INVESTIGATING THE SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS OF MGNREGA WORKS FOR GREENING RURAL DEVELOPMENT: A CASE STUDY OF DEBRA BLOCK, PASCHIM MEDINIPUR

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Piu Dutta

Department of Architecture

Jadavpur University

Kolkata 700032

West Bengal, India

DETAILS OF THESIS

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3. Name and Designation of Supervisor   Dr. Debashish Das

                                                          Professor

                                                  Dept. of Architecture

                                                  Jadavpur University

                                                  ddasju@gmail.com

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CERTIFICATE

Certified that the thesis entitled **"Investigating the Socio-Economic and Environmental Impacts of MGNREGA works for Greening Rural Development: a case study of Debra Block, Paschim Medinipur"** submitted by me for the award of the Degree of Doctor of Philosophy in ISLM at Jadavpur University is based upon my work carried out under the supervision of Dr. Debashish Das, Professor, Department of Architecture, Jadavpur University and that neither this thesis nor any part of it has been submitted before for any degree or diploma anywhere /elsewhere

PIU DUTTA

Dated: 20.4.2023

Countersigned

Prof. Debashish Das

Supervisor

Professor
Department of Architecture
Jadavpur University
Kolkata-700032

ACADEMIC INTEGRITY AND DECLARATION BY THE CANDIDATE

I hereby declare that this thesis is my own work and, to the best of my knowledge, it contains no materials previously published by any other person, or substantial proportions of material which have been accepted for the award of any other degree at Jadavpur University or any other educational institution, except where due acknowledgement is made in the thesis.

I further declare that:

1. I have successfully done the Course work as per UGC Regulation.
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4. I have also presented a pre-Ph.D. presentation and successfully incorporated the changes suggested on the basis of feedback and comments received.
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Date: 20.4.2023

Certified by Supervisor:

Professor
Department of Architecture
Jadavpur University
Kolkata-700032

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Dedicated to God

LIST OF TABLES

LIST OF FIGURES

LIST OF PICTURES

LIST OF MAPS

LIST OF ABBREVIATION

Alphabetized list of abbreviation

A/C	-	Adequacy/ Coverage
CAI	-	Capacity Assessment Index
CAT	-	Catchment Area Treatment
DTW	-	Deep Tube Well
D/Q	-	Durability/Quality
CRRID	-	Centre for Research in Rural and Industrial Development
EAS	-	Employment Assurance Scheme
EI	-	Environmental Improvement
EIA	-	Environmental Impact Assessment
EP	-	Effectiveness parameter
EPI	-	Environmental Performance Index
FWP	-	Food for Work Programme
GDP	-	Gross Domestic Product
GI	-	Green Index
GP	-	Gram Panchayat
GP	-	Green Potential
GRD	-	Greening Rural Development
GV	-	Green Value
IAY	-	Indira Awaas Yojana
ICDS	-	Integrated Child Development Services
IUCN	-	International Union for Conservation of Nature
IWDP	-	Integrated Watershed Development Programme
JGSY	-	Jawahar Gram Smridhi Yojana
JRY	-	Jawahar Rozgar Yojana
LDPE	-	Low Density Polyethylene

MGNREGA	-	Mahatma Gandhi National Rural Employment Guarantee Act.
MIS	-	Management Information Systems
MoRD	-	Ministry of Rural Development
NBA	-	Nirmal Bharat Abhiyan
NRDWP	-	National Rural Drinking Water Programme
NREP	-	National Rural Employment Programme
NRLM	-	National Rural Livelihoods Mission
NSS	-	Natural Support Systems
NTFP	-	Non -Timber Forest Product
ODW	-	Open Dug Well
PI	-	Progressive Index
RDI	-	Rural Development Index
RLEGP	-	Rural Landless Employment Guarantee Programme
RLI	-	River Lift Irrigation
SDGs	-	Sustainable Development Goals
SED	-	Socio-Economic Development
SEDI	-	Socio-Economic Development Index
SGRY	-	Sampoorna Grameen Rozgar Yojana
SPSS	-	Statistical Package for the Social Sciences
SRDI	-	Sustainable Rural Development Index
STW	-	Shallow Tube Well
SWC	-	Soil and Water Conservation
UN	-	United Nations
UNDP	-	United Nations Development Programme
WCED	-	World Commission of Environment and Development
WCS	-	World Conservation Strategy

EXECUTIVE SUMMARY OF THE THESIS

The work, Greening Rural Development (GRD) or Sustainable Rural Development (SRD) presented here is most interesting and intimate to my mind. The research work envelops a unique aspect of the largest ever Government Programme, MGNREGA. MGNREGA is a brilliant scheme is running in 18th year of its beginning. The scheme reflects Gandhian Thought, which refers to the development of India depends on its villages. Selecting this topic and selecting Debra Block as the area of study was the year of initiation of MGNREGS works and the expansion of implementation of MGNREGS works.

The study conducted on fourteen Gram Panchayats of Debra block, Paschim Medinipur district. The objectives of this study are to assess the environmental impact of MGNREGA work through Green Index concept, and to examine the societal development through Socio-Economic Development Index. The study presented here shows, how MGNREGA is significant for rural environment as well as socio-economic development of a rural region.

Case studies have revealed that the relation between societal development and environmental improvement is inversely proportional in major cases. But only one case study area, Radhamohanpur-II was found where the both developments were equally significant, which indicates Sustainable Rural Development.

At the end of the study, after complete analysis a significant concept, Progressive Index (PI) and some suggestions, which are relevant for Sustainable or Greening Rural Development were proposed. Thus, it can be concluded that, MGNREGA became a strategy for inclusive growth in rural India through livelihood security and social empowerment as well as environmental improvement through assets creation in rural premises.

TABLE OF CONTENTS

CHAPTER – I
Introduction

1.1. Background of the Study

1.2. Introduction to Greening Rural Development in India

1.3. Understanding the Concept of Greening Rural Development

1.4. Progression of MGNREGA towards Greening

1.5. Significance of the Study

1.6. Organization of the study

1.1 Background of the study

Economic development of India suddenly has come under light after getting liberty from a long duration of colonialism and most insignificant economic activities. As a developing country, India's population has grown by the compute of census, from 102.86 crore in 2001 to 121.08 crore in 2011 (Census 2011). According to the census 2011, there was 6.4 lakhs villages in India and having 83.3 crores people (68.86 percent), which is the largest rural population globally; this is 12 percent of world population (Annual-Report 2014; Ganiee 2014; Raheja 2015). So, it is obvious that India is usually rural in its nature and formation. And the primary source of livelihood in the rural section is agriculture. Near about a century ago, the father of the Indian nation, M. K. Gandhi realized that the life of India breathing from rural regions (Joshi 2002; Sarkar and Kundu 2016). However, these rural regions are continuously suffering from many challenges and the rural people who depend on natural resources for existence and livelihoods are continuously suffering from the vicious cycle of poverty (Jha et al. 2017). They have to combat to survive for their needful stuffs in their daily life and are enforced to migrate to urban areas looking for alternative income sources (Chopra et al. 2012; Sebastian and Azeez 2014). Generally, Indian villages are wrapped in abject poverty that is revealed in unemployment, low income, illiteracy, hungry people, malnourished children, anaemic pregnant women, farmer suicides, fasting deaths, migration and after all suboptimal quality of life. The requirement of a village is environmental sustainability as well as sustainable economic development. Economic developments of a region stand on the appropriate application of both human and non-human resources. The actual growth of India does not indicate generally the increase and expansion of industrial urban areas but most of all the development of rural areas.

During the year 1948-49, the National Income of India was approximated to be Rs. 86.5 thousand million, which was equal to earning a person of Rs. 246.9 per year. This was one of the insignificant per capita incomes in the world. Before the year of 1950, India had slow motion of progress of Socio-Economic sectors, low level of technological expansion and old methods of manufacturing techniques. (Bugmail, 2004). The government of India then was to establish the Planning Commission of India in March 1950 to confirm rapid growth in living standard through organized application of the resources of the country, rising production and distributing possibilities to all for employment throughout the community. This community welfare programme touched almost all dimensions of human life such as health, education, recreation, economic wellbeing and cooperation.

In order to make solution of these challenges and to provide livelihood security to rural unemployed, the planning commission of India is always striving to focus on rural development since its formation. India's anti-poverty technique consist of broad range of poverty alleviation and employment generation programmes, many of which have been in function for several years and have been strengthened to propagate more employment, build fruitful assets and improve the income status of the poor. The salient features of some of the major employment and anti-poverty programmes are given in (**Table- 1.1).**

Table- 1.1: Major employment and anti-poverty programmes in India

Sl. No.	Programmes	Plan	Launching year	Objectives
1	National Rural Employment Programme (NREP)	6th & 7th plan	1980	Improvement in the overall quality of life in the rural areas. Creation of Supplementary employment for agricultural Workers
2	Rural Landless Employment Guarantee Programme (RLEGP)	6th & 7th plan	1983	Improving and Expanding employment Opportunities for rural landless.
3	Jawahar Rozgar Yojana (JRY)	7th & 8th plan	1989	Provide the employment in the lean agriculture season to the unemployed rural people, both men and women, living below the poverty line.
4	Employment Assurance Scheme (EAS)	8th plan	1993	Ensuring ability in development delivery system and generating greater employment opportunities.
5	Jawahar Gram Smridhi Yojana (JGSY)	9th plan	1999	Combining two pay-work programs NREP + RLEGP. Creating demand-driven rural infrastructure
6	Sampoorna Grameen Rozgar Yojana (SGRY)	9th plan	2001	Integrating EAS and JGRY. To provide employment, food security, create durable assets in rural areas
7	Food for work Programme (FWP)	10th plan	2004	Creating Supplementary Employment and providing food grains to complement Wages in backward districts
8	Mahatma Gandhi National Rural Employment Guarantee Scheme. (MGNREGS)	10th plan	2005	Providing at least 100 days of wage employment with in a financial year for rural unskilled adult people.

Source: Sannyal (2011) & Ministry of Rural Development (MoRD)

Asia being the most crowded continent shelters more than half of the world's poor, with the majority living in rural parts (Raheja 2015). Throughout the developing world in general and in particular the Indian subcontinent, is the hotspot of poverty, which generate complication in a community. The principal characteristics of a rural region are low levels of income and poor quality of life and livelihood. Population explosion, deficiency of land, separated farm plot or land property, insufficient employment generation apart from agricultural labour

have all linked to increase those problems. Agriculture and related work absorb above 66% of India's labour strength but provide less than one fifth of the GDP of India (Dey, 2010). Unemployment and economic uncertainty lead to stress, impatience and loss of self-respect without which a healthy mental life is impossible. Rural poverty and unemployment are related with each other and both of them are involved in environmental degradation (Kareemulla et al. 2009). Consequently, the national developmental policy is must necessary for rural development (Muyeed 1982). Poor Indian rural people, the leading performers of Indian economy can be described as per the figure shown below (**Fig-1.1**).
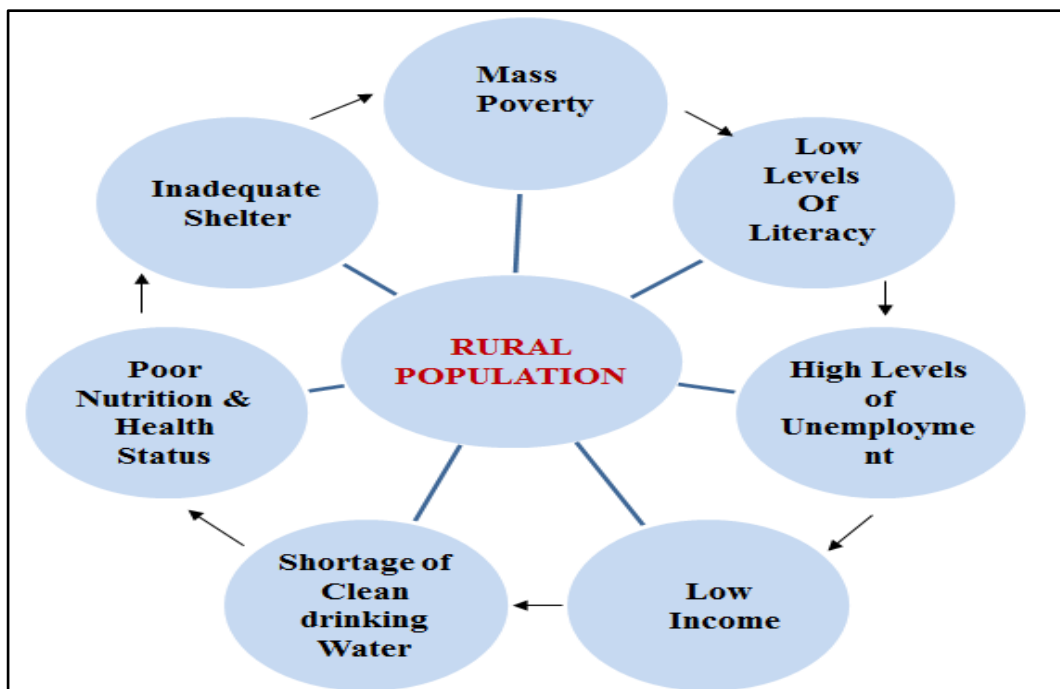
Fig-1.1: Challenges of rural people in India
Source: Author

1.2 Introduction to Greening Rural Development in India

Rural poverty and unemployment in India have increased in an unprecedented manner during the last few decades. India's 12th Five Year Plan for the first time has set for itself the aim of faster, sustainable and more inclusive growth. The Planning Commission notes in its Approach Paper to the 12th Five-year Plan that the overall development of a region will be sustainable only if it is followed in the way to protect the environment. MoRD programmes have powerful possibility for green outcomes, both at the regional and global levels. Observing the regional and global instructions for rejuvenating earth's natural

resources (i.e., air, water, soil, land, forest and wildlife etc.) and conserving the biodiversity & ecosystems, the MoRD of India solicited UNDP to explore the environmental exposition of its programs. UNDP has initiated this study 'Greening Rural Development Programmes in India' in response to this appeal. The Report has benefited from the deliberations at the international conference coordinated by UNDP and MoRD 'Towards Greening Rural Development Programmes in India: Lessons from International & National Experience' in May 2012. In this flame, this Report on "Greening Rural Development in India" is an effort to assist the systematic internalization of "greening objectives" beyond the different rural developmental schemes. The purpose of this Report is to improve the concept of greening specific to each and every major rural developmental programme. The MoRD, India, is operating the following major rural developmental programmes (**Table-1.2**). These programmes have a pivotal role in the overall development strategies of the country and also led to environmental benefits and sustainability all over the world.

Table-1.2: Green objectives of various rural development programmes in India

Sl. No	Flagship Programme	Launching year	Objectives	Green outcomes
1.	Indira Awaas Yojana. (IAY)	1985	Providing dwelling units to Below Poverty Line (BPL) households	Used environmental friendly construction materials for reducing greenhouse gas emission.
2.	Integrated Watershed Development Programme. (IWDP)	1989	To bring back the ecological balance in degraded watershed.	Maintenance of ecological balance
3.	Nirmal Bharat Abhiyan. (NBA)	1999	To stop untreated solid and liquid waste from re-entering the environment.	Solid and liquid west management for clean and healthy life
4.	Mahatma Gandhi National Rural Employment Guarantee Scheme. (MGNREGS)	2005	Providing at least 100 days of wage employment with in a financial year for rural unskilled adult people.	Improve the local and global environmental condition
5.	National Rural Drinking Water Programme (NRDWP)	2009	Ensure safe and permanent drinking water security for all rural households.	Conserve surface and ground water for ensuring drinking water availability
6.	National Rural Livelihoods Mission. (NRLM)	2011	For self-service and build up the skill of rural people.	Sustainable livelihood

Source: Website of MoRD, India

1.3 Understanding the Concept of Greening Rural Development (GRD)

Greening Rural Development (GRD) lies between environmental sustainability and economic development: one is problem and another is culture. The relationships between this two are considered on 4Rs: Resilience, Reuse, Recycle, and Restoration. There are no route maps of sustainable way of living in future. Therefore, GRD was introduced to understand such questions that, how life is sustained? The father of Indian nation M. K. Gandhi had said "Earth provides enough to satisfy every man's need, but not every man's greed" (U.N. report, 2012). The enormous demand of rapidly increasing population is raising an incredible strain on natural resources (Chandrasekharan et al. 2013; Viswanathan et al. 2014). To protect the natural resources and to improve the economic, social and environmental quality, the journey of sustainable development has been started over the past few decades. (**Figure-1.2**) shows three dimensions of sustainability of a region.
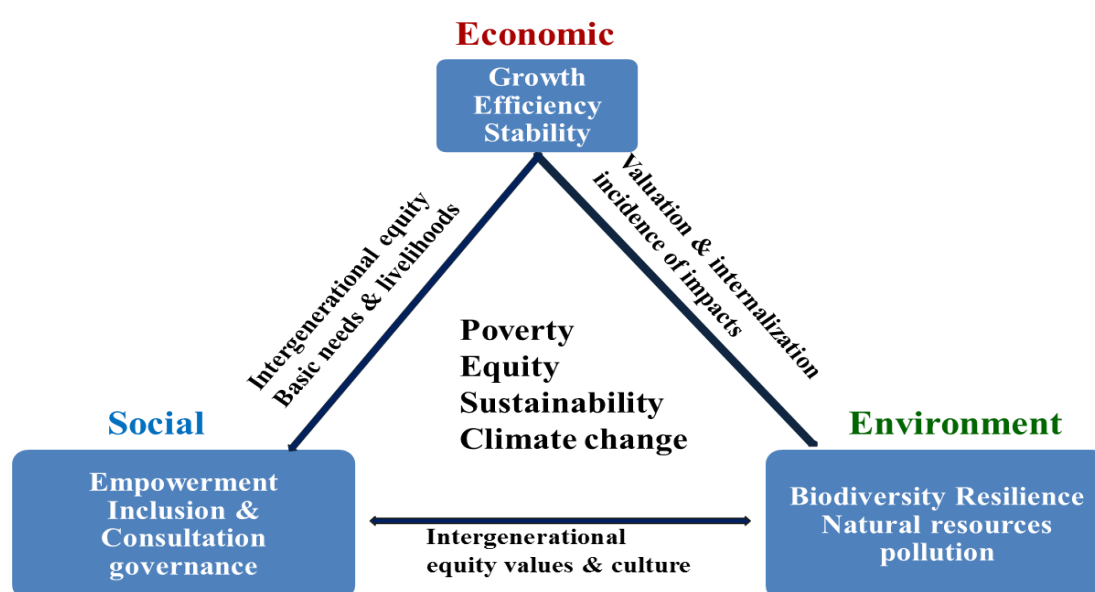
Figure-1.2: Dimensions of sustainability

Source: Munasinghe, M. and McNeely. J. (1994)

"The Greening of America", a new thinking in the USA was given by Charles Reich in the year of 1970 (Lélé1991). After that the developing world embraced the thinking of greening development as witness of paradigm shift in development thought. The concept of sustainable development has begun to be widely adopted in the year 1980, when the International Union for the conservation of Nature and Natural Resources (IUCN) presented the World Conservation Strategy (WCS). Subsequently, it came into prominence in the report of the Brundtland commission (1987) which was formerly known as World

Commission of Environment and Development (WCED) (Adams 2001; Lélé ´1991; U.N. report, 2012).

Sustainability has become a vital element in India's planning process since 1997 (ninth five-year plan). The concept "GRD" which is integral part of sustainable development was introduced in the twelfth five-year plan (2012-2017) by the Ministry of rural development (MoRD), with the assistance of United Nations Development Programme (UNDP). The major objectives of twelfth five-year plan were rapid, encyclopaedic and sustainable growth. UNDP has declared in their report 'One Planet to Share' that the rural regions are the dominant food provider and carbon sinks (Chopra et al. 2012). India's 74 percent of the rural people is depended on natural resources, in consequence of that the biodiversity of rural region comes under increasing pressure (Thong and Trung 2019).

Developing world is focusing on environmental conservation and sustainable development through clean technological infrastructure in different economic and social sectors, which is considered as green economy. In the broader concept of green economy which encompasses social security and cultural development along with economic growth and environmental protection is known to us as green development (Chandrasekharan et al. 2013). GRD in India is fully interlinked between green economy and green development, refers to different functions that rejuvenate and sustain earth's natural resource, create and apply fair component, develop technological system to generate eco-friendly outcomes and create employment opportunities for rural people (Chopra et al. 2012). Viable poverty reduction and appropriate use of natural resources are the powerful tool of GRDs, which is a dynamic process of interconnections among economic growth, social equality and environmental sustainability (Rist et al. 2007). (**Fig-1.3**) represents at a glance concept of GRD.
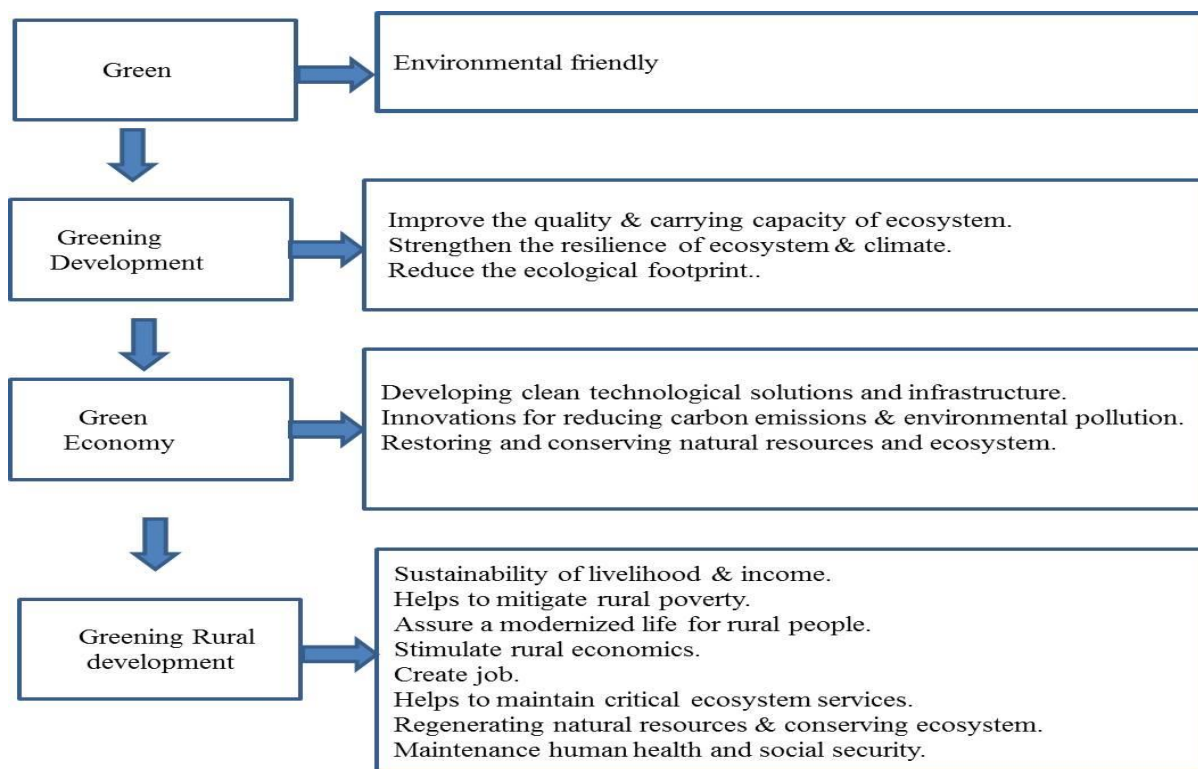
Fig-1.3: Greening Rural Development concept at a glance.
Source: Author

1.4 Progression of MGNREGA towards greening

Govt. of India has launched some welfare schemes like MGNREGA, which is known as Silver Bullet for sustainable poverty reduction, regeneration and conservation of natural resources and making villages self-sustaining (Ganiee 2014).NREGA (National Rural Employment Guarantee Act) launched on 25th August 2005, and our former Prime Minister Dr. Manmohan Singh has renamed as MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) on 2nd October 2009, on the occasion of 140th birth anniversary of our Father of Nation Mahatma Gandhi. MGNREGA is the largest and enthusiastic societal security and communal projects in the world (Deka and Panda 2015).

It was launched on 2nd February 2006. The scheme began with the 200 most economically disadvantage districts of the country. Subsequently, 130 districts were added in the second stage, while the remaining districts of the country came under the purview of the scheme during the final and the third stage. Currently, the scheme is functional in 715 districts of the country (Ganeriwala 2010; Karthika 2015).

