management and climate resilient infrastructure is given in Diagram 1.

Diagram 1: Approach and Steps to Mainstreaming Climate Resilience and Promoting Climate Resilient Infrastructure under MGNREGA



2.4.1 Planning: Climate Proofing of Watershed plans

- *Assessing Climate-related Risks in the Watershed*: This assessment should be informed by review of existing literature, State Action Plans on Climate Change, existing and on-going studies on MGNREGA. A suggested matrix (with a hypothetical example) is provided below to document climate-related risks for each watershed. **Actual tables should be constructed** based on climate modelling studies and/or vulnerability assessments that are of relevance to the watershed concerned.

Table 2: Existing Climate Risk, Impact and Probability of Occurrence Matrix

S. N.	Climate Risk	Impact of Climate Variability	Likelihood	Risk Category
1.	Dry spell & Drought	Reduction in crop yield, migration, low household income, food shortage, drinking water scarcity etc.	Once in 3-5 years	High
2.	Flood	Adverse effect on human life, reduced crop production, Promote sheet erosion, demolished drinking water & irrigation sources, damaged infrastructures like hospitals, schools, roads and others. Promote water born disease.	5-10 year	Medium
3.	Hail Storm	Ruined crop & reduced crop production	3-5 year	High
4.	Hot wind	Affect human life, livestock and reduced crop production	1-2 year	Medium
5.	Vector and water born disease	Promote cholera, chickenguniya, malaria and dysentery etc.	10-15 year	Medium
6.	Fire	Human life , fodder and forest	20-25 year	low

- *Factoring in Future Climate Projections:* In addition to addressing current climate variability, something which is already being done to some extent under MGNREGS, it is extremely important to understand climate change on a decadal scale and how this is going to impact bio-physical and socio-economic systems in the future. Watershed plans need to factor in these impacts to preserve developmental gains from current interventions. Information on this section should come from relevant climate modelling studies.

- *Gathering Community Opinion on Climate Variability and its Impact:* Community opinion on climate risks and their bio-physical and socio-economic impacts should be gathered through participatory assessments. This will serve several purposes: a) to validate findings on current climate variability and its impacts; b) to sensitize communities to future climate projections; and c) to understand existing adaptation strategies.

- *Developing a Climate Proofing Table for the Watershed:* Based on the information above, vulnerability assessments[2] at the block level, review of successful case studies, and understanding based on field intelligence, the following table (with a hypothetical example) should be developed. This should ideally be an iterative process informed by feedback from climate resilient works executed in the field.

Table3: Climate Proofing Table for the Watershed approach:

Climate Variability	**Direct Impacts**	**Indirect Impacts**	**Non-Climatic Stress**	**Vulnerability**	**Existing/ local adaptive capacities**	**Suggested Adaptation Strategies (with mitigation co-benefits)**
Consecutive dry spell & Droughts	Depletion of surface/ ground water, soil erosion, low soil moisture content, low crop yield etc.	Scarcity of food and fodder, distress sale of livestock, migration etc.	Forest fire, increase in food prices, high dependence on money lenders for credit	Large number of small and marginal farmers who are highly vulnerable, high % of rain-fed area etc.	Earning family members migrate to find alternate employment, livestock for sale in distress period, integrated farming system, loan waiver from government	**Non-arable Land** - Contour vegetative hedge, Contour trenches, Bench terraces and WAT, Plantation in contour/furrow, over seeding of graces, forestry plantation and pasture development, diversion channel, eco-restoration etc. **Arable land-** Contour bunding, graded bunding, contour trenches, contour vegetative barriers, dead furrow, farm forestry along existing bund, land levelling, land mulching crop rotation, organic manuring structures – NADEP/Tetra-bed vermi

[2] Vulnerability assessment considers climate sensitivities, as represented by biophysical parameters, and adaptive capacities, as represented by socioeconomic parameters. The parameters selected reflect those used by other studies of climate change vulnerabilities in India and particularly by such studies in relation to MGNREGS.

						composting, SS Enterprise development structure for piggery, poultry and goat rearing, water harvesting structures – percolation tank/farm pond, well with recharge unit, Agro-Horti plantation (common/private land) and silvi pausture development, development of institutional arrangement in the area etc. **Drainage line treatment –** *Construction of runoff management structure (surface/subsurface) earthen gully plug, stone gully plug, dyke, pond, anicut, rockfill dam, check and stop dam etc. *afforestation in the both side of nalla/rivers.