8

Since 2008, the country is completely shaded under MGNREGA excepting the hundred percent urban population area (Ganiee 2014; Ravindranath and Murthy 2013; Yadav 2014). The World Bank termed it a "Stellar example of rural development". It is based on the concept of integrating environmental protection, largely linked to water, soil or land and forest with economic development, which is further linked to 100 days of wage-employment along with social and civilization progress (Esteaves et al. 2013). Greening MGNREGA (**Fig-1.4**) is to address the poverty alleviation and livelihood security through conservation of national resource including soil, cropland, grazing land, common land, forests, streams, surface water bodies, groundwater and sustainable development in rural production systems include crop, livestock, agro-forestry, forest, and fisheries (Ravindranath and Murthy 2013; Shah et al. 2015). Major objectives of MGNREGA are given below:

i) Providing economic security.

ii) Creation rural assets, such as roads, canals, ponds and wells.

iii) Conserving the degraded environment.

iv) Give power to the rural women.

v) Shortening the rural urban migrations.
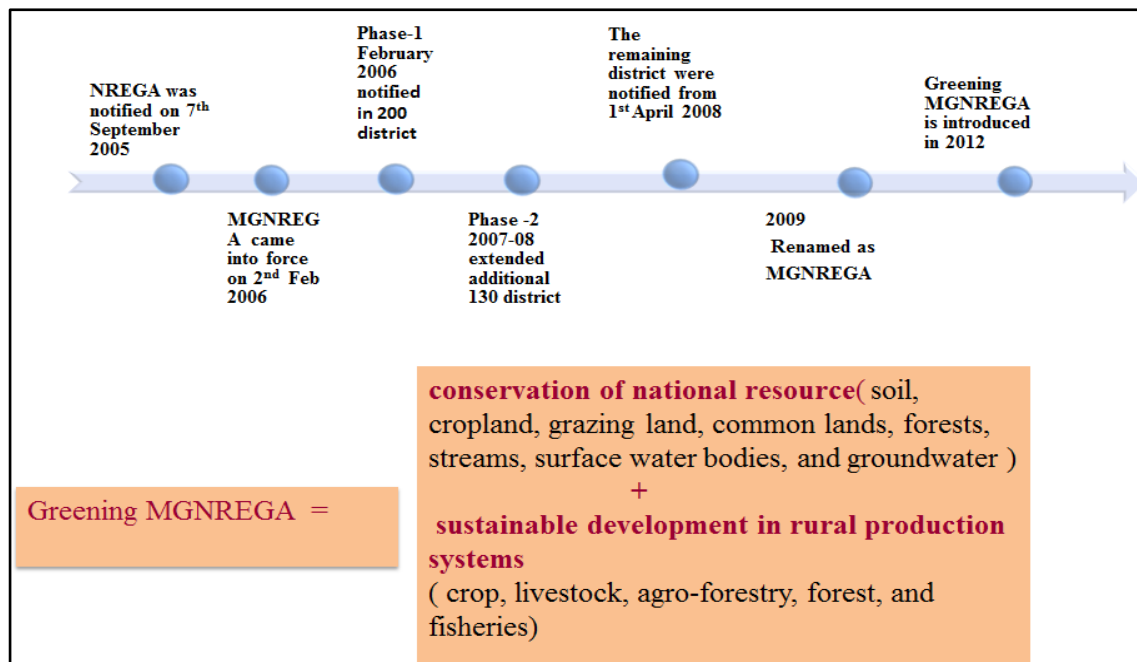
Fig -1.4: Progression of MGNREGA towards greening

Source: Author

1.5 Significance of the Study

Rural development is essential to improve the standard of living in most developing countries. The economies of most developing countries are still dependent on natural resources, both renewable (land, water and forests) and non-renewable (oil and minerals). Rural people are the stewards of most of these natural resources and play a crucial role in environmental protection. Any country's sustainable economic development depends on rural development if it walks on protecting the environment (Nair 2014). As we move more and more towards going to be a developed country, simultaneously we are reaching towards deteriorating our environmental condition (Kumar et al. 2011; UNDP 2014; Wang et al. 2011). In this circumstance, we have crept into a situation where we should not ignore the environment anymore. Hence any implemented programme has to be examined in terms of its effect on the environment (Shah et al. 2015; Viswanathan et al. 2014).

The surveyed literature focuses on a lot of issues pertaining to alleviate poverty, generate employment, infrastructure development, and social security of MGNREGA scheme. Very few studies assessed the potential of MGNREGA's environmental benefits (Esteaves et al. 2013; Sebastian and Azeez 2014; Tiwari et al. 2011). But rarely has there been an attempt to quantify the environmental implications of the activities implemented under the NREGA. So, the significance of this study is to assess the qualitative and quantitative measurement of MGNREGA works for environmental sustainability and economic development. To the best of my knowledge, there is lack of studies which correlate between Environmental Improvement (EI) created by MGNREGA works and the Socio-Economic Development (SED) of a society. The present study has explored EI by using Green Index (GI) of MGNREGA work and the regional disparities in SED by using Socio-Economic Development Index (SEDI). Finally, this research work concentrated on the impact of MGNREGA works on regional environment. MGNREGA can achieve a wider role on the rural development to conserve the environmental condition i.e. conserving water resources, soil quality and biodiversity as well as it also improves rural livelihood and infrastructure. The sustainable flow of natural resource is well controlled through MGNREGA activities, which is necessary for future generations to meet their own needs.

1.6 Organization of the study

This research work is organised through the following chapterization:

In chapter I the conceptual framework of the study is presented including greening Rural Development, the rural scenario of India and Rural Development programmes. It provides an introductory analysis to highlight the major Rural Development Programme with particular reference to potential of green outputs. The study also discusses about the largest rural development programme, MGNREGA. At the end of this chapter the significance and framework of the study is presented.

In Chapter II the relevant literature review relating to rural development, Socio-Economic development of MGNREGA works, Green development of MGNREGA work and different Indices for Sustainable Rural Development is done. At the end, the research gaps in this area of our study, particularly, the Socio-Economic and Environmental Development of MGNREGA works and the relation between these two variables are explained.

In **chapter III** the research problem or research gap, which were found from above literature survey was taken into consideration for our research question and hypothesis framing. Based on these the aim, objective and scope of the work were finalised

Chapter IV, this chapter describes the adopted methodology for the study and also describes the data collection procedures from field survey in selected Villages among fourteen Gram Panchayats of Debra block. Also, we have marked the secondary sources relevant and used in this study. The statistical techniques, like Green Index for qualitative analysis and Socio-Economic Development Index for quantitative analysis was explained in the end of this chapter.

In **Chapter V** This chapter gives an overview of the MGNREGA works in the study area and also discussed about the justification for selection of the study area.

The second part of the chapter carries a note on an overview of the MGNREGA implementation in the sample area and the chapter also discussed the perspective of Socio-Economic and Environmental works of MGNREGA works in the study area.

Chapter VI, this chapter explains the environmental and socio-economic impacts of MGNREGA work by using Green Index and Socio-Economic Development Index. This chapter also correlate between the Environmental improvement and societal development of fourteen Gram Panchayat of Debra Block and these two variables represent negative correlation in Maximum G.P. which refers unsustainable form of rural development. But only one case study area, Radhamohanpur-II was found where the both developments were equally significant, which indicates Sustainable Rural Development.

Chapter VII In this chapter, after complete analysis a significant concept, Progressive Index (PI) and some suggestions, which are relevant for Sustainable or Greening Rural Development, were proposed. At the last stage, the study highlights the performance of Gram Panchayats (G.P.) or level of G.P.in Debra Block regarding their sustainability on the basis of the value of progressive Index.

Finally, in **Chapter VIII,** a summary of key findings, implications for future research and the limitation of the study is done.

CHAPTER – II
Literature Study

2.1 Introduction

Review of literature is a significant tool in all research works. In this chapter, the researcher has scrutinized the crucial findings of some similar studies attempted by other institutions and researchers in various locations at various times. Review of literature empowers the researcher to have a clear view of what has been done in the particular field in the past. These helped the researcher to avoid overlapping of work done already. The related previous literature helps the researcher to recognize the gaps in the research attempts made by various scholars. Since the date of implementation of NREGA, various social scientists have made attempts to study the impact of NREGA in different fields. This chapter contains the view points and findings of different researchers and studies conducted in the area of rural development and to review the work already done in respect of MGNREGA. The reviews are broadly categorised under:

- Literature study on rural development
- MGNREGA and socio-economic development
- MGNREGA and green development
- Literature study on different indices for sustainable rural development

2.2 Literature review on Rural Development

According to **M. Stanny, (2000)** and co-workers who have mainly worked in the 'Green Lungs of Poland' have suggested "The level of sustainable development was presented as a meta-feature made up of three components: environmental, economic and social." For the purpose of assessing the level of development a nonstandard method was applied, i.e. Perkal's index (conducting a separate taxonomic analysis and defining particular values of a composite measure for each criterion separately). This method features simplicity as well as little loss of information during aggregation, and involves a construction of a synthetic index which is a sum of standardized values of partial indicators. In their analysis the index has been constructed on the assumption that all factors (characteristics) are equivalent.

F. Gobattoni, et. al (2015) pointed out Traditional farming systems and other activities such as craftsmanship (e.g. manufacturing activities, local food production), represent a sustainable example of human integration with nature. Their maintenance and development, with opportune adaptations to the current socio-economic situation and

cultural/technological advancements, are therefore valuable. The research conducted on the six municipalities of the Teverina Consortium provided a different perspective on today's increased need for rural re-development and social innovation.

K. Raheja, (2015) who have worked in the field of rural development of Haryana has stated that the upgradation of living standard of the rural people by providing ways to develop rural parts of Haryana at grass-root level and improving food security of rural poor. This will also assist in minimizing the rural-urban gap in terms of basic infrastructure facilities essential for 'Sustainable Development' of a settlement.

E. D. Fóris and K. F. Kovács, (2016) studied Green infrastructure as a tool of rural development in Hungary by examined local projects. Green infrastructure development in rural regions contributes to the improvement of urban life quality as well. It would be important to strengthen the spatial character of planning in rural development and it also highlights the interdependency of cities and rural regions.

A. K. Panda and A. K. Tripathy, (2020) studied on Puri district, Odisha, to understand the implementation procedures of MGNREGA and its impact on rural livelihoods. The research pointed out from case study analysis that the villagers are very much satisfied with the works done under MGNREGA. So, it is concluded that in the sphere of rural development the role of MGNREGA scheme is very pertinent. The success and effectiveness of these programmes will depend upon the sustained, intelligent and enthusiastic involvement and cooperation of the village community.

R. K. Malar, (2021) who have worked in the field of impact assessment of MGNREGA work on rural development in Villupuram and Salem district of Tamil Nadu has stated that, MGNREGA not only promises to provide employment but also a multi-dimensional act aimed to focus on environmental sustainability in the rural areas. It provides an alternative income sources for livelihood which will have an impact on reducing migration, restricting child labour, alleviation poverty and making village self-sustaining through productive asset creation. Overall the MGNREGA has great potential to enhancing income and livelihood security for rural development.

2.2.1 Conclusion

Development of a developing country depends on Rural Development. Rural developmental project is a tool of rural infrastructure development, which contributes to the improvement of urban region as well. MGNREGA provided a different perspective on today's increased need for rural re-development and social innovation. MGNREGA will also assist in minimizing the rural-urban gap for Sustainable Development. Therefore, the national developmental policy is must necessary for rural development.

2.3 MGNREGA and Socio-Economic Development

N. Jacob, (2008) pointed out of the study in Villupuram District, Tamil Naduthat MGNREGA would improve their economic position, reduce vulnerability and discourage migration to facilitate their continued access to health, education and welfare facilities available in the village. NREGA is also a lifeline for the rural poor through generating employment in a massive scale.

K. H Rao, (2014) examined MGNREGA for reducing poverty in Karnataka, Madhya Pradesh, Maharashtra and Rajasthan that MGNREGA plays an important role on overall poverty reduction basically it reduces the intensity of poverty of the beneficiary households. MGNREGA has strengthened the rural livelihood through sustainable poverty reduction and improved natural resource conservation and use. This is an innovative approach for the way of Greening Rural Development.

S. Narayanan et. al (2014) assessed about MGNREGA Works and Their Impacts in Maharashtra, that this work has two goals: the first was to verify the durable assets and the second was to bring out the user perceptions about problems and benefits of the work. Allover 91% respondents claim that the MGNREGA work was very useful and they also suggest that their livelihood have been changed after implementation of MGNREGA.

K. T. Karthika, (2015) pointed out that MGNREGA is an Act that aims to strengthen the women employment by enforcing that about 33 percent of total work force should be women and also that there will be equal wages for men and women. The study reveals that, 95% of participants are women workers in Kerala. The extensive participation of women in MGNREGA has meant that women are coming out of their homes, not only to work but also

to visit banks and Panchayat offices, which they may not have done previously. This enhanced mobility comes with the higher status of being income-earning workers.

2.3.1 Conclusion

MGNREGA would improve the rural livelihood creating durable and productive assets. MGNREGA would also improve the villager's economic status, reduce vulnerability and discourage migration to facilitate their continued access to health, education and welfare facilities available in the village. India consists of the largest rural population globally. The livelihood of these rural people is improved by MGNREGA works.

2.4 MGNREGA and Green Development

K. Kareemulla et al (2009) noticed the outcomes of MGNREGA on rural life and the improvement of water conservation and soil or land development work in Andhra Pradesh. They created a liner regression function to clarify the participation of the rural people in MGNREGA with four explanatory variables i.e. size of the MGNREGA benefited family, source of family income other than MGNREGA, migration status before and after MGNREGA and land holdings. It was viewed that the variables were positively related to dependency on the MGNREGA works. The NREGS earnings are being used mainly for food, education and health security. In Andhra Pradesh, 80% and above MGNREGA work were related to soil and water conservation (SWC) works.

R. Tiwari et al (2011) discussed a multifaceted appraisal in Chitradurga district of Karnataka to examine the impact of the MGNREGA work in prosperous rural life and livelihood through environmental improvement and decreasing the climatic vulnerability. The findings clearly point out that the MGNREGA has provided different environmental services i.e. recharging the groundwater storage, improving surface water storage in tanks, pond, improved soil organic matter, reclamation of degraded lands and carbon sequestration. Also, it is decreasing the vulnerability of production systems and livelihoods in the short and long term, mainly against the background of different climatic condition.

S. Verma, and T. Shah, (2012) observed the water assets created by MGNREGA on the basis of the study in Bihar, Gujarat, Kerala and Rajasthan that MGNREGA is also among the world's largest water security programs, investing some US$ 3 billion annually in constructing, repairing, renovating rural water structures, public and private. This study

synthesizes over 140 case studies of MGNREGA water structures that were useful, productive and durable.

N. Ravindranath, and I. Murthy, (2013) examined MGNREGA works in their green aspect by using Green Index throughout India. The study revealed that the MGNREGA works are generally linked to water, soil or land and vegetation. The environment related MGNREGA works have the potential to deliver green impact through the regional and global level. In the context of greening MGNREGA, the focus should be on sustainable economic development through the natural resource conservation

T. Esteaves et. al (2013) conducted a synthesis report to Environmental benefits and vulnerability reduction through MGNREGA in selected 4 districts and states namely, Madhya Pradesh (Dhar) Andhra Pradesh (Medak), Rajasthan (Bhilwara)) and Karnataka (Chitradurga). The main purpose of this research was to assess the potential of MGNREGA's environmental benefits and decrease the vulnerability of climate risks. The findings also assured that the MGNREGA works conserve the natural resources, sustained water supply and food production, in addition to sustained job opportunity and livelihoods.

T. Esteves, et. al (2013) studied on Agricultural and livelihood Vulnerability Reduction after implementation of MGNREGA in four state of India, Andhra Pradesh, Karnataka, Madhya Pradesh and Rajasthan. They find out that the evidence from the 40 sample villages in four districts with diverse socio-economic and environmental conditions shows that MGNREGA works are generating multiple environmental and socio-economic benefits, such as enhancing groundwater levels, improving the storage capacity of waterbodies, improving irrigation, increasing the Soil Organic Carbon content, and reducing soil erosion. Thus, the environmental improvement created by MGNREGA works has the potential to reduce the current climate risks and also improve the long-term climatic condition.

2.4.1 Conclusion

MGNREGA assets have been conducive to the environment and have contributed towards natural resource regeneration; any country's sustainable economic development depends on rural development if it walks on protecting the environment. As we move more and more towards going to be a developed country, simultaneously we are reaching towards deteriorating our environmental condition. In this circumstance, we have crept into a

situation where we should not ignore the environment anymore. Hence any implemented programme, like MGNREGA has to be examined in terms of its effect on the environment. So, it is essential to examine MGNREGA works in their green aspect.

2.5 Literature Review on Indices for Sustainable Rural Development

A. Rai et. al (2008) developed Integrated Livelihood Status Index, which indicates the livelihood status of different agro-climatic zones in the country. Six different sub-indices obtained are indicators of Infrastructure Status, Agricultural Status, Nutritional Status, Economic Status, Health and Sanitation Status and Food Availability Status in respective zones. A total of 57 variables have been considered for this study. Finally, a composite integrated livelihood index has been developed which indicates the livelihood status of different agro-climatic zones in the country. This study has shown that there was a high association between backwardness and agricultural development. It has also revealed regional disparity in the development process and has suggested to formulate appropriate policies to bridge this disparity gap.

J. Michalek, and N. Zarnekow, (2011) applied the Rural Development Index (RDI) to Analysis of Rural Regions in Poland and Slovakia. The main purpose of this research was to construct a multi-dimensional (composite) index measuring the overall level of rural development and quality of life in individual rural regions. RDI Index is suitable both to analysis of the overall level of development of rural areas and to an evaluation of the impacts of economic, social and environmental indicators of rural development and structural programmes at regional levels.

R. Chopra et. al (2012) coined the term Greening Rural Development (GRD) in India which is necessary to address poverty and ensure the environmental sustainability of economic growth. GRD uses green indicators and metrics for assessment and examination of rural development projects and schemes. The Report is to examine the potential of rural development programmes to provide environmental benefits. Maximum MGNREGA works are 'green' in nature given their emphasis on the rejuvenation and conservation of earth's natural resources and ecosystems and their principal focus being on land or soil, vegetation and water resources related work.

I. Chandrasekharan et. al (2013) constructed an environmental performance index (EPI) to arrest degradation of the environment. EPI builds to measure environmental health and to protect ecosystem and natural resources. The overall EPI is calculated based on 22 indicators, relating environmental health, air quality, water resources, biodiversity and habitat, productive natural resources and climate change. This article attempts to detail methodology for constructing an EPI for the country and based on the EPI scores, ranks the states and suggests options for devolving Central funds to states.

R. Samanta, (2015) pointed out in his study Block Level Disparity in Social Development that the social development generally includes the basic social needs which are very essential to lead a healthy lifestyle within society. Social Development Index (SDI) is a Composite index, which is taken into consideration for analysis of development scenario at block level of Paschim Medinipur District, West Bengal. SDI is the aggregate picture of regional disparity in the levels of social development, differential patterns of sectoral development in education, health, urbanization and public-utility are taken into consideration to understand the nature and pattern of spatial inequality.

S. kharkwal and A. Kumar (2015) assessed the socio-economic impact of MGNREGA at Udham Singh Nagar in Uttarakhand, by using socio economic index. To assess the impact of MGNREGA on the socio-economic condition of beneficiaries, twelve qualitative and quantitative socio-economic indicators were evaluated using three-point scale for two selected years, i.e. 2007-08 and 2013-14. The changes in the value of these indicators over the six years period were examined. It was found that in the initial year of implementation (2007-08) of MGNREGA in the study area 29 (36.25%) out of total 80 beneficiary households were in poor socio-economic condition. In 2013-14 only 10 households (12.5%) were found under poor category. These results suggest that MGNREGA is effective in improving the socio-economic conditions of job participants.

N. Hashemi, and G. Ghaffary, (2017) fostered a Sustainable Rural Development Index (SRDI), which is a new proposed indicator that compares the current situation to future conditions in the development plans. The SRDI value is the weighted average of the values of 20 indicators. This study has introduced a novel dynamic index to better evaluate the sustainability in the rural development as a result of tourism development in Hajij village, Iran. They define sustainability based on participation and the attitude of the community members

S. K. Jha, (2017) and co-author evaluated the potential of well-designed government programmes to contribute to sustainable development through improving adaptive capacity and by combating poverty and vulnerability to climate change among marginalised people in a tribal region of Dhar district of Madhya Pradesh state, India. This study confirms that well designed programmes can reduce both the socio-economic and climate change vulnerability of marginalised tribal peoples. The Capacity Assessment Index (CAI) is used to measure the effectiveness of the program based on the specified indicators.

N. Kumar and R. Rani (2019) examined the regional disparities in social development in India by using social development index (SDI). Social indicators represent social conditions of various sections of the society. Indicators should be selected by bearing in mind all economic, social and ethical norms of culture. Choice of the social indicators also depends on the accessibility of the data. The present study used 12 social indicators for the construction of SDI and ranking of the UTs and states of India. The study used these indicators because all of these signify the basic necessities of the society.

2.5.1 Conclusion

The requirement of a village is environmental sustainability as well as sustainable economic development. With all these important aspects, the findings explored that the regional disparities in Socio–Economic Development by using Socio-Economic Development Index (SEDI) and Environmental Improvement by using Green Index (G.I.). Among other indices, these two indices are appropriate for small scale (Gram Panchayat) impact assessment study. This study is significant for the measurement of ground level development.

2.6 Overall Findings from Literature Review

This may be clear from the following review of concerned literature on the field of Rural Development, Environmental improvement of MGNREGA work, Socio-economic development of MGNREGA work and different indices for sustainable rural development we find some summary of literature:

2.6.1 Summary of Studies Analysing Socio-Economic Impacts of MGNREGA Works

All socio-economic development related literatures point out the development status of rural people. But the qualities of MGNREGA work, which are related to socio-economic

development (IAY house, rural road etc.) were not discussed. Here we identify some research gap:

i) Too much study has been directed towards the socio-economic benefits of MGNREGA works; but, at the same time environmental benefits of MGNREGA works were neglected.

ii) There are no reports which correlate between the gaps in Greening rural development and socio-economic development of a region after implementation of MGNREGA works

iii) Maximum socio-economic development index is prepared from sampling technique of primary survey which is not covered the entire beneficiary household. On the contrary census method covered entire beneficiary.

2.6.2 Summary of Studies Assessing Environmental Impacts of MGNREGA Works

From the above reviews, it has inferred that there is no in-depth analysis of the environmental improved created by MGNREGA works. Now a day, few researchers have initiated to evaluate the environmental impacts of MGNREGA works, specially focusing on water resource. Some findings are point out bellow:

i) Very few studies assessed the potential of MGNREGA's environmental benefits. But rarely has there been an attempt to quantify the environmental implications of the activities implemented under the NREGA.

ii) There are no reports which correlate between the gaps in Greening rural development and environmental improvement of MGNREGA works.

iii) Very few guidelines have been found for designing the Green Index of MGNREGA works for a smallest administrative unit (G.P.).

iv) There is lack of studies which correlate between Environmental Improvement (EI) and Socio-Economic Development (SED) of MGNREGA work.

CHAPTER – III
Aim& Objectives

3.1 Introduction

3.2 Statement of the Problem and Research Gap

3.3 Research Assumptions or Hypothesis

3.4 Research Questions

3.5 Objectives

3.6 Scope of the Study

3.7 limitation of the study

3.8 Methodology

3.1 Introduction

MGNREGA enhances the livelihoods of rural people on a sustained basis, by developing the economic and social infrastructure in rural areas. Construction of roads, ponds, drainage system and plantation are some of the popular areas where MGNREGA complemented in village development. It has also contributed to improve global and regional environment for sustainable rural development or Greening rural development. The overall rural development scenario in the concerned regions has been measured by Green Index of MGNREGA. The present study seeks to explore the performance of MGNREGA in Debra block, Paschim Medinipur district.

3.2 Statement of the Problem and Research Gap

1. Limited focus on long-term sustainability: Many studies on MGNREGA have primarily examined short-term impacts, but there is a research gap regarding the long-term sustainability of the socio-economic and environmental outcomes of MGNREGA works for greening rural development.

2. Insufficient analysis of regional variations: There is a need for more research that investigates regional variations in the socio-economic and environmental impacts of MGNREGA works, considering diverse ecological contexts, socio-cultural factors, and administrative effectiveness across different regions.

3. Lack of comprehensive assessment frameworks: Existing studies often lack a comprehensive assessment framework that integrates both socio-economic and environmental dimensions, leading to limited understanding of the synergies, trade-offs, and overall sustainability of MGNREGA works for greening rural development.

3.3 Research Assumptions or Hypotheses

In the light of the above Research Gaps, the following hypotheses is proposed

There is a positive correlation between the socio-economic and environmental impacts of MGNREGA works, suggesting that investments in green rural development can yield co-benefits in terms of poverty reduction, sustainable livelihoods, and ecological conservation.

3.4 Research Questions

1. What are the socio-economic impacts of MGNREGA works on rural communities in terms of income generation, livelihood improvement, and poverty reduction?
2. How do MGNREGA works contribute to environmental sustainability and conservation efforts in rural areas?
3. What are the key factors influencing the success or effectiveness of MGNREGA works in achieving green rural development?
4. What are the potential long-term impacts and outcomes of MGNREGA works in terms of sustainable development, resilience, and community empowerment?

3.5 Objectives

The main objectives of the study are:

1. Assessing the socio-economic impacts of MGNREGA works on rural communities, including income generation, employment opportunities, poverty reduction, and overall livelihood improvement.
2. Evaluating the environmental impacts of MGNREGA works in terms of natural resource conservation, land restoration, water management, and biodiversity enhancement.
3. Examining the correlation between socio-economic development and environmental improvement created by MGNREGA works in a rural region.
4. Providing recommendations and strategies for maximizing the socio-economic and environmental benefits of MGNREGA works and promoting sustainable and green rural development.

By addressing these objectives, the study aims to generate valuable insights into the socio-economic and environmental impacts of MGNREGA works and their potential contribution to greening rural development. The findings can inform policymakers, practitioners, and researchers in designing and implementing effective strategies for sustainable rural development programs

3.6 Scope of the Study

1. To understand the impact of MGNREGA works on Greening rural development.
2. To study about Green index for the analysis of MGNREGA works.
3. To analyze environmental as well as socio-economic development of MGNREGA works.
4. To analyze interrelationship between socio-economic development and environmental improvement in a rural region.
5. To suggest the way of achieving sustainable rural development with respect to rural development program (MGNREGA).

3.7 Limitation of the study

So many limitations arise during data collection in our study period

1. After MIS data of financial year 2017-2018, there have not any complete year base MGNREGA data due to Covid reason. 2017-18 financial year was the latest complete yearly available data during our research period.
2. Till now, the Current census data 2021 was not readily available.
3. In some cases, field data and Internet based MIS data are not merged each other due to corruption at grass root level.

3.8 Methodology

An overall methodological structure has been presented in (**Fig - 3.1**) to understand at a glance concept of the thesis.

Research Title	Investigating the Socio-Economic & Environmental Impacts of MGNREGA works For Greening Rural Development – A case study of Debra Block, Paschim Medinipur.			
Introduction	Rural scenario of India	Greening Rural Development concept	Progression of MGNREGA	Significance & Organization of the study
Literature Review	Literature study on Rural development	MGNREGA and Socio-Economic development	MGNREGA and Green development	Literature study on Different Indices for sustainable rural development
Aim and Objectives	Research gap	Hypothesis & Research questions	Objectives of the study	Scope of the study	Methodology	Limitation of the study
Materials and Methods	Introduction of Research design	Questionnaire Design & Approach	Sampling Technique	Questionnaires survey	Statistical Analysis
Analysis & Observation	MGNREGA implementation & Greening efforts in case study area			
	Environmental Impacts of MGNREGA works			
	Socio-Economic Impacts of MGNREGA works			
	Comparative analysis between Socio-Economic & Environmental Improvement			
	Proposed progressive index for Sustainable Rural Development			
Conclusion	Research findings	Future Direction	Limitation of the research	

Fig -3.1: An overall methodological structure

CHAPTER – IV
Materials & Methods

4.1 Introduction

Methodology plays an important role in the research process. It not only helps the researcher to formulate the research question but also plays an important role in the research process. This is the equipment of researcher to accumulate and organized required material such as data collected from questionnaires survey, and suitable statistical methods for analysing and interpreting the collected data.

Designing the research plan is the most important stage of any research work. Planning is very important for the successful implementation of any programme, research plan elucidates the launching pad towards identifying direction of the work. A description of the research plan showing in (**Fig-4.1**) for the present study has been discussed in this chapter. The design of study can be observed as under:
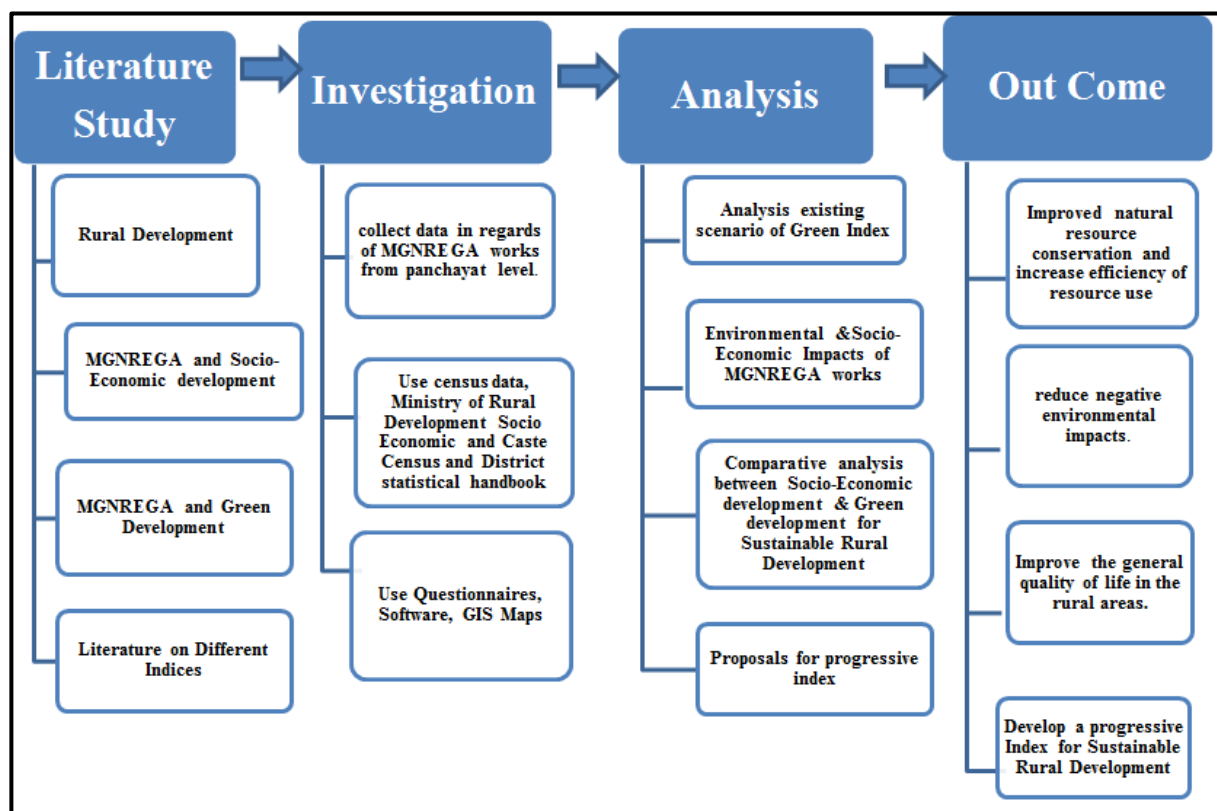
Fig-4.1: Research design

4.2 Questionnaire Design and Approach:

Questionnaire is the most important Survey Instruments of any researcher. Research questionnaires are prepared from the research problem, scope and objectives of the study,

significance of the study, limitations of the study etc. Here we collet both primary and secondary survey data for the study. We adopt sampling method for primary survey through structured questionnaires. Census data and district statistical handbook were used for secondary data. Data collection & survey design were presented in (**Fig-4. 2**)
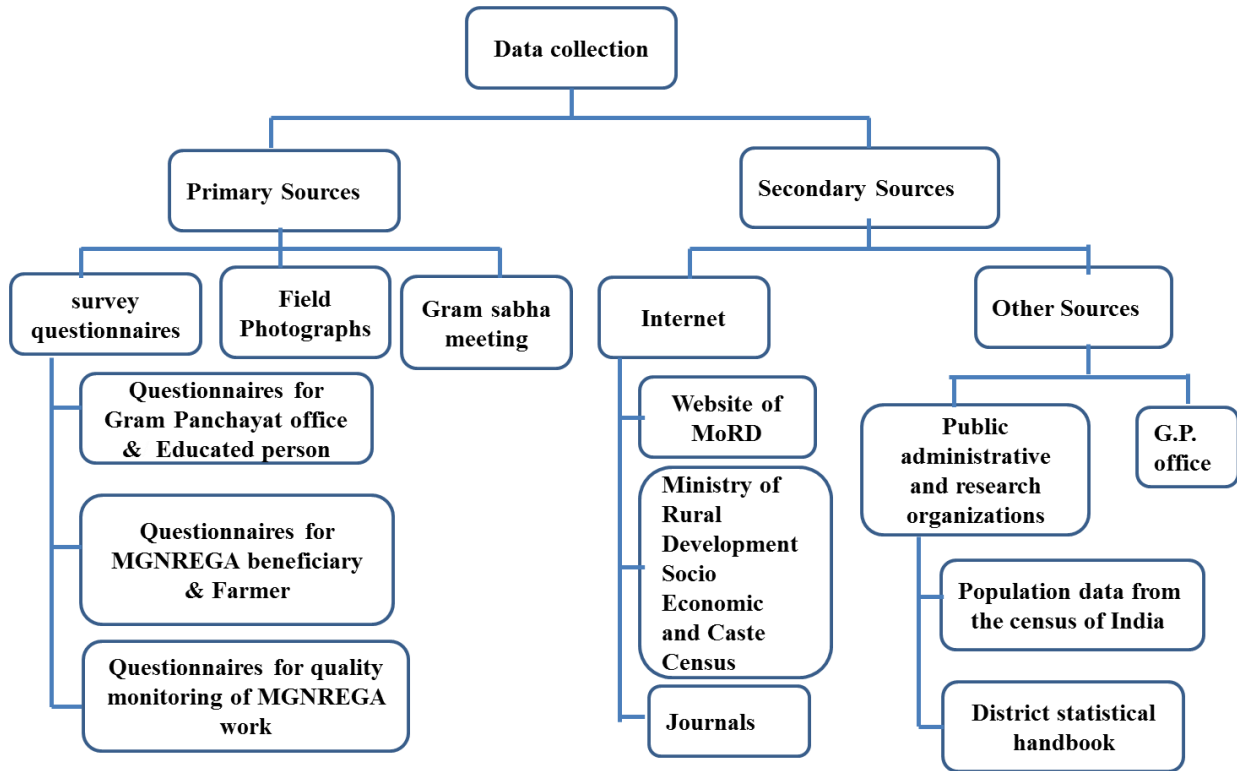
Fig-4. 2: Data collection and Survey design

In order to examine the societal development and environmental improvement of a particular G.P., we collected two types of data: primary and secondary data of MGNREGA works and the data related to socio-economic development of all G.P. The sources of all secondary socio-economic information include census, District statistical handbook and collected data from related administrative departments and organizational records like MoRD (Ministry of Rural Development), MIS (Management Information Systems) data related to MGNREGA. Summarizing the micro level or village data we developed the Panchayat-level data. In our study area, to interpret the improvement of MGNREGA works, we collected Secondary data from panchayat office and the website of MGNREGA (www.nrega.nic.in, www.nrega.ap.gov.in). In addition, we interviewed resource persons (highly educated) of different official unit to understanding about MGNREGA works and assets. Secondary data

of MGNREGA work were accumulated from the MIS data of financial year 2017-2018 and the socio-economic data were collected from the last census year 2011.

4.3 Sampling Technique:

The present study is based on Debra block, district Paschim Medinipur, West Bengal. Debra block will the scope of our study. The administrative structure of Debra block is divided into fourteen Gram Panchayat (G.P.). The total number of villages in our concerned Debra block is 487 mouzas or villages. The sample of the study would cover all fourteen panchayats for the present explorative investigation.

After accumulation of all secondary data, a field work was conducted at village level for the verification of ground truth. The purpose of this is to verify the asset created by MGNREGA works, which is known as sample survey. We used the process of two-stage cluster sample survey. The sizes of the clusters for this study are large which creates difficulty to take the information of all the units inside the clusters. At first in each G.P., five villages were purposively selected. After that, 10 households (benefited from MGNREGA assets and non-benefited) in each village were selected randomly for the impact assessment of MGNREGA works. In each G.P., 20% assets were verified including all type of assets. So, we selected 700 households for this study. Thus, sample of the present study altogether is 700, which consists of 14 Gram Panchayat of Debra block.

4.4 Primary Survey

Data was collected through structured questionnaires according to investigation plan and recorded their responses in the same. The questionnaire contained close ended questions about the regional and global environmental impact and socio-economic impact of MGNREGA works. Probable answers of all the questions related to environmental and socio-economic indicators were set at either 'Yes' or 'No'. Primary data or field survey was conducted after the interpretation of secondary data or internet-based data. Field survey was completed between April 1, 2018 and December 31, 2018. The information of rural socioeconomic condition and environmental condition both were extracted from household interview. The subject matter of the questionnaire may be highlighted as follows - household livelihoods condition, characteristics of out migration, household income status, utilization of NREGA earnings, household asset or amenity status, change in forest area, runoff

condition during heavy rainy season, condition of soil erosion and siltation after every rainy season, change in area under irrigation, crop diversification, ground water availability throughout the year, utilization of surface water bodies etc. From this field survey and some literature study, we finalised the indicators of Green Potential and Effectiveness Parameter and analysed the relation between socio-economic condition and environmental condition. Three types of survey questionnaires were used in this research programme:

4.4.1 Gram Panchayat Questionnaire

G.P. questionnaires demonstrate the basic knowledge about the villages under a particular G.P. From this survey showing in (**Pic - 4.1**) some basic information about gram panchayat and information of selection procedure of MGNREGA works were understood. The information of this survey can be combined with primary and secondary data (Census data 2011).

4.4.2 Asset Verification Schedule and Sampling Sheet

This Sampling Sheet comprised for the works completed between March 1, 2017 and March 31, 2018, arranged by type of MGNREGA works. The sampling sheet is prepared for asset verification showing in (**Pic - 4.2**) that include the location, dimensions and the condition of the assets at the time of their verification.

4.4.3 Beneficiary & Non- beneficiary Questionnaire

This questionnaire captured household characteristics, their assets and use by the households as well as the perceived benefits. This survey showing in (**Pic - 4.3**) was prepared for investigating the environmental benefit and socio-economic benefit of Different MGNREGA works such as

a. Development or Improvement of Land
b. Rural Connectivity
c. Water Conservation or Water Harvesting
d. Plantation or Afforestation
e. Disaster preparedness
f. Construction related work (toilets, anganwadis, panchayat bhavan, IAY house)

Pic - 4.1: Visit to Gram Panchayat Office (2017)

Pic - 4.2: Field Survey (MGNREGA work and Asset survey in the year 2018)

Pic - 4.3: Household survey (2017)

4.5 Data Extraction and Synthesis Methods

The data was prepared, scrutinized, and examined for focusing on the progress of the research strategy. Survey data was analysed through some statistical techniques and suitable cartographic presentation. To meet the different objectives of the study, mixed research methods were used i.e. Green Index, Socio-Economic Development Index, Progressive Index, tabular analysis, percentage, and Co-relation. This combines both qualitative and quantitative forms, for analysing the role of MGNREGS in improving the socio-economic development and environmental improvement of a rural region.

4.5.1 Qualitative Analysis (Green Index)

The term Green Index is a significant index and easy to measure and understand the green outcomes of MGNREGA works. Green indicators and mathematical functions are used for observing and evaluating the outcomes of MGNREGA, the largest rural development project. It is well known qualitative, quantitative and semi quantitative type assessment of MGNREGA's environmental potential services such as ecological balance, natural resources management, reclamation of natural ecosystem etc. Multi-disciplinary aspects, such as technical, social, environmental and statistical variables are required for the development of GI. Dr Ravi Chopra proposed the formula of Green Index (GI). The formula is

$$\boldsymbol{GI}_{GP} = \frac{\sum_{i=1}^{N}(GV)_i}{4N}.$$

Where, N= No of MGNREGA works undertaken in a G.P

GV= Green Value (Green Potential * Effectiveness parameter).

Green Potential is a set of indicators that were developed on the potential environmental benefit of each and every MGNREGA works. Also, the effectiveness value depends on quality of the work and coverage of the work. The range of index value belongs between 0 to 1 where 1 indicates 100% good environmental impact and 0 indicate poor environmental impact.GI aims at offering a general overview of the present state, and variation with time of GRD within rural areas. We hope GI will be widely used as a tool to evaluate and influence the environmental works around the world. Positive environmental outcomes will help us to access a healthy environment.

4.5.1.1 Green Potential

Green Potential is a set of ecological, physical and socio-economic indicators that are related to the structure of Greening or Sustainable Rural Development. The structure of or Greening or Sustainable Rural Development depends on the following environmental effects (Chopra et.al 2012): i) Improved resource conservation, ii) Improved resource efficiency, iii) Strengthened climate resilience of communities, iv) Reduced negative environmental impacts, v) Contribution to climate change mitigation. The indicators of Green Potential are divided into four categories:

i) Indicator **P** = improving the **Productivity** (P), that means improving the quality of natural resource or eco system.

ii) Indicator **S** = growing the **Sustainability** (S), that means the sustainable development of natural resource or eco system.

iii) Indicator **I** = Decreasing the negative **Impact** (I), that means decreasing the negative environmental Impact of development related work

iv) Indicator **R** = improving **Resilience** (R), that means enhancing the elasticity to climate change vulnerability.

Table-4.1: Indicators of the Green Potential

Sl. No	Work Name	Green Potential (G.P.)				G.P. Value
		Indicator P	**Indicator S**	**Indicator I**	**Indicator R**	
1	Water conservation	i) Irrigation water availability. ii) Enhancing crop production.	i) Improved water storage capacity in surface area.	i) Reducing surface runoff. ii) Increasing ground water recharge.	i) Regional flood control during heavy rainy season.	4
2	Watershed Management	i) Irrigation water availability. ii) Enhancing crop production.	i) Improved water storage capacity in surface area.	i) Reducing surface runoff. ii) Increasing ground water recharge.	i) Regional flood control during heavy rainy season.	4
3	Irrigation	i) Irrigation water availability. ii) Change in area under irrigation. iii) Enhancing crop production. iv) Increasing crop diversity	i) Increase the sustainability of ground water reservoir. ii) Improved water storage capacity	i) Reducing the Arsenic contamination in ground water. ii) Reducing surface runoff	i). Regional flood control during heavy rainy season.	4
4	traditional water bodies	i) Irrigation water availability. ii) Enhancing fish farming. iii) Change in area	i) Improved water storage capacity in surface area. ii) Soil quality improvement.	i) Reducing surface runoff. ii) Increasing ground water recharge &ground water level iii) Maintenance pond eco	i) Regional flood control during heavy rainy season. ii) Drought proofing.	4

35

		under cultivation iv)Increasing crop diversity v)Extent of area cultivated during different season	iii)Improved water storage capacity	system.		
5	Afforestation	i) Non-Timber Forest Product (NTFP) availability. ii) Recharge the ground water by enhancing infiltration. iii) Increase soil organic matter.	i) Conservation & regeneration of biomass & carbon stock. ii) Biodiversity conservation.	i) Soil erosion control by reducing surface runoff. ii) Reduced the siltation rate in water bodies. iii) Air quality improvement.	i) Resilience to be a heat island. ii) Controlled Ozone depletion & Global warming. iii) Halting desertification.	4
6/ 7/ 9	Land Development / Improving productivity of lands/ Development of fallow or waste land	i) Potential to generate increased crop, livestock and forest production. ii) Improve soil fertility	_	i) Reduced the risk of water logging during heavy rainy season.	i). Halting land degradation and desertification.	3
10	Construction of Houses	_	_	i) Increasing the livelihood security. ii) Generate employment opportunities.	_	1
8/ 11/ 12	Improving livelihoods/ Promotion of livestock/ Promotion of fisheries			i) Increasing the livelihood security. ii) Generate employment opportunities.		1
13	Rural Sanitation			i) Increasing the rural lifestyle. ii) Generate employment opportunities		1
14	Rural Connectivity	_	_	i) Increase accessibility. ii) Generate employment opportunities.	_	1
15	Play field			i) Increasing the rural lifestyle. ii) Generate employment opportunities		1
16	Disaster preparedness/ Restoration	i) Recharge the ground water by enhancing infiltration.	i) Improve the drainage ecosystem by removing silt and garbage. ii) Improve soil moisture	i) Controlling runoff velocities, soil erosion and sedimentation in small drainage system.	i) Flood control.	4

Source: Author (prepared from literature survey & local people's point of view)

Table- 4.1 refers a set of indicators that were promoted to assess the environmental impact of each MGNREGS works. The value of above mentioned four factors may be given either 1 or 0 depending on if the work has the potential to meet the objectives of GRD or not. If the work fulfils all four indicators, its Green Potential will be 4.

4.5.1.2 Effectiveness parameter

Effectiveness value of any work is the average value of coverage of the work and quality of the work. From the outcomes of MGNREGA works we can measure the adequacy or coverage of all the works. This is the quantitative measurement of effectiveness value. The author distributed the coverage values among three categories namely,

i) High coverage = (1.0), ii) Moderate = (0.50) and, ii) Low coverage = (0.25)

On the other hand, the quality or durability of every work is the qualitative measurement of effectiveness value. The standard quality of every work has been described in MGNREGA guideline, which was selected to consider the local development and the environmental services. The quality or durability of every work is described in (**Table-4.2**). Also, the standard quality has three categories i.e.

i)   High (1.0) = Fulfil all durability features / 80-100 % (Good quality)

ii)   Moderate (0.50) = Fulfil average durability features / above 50 % (Neither very good nor very bad) and

iii)   Low (0.25) = Fulfil partial durability features / Bellow 50 % (bad quality)

Table 4.2: Indicators of durability/ quality of assets

Sl. No.	Work	Indicators of Durability/ Quality
1	Water conservation/ Water harvesting	i) Conserve the Small & shallow water bodies ii) Catchment Area Treatment (CAT) minimum 400 surviving sapling/ Hec iii) Stone pitching for Dam/ Tank/ Pond iv) Greening the slope of Dam/ Tank/ Pond v) The measurement of a standard earthen dam is 65 m length, 4.65 m height and a top width of 2m.
2.	Watershed Management	i) Catchment area treatment has minimum survived 400 saplings /ha ii) Other durability features like- stone pitching for dam, greening of dam slope. iii) CA <10 ha for regions with > 1,000 mm rainfall iv) The measurement of a standard boulder check is 7m length, 1 m height, a top width of 0.5m and upstream and downstream slopes are 1:1 and 3:1
3	Micro irrigation work/ Irrigation Canal	i) Catchment area treatment have minimum survived 400 sapling /ha ii) Canal requires regular desilting. iii)30% BPL/SC/ST lands are irrigated by canal iv) The measurement of a standard canal bank is 0.6m height, 1.7m width and cross section area is 0.57 sq. m
4	Renovation of traditional water bodies	i)Edges of Ponds should be either earthen tiles or lined with LDPE (Low Density Polyethylene). ii) Trees planted along the edges of pond. iii) Waterbodies have to be at least on 5% of farm area. iv)A standard pond of 25m*20m*2m dimensions (1000 cubic metre storage capacity)
5	Forestry/ Plantation	i) On community land 600 saplings/ ha. are desired, ii) Minimum survived 400 sapling /ha, iii) One fruit tree/ family, one fodder tree/ cattle head is required

		iv) Create grass bed in addition to trees.
		v) Saplings areas should have a Protective wall.
		vi) Frequent watering in dry season
		vii) Organic & chemical fertilizer used several times
6/7/ 9	Land Development / Improving productivity of lands/ Development of fallow or waste land	i) Height should not be less than 0.5m after compaction. ii) Slope of the land should be less than 10 degree. iii) Vegetative cover enhances their durability
10	Construction of Houses	i) Adopting eco-friendly materials and technologies in shelter construction ii) Adequate or not to fulfil the people's requirement.
8/11 /12	Improving livelihoods/ Promotion of livestock/ Promotion of fisheries	i) The measurement of a standard shelter area is 7.50 sq. m. of which 3.75 m length and 2 m width and average height of 2.20 m. This is suitable for 100 birds. ii) The roof of the shelter will be constructed by a steel truss and galvanised iron corrugated sheets. iii) The floor of the shelter will be filled by hard moorum. The floor will be constructed by applying 2nd grade bricks with packing in 1:6 ratio of cement mortar. iv) Adequate grass plantation for livestock requirement. v) Maintain the proper dimension of fish tank
13	Rural Sanitation	i) Public places with sanitary facilities. ii) Does the village have a liquid and solid waste management system? iii) adopting eco-friendly materials and technologies for rural sanitation
14	Rural Connectivity	i) Encourage people not to cut trees. ii) Trees planted along the edges of road side. iii)Adequate or not to fulfil the people's requirement iv) No disruption on local water bodies.

Source: Author

Applications to other 30 works given in the latest MGNREGA guidelines can be similarly prepared. As a sample calculation of GI of MGNREGA works are presented in (**Fig- 4.3**). The Green Potential of every work becomes predetermined and the Gram Sabha meeting and asset survey can do the Effectiveness assessment based on the High, Moderate, Low, parameters. Computing Green Index for every MGNREGA works in a smallest administrative unit (Gram Panchayat) can be determined by using primary and secondary data related to Green Potential and Effectiveness parameter. Green Index becomes an instrument for the evaluation of the MGNREGA implementation in the particular Gram Panchayat. The measurement process of Green Index is differed from one investigator to another investigator.
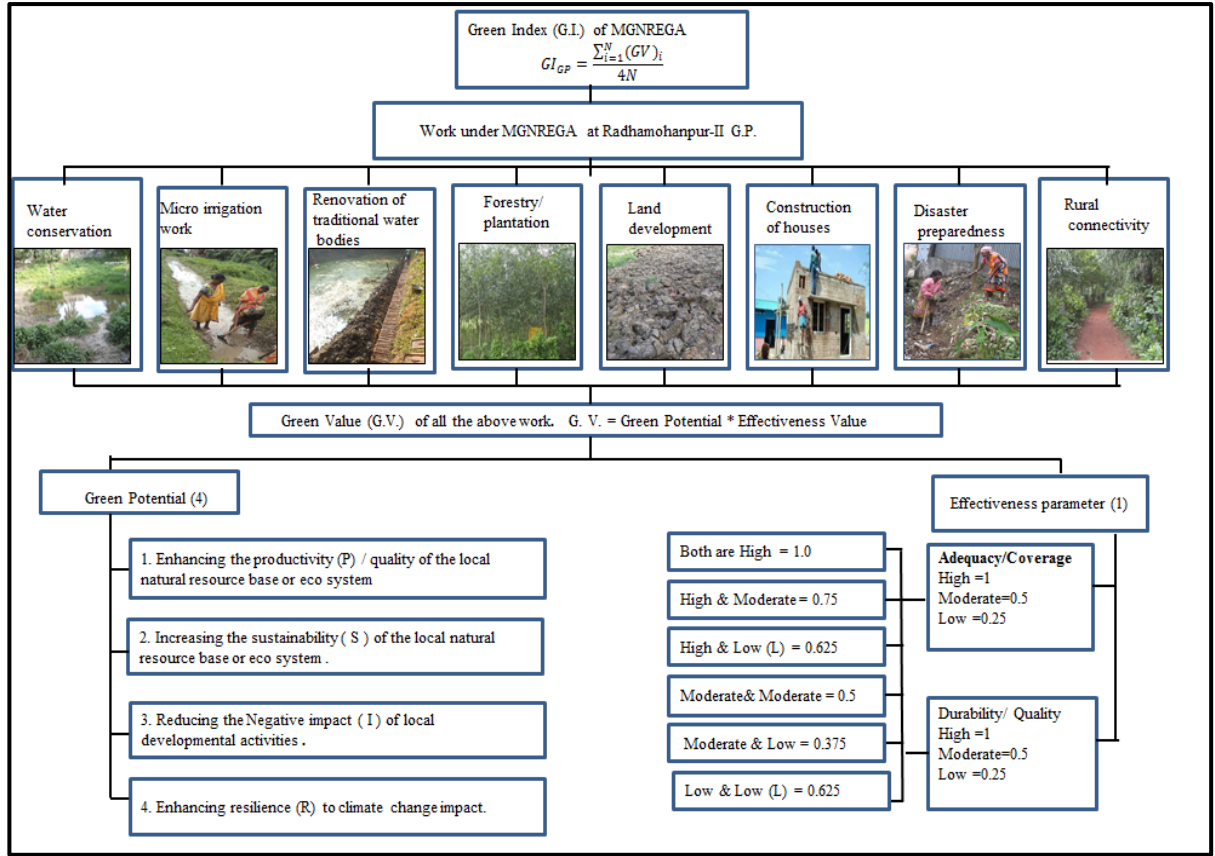
Fig- 4.3: Typical Calculation Framework of GI for each Gram Panchayat

Source**:** Author

4.5.2 Quantitative Analysis Methods

4.5.2.1 Socio-Economic Development Index (SEDI)

Social indicators represent social conditions of various sections of the society. It is advised that indicators should be selected by bearing in mind all economic, social and appropriate pattern of culture. Here socio-economic development index is developed using four widely recognized components, those are a) economic b) education c) health, and d) modernization. There are many problems to measure development of some works and there is lack of any standard guidelines for those. The present study used 12 indicators (**Table- 4.3**) for the understanding of SEDI and its ranking. The method selected was based on the purpose of the study, variety of problems and data availability. The formula is

$$SEDI(Ij) = \frac{\Sigma Iij}{n}$$

Where, Ij is Index of jth Indicator of study, and

n is the no. of indicators used in study

Table-4.3: Indicators of Socio-Economic Development Index (SEDI)

Perspective of Socio-Economic Development Index	Indicator	Index (Ij)
Economic growth	Index of worker	(Total worker/ Total Population) * 100
	Index of Households with any member earning more than Rs. 10,000 p.m	(Households earning more than Rs. 10,000 p.m./ Total household) *100
Level of Education	Index of literacy	(Literate people/ Total Population) *100
	Index of female literacy	Female literate people/ Total female Population) *100
	Index of school	[Total School (primary, middle, secondary, higher secondary, Govt. school, Private School)/ total population] *100
Health services	Index of mouza having safe drinking water	(Average no.of hand pump, Tube well, bore whole status/ total mouza)*100
	index of mouza having nutrition centre	(Average no. of ICDS, Anganwari and other nutrition centre/ total mouza) *100
	Index of mouza having health centre	Total no. of Health centre/total mouza) *100
Degree of modernization	Index of Urbanization	(Urban population/ Total Population) * 100
	Index of mouza having electrification for all users	(Average power supply for all domestic user/ total mouza) *100
	Index of household with three/more rooms with concrete wall and roof	(Household with three/more rooms with concrete wall and roof/ total household) *100
	Index of mouza having communicated by rail and road	Total no. of National and State highway, major and other district road, Black topped road /total mouza) *100
	$\Sigma n = 12$	$SEDI(Ij) = \dfrac{\Sigma Iij}{n}$

Source: Author

A simple index of SEDI is being combined with relevant indicators, which can explain the societal variation of different G.P across the blocks. This section explains the regional imbalances in socio-economic development at micro level at Debra block

4.5.2.2 Spearman's rank correlation coefficient

Spearman's rank correlation coefficient or Spearman's rho is named after Charles Spearman. Spearman's rank correlation coefficient is explained in statistics to measure the strength of interrelation between two variables and their association with each other. It looks at the relationship between two variables used Greek letter ρ (rho) or as rs (non-parametric measure of statistical dependence between two variables). In our study to examine the relation between SEDI and GI Spearman's rank correlation coefficient matrix have been used.