2.4.2 Design and Implementation: Infrastructure Resilience

- *Identifying Livelihood Assets and NRM Infrastructure:* Livelihood assets typically include agriculture, livestock and labour. Information can be accessed through development plans and community assessments. NRM infrastructure should be identified from the climate proofing table above.

- *Assessing Risks to Infrastructure from Climate Impacts:* NRM infrastructure, such as dams, farm ponds etc. can be vulnerable to impacts from climate risks that are identified in the planning phase. With projections such as more intense rainfall, increasing salinity, and sea-level rise, physical infrastructure can be subject to damage. Technical and engineering specifications, therefore, need to consider such risks and associated impacts. A decline in annual rainfall, for example, means that water levels in dug wells are significantly lower and farm ponds dry up more rapidly. Information on such risks and there impacts should come from climate change literature as well as MGNREGA engineers and communities.

- *Proposing Design Modifications to Cope with Climate Impacts:* These modifications include the nature of appropriate site selection, plantations on side bunds and banks of drains, and changing the location or design (depth, capacity etc.) of structures, such as farm ponds, dams etc. In general, MGNREGA works will not enhance climate resilience unless they are designed to cope with projected climate change and the increasing frequency of flash floods, droughts and other climatic extremes. Table 4 illustrates some design modifications for various MNREGA works that will reduce the vulnerabilities of rural households through promoting climate resilient infrastructure.

Table 4: Developing Climate Resilient Infrastructure

Activity Area	Livelihood/NRM Assets	Risks	Proposed Actions/Design Modifications
Watershed development for rain fed areas	Earthen dams and pond	More intense rainfall, change in monsoon precipitation, droughts	a) Storage or pondage area should be calculated and plotted on a map to estimate the availability of water during summer, monsoon and winter seasons; b) Agriculture, fisheries, selection of tree species for catchment area, and de-silting should be planned accordingly; c) Timetable for annual or biannual de-silting should be prepared and followed.
Afforestation, tree plantation and horticulture	Plantation on public land	Change in temperature and precipitation, more intense rainfall, soil erosion etc.	Climate resilient plantations on upstream and public lands should be created using natural regeneration by: a) Measuring the available land and dividing it into 2 to 5 hectare areas, which will help in preparing a plan for not opening the entire area for community use at any one time; b) Enclosing each of the areas using a cattle-proof trench or fence; c) Allowing the available root stock of grasses, shrubs and trees to regenerate during the first year; d)During the second year when the monsoon season is over, using the MGNREGS labour for thinning, trimming and pruning trees that have started growing on the land; d) Leaving grasses alone to establish for the first two years; e) From the third year onwards, after October when the seeds of the grasses are fallen, allowing the communities to cut the grasses for fodder purposes.
	Horticulture plantations	Ditto	a) Plantations of fruit trees should be promoted on farm bunds, in between the agricultural fields, on farm boundaries, private lands not being utilized for agriculture, school/college lands, industrial lands and other suitable lands; b) Agro-horticulture is the most suitable activity to promote climate resilience, as fruit trees can ensure survival and incomes during dry periods or lean periods when crop cultivation is not possible; c) Plants should be selected for their economic and medicinal values