Spearman's correlation coefficients range from -1 to +1. The sign of the coefficient reveals whether it is a positive or negative monotonic relationship. A positive correlation indicates that two variables were increase simultaneously. And a negative correlation indicates that as one variable increases, the other tends to decrease. Values close to -1 or +1 represent stronger relationships than values closer to zero. The formula for Spearman's rank correlation coefficient is

$$\rho = 1 - \frac{6\Sigma\,d^2}{n(n^2 - 1)}$$

Where, ρ = Spearman's rank correlation coefficient
d = Difference between the two ranks of each observation
n = Number of observations

4.6 Software's used

Microsoft Excel, SPSS software, Arc Gis software were used to accumulate, analyse and interpret the data evaluated from primary and secondary survey.

CHAPTER - V
Case Study

5.1 Introduction to the Study Area

The study was carried out at Debra Community Development (C.D.) Block of Paschim Medinipur district, West Bengal (**Map.-5.1**). The block covers 342.29 sq. k.m and is divided into 14 Gram Panchayats and 487 mouzas or villages. Among those, 472 are inhabited mouzas and another 15 are depopulated mouzas. The population of the block is 2, 84,968of which 1, 44,566are male and 1, 40,402 are female and the population density is 832 sq. km, according to the census 2011.

National Highway (NH-6) covers 15.5 k.m. in this Block. Maximum population in this region depends on rural sources for survival. The study area is under the hot and humid monsoon region. The average annual rainfall is 1400 mm and a large amount of rainfall (near about 80 percent) is received in the monsoon period from June to September. The winter and summer temperature ranges between 10 °C and 40 °C. The region is rich in alluvium soil, which mainly consists of clay particles. So, this soil gives high yield in agricultural fields. Here, the occupation of most of the people (48491 people) is as agricultural labourers. In this Block, the total number of workersare1, 14,400of which 6,681are employed, 73,160 are semi employed and 34559 are unemployed. A vast amount of household 37,188 are Marginal & Small Farmers (1 to 2hectares of farm land).

This block is one of the places where Rural and Urban livelihood both are presented. The census town Balichak, under Duan -II Gram Panchayat is one and only urban area in Debra block. It is a large rural settlement or small town, which is surrounded by rural areas. This is known as 'Urban Village' (Samsurijan., et.al 2017), Where rural land is slowly turning into a form of urban islands. It is also known as Rurban area where urban and rural activities were merged together (Mandal 1989, Kolhea and Dhoteb 2016). This urban region has a population of 13784. This region is "urban" in nature but is administrated by Rural Local Bodies (Gram Panchayats),

Map. -5.1: Location Map of Study area

5.2 Environmental, Demographic and Socio-Economic Context of Debra Block

Debra block, lying in the Eastern part of Paschim Medinipur district has been selected for the study of different dimensions of sustainable rural development. It is like other parts of rural India, predominately agricultural-based rural society (94.22 % population is rural). Geographical, Demographic and socio-economic condition, of Debra block, which has been used in the Research study, is presented in a tabular form. The source of all socio-economic secondary data are Census 2011 and District Statistical Handbook.

5.2.1 Geography

- Latitude (Approximate) – 22°18´34″ North to 22°33´51″ North

- Longitude (Approximate) –87°30´17″ East to 87°39´29″ East

- Height from Mean sea level – 11 meter

- Total Area –342.29 sq. k.m

- Depth of Water Table-55ft.

- Depletion of Water Rate-35ft.

- Net area under cultivation-29287 Hec.

- Area under forest-540 Hec.

5.2.2 Administrative Setup

The district headquarter of Debra block is situated at Pashim Medinipur town. Distance form Debra block to District Head Quarters is: 40.5 k.m by road and 38 k.m by rail. The Block comprises of 487 Villages out of which 472 are Inhabited mouzas and another 15 are depopulated mouzas. (**Table- 5.1)** represents the administrative setup of the study area.

Table 5.1: Administrative setup of Debra block

Sl.No	G.P. Name	No of Mouza or villages			area	No of household
		Total	Inhabitat	Uninhabitat		
1	Bharatpur	34	33	1	2505.92	4506
2	Bhabanipur	29	29	0	1790.62	5201
3	Debra -I	23	23	0	1711.45	3515
4	Debra -II	30	30	0	1788.22	4000
5	Duan -I	26	25	1	1812.59	3380
6	Duan -II	7	7	0	1207.82	4649
7	Golgram	37	37	0	2351.19	5592
8	Jalimanda	43	43	0	3416.81	5848
9	Khanamohan	65	65	0	2924.89	4858
10	Malighati	36	35	1	2807.34	4737
11	Radhamohanpur -I	28	26	2	2245.2	4359
12	Radhamohanpur -II	10	9	1	1422.77	3578
13	Satyapur	45	44	1	3155.67	6017
14	Shanrpur - Loyada	57	55	2	3240.14	6157

Source: Census 2011

5.2.3Demography & educational setup

Every area has distinct demographic structure. Total population of this block is 284968. Among fourteen G.P., Highest population live in Satyapur G.P. Only one G.P., Duan-II, where male population is lower than female population.

Literacy rate is one of the primary indicators of development of a society. It indicates the status, development or progress of a nation. In Debra block 82.03 % population is literate of which 88.78 % is male literate and 75.16 % is female literate according to census 2011. (**Table - 5.2**) represents the demography and educational structure of study area.

Table 5.2: Demography & educational setup of Debra block according to the Census 2011

Sl. No	G.P. Name	Total population	Female Population	Male	Literate population	Female Literate	Total School (primary, middle, secondary, higher secondary, Govt. school, Private School)
1	Bharatpur	20016	9905	10111	13584	5987	68
2	Bhabanipur	23108	11272	11836	16998	7602	64
3	Debra -I	15200	7527	7673	10683	4833	41
4	Debra -II	16868	8408	8460	12325	5616	60
5	Duan -I	14568	7200	7368	11359	5228	50
6	Duan -II	19296	9771	9525	15043	7197	18
7	Golgram	25212	12419	12793	18189	8140	95
8	Jalimanda	24845	12341	12504	18007	8086	78
9	Khanamohan	20718	10295	10423	15371	7095	77
10	Malighati	21431	10595	10836	15957	7191	75
11	Radhamohanpur -I	18656	9198	9458	13717	6288	39
12	Radhamohanpur -II	15,561	7,744	7,817	12202	5670	32
13	Satyapur	26503	13221	13282	18102	8085	90
14	Shanrpur - Loyada	26362	13031	13331	18872	8506	106

Source: Census 2011

5.2.4 Economy and health status

Every area is characterised by a distinct socio-economic profile. This profile including occupational structure, per capita income, dependency ratio, monthly expenditure etc. reflects the developmental directions as well as standard of living of this particular area. Maximum population of this study area are engaged in Agricultural Labour, which is 48% of

total worker. Also, the facilities of drinking water, nutrition centre, health centre etc. are the indicator of a healthy society. (**Table - 5.3)** represents the economy and health status of study area.

Table 5.3: Economy and health status of Debra block

Sl. No.	G.P. Name	Total worker	Households with any member earning more than Rs. 10,000p.m	average no. of hand pump, Tube well, bore whole status	average no. of ICDS, Anganwadi and other nutrition centre	Total no. of Health centre
1	Bharatpur	9385	101	27.5	29.67	4
2	Bhabanipur	10586	170	27.5	27	9
3	Debra -I	6966	293	23	19.67	3
4	Debra -II	7956	352	29	20	2
5	Duan -I	6807	174	14.5	19	3
6	Duan -II	7741	854	5	5.33	3
7	Golgram	11717	316	28.5	28.33	7
8	Jalimanda	12139	290	42.5	37.67	4
9	Khanamohan	9769	217	42.5	38.33	5
10	Malighati	9918	226	32	26	10
11	Radhamohanpur -I	8292	172	19	23.33	5
12	Radhamohanpur -II	6177	319	9	8.67	3
13	Satyapur	12493	205	33.5	37.67	6
14	Shanrpur - Loyada	11818	417	41.5	35.67	25

Source: Census &Socio Economic and Caste Census 2011

5.2.5 Urbanization or Modernization status

House type, electricity facility, transport & communication system etc. are the indicator of Urbanization or Modernization status. Duan -II Gram Panchayat is one and only urban area in Debra block, which is surrounded by rural areas. This is known as 'Urban Village'. Balichak, the Census town of Debra block is under Duan –II G.P. Being the census town, urbanization and modernization rate is highest as well as population density (3739.16/ sq. Km.) is also high in Duan –II G.P and it performs as an administrative, cultural, economic and health service centre in the study area. (**Table** -**5.4)** represents the Urbanization or Modernization status of study area.

Table 5.4: Urbanization or Modernization status of Debra block

Sl. No.	Name of G.P.	Urban Population	average power supply for all domestic user (Hour)	Households with three or more rooms with pucca walls and pucca roof	Total no. of National and State highway, major and other district road, Black topped road
1	Bharatpur		30	162	8
2	Bhabanipur		22.5	216	16
3	Debra -I		17	291	10
4	Debra -II		25.5	314	11
5	Duan -I		20	173	4
6	Duan -II	13784	5	629	5
7	Golgram		31.5	417	13
8	Jalimanda		40.5	171	7
9	Khanamohan		50.5	214	8
10	Malighati		33	278	27
11	Radhamohanpur -I		20	279	14
12	Radhamohanpur -II		7.5	228	9
13	Satyapur		28.5	465	14
14	Shanrpur - Loyada		38	305	18

Source: Census &Socio Economic and Caste Census 2011

5.3 Justification for selection of the study area

The purpose for selecting the Study area was the inauguration year of MGNREGS works and the expansion of MGNREGA work.

i) Debra block was selected as it is a representative of rural area in West Bengal. This Block has high level of implementation of MGNREGA works, also in this Block where the works were started during the initial phase (2006) of the programme.

ii) This Block is well connected through rail (South-Eastern Railway), road (NH-6) and water transport (Kangsabati River), and it is located nearly about 100 km away from the capital city of West Bengal (Kolkata) and 40 km away from district headquarter, Medinipur.

iii) One other fact which I would like to point out that this block is one of the places where Rural and Urban livelihood both are presented. The census town Balichak, under Duan -II Gram Panchayat is one and only urban area in Debra block. This is known as 'Urban Village' (Samsurijan., M.S. et.al 2017).

5.4 MGNREGA Implementation and Greening Efforts in Debra Block

MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) is a government scheme in India that guarantees a minimum of 100 days of wage employment per year to every rural household whose adult members volunteer to do unskilled manual work. MGNREGA which has recently passed one decade, first implemented in this Block in the year of 2006. While the primary objective of MGNREGA is to provide livelihood security to rural households, it is also focus on incorporating adaptive and sustainable approaches within the program. This scheme aims for Natural Resource Management, Renewable Energy, Sustainable Agriculture, Watershed Development, Skill Development and Capacity Building, and Climate Change Adaptation. Rural people mainly depend on natural resources or primary activities like agriculture, fishing, mining etc. (Sarkar and Kundu 2016). Enormous dependency of natural resources puts an incredible strain on climate, environment, habitat and ecosystem. MORD has introduced MGNREGA, an innovative programme to improve ecosystem services (water, land, soil, forest) as well as human systems (employment opportunities, shelter, communication) (Ravindranath and Murthy 2013; Shah et al. 2015). Implementation of MGNREGA has reduced the vulnerability related to climate change, water scarcity, and agricultural variability and at the same time it has increased economic status, crop yield, employment opportunities and increased the daily wage level. Environmental conditions as well as rural livelihood both are improved after implementation of MGNREGA. So, this chapter analyses the performance of both socio-economic impact and environmental improvement of MGNREGA work in a rural region.

In the long run, it has a huge potential to enrich environmental protection and ecosystem services, which is linked to water, soil, land and forest. As per reports, among fourteen Gram Panchayats (G.P.) of Debra block, sixteen major types of works are currently in progress under the MGNREGA. The MGNREGA works were analyzed (**Table-5.5**) in Study area based on their category:

Table-5.5: MGNREGA work category wise analysis in financial year (2017-18)

Category	Work category name	Sub-Work category name
A.	**Public works relating to natural resources management**	1. Water Conservation 2. Watershed Management 3. Irrigation 4. Traditional Water bodies 5. Afforestation 6. Land Development
B.	**Individual assets for vulnerable sections**	7. Improving productivity of lands 8. Improving livelihoods 9. Development of fallow /waste land 10. Construction of house 11. Promotion of livestock 12. Promotion of fisheries
C.	**Rural Infrastructure**	13. Rural Sanitation 14. Road Connectivity 15. Play field 16. Disaster preparedness/Restoration

Source: Management Information Systems (MIS) data from website

The work under MGNREGA is related to both environmental and societal development. Environment related work has the potential to improve environmental quality through the conservation and regeneration of ecosystem services like water, soil or land and forest. Also, the societal development related work has the potential to empower rural people and strengthen the livelihood capacity through generating employment opportunities and create durable assets in the rural region (Kharkwal and Kuma 2015). (**Fig-5.1)** represents the MGNREGA works according to environment and Socio-economic development purpose.
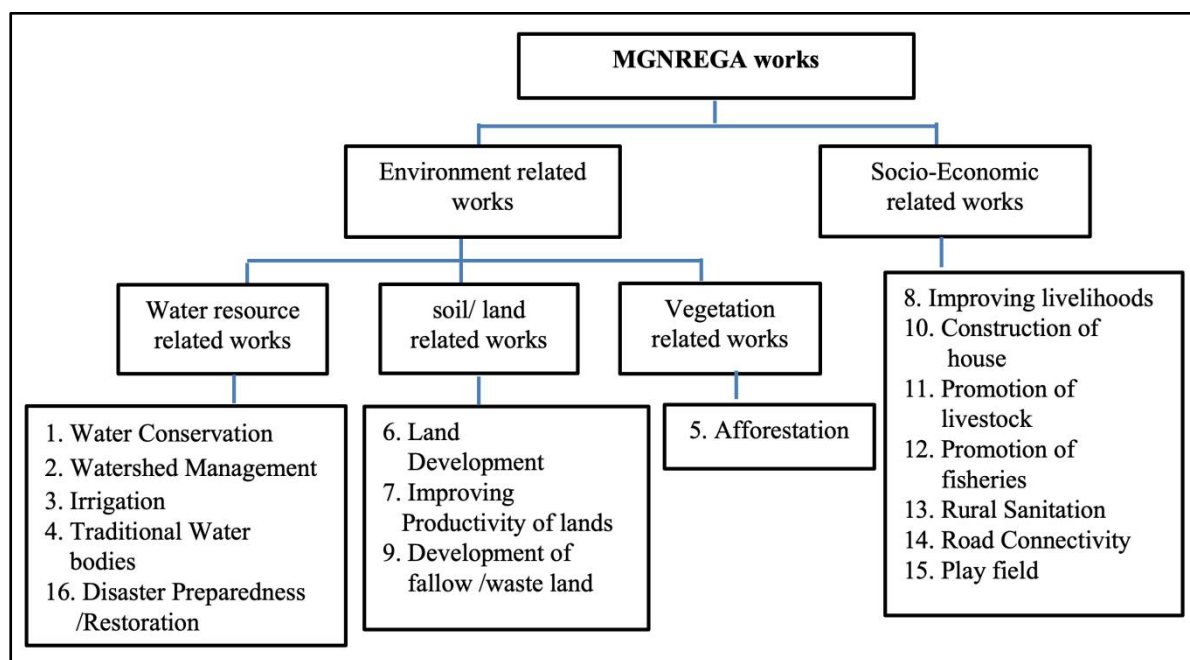
Fig-5.1: Perspectives of MGNREGA works
Source: Author

5.4.1 Environment related MGNREGA work

Environmental conservation (land, water, forest conservation) which is upgraded by Environment related MGNREGA works were assessed in this section. Such type of MGNREGA works are Earthen Dam and Check Dam construction, Irrigation Canal, Development of traditional water bodies, Land Development Plantation etc.

5.4.1.1 Water Resources related MGNREGA works

Water related MGNREGA works are probably to have a direct impact on surface and ground water recharge. Water resource management related such MGNREGA works are Farm pond, Check Dam, Earthen Dam, Mini-percolation tank, Earthen bounding, Construction and renovation of canal, Re-excavation of tank or pond, Desilting of irrigation tank or pond etc. Those works also have the potential to control surface water runoff, control soil loss, increase infiltration of water and recharge the ground water, availability of irrigation water, area irrigated by bore wells /open wells, availability of drinking water for humans and livestock (Verma and Shah 2012).

The ground water level of Debra block area is 50-115 m during Rainy season and 120-195 m in dry season. The no. of Deep Tube well (DTW) of water extraction for irrigation were 492 before MGNREGA period (2003-04) and after MGNREGA implementation (2013-2014) the no. of DTW has increased to 2898 (**Table-5.6**). Also, the figure (**Fig-5.2)** shows ground water availability, which increases in the post MGNREGA period. So, we can accept that MGNREGA works have positive impact on the underground water level in the study region, despite outstretched removal of ground water. Surface water storage was also increased by the work of renovation or desilting of traditional water bodies.

Table-5.6: Area irrigated by different sources in Debra block for the year 2003-04 and 2013-2014

Sl. No	Source of Irrigation	2003-04		2013-2014	
		No	Area irrigated inHec	No	Area irrigated inHec
1	Cannel	-	8250	-	-
2	Tank	2370	2000	2450	2200
3	DTW	492	4680	2898	23700
4	STW	2310	4620	-	-
5	RLI	16	640	18	830
6	Others	-	200	-	-

	Total	5296	27860	5366	26730

STW = Shallow Tube well

RLI = River Lift Irrigation

DTW = Deep Tube well

	cannel	Tank	DTW	STW	RLI	Others
■ Area irrigated in hec (2003-2004)	8250	2000	4680	4620	640	200
■ Area irrigated in hec (2013-2014)	0	2200	23700	0	830	0
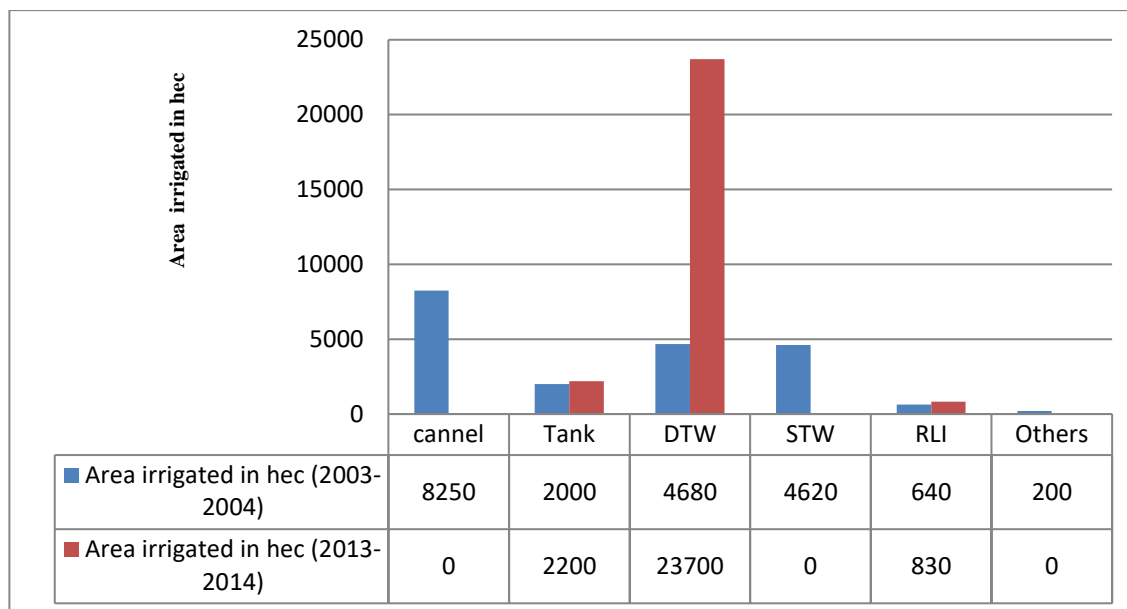
Fig-5.2: Figure showing area irrigated by different sources in Debra block

Water conservation related some MGNREGA works are probably to have a direct impact on surface and ground water recharge. In this block, water resource management related permissible works are followings:

1. Water conservation and water harvesting structures to augment and improve groundwater like earthen dams, check dams, farm pond with special focus on recharging ground water including drinking water sources.

2. Micro and minor irrigation works and creation, renovation and maintenance of irrigation canals and drains.

3. Renovation of traditional water bodies including re-excavation of tank or pond, desilting of irrigation tanks and other water bodies.

4. Disaster preparedness/Restoration includes construction & renovation of drainage system/construction of retaining guard wall at the side of drainage. Strengthening of embankment/ deepening & repairing of flood channel/desilting/ construction of intermediate & link drains

1. Water conservation / watershed management (earthen dams, Farm pond, and check dams)

Earthen Dam:

i) Earthen dams showing in (**Pic-5.1**) are necessary for those particular areas where groundwater resources are very poor and also those areas where they do not have access to canal irrigation.

ii) Earthen dams are also used as an infiltration structures to increase the groundwater storage.

iii) The length of a standard earthen dam is 65 m, maximum height is of 4.65 m, and a top width of 2m.

(i)   (ii)

Pic-5.1: (i) Earthen Dam, (**ii**) Dam with earthen embankment in study area

Farm pond:

i) Farm pond showing in (**Pic-5.2**) is built on agricultural field to control soil loss and to improve the storage of soil moisture profile. Mainly the Farm pond is constructed to provide water for irrigation during dry spells in Monsoon.

ii) A Monsoon break occurs when there is little or no rainfall for a few days in the rainy season. The lack of sufficient rainfall in Monsoon is called dry spells, which may actually damage the kharif crop. This type of crop failure is controlled by Farm pond.

iii) The measurement of a standard farm pond is 0.6m height, 1.7m width and the cross-section area is 0.57 sq.m.

(i)   (ii)

Pic -5.2 :(i) Renovate the farm pond**, (ii)** Pond with earthen embankment in study area

Check dam/ Boulder checks:

i)   Check Dams showing in (**Pic-5.3**) is constructed with loose rock made on small seasonal streams or irrigation canal, which have very small catchment area, i.e. less than 50 hector.

ii)   The purpose of constructing a check dam is to decrease the velocity of water flow in a canal.

iii)   Controlling the velocity of runoff, it helps to reduce soil erosion, increase infiltration, reduce the siltation rate and finally increase the duration of drainage flow.

iv)   The measurement of a standard boulder check is 7m length, 1 m height, a top width of 0.5m and upstream and downstream slopes are 1:1 and 3:1.

Pic -5.3: Check dam has constructed on irrigation canal in study area

Findings from water conservation related work:

This work control surface runoff, soil loss, availability of irrigation water, availability of drinking water for humans and livestock, increases ground water level and provides effective drought proofing by storing rain water. So, this work has the potential to fulfil all the four indicators of Green Potential, shown in (**Fig-5.3**) but both the coverage and quality of the work is Moderate due to some causes mentioned below:

 i. Outcomes are not adequate to fulfil the requirements of people & livestock requirement (Surface waterbodies must be at least on 5% of farm area). Enough new water reservoirs, such as pond, dam and tank have to be constructed through this MGNREGA scheme.

 ii. There has not been proper maintenance of catchment area i.e. greening the slope and stone pitching of wall and sufficient surviving saplings (Minimum 400 per ha) are required

 iii. The small and shallow water bodies were converted into land in this study area to bear the increasing population pressure.
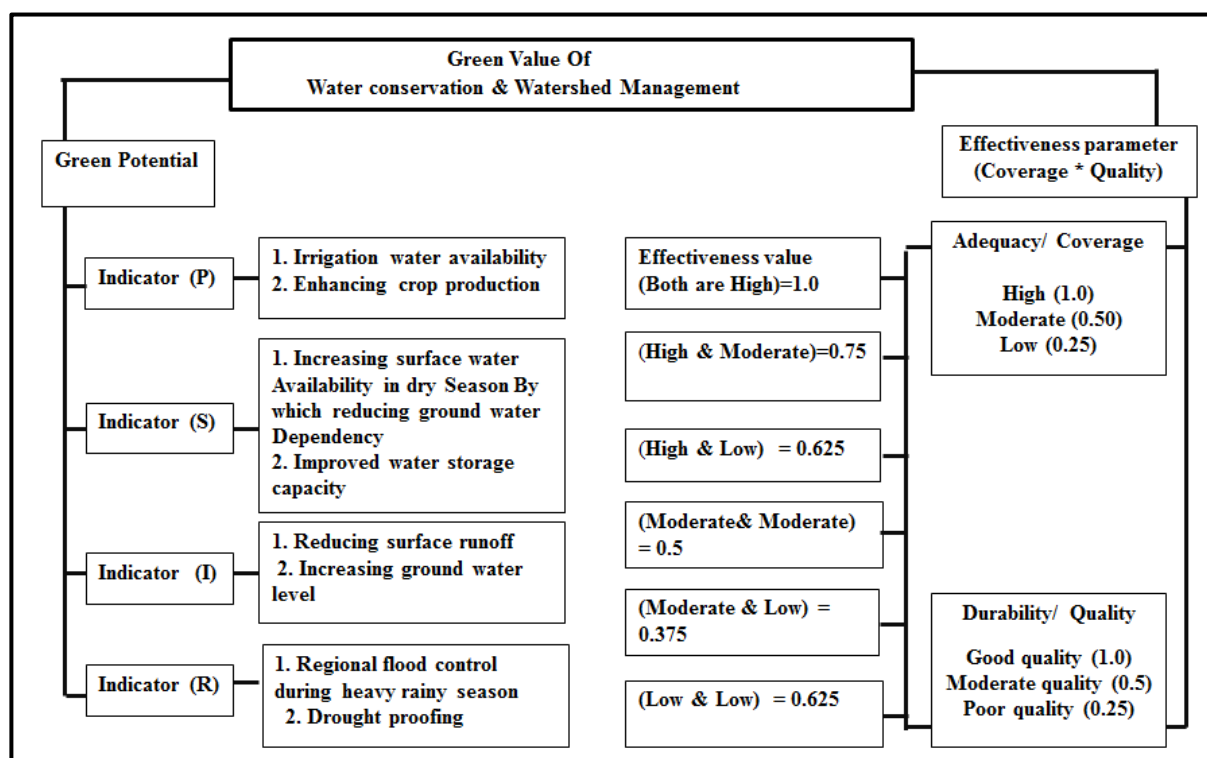
Fig 5.3 : Typical Structure of Green value calculation of Water conservation & Watershed Management Work

2. Micro irrigation work/ irrigation canal

    i)   Irrigation related works showing in (**Pic -5.4**) are related to construction, renewal and repair of irrigation canals or drainages.

    ii)   Canal irrigation systems have made a major contribution to protect the crop failure in India.

    iii)   The permissible irrigation related MGNREGA works are desilting of canal, repair of earthen bank of irrigation canal. Repair cracks of concrete embankments, raising the canal bank etc.

          (i)   **(ii)**   **(iii)**
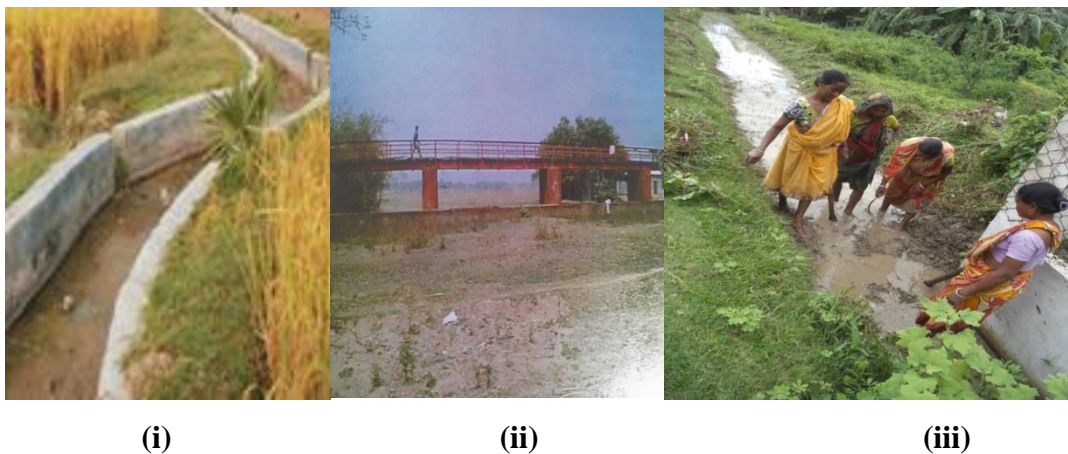
Pic -5.4: (i) Minor irrigation Canal in dry season**, (ii)**Main Irrigation canal in Dry season**, (iii)** Desilting of cannel in rainy season in study area

Findings from Micro Irrigation work:

    i)   Irrigation canal also recharge the ground water by enhancing infiltration and reducing the surface flow. Also, it can stop arsenic contamination. Therefore, it is assigned the green potential 4, shown in (**Fig-5.4**).

    ii)   The coverage of the work is very poor and quality of the work is moderate due to low depth of irrigation canal and low vegetation cover. Canals require regular desilting to maintain the depth and flow of water and more vegetative cover along the embankment of canal would enhance the quality of the work.

    iii)   Canal irrigation should get priority. Recently, canal irrigation has been largely neglected. On the other hand, Deep Tube Well (DTW) irrigation has increased enormously which is the main cause of arsenic contamination in ground water in west Bengal. Boro paddy cultivation (November-March) is totally depending on DTW irrigation or ground water.
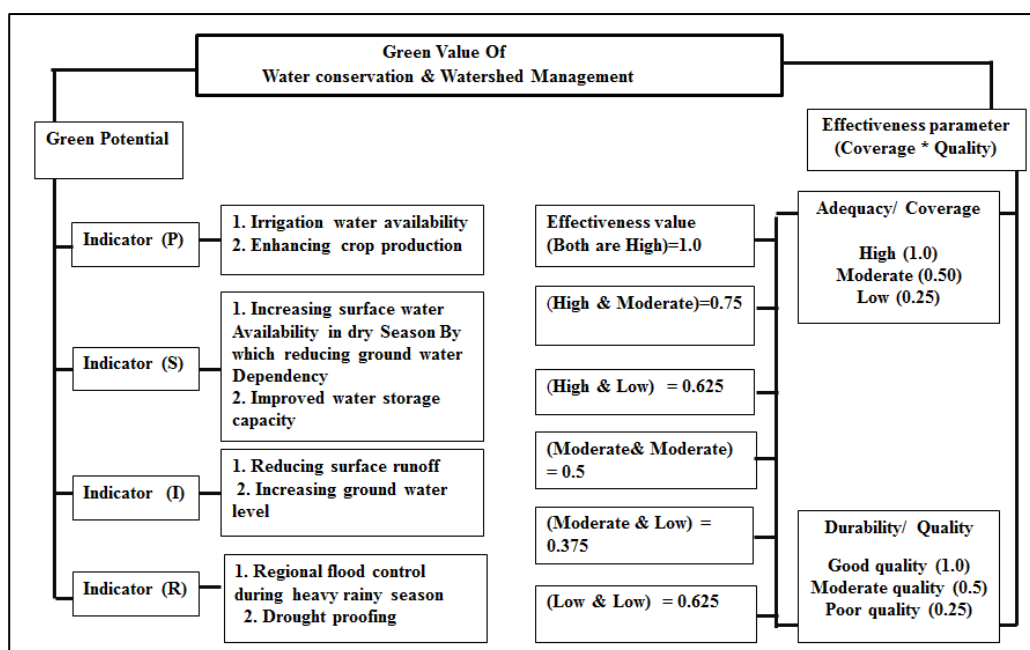
Fig-5.4: Typical Structure of Green value calculation of Micro irrigation work or irrigation cannel

3. Renovation of traditional water bodies

i)   Dugout tank or ponds are built on private land or public land shown in (**Pic - 5.5**) to control surface runoff during heavy rainy season.

ii)   In addition, in West Bengal, ponds have been traditionally used for fish farming.

iii)   The measurement of a standard pond is 25m*20m*2m (1000 cubic metre storage capacity), which is suggested as per MGNREGA guideline.

(i)   **(ii)**   **(iii)**

Pic - 5.5: (i) Digging of pond**, (ii)** After excavation silt was used in land development, **(iii)** Strengthening of embankment with Guard wall construction in study area**.**

Findings from the work Renovation of traditional water bodies:

i)   This work helps to maintain water resource, pond ecosystem and biodiversity conservation. So, the green potential of this work is 4, shown in (**Fig-5.5**).

ii)   In the study area Maximum MGNREGA work is under Renovation of traditional water bodies, which is the highest coverage, but the quality of the maximum work is moderate due to discussed problems.

iii)   Most of the reservoir walls were made with clay soil. This caused the reservoir walls to be washed away in every rainy season and deposit the clay in pond bed thereby causing siltation which decreases the water storage capacity.

iv)   Reservoir walls should be made using either concrete or LDPE (Low-Density Polyethylene).

v)   Sufficient plantations are required along the edge of the water reservoirs.
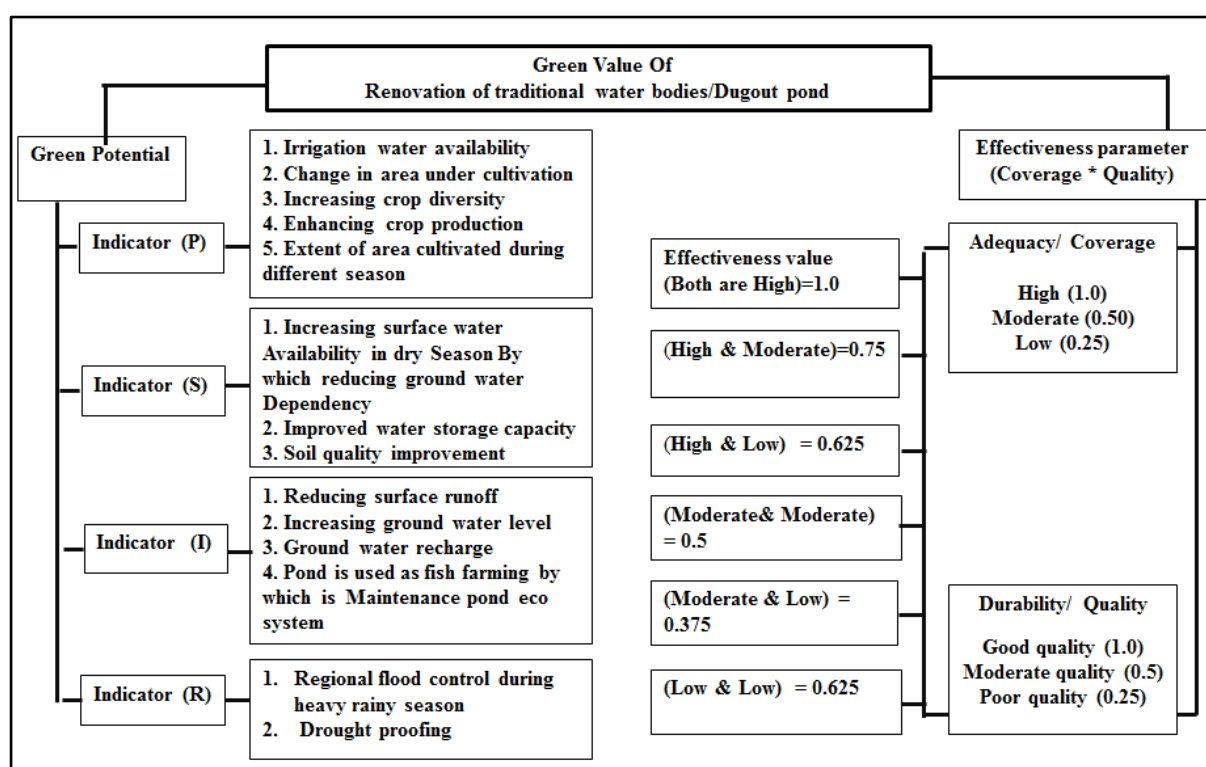
Fig- 5.5: Typical Structure of Green value calculation of Renovation of traditional water bodies

4. Disaster preparedness/restoration

i)   Disaster preparedness/Restoration includes Construction & Renovation of earthen & pucca drain/ Construction of retaining guard wall at the side of drainage. Strengthening of embankment/ deepening & repairing of flood channel/ Desilting/ Construction of intermediate & link Drains shown in (**Pic - 5.6**).

ii) Most parts of India typically receive rainfall between June and September, very intensely within a few hours and a few days. The number of rainy days does not exceed the average number i.e. 40-50. Moreover, rains are extremely erratic, so improving the flood channel is an important work.

iii) The flood channels play an important role to discharge the flood waters out of the village. But in many flood-prone villages, drainage has become silted up.

iv) the villages need to be repaired and the flood channel is to be renewed regularly.

(i)   (ii)   (iii)

Pic - 5.6: (i) Improving the depth of drainage by removing garbage**, (ii)** Desilting of drainage, **(iii)** Concrete drain with strengthening of embankmentin study area

Findings from the work Disaster preparedness

i)   This work also has the potential to improve the ground water, drainage ecosystem and flood or run off control. So, the green potential is 4, shown in (**Fig-5.6**).

ii) But the coverage and quality of the work is moderate due to illicit dumping along the drain throughout all G.P.

iii) There is no waste management work in the study area. People would dump their garbage in Drain or Nala, which creates water logging in every rainy season and creates health hazard.

iv) Good drainage system is required along both the sides of road. Also, drainage requires regular desilting for the maintenance of the depth and flow of water in rainy season.
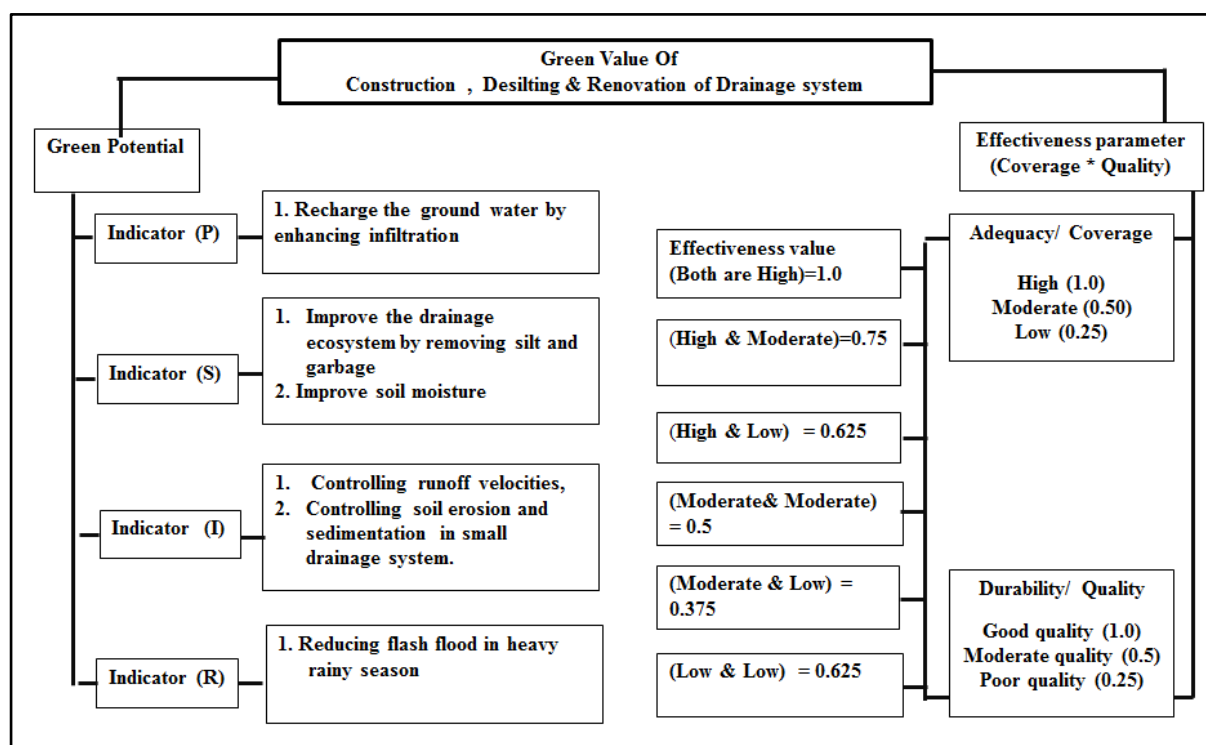
Fig - 5.6: Typical Structure of Green value calculation of Disaster preparedness or Restoration

5.4.1.2 Land/ soil related MGNREGA works

Land development activities under MGNREGA involves land levelling, Reclamation of land, Development of waste & fallow land, Low land filling and Silt removed through desilting of traditional water bodies shown in (**Pic - 5.7**). Silt was applied to crop land to enhance the land fertility and improve the organic carbon concentration, which is an indicator of nitrogen in soil. Before, the degraded lands or waste lands had not been fertile. After land development activities the degraded land are being cultivated and crop yield will be increased. So, these activities have not only improved the ecological condition of degraded land but also caused huge financial benefits to local farmers. There has been a

significant improvement in crop cultivation and income generation of individual farmers. So, we can accept that land development related MGNREGA works have positive impact on the soil or land and the work has the potential to improve crop productivity and income generation.

<center>**(i)**   **(ii)**</center>

Pic - 5.7: (i) Low land filling with silt**, (ii)** plantation after land developmentin study area

Findings from land related work

i) Low land or shallow water bodies which are the habitats of many lives are converted into reclaimed land through this work, resulting, in the loss of bio-diversity. So, the work cannot fulfil the indicator 'S'. Hence their green potential is 3, shown in **(Fig-5.7).**

ii) Also, both the quality and coverage of the work are moderate. Most of the developed land also faces erosion during rainy season.

iii) So, height and slope of the reclaimed or developed land should be properly maintained.

iv) After land development sufficient plantation is required.

Green Value Of Land Development/Low Land Fill up

Green Potential

Indicator (P) — 1. Improve soil fertility. 2. Potential to generate increased crop, livestock and forest production

Indicator (S) — No Impact

Indicator (I) — 1. Reduced the risk of water logging during heavy rainy season

Indicator (R) — 1. Halting land degradation and desertification

Effectiveness value (Both are High)=1.0

(High & Moderate)=0.75

(High & Low) = 0.625

(Moderate & Moderate) = 0.5

(Moderate & Low) = 0.375

(Low & Low) = 0.625

Effectiveness parameter (Coverage * Quality)

Adequacy/ Coverage
High (1.0)
Moderate (0.50)
Low (0.25)

Durability/ Quality
Good quality (1.0)
Moderate quality (0.5)
Poor quality (0.25)

Fig - 5.7: Typical Structure of Green value calculation of Land Development activities

5.4.1.3 Plantation related MGNREGA work

Droughts proofing related MGNREGA works Such as Plantation, Social Forestry, Social Afforestation at Play Ground, Plantation beside pond or Khal, Strip plantation at Burial & Cremation Ground etc. shown in (**Pic - 5.8**) are the works that improve the vegetation density, biomass concentration and carbon sequestration in the rural region (MoRD, 2012). MGNREGA work increases and improves the forest cover of the country. Plantation work has the potential to improve all environmental quality i.e. air, soil, water, biodiversity. The work covers tree plantation on embankment of tank, wastelands and fallow land, road sides, canal banks, drainage sides. The name of maximum planted trees in the study area are Eucalyptus (Scientific name- Tasmanian Bluegum), Akashmoni (Scientific name- Acacia auriculiformis), Kadam tree (Neolamarckia cadamba), Neem (Azadirachta indica) etc. Those plants are timber and fuel wood in nature. Guava, Mango, Jackfruit, etc., have been planted as fruit tree. It is known from the MGNREGA guideline data that the plantation works constitute approximately 10% of the total MGNREGA works.

| (i) | (ii) |
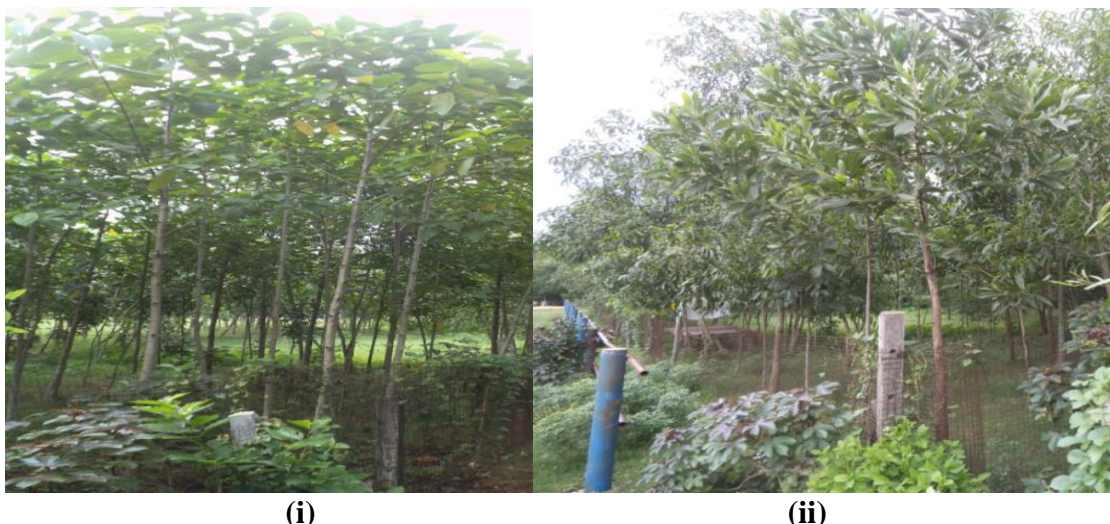
Pic - 5.8: (i) Plantation/ Social Forestry**, (ii)** Afforestation at the boundary of Play Groundin study area

Findings from plantation related work

i) Plantation work has the potential to improve all environmental quality i.e. air, soil, water, biodiversity, hence their green potential is 4, shown in (**Fig-5.8**).

ii) But coverage and quality of the work both are low. If the given suggestions are followed then the coverage and quality of the work would improve.

iii) Plantation area must be increased (600 surviving saplings per ha) by planting trees on the road sides, canal banks, drainage sides, wasteland and fallow land and proper maintenance should be performed.

iv) There was no proper maintenance. For instance, lack of providing organic and chemical fertilizers also increase the frequency of watering in dry season.

v) All plantation area does not have protection wall.
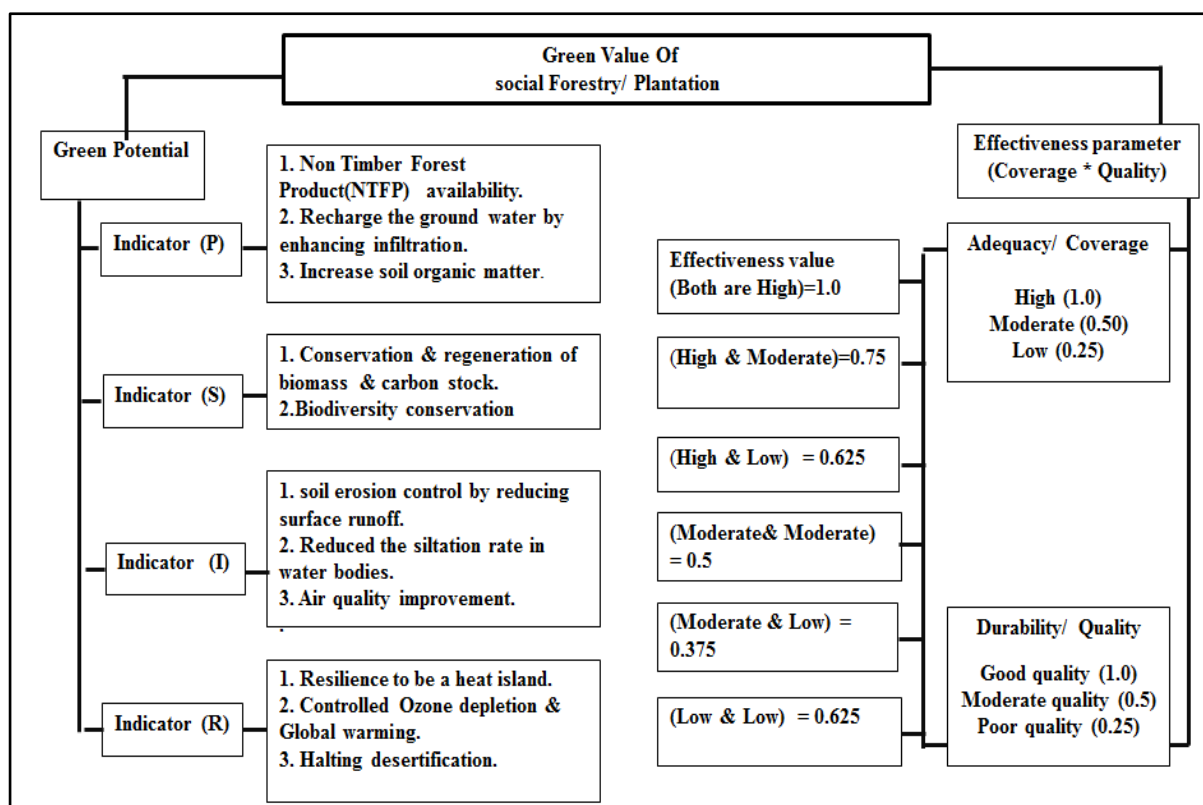
Fig - 5.8: Typical Structure of Green value calculation of social forestry / Plantation work

5.4.2 Socio-Economic Development related MGNREGA works

Several MGNREGA works such as Construction of IAY houses, Houses for S.C /S.T. & Low/Middle class people, repair of village road with moorum, construction of earthen roads, concrete road, toilets, play grounds etc. have large impact on social, economic and cultural improvement, but there is no environmental improvement. So, these works have only positive impact on rural livelihood, employment, rural infrastructure development (Haque 2011). Those MGNREGA works can potentially lead to reduction in the migration of landless labourers or unskilled labourers through the massive employment generation at village level (Kumar and Prasanna 2010). Non environment friendly materials, such as sand, stones, iron, steel, Brick and cement etc. are used to construct the rural assets, such as road, house, toilet etc. Manufacture and transportation of those construction materials have heavy impact on environment. Green House Gas emissions from construction activities are the sum of environment toll of material manufacture and environment toll of transportation of material (Bhaskar.et. al 1017).