Activity Area	Livelihood/NRM Assets	Risks	Proposed Actions/Design Modifications
	Nursery raising	Ditto	a) Climate resilience will be promoted by establishing vegetative cover through natural regeneration of tree, shrub and grass species.
	Livestock	Drought, disease etc.	a) Availability of fodder for cattle should be ensured by growing it near cattle, goat and piggery sheds; b) Shed roofs can be used for rain-water harvesting and the water can be stored in over ground tanks; excess water can be directed into dug pits through filter media, which will help recharge shafts, trenches, dug-wells, abandoned tube-wells, hand pumps, etc.; c) If cattle sheds are lit then farmers should be encouraged to use LED lights to reduce energy use and costs; d) Biogas digesters should be set up within the shelters; resultant slurry can be sold locally to promote organic farming.
Agriculture Infrastructure	Fisheries	Higher monsoon rainfall, more intense rains etc.	a) Seasonal water bodies and small ponds created for rearing fish and other aquaculture species, like shrimps and crabs, should be provided with 'Fish Traps', which will help in trapping fish and other species during high intensity and short duration rains that can cause water to overflow and flush fish out of the ponds/tanks; b) For fish-drying yards, the tanks/ponds proposed for construction should be earthen ponds without utilization of any concrete boundary, as earthen ponds would help to regulate water temperature by delaying it heating up and increasing the cooling intensity; c) Oxygenation of fish tanks should be achieved through surface aeration by fountain/paddle-wheel aerators and sub–surface aeration by jet aerators that infuse air at the bottom of the pond and/or by Fine Bubble Aeration and/or by Coarse Bubble Aeration; d) Monitor the water quality of fish tanks by measuring parameters like transparency and colour of water, temperature of tank water, water pH, biological factors, odour of the fish pond, and level of dissolved oxygen; e) Improve the

Activity Area	Livelihood/NRM Assets	Risks	Proposed Actions/Design Modifications
			water-retention capacity of the fish tank during the dry season by deepening the pond at the time of construction or raising the height of the dykes; f) Protect the siltation of fish ponds/tanks by planting native species in the catchment area; g)Promote poly-culture of fish in the tank by assessing their adaptive behaviour and their economic value.
	Dug wells	Higher temperature, change in incidence of droughts and dry spells etc.	a) Dug well with recharge unit pit and Use of energy efficient pump-sets along with the use of drip or sprinkler irrigation methods will help to conserve more than 45% of energy and water b) Water availability should be considered as one of the criteria for crop selection, e.g. oilseeds and pulses require less water and have a higher economic value c) Pulses and legumes are good at fixing nitrogen in the soil and are also considered as soil-building crops.

In addition to the infrastructure-specific design changes mentioned in the table above, there are also certain generic best practices that should be adopted. In order that natural resource management measures are resilient to climate change, trees, shrubs, grass and other vegetation should be selected that have grown in the locality historically, as these will be best suited to climatic (temperature and rainfall) and soil conditions, and most able to adapt. They should be planted around the proposed soil and water conservation measures on arable, non-arable lands and drainage line treatments within micro and sub-watersheds in each village. For example, while constructing diversion drains, the design and recommendations should include mandatory plantations on both side bunds and banks of drains, along with the plantation of perennial grass species for soil binding and for fodder. The trees selected should not only be of local varieties but also of a multi-purpose nature to provide an additional source of income for the villagers and help in protecting them against the complete failure of crops during periods of drought, flood or natural disaster. Grass species should also be planted in drainage areas to protect the bed and the walls from soil erosion. The carpet of planted grass varieties will also help to control the flow of water and increase the percentage of moisture in the soil around the drain. The construction of diversion drains along with proper treatment and vegetative cover in the form of trees and grass will ensure the longevity of diversion drains. Such measures should be adopted for all soil and water conservation structures, such as contour trenching, spring-shed development, village pond, bunding, conservation ditching, bench terracing, farm ponds, tankas, khadins, diversion drains, drainage lines and earthen dams.

Planning of activities and infrastructure design suggested in subsequent chapters 3 – 7 should be looked at through a climate lens, as suggested in this chapter.

Chapter 2 in the current Samarthya Manual will now become Chapter 3 and so forth. No changes proposed in chapter 3 – 8 (2 – 7 in the current Manual).

Chapter 9 (Chapter 8 in the current Manual): Convergence of MGNREGS with other on-going schemes in the area for filling and added value

8.3 Convergence Guidelines Issued so far are at Annexure XXI

Suggested text for insertion - In addition, the State Action Plans for Climate Change (SAPCCs) and State Adaptation Plans (SAPs) should also be considered for integrated planning of works under MGNREGS. Domestic and international climate finance also constitute interesting and innovative sources that should be considered. For example, States already access funds from the National Adaptation Fund for Climate Change (NAFCC) for implementing adaptation projects. States are also in the process of building a pipeline of projects to access funds from the Green Climate Fund (GCF) through NABARD (national implementing entity for GCF).