5.4.2.1 Findings from the work Construction of house

i)   According to the environmental sustainability, Natural or Eco-friendly materials (husk, fly ash, bamboo, timber, stones and mud) should be used to construct houses.

ii)   Majority of houses were constructed with non-environmental friendly materials such as burnt bricks, cement and steel. Cement and burnt bricks are one of the major sources of the CO_2 emission in the environment.

iii) Manufacture and transportation of those construction materials have heavy impact on environment. Green House Gas emissions from construction activities are the sum of environment toll of material manufacture and environment toll of transportation of material

iv)   So, this work has fulfilled only the indicator I, shown in (**Fig-5.9**) other indicators have not been fulfilled**.**

v)   Also, both the quality and coverage of the work are moderate. If the energy and CO_2 Emission have to be reduced then the quality of the work has to be improved.

vi)   Also, the area of the house (within 300 sq. m) is small shown in (**Pic - 5.9**) and there is no attached kitchen and bathroom facility.

Pic-5.9: Construction of IAY houses, Houses for S.C /S.T. & Low/Middle class people in study area

5.4.2.2 Findings from the work Road connectivity/ Internal roads/Streets

i) Rural roads showing in (**Pic-5.10**) provide a major incentive for the development of rural economy or agro-economy.

ii) For example, when the new road would be constructed, trees would be cut down and it will have impact on local environment and the construction materials also release greenhouse gasses. So, this work does not have the potential to fulfil all objectives, only indicator I is fulfilled, shown in (**Fig-5.9**).

iii) The study area has been connected with 1120 km metal road and 72 km unmetal road, which have been made with laterite soil (local name Moorum). As a result, unmetal roads get damaged after every rainy season.

iv) More than 50% roads are too narrow in width, within a range of 6 feet. This is not adequate to fulfil the people's requirement.

V) The coverage and quality of the work both are moderate. The quality and quantity of connectivity have to be increased through new road construction, plantation along the edge of the road side and good drainage system beside the road side.

| i) | (ii) |

Pic-5.10: **(i)** concrete road, **(ii)** village road with moorum in study area
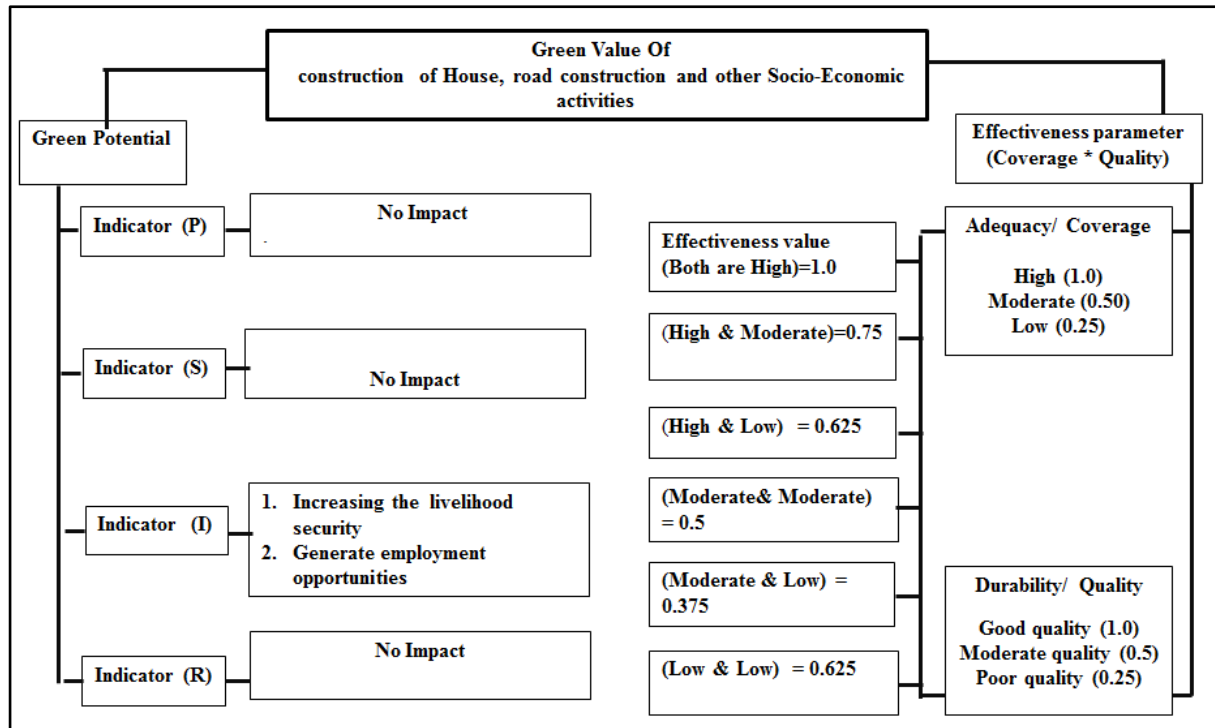
Fig-5.9: Typical Structure of Green value calculation of Socio-Economic development related work (IAY, Road construction)

5.5 Conclusion:

The methodological framework of MGNREGA lies between these two significant aspects: one is environment conservation and another is improving the well-being of local people. Approach to Sustainable Rural Development is the combination of these two factors. This study will help us in understanding the existing lacunae and focus on the need to bridge the gap between these socio-economic and environmental development challenges. The environment and development debate is well documented and discussed in the last few decades. The thought of sustainability originated from the concept of renewable resources like forest or fisheries, so, one of the characteristics of sustainability is environmental protection. Also, the concept has been accepted broadly as a slogan of environmental movement (Lele. 1991). MGNREGA, delivers various environmental profits and also decrease the environmental vulnerability. Despite the environmental aspect, MGNREGA can provide employment, food, education and health security, rural assets, etc. However, interventions are needed for fundamental methodological improvement to get better impact on rural villages.

CHAPTER – VI

Environmental & Socio-Economic Impacts of MGNREGA Works in Greening Rural Development in study area

6.1 Introduction:

Greening or sustainable Rural Development is a process to develop a local region and at the same time improve the environmental condition and natural assets. Environment and sustainable development have been introduced in the world since the year 1960 (Mattei. L.2015). The term sustainable development consists of two principal approaches: one is the 'needs' and another is 'limitations' or the environment's ability. In the year 1983, the term 'sustainable development' was conceived by the Indian economist, Nitin Desai, while he was a senior economic consultant to the Brundtland commission formerly known as World Commission on Environment and Development (WCED) that was authenticated by UNEP Governing Council (Mathur. R.2013). The development of any area consists of: economic status, educational status, health and nutrition services, magnitude of modernization and urbanization, women status, housing quality, transport and communication services and distribution of essential facilities (Das 1999).

Being a developing country, the progress of India depends on rural development or micro level accessible facilities. According to the census 2011, there were 6.4 lakhs villages in India and having 83.3 crores people. They spend poor quality of life style and they have to struggle to accommodate their basic needs (Jha et al. 2017). The idea of human development explains the process of quality and quantity of human being which refers to the prosperous live, higher education, happiness and good health of the human being. The Indian government has initiated various programmes for attaining equitable development all over India (Muyeed 1982). The government of India as well as the state government of West Bengal enacted some development policies for last few years to improve rural literacy, education, health, adequate shelter, transport and communication system etc. on the contrary to reduce migration, poverty, unemployment among the village level.

Development policy like MGNREGA has a significant role on the sustainable development. This is very much important paradigm change in how we look at progress of any region. Most of rural people are hugely dependent on the natural resources for their daily life (Sarkar and Kundu 2016). Rural peoples are the extremely vulnerable groups for their poverty and dependency on natural support systems (NSS) and agriculture. Hence, the developmental policies are necessary to reduce poverty and vulnerability of agricultural dependency. Environmental conditions as well as rural livelihood both are improved after implementation of MGNREGA. The study analyses the performance of both socio-economic

condition and environmental improvement in a rural region. The Green Index (GI) combines socio-economic and environmental factors to assess overall green performance of a region. By examining the relationship between these indices, the study seeks to shed light on interplay between Socio-Economic Development (SED), Environmental Improvement (EI), and green initiatives. This chapter emphasized on the relation between SED and EI among 14 Gram Panchayat (G.P.) of Debra block, Paschim Medinipur, West Bengal, where 16 major types of works (N) are currently in progress under the MGNREGA. The present chapter explored the regional disparities in SED by using Socio-Economic Development Index (SEDI) and EI by using Green Index (GI).

The objectives of this section are i) To evaluate MGNREGA works according to their environmental aspect for improving the 'sustainable natural resource management and green impact of rural region, ii) Exploring inter-G.P. regional imbalances in socio-economic development within 14 G.P. of Debra block, and iii) To develop a correlation between socio-economic development and environmental improvement to achieve healthier societies or sustainable development.

6.2 Analysis of the environmental impact of MGNREGA works by using Green Index (GI):

At first environmental conservation (land, water, forest) which is upgraded by MGNREGA works were examined by green index or to assess the qualitative and quantitative measurement of MGNREGA works through Green Index. The measurement of GI started from a Gram Panchayat level, which is a micro level study. The formula of GI is applied on each and every G.P. of the study area. At first the Green Value (GV) (product of Green Potential and effectiveness parameters) for every work is computed, after that calculates total Green Value of all works and standardize by the factor 4N. Each indicator of green potential value is 1 when MGNREGA work has ability to fulfil the objectives. Differently, the value of each indicator is 0, when MGNREGA work does not meet the objectives. The highest green potential score is 4 and the score of effectiveness parameter is 1. So, the maximum achieved green value score will be 4x1 = 4. As for example, **(Table-6.1)** represents the Calculation of Green Value and Green Index of a particular G.P.

Table-6.1: Green Value and Green Index of Radhamohanpur-II G.P.

Sl. No.	Work Name.	Green Potential (G. P.)				G.P.	Effectiveness Value (E. V.)		E.V.	Green Value (G. V.) =GP x EV	G.I. = ∑G.V/4N
		P	S	I	R		A/C	D/Q			
1	Water Conservation	1	1	1	1	4	High	High	1	4	
2	Irrigation	1	1	1	1	4	Moderate	High	0.75	3	
3	Traditional Water bodies	1	1	1	1	4	Moderate	High	0.75	3	
4	Afforestation	1	1	1	1	4	Low coverage	Low coverage	0.25	1	
5	Land Development	1	0	1	1	3	Moderate	Moderate	0.5	1.5	
6	Improving productivity of lands	1	0	1	1	3	Low coverage	Low coverage	0.25	0.75	$\frac{\sum_{i=1}^{N}(GV)_i}{4N}$ $=\frac{\sum G.V. = 16.875}{4*10}$
7	Development of fallow /waste land	1	0	1	1	3	Moderate	Low coverage	0.375	1.125	
8	Construction of house	0	0	1	0	1	Moderate	High	0.75	0.75	
9	Road Connectivity	0	0	1	0	1	Moderate	High	0.75	0.75	
10	Disaster preparedness/Restoration	1	1	1	1	4	Low coverage	Low coverage	0.25	1	
	∑N = 10									∑G.V.=16.875	G.I. = 0.4218

Source: Computed by author

MGNREGA works, which has been applicable in rural villages, has the potential to improve the rural socio-economic condition, and it also has the potential to improve environmental condition, to assure poverty reduction and distress migration (Shah Et. al. 2015). Finally, MGNREGA acts as a micro level developmental process. If the G.P. has more environmental conservation related works, such as natural resource (water, soil/land, vegetation) conservation work, those works have the potential to fulfil all the four indicators of Green Potential, then the Green Index value of G.P. will be increased. Also, the coverage and quality, which is the effectiveness parameter of all work, would be maintained properly for increase in GI value.

Some MGNREGA works, such as, road construction, construction of house and toilets, play grounds, etc. have huge socio-economic benefit on rural region but they have not met any environmental benefits. Those works are constructed with non-environmental friendly materials such as burnt bricks, cement, steel, sand, stones, iron etc. and they are not designed to have any environmental benefits. So those works have fulfilled only the indicator I, other indicators were also not fulfilled and the Green Value of all works are low. So, this type of works has negative impact on the environment and also, they decreased the GI value of G.P. In the same way we have calculated GI value of another 13 G.P. of Debra block. (**Table - 6.2**) represents the Green Index (GI) of MGNREGA of all Gram Panchayet of Debra Block.

Table -6.2: Green Index (GI) of MGNREGA at fourteen G.P. of Debra Block (Based on Financial Year 2017-18)

Gram panchayat (G.P.) name	Work Type(N)	Total works	Estimated Outcome (hec.)	Expenditure (in Lakhs)	Green Value ∑G. V	Green Index value (G.I.) = ∑G. V./4N	Green Index	Green Index In %	Green Index	Rank
Bharatpur	9	556	313.75	129.23	15.85	15.85/ (4*9)	0.4402	44.02	High	7
Bhabanipur	11	557	184.3	139.88	17.6	17.6/ (4*11)	0.4000	40.00	Moderate	9
Debra -I	10	576	503.22	145.06	12.2	12.2/ (4*10)	0.3050	30.50	low	13
Debra -II	10	408	205.19	123.57	18	18/ (4*10)	0.4500	45.00	High	5
Duan -I	9	304	373.27	142.86	13.65	13.65/ (4*9)	0.3791	37.91	Moderate	10
Duan -II	10	615	126.16	57.01	10.5	10.5/ (4*10)	0.2625	26.25	very low	14
Golgram	12	753	340.17	197.37	16	16/ (4*12)	0.3333	33.33	low	12
Jalimanda	9	1020	505.34	261.13	16	16/ (4*9)	0.4444	44.44	high	6
Khanamohan	8	941	136.06	286.22	15.3	15.3/ (4*8)	0.4781	47.81	Very high	2
Malighati	13	554	143.45	136.2	18.05	18.05/ (4*13)	0.3471	34.71	low	11
Radhamohanpur -I	10	743	233.11	174.03	18.85	18.85/ (4*10)	0.4712	47.12	Very High	4
Radhamohanpur -II	10	777	457.98	159.84	16.875	16.875/ (4*10)	0.4218	42.18	High	8
Satyapur	9	892	129.46	254.59	17.15	17.15/ (4*9)	0.4763	47.63	very High	3
Shanrpur - Loyada	11	1003	126.13	234.04	22	22/ (4*11)	0.5000	50.00	Very high	1

Source: computed by author

From the above table **(Table – 6.2)** the highest GI value of (50 %) was found at Shanrpur – Loyada G.P., followed by Khanamohan (47.81%) and Satyapur (47.63), and the lowest value (26.25%) found at Duan –II G.P. Green Index value of all the fourteen G.P. have been prepared in five categories in descending order (**Map. - 6.1**).

Among fourteen G.P. Duan - II has achieved lowest rank according to the GI value. After that Debra - I G.P. has ranked thirteen. Low & very low GI value represent that the no. of Socio-economic development related MGNREGA work is higher than the environment related work in those G.P. Duan - II G.P. ranked lowest for its unplanned urbanization & modernization process and Debra - I is going to be a modern hub in very recent year. Both two G.P. delivers urban facilities (i. e. medical facility, education, wholesale Services, Good transport, residential services, amusement etc.) throughout Debra block. In maximum cases development does not protect the environment. The G.P., those achieved highest GI value have sufficient open land for implementation of environment related MGNREGA works i.e., open land for creating new surface water reservoir, plantation, land development etc. From the overall assessment of G.I. value, it is recommended that more than 50% areas of Debra block achieved good environmental impacts.
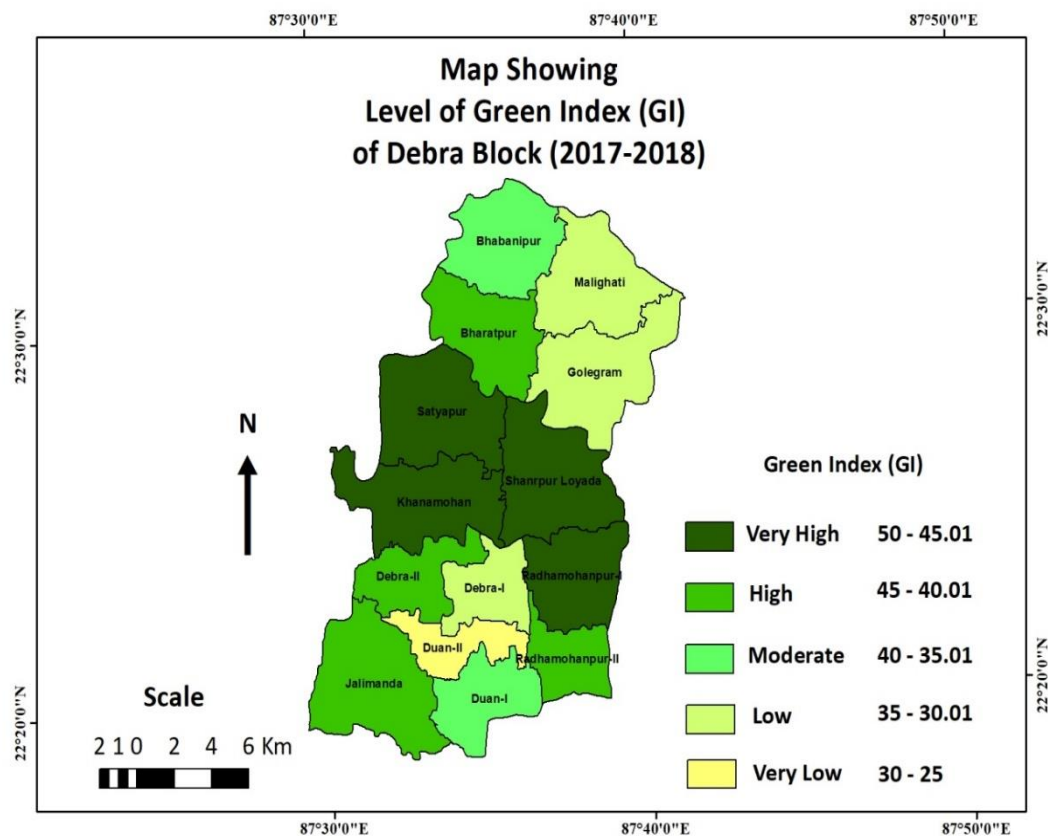
Map. -6.1: Level of GI of Debra block

6.3 Analysis of Socio-Economic impacts of MGNREGA works by using Socio-Economic Development Index (SEDI)

Socio-economic Development Index (SEDI) is necessary to understand the entire depiction of development of a society. To realise the structure and pattern of inequality in different sectors of society we selected some indicators. At first, we have selected four largely accepted components, next 12 indicators were chosen for different sectors (**Table-6.3.**) This societal development index explores the actual variability of inter-G.P. (micro-level) progress and explains the responsibility of indicators to create diversity in development of a society. The value of Socio-Economic Development Index (SEDI) is the average of all the indicators selected at the meantime forms various sectors. The units of all indicators are not uniform in nature, so they are standardised for easy calculation and understanding. The distribution of socio-economic improvement among fourteen G. P. of Debra block is not homogenous. The simple averages technique is used to calculate and extract the Socio-economic development value (Samanta, R. 2015).

Table-6.3: Indicators of Socio-Economic Development Index (SEDI)

Perspective of Socio-Economic Development Index	Indicator	Index (Ij)
Economic growth	Index of worker	(Total worker/ Total Population) * 100
	Index of Households with any member earning more than Rs. 10,000 p.m	(Households earning more than Rs. 10,000 p.m./ Total household) *100
Level of Education	Index of literacy	(Literate people/ Total Population) *100
	Index of female literacy	Female literate people/ Total female Population) *100
	Index of school	[Total School (primary, middle, secondary, higher secondary, Govt. school, Private School)/ total population] *100
Health services	Index of mouza having safe drinking water	(Average no.of hand pump, Tube well, bore whole status/ total mouza)*100
	index of mouza having nutrition centre	(Average no. of ICDS, Anganwari and other nutrition centre/ total mouza) *100
	Index of mouza having health centre	Total no. of Health centre/total mouza) *100
Degree of modernization	Index of Urbanization	(Urban population/ Total Population) * 100
	Index of mouza having electrification for all users	(Average power supply for all domestic user/ total mouza) *100

Next, we calculated SEDI value of fourteen G.P. and used this index for comparative analysis of every G.P. of Debra block. **Table-6.4** represents SEDI value of all G.P. of the study area.

Table-6.4: Socio-Economic Development Index (SEDI) of fourteen G.P. of Debra Block (Census data 2011)

name of the G.P.	Economic growth		Level of Education			Health services			Degree of modernization				Socio-Economic development index (S.E.D.I.) = Ij = (Σ Iij / n)	Socio-Economic development index	Rank
	Index of worker	Index of Households with any member earning more than Rs. 10,000 p.m	Index of literacy	Index of female literacy	Index of school	Index of mouza having safe drinking water	index of mouza having nutrition centre	Index of mouza having health centre	Index of Urbanization	Index of mouza having electrification for all users	Index of household with three/ more rooms with concrete wall and roof	Index of mouza having communicated by rail and road			
Bharatpur	46.88	2.24	67.86	60.44	0.33	83.33	89.91	12.1		90.91	3.6	24.24	40.16	moderate	10
Bhabanipur	45.81	3.27	73.35	67.44	0.27	94.83	93.1	31		77.59	4.15	55.17	45.5	high	4
Debra –I	45.82	8.34	70.28	64.2	0.26	100	85.52	13		78.26	8.28	43.48	43.12	moderate	5
Debra -II	47.16	8.8	73.06	66.79	0.35	96.67	66.67	6.67		85	7.85	36.67	41.31	moderate	8
Duan -I	46.72	5.15	77.97	72.61	0.34	58	76	12		80	5.12	16	37.49	low	11
Duan -II	40.11	18.37	77.95	73.65	0.09	83.33	76.14	42.9	71.43	75	13.53	71.43	53.66	Very high	1
Golgram	46.47	5.65	72.14	65.54	0.37	77.03	76.57	18.9		85.14	7.46	35.15	40.87	moderate	9
Jalimanda	48.85	4.96	72.47	65.52	0.31	98.84	87.6	9.3		94.19	2.92	16.29	41.77	moderate	7
Khanamohan	47.15	3.71	74.19	68.91	0.37	65.39	58.97	7.69		77.69	4.41	12.31	35.07	low	13
Malighati	46.27	4.77	74.45	67.87	0.34	91.43	74.29	28.6		94.29	5.87	77.14	47.11	high	3
Radhamohanpur -I	44.66	3.95	73.52	68.36	0.2	73.08	89.73	19.2		76.92	6.4	53.85	42.49	moderate	6
Radhamohanpur -II	39.69	8.92	78.41	73.21	0.2	100	96.33	33.3		83.33	6.37	100	51.65	Very high	2
Satyapur	47.13	3.41	68.3	61.15	0.33	76.14	85.61	13.6		64.77	7.73	31.82	34.41	Very low	14
Shanrpur -Loyada	44.82	6.77	71.58	65.27	0.4	75.45	64.85	45.5		69.09	4.95	32.73	36.38	low	12

Source: computed by Author

Socio-economic Development Index is a statistical index that refers to the levels of development among fourteen G.P. of Debra block. The index value is highest in Duan-II (53.66), followed by Radhamohanpur-II (51.65) and lowest in Satyapur (34.41). SEDI value of all the fourteen G.P. have been prepared as five categories in descending order (**Map. - 6.2**).
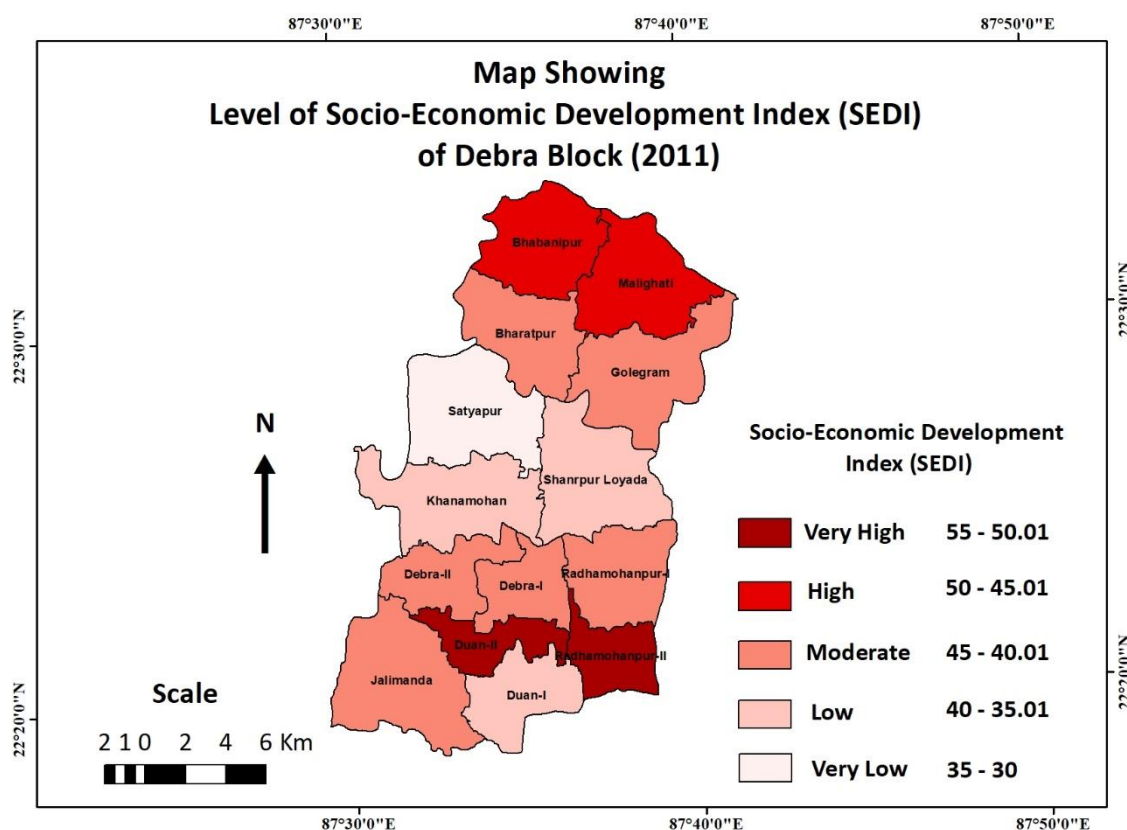
Map. - 6.2: Level of SEDI of Debra block

Balichak (under Duan –II G.P.) is the census town of Debra block and one and only urban area in this region with highest economic growth. Being the census town, urbanization and modernization rate is highest in Duan –II G.P. in relation to other G.P. and it performs as an administrative, cultural, economic and health service centre. This G.P. belongs to the highest category of development due to its urbanization hub.

Satyapur, Khanamohan, Shanrpur - Loyada and Duan -I G.P. belongs to very low to low development stages. It is significant to mention that the performance of these blocks is consistently poor in few sectors of the social development. Economic status of those G.P. is poor because maximum household of this G.P. depends on agricultural sector. Also, those G.P. have poor modernization, basically transport and communication system is not good. It

can be noticed that few G.P. is in bad state in their development status due to poor transportation system and job opportunity. A strong initiative from the advisers of state to central govt. can reduce this type of inter panchayat inequality as well as entire development of a block in future

6.4 Correlations between Socio-Economic Development and Environmental Improvement:

It is found from the above calculation and graphical representation, that the relation between GI and SEDI of maximum G.P. is inversely proportional. Satyapur, Khanamohan, Snarpur – Loyada G.P. belong to high level of development according to environmental purpose, but according to Socio-economic development purpose those three G.P. belong to very low to low development category. From the village level survey, we found that modernization and urbanization lack in these G.P., and are deprived from urban facility both from State and Central level. They belong in typical rural region. Geographical circumstances are also liable for poor development. The blocks are mainly concentrated within tributary of Kanhsabati river basin shown in (**Pic-6.1**). It is a perennial river and the depth of the river is very low. For this reason, the river water overflows in every rainy season and creates flash flood. In monsoon season, the transport system of those blocks is totally collapsed. However, transport system is the back bone of socio-economic development of a society. People demands for improvement in their livelihood but improvements are not being created at ground level in this region.

Pic-6.1: **(i)** Dry season condition and **(ii)**rainy season condition

Despite the miserable condition of social infrastructure those G.P. improved in environment related works. Villages have sufficient open land, there is no population pressure and urbanization pressure on land. Shanrpur - Loyada G.P have highest vegetation cover (107.76 Hec) and other G.P. Satyapur (0.8 hec) and Khanamohan (4.67 hec) have partially vegetation cover. Here the villages have traditional water bodies for surface water reservoir and land or soil related work is also high in comparison with other G.P. So, we found highest GI value from those three G.P.

In case of Duan –II G.P. the situation is reverse. Here the modernization, urbanization and economic growth are high as well as population density (3739.16/ sq. Km.) is also high. So, this G.P. achieved highest SEDI score. According to environmental impact this G.P. has ranked lowest due to some causes mentioned below. Waterlogged lowlands (**Pic-6.2**) which acts as a natural sponge during flooding condition and also act as a biodiversity reservoir were transformed to land to carry the excessive population growth and modernization and urbanization growth. In this G.P. maximum MGNREGA works were related to roads and houses construction, play grounds, etc. Those works have huge socio-economic benefit but they do not have any environmental benefits. Those works are constructed with non-environmental friendly materials such as burnt bricks, cement, steel, sand, stones, iron etc. and they are not planned in sustainable or green building techniques. So, this type of work has negative impact on the environment and also, they decrease the GI value of G.P.

Pic-6.2: (i) Small and Shallow waterbodies in 2016 **(ii)**After converted into Land in 2019
.

Here discussion about the G.P. where SEDI and GI vale both are high. Radhamohanpur-II G.P. is a semi urban area, where both development (environmental condition and socio-economic condition) happened simultaneously. This G.P. achieved 100% development in

safe drinking water and transport and communication sector. After Duan-II this G.P. is second highest position in socio-economic development as well as environment related MGNREGA works is also high in this G.P. Among fourteen G.P. of Debra block, we found only one G.P. which represent sustainable rural development. (**Fig-6.1**) represents the SEDI and GI value of fourteen G.P. of Debra block.

	Bharat pur	Bhaba nipur	Debra -I	Debra -II	Duan - I	Duan - II	Golgra m	Jalima nda	Khana mohan	Maligh ati	Radha mohan pur -I	Radha mohan pur -II	Satyap ur	Shanrp ur - Loyada
(G.I.)	44.02	40	30.5	45	37.91	26.25	33.33	44.44	47.81	34.71	47.12	42.18	48	50
(S.E.D.I)	40.16	45.5	43.12	41.31	37.49	53.66	40.87	41.77	35.07	47.11	42.49	51.65	34.41	36.38
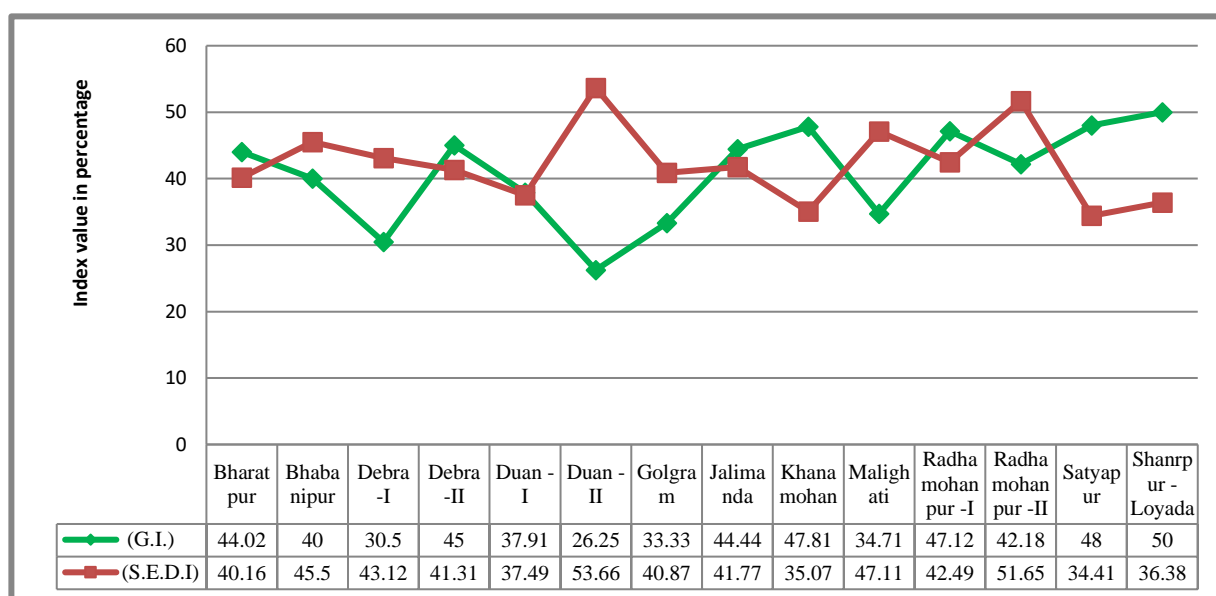
Fig-6.1: Comparison of SEDI and GI value of fourteen G.P. of Debra block.

6.4.1 Spearman's Rank correlation coefficients

Correlation is a statistical measure that determines how closely two variables fluctuate. A positive correlation shows the extent to which those variables increase or decrease in Parallel. A negative correlation shows the range in which one variable increases as the other decreases. If the value is near 0, which means that there is a weak correlation between the two ranks. Spearman's correlation coefficients method is applied here to correlate the SEDI and GI value shown in (**Table - 6.5**).

Table -6.5: Calculation Table for Spearman's Rank correlation coefficients

Gram panchayat (G.P.) name	Green Index	Green Index In %	Green Index	Rank (R₁)	Socio-Economic development index (S.E.D.I.) = Ij = (Σ Iij / n)	SEDI	Rank (R₂)	R₁ – R₂ = d	d²	$\rho = 1 - \frac{6\Sigma\,d^2}{n(n^2-1)}$
Bharatpur	0.4402	44.02	High	7	40.16	moderate	10	- 3	9	
Bhabanipur	0.4000	40.00	Moderate	9	45.5	high	4	5	25	
Debra -I	0.3050	30.50	low	13	43.12	moderate	5	8	64	
Debra -II	0.4500	45.00	High	5	41.31	moderate	8	-3	9	
Duan -I	0.3791	37.91	Moderate	10	37.49	low	11	-1	1	
Duan -II	0.2625	26.25	very low	14	53.66	Very high	1	13	169	
Golgram	0.3333	33.33	low	12	40.87	moderate	9	3	9	
Jalimanda	0.4444	44.44	high	6	41.77	moderate	7	-1	1	
Khanamohan	0.4781	47.81	Very high	2	35.07	low	13	-11	121	**-0.657**
Malighati	0.3471	34.71	low	11	47.11	high	3	8	64	
Radhamohanpur -I	0.4712	47.12	Very High	4	42.49	moderate	6	-2	4	
Radhamohanpur -II	0.4218	42.18	High	8	51.65	Very high	2	6	36	
Satyapur	0.4763	47.63	very High	3	34.41	Very low	14	-11	121	
Shanrpur - Loyada	0.5000	50.00	Very high	1	36.38	low	12	-11	121	
									ΣD² = 754	

Source: computed by author

Spearman's rho is a significant choice for this type of ordinal data. Correlation between GI and SEDI is determined **-0. 657.**There is a negative correlation between the two variables. So, it can be interpreted that the Green Index is low where SEDI value is more. So, the relation between SEDI and GI is inversely proportional.

In general, Socio-economic development like Urbanization and Modernization and Environmental Improvement could not happen parallel. In this respect the rank value is authentic or the value has reality. If the value would be close to -1 then there have not any environmental impact only development is happened. Here the Correlation value close to the moderate negative value (-0.5), that means Green Impact of MGNREGA works has more or less in each and every G.P. throughout the financial year 2017-18.

6.5 Conclusion

This chapter elaborates on the correlation between the Socio-Economic Development Index (SEDI), and Green Index (GI) which provides valuable insights into the interplay between socio-economic development, environmental considerations, and green progress. The findings have significant implications for sustainable development and the achievement of several Sustainable Development Goals.

Through the examination of these indices, it becomes evident that socio-economic development can be achieved while simultaneously promoting environmental sustainability and green practices. The study highlights the importance of integrating green initiatives into socio-economic development strategies, emphasizing that economic growth should not come at the expense of environmental degradation.

Furthermore, the study highlights the importance of green initiatives in addressing climate change, which is a pressing global challenge. The findings emphasize the role of the Green Index (GI) in assessing and promoting effective climate action, enabling policymakers and stakeholders to identify and prioritize green practices that mitigate climate change impacts.

CHAPTER – VII

Recommendations for sustainable and green rural development

7.1 Introduction:

Sustainable development is essential in modern era, where world population have witnessed the impact of development status (like urbanization and modernization status) which only promotes growth, through enormous extraction of natural resources. This is the main cause of unsustainable and unhygienic development of a region. MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) is a government scheme in India that guarantees a minimum of 100 days of wage employment per year to every rural household whose adult members volunteer to do unskilled manual work. While the primary objective of MGNREGA is to provide livelihood security to rural households, there is also a focus on incorporating adaptive and sustainable approaches within the program. This scheme aims for Natural Resource Management, Renewable Energy, Sustainable Agriculture, Watershed Development, Skill Development and Capacity Building, and Climate Change Adaptation. The Green Index (GI) combines socio-economic and environmental factors to assess the overall green performance of a region. By examining the relationship between these indices, the study seeks to shed light on the interplay between socio-economic development, environmental conservation, and green initiatives. The climate adaptive approaches significant in MGNREGA works focusses on following aspects of sustainable and Green rural development as given below:

i. Natural Resource Management: MGNERA encourages the implementation of works that promote sustainable management of natural resources. This includes activities like water conservation through construction of check dams, water harvesting structures, and recharge wells. Afforestation and soil conservation measures, such as contour stabilizing and tree plantation, are also undertaken to prevent soil erosion and improve environmental sustainability.

ii. Renewable Energy: To promote sustainable energy practices, MGNERA works incorporate the use of renewable energy sources. This involves the installation of solar-powered streetlights, solar water pumps for irrigation, and solar panels for electrification of public facilities. By reducing reliance on fossil fuels and promoting clean energy alternatives, these initiatives contribute to both environmental sustainability and rural development.

iii. Sustainable Agriculture: MGNERA supports initiatives that focus on sustainable agricultural practices. This includes the promotion of organic farming, vermicomposting, and the use of bio fertilizers and bio pesticides. The program also encourages the

establishment of seed banks to conserve local varieties of crops and promotes agroforestry practices that combine tree planting with agricultural crops, enhancing soil fertility and diversifying income sources.

iv. Watershed Development: Integrated watershed management is a key component of MGNERA. Watershed development projects involve the construction of earthen and masonry check dams, percolation tanks, and farm ponds. These structures help in rainwater harvesting, recharging groundwater levels, and improving irrigation facilities. Watershed management also includes soil and moisture conservation measures, afforestation, and water conservation awareness campaigns.

v. Skill Development and Capacity Building: MGNREGA emphasizes skill development and capacity building of rural workers. By providing training in various trades and vocations, such as construction, masonry, plumbing, and carpentry, the program equips individuals with skills that can lead to sustainable livelihood opportunities beyond the 100 days of guaranteed employment. This helps in reducing dependency on unskilled manual work and enhances the long-term resilience of rural communities.

vi. Climate Change Adaptation: MGNREGA recognizes the importance of climate change adaptation in rural and urban villages. It promotes climate-resilient infrastructure development, such as construction of flood-resistant roads, bridges, and buildings. The program also encourages the adoption of climate-smart agricultural practices, including drought-tolerant crops and water-efficient irrigation techniques, to mitigate the impacts of climate change on rural livelihoods.

The objective of this chapter is to propose a Progressive index to define sustainability based on environmental impact of MGNREGA works and the economic, social and cultural development of a society. The objectives and approaches of MGNREGA works cover more or less all seventeen Sustainable Development Goals for 2030 Agenda. This chapter also focusses on the SDG Goal 8, 11 and 13. The Socio-Economic Development Index (SEDI) is a measure of socio-economic progress, which aligns with the objective of Goal 8. This goal aims to promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all. By examining the correlation between SEDI and environmental and green indices, this chapter provides insights into how socio-economic development can be achieved while considering environmental sustainability. It can shed

light on the integration of green practices and employment opportunities, contributing to the goal of decent work and economic growth. The Environmental Index and Green Index (GI) are indicators of environmental conditions and green performance, which are closely linked to SDG Goal 11. This goal focuses on making cities and human settlements inclusive, safe, resilient, and sustainable. The study's exploration of the relationship between these indices can provide insights into how cities and communities can promote sustainable practices, enhance environmental quality, and improve resilience to climate change. It can inform strategies for urban planning, infrastructure development, and resource management, aligning with the objectives of Goal 11. The Green Index (GI) specifically highlights green initiatives and practices, which are crucial for addressing climate change, the focus of SDG Goal 13. This goal aims to take urgent action to combat climate change and its impacts. By examining the correlation between the G.I. and the socio-economic and environmental indices, the study provides insights into the effectiveness of green practices in mitigating climate change and promoting sustainable development. It offers valuable information for policymakers and stakeholders working towards climate action and enhancing resilience to climate-related challenges.

7.2 Proposed Progressive index (P.I.):

Social scientist always embarks to discover new paths for societal developments. Socio-Economic Development (SED) as well as Environmental Improvement (EI) plays a crucial role in overall development of a region, which is an indicator of sustainable development or greening rural development. Ministry of Rural Development of India has launched MGNREGS which is an incentive-based programme. This scheme deals with the socio-economic issues and also its global and regional environmental impacts. This study is to develop a Progressive index to define the sustainability based on environmental impact of MGNREGA works and the economic, social and cultural development of a society. In this regard, this study emphasized on the relation between SED and EI among fourteen Gram Panchayat (G.P.) of Debra block, Paschim Medinipur, West Bengal. It is an effort to understand sustainability and unsustainability through a developmental model. A comprehensive Progressive-Index has been developed to easy computation of Sustainability for a region, covering a broad range of sustainable indicators.

i. Progressive index (P.I.) is a composite index, which is used to understand the performance of village sustainability. Therefore, to understand the Sustainable Rural

Development we used progressive index, which is the combined index of socio-economic development and environmental improvement created by MGNREGA.

ii. According to data availability, 12 attributes of Socio-Economic Development Index (SEDI) and Green Index (GI) are used to calculate Progressive Index.

$$\textbf{Progressive Index (P.I.)} = \sqrt{\textbf{GI} * \textbf{SEDI}}$$

iii. PI is the Geometric mean or average value of these two observations, which signifies the central tendency of the fourteen data set of our study. Here the data have different units of measure, so it is appropriate for Geometric mean. Arithmetic mean is appropriate when all values in the data have same units of measure. The Arithmetic mean can easily be distorted if the sample of observation contains outliners, which mean few values far away from all other values.

iv. The PI can be used to carry out a more in-depth analysis of development. The first case, development trajectories have been identified by assessing the social and economic context of development, which helped us to identify the progress of the rural environment. (**Table-7.1**) represents the Progressive Index (PI) of all Gram Panchayat of Debra Block. And (**Fig-7.1**) represents the GI, SEDI and PI value of fourteen G.P. of Debra block.

Table-7.1: Calculation table for progressive index (P.I.) at fourteen G.P. of Debra Block

G.P. Name	Green Index in %	Socio- Economic Development Index (SEDI) in %	GI* SEDI	PI= √ (GI *SEDI)	Rank	Level
Bharatpur	44.02	40.16	1767.84	42.05	7	high
Bhabanipur	40.00	45.5	1820.00	42.66	5	high
Debra -I	30.50	43.12	1315.16	36.27	14	Very low
Debra -II	45.00	41.31	1858.95	43.12	3	high
Duan -I	37.91	37.49	1421.25	37.70	11	low
Duan -II	26.25	53.66	1408.58	37.53	12	very low
Golgram	33.33	40.87	1359.20	36.87	13	very low
Jalimanda	44.44	41.77	1856.26	43.08	4	high
Khanamohan	47.81	35.07	1676.70	40.95	8	moderate
Malighati	34.71	47.11	1635.19	40.44	10	moderate
Radhamohanpur -I	47.12	42.49	2002.13	44.75	2	very high
Radhamohanpur -II	42.18	51.65	2178.60	48.68	1	very high
Satyapur	47.63	34.41	1638.95	40.48	9	moderate
Shanrpur - Loyada	50.00	36.38	1819.00	42.65	6	high

Source: Prepared from G.I. and S.E.D.I. values from Debra Block

	Bharat pur	Bhaba nipur	Debra -I	Debra -II	Duan -I	Duan -II	Golgr am	Jalima nda	Khana mohan	Malig hati	Radha mohan pur -I	Radha mohan pur -II	Satyap ur	Shanr pur - Loyad a
(G.I.)	44.02	40	30.5	45	37.91	26.25	33.33	44.44	47.81	34.71	47.12	42.18	48	50
(S.E.D.I)	40.16	45.5	43.12	41.31	37.49	53.66	40.87	41.77	35.07	47.11	42.49	51.65	34.41	36.38
(P.I)	42.05	42.66	36.27	43.12	37.7	37.53	36.87	43.08	40.95	40.44	44.75	48.68	40.48	42.65
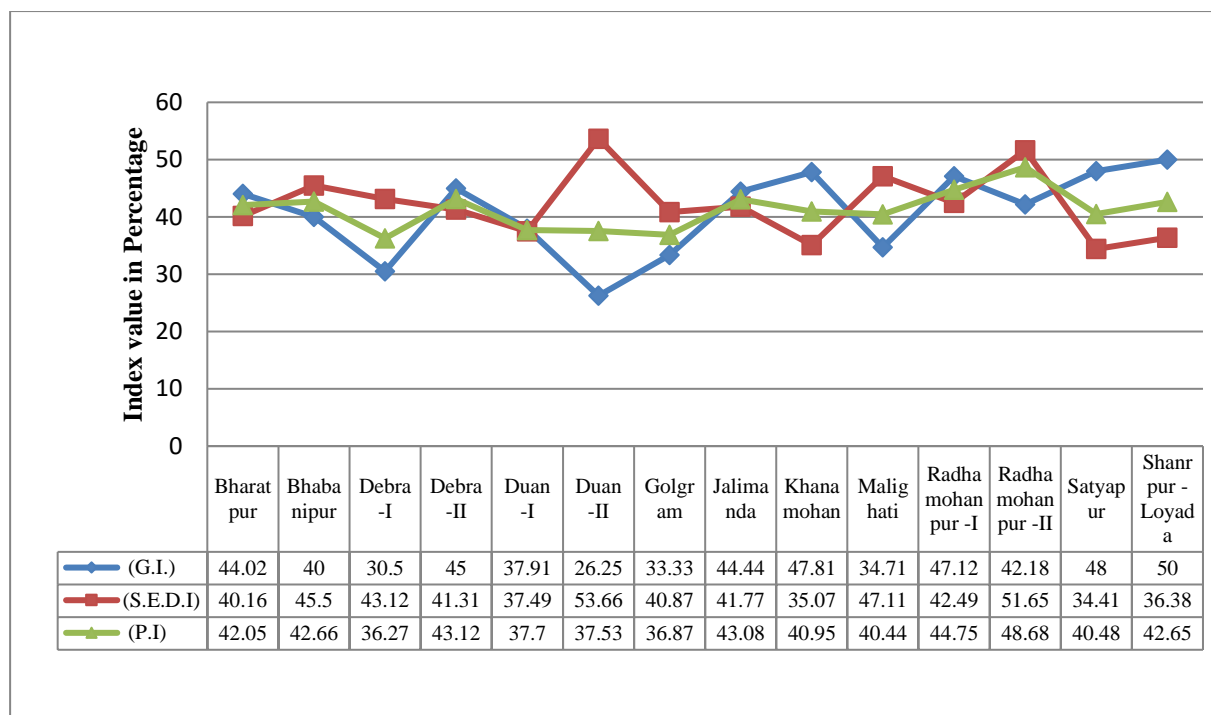
Fig-7.1: Representation of GI, SEDI and PI value of fourteen G.P. of Debra block.

7.3 Level of sustainable rural development among 14 G.P. of Debra block:

Wellbeing of a nation is closely related to healthy environment. According to the report of World Health Organization, 24% of deaths can be traced back to avoidable environmental factors all over the world. From the ancient period, we know every people have three primary needs such as food, cloth and shelter. Now we live in the period of modernization, urbanization and Globalization, where every people need purified air to breathe, fresh water to drink, and places to live that are free of toxic substances and hazards. So, for any country sustainable development depends on every dimensions of development with protecting the environment. From the proposed 'Progressive Index', the Gram Panchayat could be categorized into five grades (**Table-7.2**) on the basis of its average score of SEDI and GI. Five grades are described below:

A. Compliant Sustainable Development

B. Conscious Sustainable Development

C. Sensitive Sustainable Development

D. Alarming Sustainable Development

E. Inert Sustainable Development

Table-7.2: Table shows the level of sustainable rural development among fourteen G.P of Debra block

Category	attributes	Index value	Name of the G.P.	Total No. of G.P.	Colour code
A	Very high development (Compliant)	Above 43.6	Radhamohanpur -II Radhamohanpur -I	2	Green
B	High development (conscious)	43.59 - 41.6	Debra -II Jalimanda Bhabanipur Shanrpur - Loyada Bharatpur	5	Yellow
C	Moderate development (sensitive)	41.59 – 39.6	Khanamohan Satyapur Malighati	3	Blue
D	Low Development (alarming)	39.59 – 37.6	Duan -I	1	Red
E	Very low development (inert)	Bellow 37.59	Golgram Duan -II Debra -I	3	Grey

A. Compliant Sustainable Development

From the above table **(Table-7.1)** the highest PI value of (48.68%) was found at Radhamohanpur-II G.P., followed by Radhamohanpur-I (44.75) both G.P. belongs to very high development according to sustainable purpose that refers to Compliant Sustainable Development and indicates as green colour region. This is the perfect development region where both environmental and socio-economic development took place simultaneously.

B. Conscious Sustainable Development

Among the fourteen G.P. of Debra block, highest no. of G.P. (5 G.P.) belongs to this development category. Conscious development is not perfect development as there the Socio-Economic development is deprived due to poor transport & communication system and job opportunity. Those G.P. achieved more GI value than SEDI. They belong in typical rural region and indicated as yellow colour region. According to environmental aspects they achieved highest score because those G.P. has more environmental conservation related works, such as natural resource (water, soil/land, vegetation) conservation work, so Green Index value of those G.P. was high.

C. Sensitive Sustainable Development

Sensitive Sustainable Development refers that where both socio-economic and environmental development happened in moderate form. Also, those G.P. belong to rural in its nature and indicated as blue colour region. Sensitive Development is the marginal part of sustainable development that means those regions are environmentally sensitive and

ecologically aware. If this region upgrades one step in socio-economic development purpose, then there is a need to protect the environment

D. Alarming Sustainable Development

Only one G.P. (Duan-I) lies in this category of alarming development. It can be noticed that this G.P. has insufficient development works. So, This G.P. is also indicated as red alert region.

E. Inert Sustainable Development

The lowest value found at Debra - I (36.27), Duan –II (37.53) and Golgram (36.87) G.P. Here the modernization, urbanization and economic growth are high as well as population density is also high. So, these G.P. have achieved highest SEDI score. According to environmental impact this G.P. has ranked lowest, that means development process could not protect the environment. Excessive development and unplanned urbanization create climate crisis. The lack of appropriate planning, zonation and unscientific building construction led to unstable growth, haphazard and unhygienic development that destroys the local habitat and ecosystem services. So, these regions are inert in sustainable purpose that has been referred as grey region.

The Progressive Index value of all the fourteen G.P. have been presented in five categories with appropriate colour in descending order (**Map. - 7.1**).
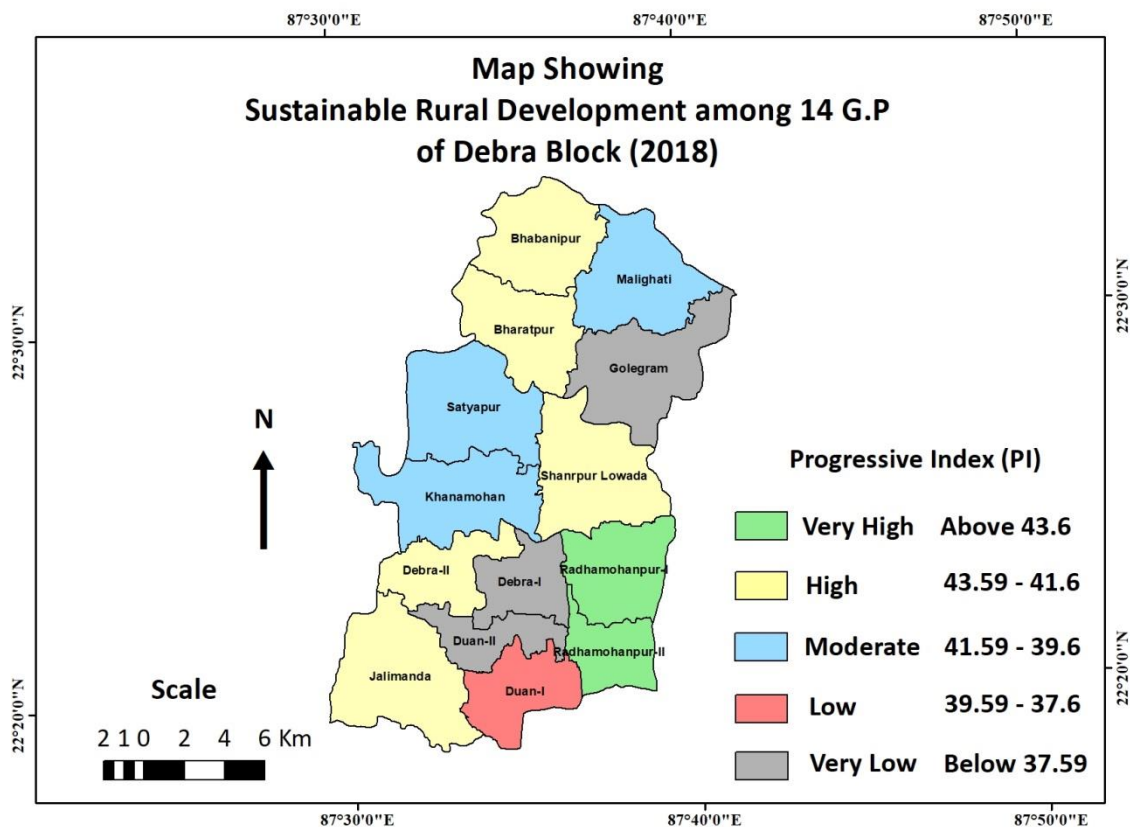
Map-7.1: Level of sustainable rural development based on PI value

7.4 Findings from PI study

Utilizing the model (**Fig-7.2**) for introducing the sustainable rural development approach to evaluate both development plans (Socio-economic and environmental) is proposed. Analysis of data highlights that the correlation between GI and SEDI of maximum G.P is inversely proportional. Among 14 G.P., Duan –II G.P, represents strong negative correlation between GI and SEDI. Negative relation represents poor sustainability or very low Progressive Index value. Balichak, the Census town of Debra block is under Duan –II G.P. Being the census town, urbanization and modernization rate is highest. Excessive development and unplanned urbanization create climate crisis. According to environmental benefits this G.P. has ranked lowest, as it is surrounded by urban environment which was formed naturally due to urbanization and modernization. The lack of appropriate planning, zonation and unscientific building construction led to unstable growth, haphazard and unhygienic development that destroyed the local habitat and ecosystem services. Another two G.P. Golgram and Debra-1 also achieved low PI value for unplanned urbanization growth. Those G.P. goes through loop-2 of the model. Unsustainable state of rural development has been shown in loop-2, which is the indicator of negative relation between these two developmental processes.

The G.P. where SEDI and GI values both are high example Radhamohanpur-II G.P. is a semi urban area, where both environmental and socio-economic development took place simultaneously. This G.P, achieved highest PI value. Also, Radhamohanpur-I G.P. achieved second highest PI value. This relation goes through loop-1of the Model, where both Socio-Economic and Environmental Improvement is directly proportional then the progress would have positive impact. The developments of these two villages have been in a sustainable way. Sustainable rural development has been shown in loop 1, which is the indicator of positive relation between these two developmental processes. Some development guidelines have essential need for this upcoming new centre of urban growth at Radhamohanpur –II & Radhamohanpur-I G.P., which have huge potential to reach a sustainable urban village in future.
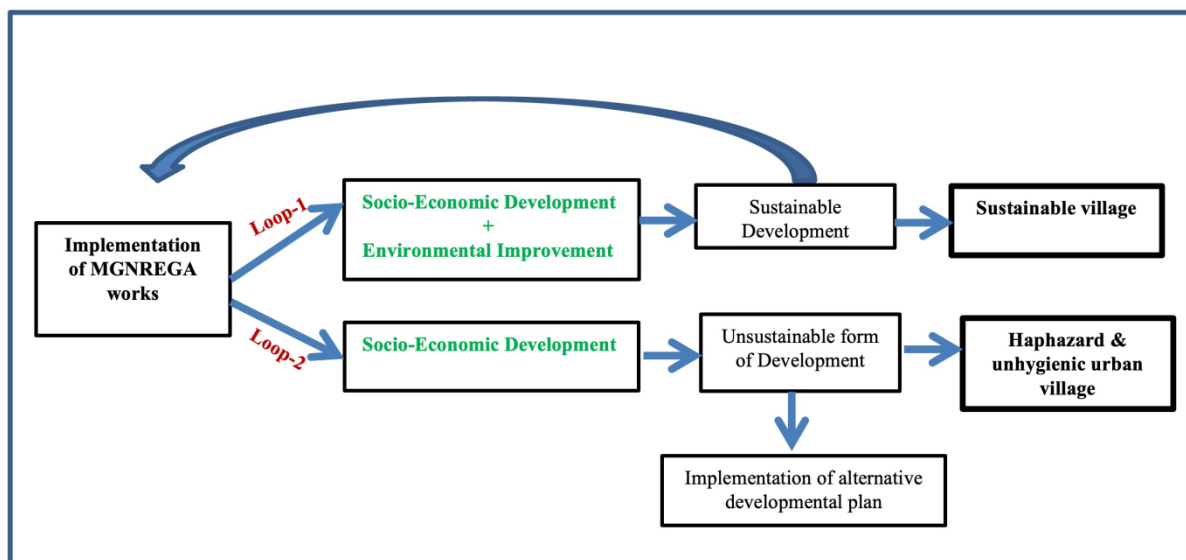
Fig-7.2: Sustainable rural development Model

7.5 Recommendations for maximizing Sustainable Rural Development

Unsustainable state of rural development can be made sustainable by applying appropriate planning and the scientific developmental strategy in MGNREGA or alternative developmental plan. In the light of the findings from this research, there are several recommendations and strategies for maximizing Sustainable or Greening Rural Development are recommended here:

1. For effectiveness and durability of productive asset created by MGNREGA work, social and technical merit attentions should be focused for maximizing the benefits.
2. It is significant that water and soil protection works is made a part of macro and micro level design plan based on watershed principle.

3. An appropriate set of pre-conditions/ operational mechanism has to be put in place so that this estimated expenses and budgets of MGNREGA works does not become incentive for poor quality construction of assets.

4. Every marginal effort in better design and more participation of villagers can lead to multiplier effect on the impact of effectiveness and durability of assets

5. A better designed and quality-built asset may not need frequent repairs, so it is advised that a separate 'maintenance expense' should be sanctioned for each GP or each work. Minimum fifteen percent funds should be allotted for the maintenance purpose of former assets to make them more sustainable.

6. Environmental Impact Assessment (EIA) is necessary before the implementation of any development activities.

7. Natural habitat or ecosystem (like wetland, pond, agricultural field, forest etc.) should not be destroyed for development activities (like construction of house, road construction etc.)

7.6 Conclusion:

The Green Index (GI) combines socio-economic and environmental factors to assess overall green performance of a region. By examining the relationship between these indices, the study seeks to shed light on interplay between Socio-Economic Development (SED), Environmental Improvement (EI), and green initiatives. Therefore, to understand the Sustainable Rural Development we used progressive index, which is the combined index of SEDI for social aspects and GI for environmental aspects.

Overall, this study reinforces the notion that sustainable development requires a balanced approach that considers both socio-economic development and environmental sustainability. By integrating green initiatives, fostering inclusive growth, and prioritizing climate action, societies can work towards achieving the Sustainable Development Goals and building a more sustainable and resilient future. The insights from this study can inform policymakers, researchers, and sustainable development practitioners in designing effective strategies and policies for sustainable development at local, regional, and global levels.

The research underscores the need for a holistic approach to sustainable development, where socio-economic progress goes hand in hand with environmental conservation and the promotion of green solutions. It emphasizes the role of cities and communities in adopting sustainable practices, building resilience, and creating inclusive, safe, and sustainable urban environments.

CHAPTER – VIII

Conclusion and Future Scope of Works

8.1 Summary of Key Findings

8.2 Implications for Future Research

8.3 Limitation of the study

MGNREGA achieved highest rank among the other significant programmes ever undertaken to improve the rural environment and modify the rural life and livelihood (Ambasta, et. al., 2008). Also, MGNREGA is a milestone in Indian history of social security legislation after independence. MGNREGA also appraised as an overall developmental tool to emphasize the social security, economic development and environmental improvement of rural India. It provides different scope to rehabilitate rural infrastructure through watershed management, restoration and regeneration of water bodies such as tanks and pond, activities related to forestry, land development, soil erosion and flood control, and construction of roads and institutional facilities. MGNREGA was revised in 2011 with a large scope including 30 new works aligning with other development related work (MoRD, 2012).

8.1 Summary of Key Findings

This research work is concentrated on the impact of MGNREGA works on social, environment works for sustainable rural development. The findings clearly point out that

i) Most of the MGNREGA works has considerable positive impact on the environment and also has the potential to conserve the environmental condition i.e. conserving water resources, soil quality and biodiversity.

ii) From the scientific assessment of Greening Rural Development (GRD) and Green Index (GI), we can conclude that MGNREGA can achieve a great role on rural development in coming decades.

iii) GRD is a major step to get better lives of millions of rural people. And GI is an attempt to reshape about the environmental development.

iv) The livelihood of rural people as well as development of a developing country depends on rural development. As, the economies of the most developing countries are still dependent on natural resources, both renewable (land, water and forests) and non-renewable (oil and minerals).

v) The sustainable flow of natural resource is well controlled through MGNREGA activities, which is necessary for future generations to meet their own needs.

8.2 Implications for Future Research

This research work clearly revealed that the potentiality of MGNREGA works is to provide environmental benefits and decrease the vulnerability of climate risk. The proposed following steps has disclosed here for future research:

i) Availability of information related to natural resources of villages, environmental impact & assets created by MGNREGS works, village production systems, etc. assist to create a blueprint in village-level resource availability.

ii) Develop and demonstrate mechanisms to promote maintenance and management of assets created under MGNREGA.

iii) Improve the guidelines and perspectives for monitoring environmental benefits created by MGNREGA works.

8.3 Limitation of the study

Even a well-designed high level investigation plan may not be free from research limitations. Therefore, the present research methodology that was adopted for the entire research has its own limitations. Some of the limitations are listed below:

i) There was no baseline or benchmark or pre-MGNREGA scenario data or information for comparison with the post-MGNREGA implementation scenario.

ii) There is no access to knowledge and information on baseline status of natural resources.

iii) Secondary data was not easily accessible in few villages for several indicators i.e. increased irrigated area, afforested area, land development area etc.

iv) It is a long process to realize The Environmental condition improvement through MGNREGA activities.

v) We can realize the environmental condition but everywhere we cannot quantify environmental condition with digital form.

vi) Members of respondent households were found hesitating in disclosing the information about various section. Therefore, the given information of respondent households according to the questionnaires survey were not free from some possible margin of error.

vii) The analysis considers five sample villages in every G.P. of Debra Block. Consideration of more villages in each G.P. could have improved the robustness of the results. This along with the inter-temporal consideration of data should be the future research agenda.

Hence campaigns are required at panchayat level to increase the awareness of the local people for the proper use of natural resources as securing availability of resource in future.

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QUESTIONNAIRES - 1

Questionnaires for Gram Panchayat office

This questionnaire of relevant information is used only for academic purpose. It will never be prepared public in any form. Your outspoken opinions in different aspects of our study are very important and precious for effective fulfilment of the present work. We, therefore, request you kindly to provide the necessary information as per the given proforma.

The information will be used for research purpose only.

Conducted by: …………………………………………………………………..

Date:………………………………………….Time:………………………………….

___

A. **General information about the G.P.**

- Name of the Gram Panchayat:
- Name of the Block:
- Total area of the G.P.:
- Total population of the G.P.:
- No of villages under this G.P. and their names:
- Among those which flagship programs are working in this G.P.
    1. MGNREGA   2. NRLM   3.IAY   4.IWDP
    5. NRDWP   6. NBA   7.NSAP   8.PMGSY

- **Occupational Structure of G.P.**

Pattern \ involved people	Farmer	Agricultural labour	Small scale Industry	business	Service	Fish Cultivation	Others
Male							
Female							

B. Information about MGNREGA

- In which year the work of MGNREGA has been started in this G.P.:

  1st phase 2006 / 2nd phase 2007 / 3rd phase 2008

- Total no. of people works under NREGA:

- **Total no. of works are undertaken in the financial year 2017-2018**

Sl. No.	Name of the work	No. of work in 2017-2018
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
Total		

- **Source of irrigation before and after implementation of MGNREGA**

Name	Before MGNREGA		After MGNREGA	
	Area	number	Area	Number
Cannel				
Tank/Pond				
D.T.W.				
S.T.W				
R.L.I.				
O.D.W.				
Others				
Total				

DTW= Deep tube well
STW= Shallow tube well
RLI= River left irrigation
ODW = Open dug well

- **Main source of drinking water**

Sl. No.	Name	No	Percentage
1.	Tape water from treated source		
2.	Tap water from untreated source		
3.	Covered well		
4.	Un covered well		
5.	Hand pump		
6.	Tube well/ Bore hole		
7.	River/ Cannel		
8.	Pond/Tank/Lake		
9.	Other		

- **Average depth of ground water**

Sl.no.	Name	Depth
1	Deep tube well	
2	Shallow tube well	
3	Dug well	
4	Tube well	

- **Opinion of the educated person of G.P. office**

Sl. No.	Opinion	Yes	NO
1.	There have Irrigation water availability in dry season		
2.	Increase Irrigation intensity		
3.	Increased crop diversity		
4.	enhanced crop production		
5.	Pond water is used in irrigation		
6.	Removed silt from drainage & cannel is rich in fertility		
7.	Pond water is used in domestic purpose		
8.	Pond is used as fish-farming		
9.	Pond increase surface water availability		
10.	It can help in ground water recharge		
11.	Pond and cannel Controlled runoff in heavy rainy season		
12.	Controlled seasonal flood by improving drainage system		
13.	Increased soil moisture by land development activities		
14	In this G.P. Small and shallow water bodies are converted into lands		
15	Water availability in dry season For livestock and domestic use		
16	Maintained pond ecosystem through the work renovation of traditional water bodies		
17	Overall MGNREGA work is good programme for improving rural environment		

QUESTIONNAIRES -2

Asset Verification Schedule and Sampling Sheet (For external Quality Monitors)

- Quality monitoring carried out by...............................
- Date of Quality monitoring............................

1. Water conservation/ Water harvesting

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type Public(1)/ Private(2)**						
5	**Indicators of Durability/ Quality**						
	Conserve the Small & shallow water bodies						
	Catchment Area Treatment (CAT) minimum 400 surviving sapling/ Hec						
	Stone pitching for Dam/ Tank/ Pond						
	Greening the slope of Dam/ Tank/ Pond						
	A standard earthen dam of 65 m length, maximum height of 4.65 m, and a top width of 2m						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

2. Watershed Management

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type Public (1)/ Private(2)**						
5	**Indicators of Durability/ Quality**						
	Catchment area treatment has minimum survived 400 saplings /ha						
	Other durability features like- stone pitching for dam, greening of dam slope.						
	CA <10 ha for regions with > 1,000 mm rainfall						

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
	A standard boulder check is 7m length, maximum height of 1m, upstream and downstream slopes 1:1 and 3:1 and top width of 0.5m						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

3. Micro irrigation work/ Irrigation Canal

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type** **Public (1)/ Private (2)**						
5	**Indicators of Durability/ Quality**						
	Catchment area treatment have minimum survived 400 sapling /ha						
	Canal requires regular desilting.						
	30% BPL/SC/ST lands are irrigated by canal						
	standard canal bank of height 0.6m, base width 1.7m and cross section area of 0.57 sq. m						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

4. Renovation of traditional water bodies (RTWB

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type** **Public (1)/ Private (2)**						
5	**Indicators of Durability/ Quality**						
	Edges of Ponds should be either earthen tiles or concrete or LDPE						
	Waterbodies have to be at least on 5% of farm area.						
	Trees planted along the edges of pond.						
	A standard pond of 25m*20m*2m dimensions (1000 cubic metre storage capacity)						
	Maintain good pond ecosystem						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

5. Forestry/ Plantation (FP

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type Public (1)/ Private(2)**						
5	**Indicators of Durability/ Quality**						
	On community land 600 saplings/ ha. are desired,						
	Minimum survived 400 sapling /ha,						
	One fruit tree/ family, One fodder tree/ cattle head is required						
	Create grass bed in addition to trees.						
	Saplings areas should have a Protective wall.						
	Frequent watering in dry season						
	Organic & chemical fertilizer used several times						
6	Name of planted trees						
7	Name of plantation site: road side, school boundary, embankment of pond, canal, cremation etc.						
8	Overall Quality of work (G/M/P)						
9	Present condition of work (G/M/P)						
10	Any other important information						

6. Land Development / Improving productivity of lands/ Development of fallow or waste land

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type Public (1)/ Private(2)**						
5	**Indicators of Durability/ Quality**						
	Height should not be less than 0.5m after compaction.						
	ii) Slope of the land should be less than 10 degree.						
	iii) Vegetative cover enhances their durability						
	Land quality improvement						
	Improved productivity of land						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

7. Construction of Houses (C.H.)

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**House type (one/two storied)**						
5	**Indicators of Durability/ Quality**						
	adopting eco-friendly materials and technologies in shelter construction						
	Adequate or not to fulfil the peoples requirement.						
	Improved livelihood status						
	House attached with kitchen & bathroom						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

8. Improving livelihoods/ Promotion of livestock/ Promotion of fisheries

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type** **Public (1)/ Private (2)**						
5	**Indicators of Durability/ Quality**						
	A shelter of 7.50 sq. m. (length 3.75 m and width 2 m) would be suitable for 100 birds and average height of 2.20 metres						
	The roof will be supported by a steel truss. The roof will have galvanised iron corrugated sheets.						
	The base of the floor will be constructed by hard moorum filling. The floor will be built by using 2nd grade bricks with packing in 1:6 ratio of cement mortar.						
	Adequate grass plantation for livestock requirement.						
	Maintain the proper dimension of fish tank						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

9. Rural Sanitation

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type Public (1)/ Private(2)**						
5	**Indicators of Durability/ Quality**						
	Public places with sanitary facilities.						
	Does the village have a liquid and solid waste management system?						
	adopting eco-friendly materials and technologies for rural sanitation						
	Adequate for people's requirement						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

10. Rural Connectivity

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Type of Road: i. Kuccha ii. Semi Pucca iii. Metalled road**						
5	**Indicators of Durability/ Quality**						
	Encourage people not to cut trees.						
	Trees planted along the edges of road side.						
	Adequate to fulfil the people's requirement						
	No disruption on local water bodies						
	Length & width of road						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

11.Disaster preparedness/Improving Drainage system

		Asset-1	Asset-2	Asset-3	Asset-4	Asset-5	
1	**Name of sample village**						
2	**Location of assets**						
3	**Name of assets**						
4	**Asset type** **Public (1)/ Private (2)**						
5	**Indicators of Durability/ Quality**						
	Drainage have need regular desilting so that water holding capacity is not reduce						
	Catchment area treatment minimum survived 400 sapling /ha.						
	Depth at least 0.5 m						
	Drainage wall is made with concrete or earthen						
	Adequate drainage system is all over the village						
6	Overall Quality of work (G/M/P)						
7	Present condition of work (G/M/P)						
8	Any other important information						

(G = Good Quality, M = Moderate, P = Poor Quality)

QUESTIONNAIRES -3

Questionaries' for MGNREGA Beneficiary / Non- Beneficiary

- **Primary Information**

Sl. No	Primary Information	
1	G.P. Name	
2	Village Name	
3	Block Name	
4	Name of Beneficiary/ Non- Beneficiary	
5	Gender: Male(M) Female(F)	
6	Status: BPL(B) /APL(A)	Name of Work
7	Is the beneficiary aware the MGNREGA schemes?	Yes (1) / No (2)
8	When did the Scheme start?	Month…………. Year…………….
9	Job card No.	

- Family Details about Literacy

Family Details	A	B	C	D	E
	Total no. of members	No. of Literate members	No. of class 10 passed and above	No. of Graduate and above	No. of illiterate members
Adult Male					
Adult Female					
Minor-Boys					
Minor-Girls					

- Family Details about Income status

1	No. of earning members in the family	Male	Female
2	Current main income sources?	i) Agricultural labour ii) Non-Agricultural labour iii) own Farming iv) Small shop v) livestock farming Vi) Govt. Scheme vii) Salaried/ contact vii) Other (specify)………	

3	What was the income source before MGNREGA was introduced?	i) Agricultural labour ii) Non-Agricultural labour iii) own Farming iv) Small shop v) livestock farming Vi) Govt. Scheme vii) Salaried/ contact vii) Other (specify)………	
4	Does beneficiary have own land?	Yes	No
5	If yes, how much	Acres	
6	Does beneficiary have irrigation facility?	Yes	No

- Source of irrigation before and after MGNREGA was introduced

Name of irrigation facility	before MGNREGA	after MGNREGA
Canals		
Tank/Pond/ Lake		
D.T.W.		
S.T.W		
R.L.I.		
O.D.W.		
Others		

DTW= Deep tube well

STW= Shallow tube well

RLI= River left irrigation

ODW = Open dug well

- **About MGNREGA**

1	Do you know about MGNREGA?	Yes	No
2	From which source you are getting information about MGNREGA work?	i) Gram panchayat ii) Poster iii) Key Informatory iv) Gram Rozger sahayak v) Others (Specify)	
3	Are you aware about MGNREGA planning?	Yes	No
4	Are you involved in MGNREGA planning?	Yes	No
5	How many family members are working in MGNREGA scheme?	Male	Female
6	You are working for which activity	i) Flood control ii) Water conservation	

		iii) Road iv) Plantation v) Land development vi) Improve Drainage system vii) Renovation of Traditional Waterbodies viii) House construction ix) Others	
7	What is the per day wage given to you under MGNREGA	Rs / Day	
8	What was the total yearly family income?	Before the scheme Rs……	After the scheme Rs……….
9	How many members are migrating to other places for earning their livelihood?	Before the scheme No……….	After the scheme No………..

- ▪ Has the scheme brought about the following changes in your life and your surrounding environment?

	Sl. No	Impact	Poor	Average	High
Socio-Economic	1	Economic security			
	2	Assured employment			
	3	Increased HH income			
	4	Poverty Reduction			
	5	Enhanced self confidence			
	6	Improved Rural connectivity			
	7	Adequate space for living at home			
	8	Has there any attach Kitchen and Bathroom			
	9	MGNREGA improved overall livelihood status			
Environmental	10	Enhanced knowledge of Natural Resource Management			
	11	MGNREGA improved your soundings environment			
	12	Ground water level increased			
	13	Soil erosion reduced			
	14	Water level increased			
	15	Water scarcity in village came down			
	16	The assets created under MGNREGS are durable			
	17	MGNREGS has uplifted the Drinking Water Facilities			
	18	MGNREGS has improved the Drain System in your place			
	19	irrigation facilities increase			
	20	water conservation increase			
	21	area under tree increase			

■ felt Needs in the village:

	Needs	Yes	No
1	Safe Drinking Water		
2	Hospital/Dispensary		
3	Electricity		
4	School/college		
5	Greeneries		
6	Tank/bandh/irrigation		
7	Transport Facility		
8	Garbage disposal system		
9	Rain water storage		
10	Improved drainage system		
11	Arsenic Contamination		
12	Others		

Overall views on the scheme:

1. Is it helpful as a livelihood option?   Yes -1   No – 2

2. Any other livelihood option in your mind?

3. Do you think MGNREGS is a useful program for you and your environment.

4. What suggestions do you have for better implementation of the scheme?

Appendix: A

Awards and Certifications

1. Qualified UGC National Eligibility Test (NET 2014) in Geography. (A national level examination for eligibility of lectureship in Indian college and Universities).

2. Qualified State Eligibility Test (SET 2014) in Geography. (A state level examination for eligibility of lectureship in college and Universities of West Bengal.

PhD Publications

1. P. Dutta*, D. Das (2022); "Impact of Green Index in greening Rural Development: A case study in Indian context", Indian Journal of spatial science, 13(4) pp1-9, ISSN: 2249-3921.

2. P. Dutta*, D. Das and D. Bardan; "Emphasizing MGNREGA for Sustainable Rural Development through social development index and Green Index concept", Sustainable Development Goals (SDG) Book Series, Springer Nature Switzerland AG (Publisher) (Accepted 2023).

Conference Presentations

1. Presented the paper "Impact of Green Index in Greening Rural Development" in the International conference on Resurgence of Regions organized by Regional Science Association, December 8-10, 2021, Kolkata.

2. Presented the paper "Quantifying MGNREGA for Sustainable Rural Development: A case study of Debra Block" in the International Seminar on Sustainable Development: From the Perspective of Nature and Nurture organized by dept. Geography, Netaji Subhas Open University February10-11, 2023, Kolkata.

INVESTIGATING THE SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS OF MGNREGA WORKS FOR GREENING RURAL DEVELOPMENT: A CASE STUDY OF DEBRA BLOCK, PASCHIM MEDINIPUR

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