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Greening Rural Development in India



Greening Rural Development **in India**

Volume-1

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Volume 1

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FOREWORD

The Government of India's 12th Five Year Plan for the first time has set for itself the goal of faster, sustainable and more inclusive growth. Sustainability has been mainstreamed as a core objective of India's development strategy. This is hugely important paradigm shift in how we look at development.

With an annual budget of around INR. 75,000 crore, the Ministry of Rural Development's Schemes have an immense potential to contribute to the goal of sustainable poverty reduction and efficient use of natural resources, including improved land use planning and management practices.

For the people in rural areas, particularly the marginalized communities, healthy ecosystems support sustainable agriculture-based livelihoods and essential services such as drinking water, sanitation and health care. Investing in natural resources also strengthens adaptation and resilience of communities towards climate change and natural disasters.

This report examines the potential contribution to environmental sustainability of the schemes administered by the Ministry. In specific it looks at:

- Improving quality and carrying of eco systems including, water in surface bodies, aquifers and soil profile and arresting degradation of natural resources
- Enabling sustainable livelihoods, based on sustainable use of natural resources
- Strengthening ecosystem resilience to enable them to recover from extreme weather events and cope with climate change
- Reducing the ecological footprint of interventions through efficient use of energy, material, natural resources and increased use of renewables materials

The report recommends measures needed to achieve green, including measuring and tracking, the use incentives and the building of capacities. It also contains a number of case studies showing how green results can be achieved.

The Ministry of Rural Development, with continued support from the United Nations Development Programme (UNDP), is keen to take forward the recommendations of this report and make delivery of green results a part of policy considerations and guidelines for its different programmes. I hope that these actions will contribute in large measure to achievement of the goals we have set ourselves of the 12th Five Year Plan and beyond.

Jairam Ramesh
Minister of Rural Development
Government of India

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EXECUTIVE SUMMARY

Poverty reduction and economic growth can be sustained only if natural resources are managed on a sustainable basis. Greening rural development can stimulate rural economies, create jobs and help maintain critical ecosystem services and strengthen and strengthen climate resilience of the rural poor. Conversely, environmental challenges can limit the attainment of development goals. The Approach Paper to the Twelfth Five Year Plan notes that “as the economy gains the capacity to grow rapidly, it will come up against the constraint of limitations of natural resources and then need to exploit these in a sustainable manner”¹.

Recognizing the national and global imperatives for regenerating natural resources and conserving ecosystems, the Ministry of Rural Development requested UNDP to examine the environmental implications of its schemes and assess the potential of these schemes to deliver green results. The Report defines ‘green’ outcomes for major RD schemes, reviews the design and evidence from the field to highlight potential green results and recommends steps to improve green results.

In the context of this report, greening rural development refers to five broad green outcomes:

- Improved natural resource conservation,
- increased efficiency of resource use,
- reduced negative environmental impacts,
- strengthened climate resilience of communities and
- contribution to climate change mitigation.

These outcomes can be delivered by RD schemes by a) investing in regenerating natural resources, b) mobilizing and developing the capacities of community institutions to utilize natural resources in a sustainable manner and c) aggregating ‘small initiatives’ in several locations to improve natural capital on a macro scale.

The rationale for greening rural development emerges from the Twelfth Five Year Plan (2012-17) strategy of faster, sustainable and inclusive growth for poverty alleviation and MoRD’s mandate to reduce rural poverty and ensure a better quality of life especially for the poor:

1. Greening rural development will contribute to inclusive growth by a) enabling the target growth rate of agriculture of 4 percent, which is important due to agriculture’s multiplier effects and due to the continued dependence of 58 percent of India’s rural population for livelihoods on agriculture, b) regenerating common land and water bodies, which offer sustenance to the rural poor through provisioning of goods and ecosystem services, c) ‘crowding in’ private investment in green businesses: renewable energy generation, organic input chains and advisory services, green product supply chains, production of environment-friendly construction materials.
2. Greening rural development is essential for ensuring the environmental sustainability of economic growth: RD schemes can contribute significantly to conserving water resources, soil quality and biodiversity. RD schemes such as MGNREGS, IWDP and the source sustainability component of NRDWP can help arrest and even reverse the decline in groundwater levels in critical regions. This

¹ Planning Commission, 2011, Faster, Sustainable and more Inclusive Growth. An Approach Paper to the Twelfth Five Year Plan.

is particularly useful for hard-rock regions where groundwater depletion is at its most acute. Soil conservation works are a large part of MGNREGS and IWDP activities. Soil fertility enhancement is a key objective of the MKSP and sustainable agriculture components of NRLM. MGNREGS, IWDP and NRLM activities can play a major role in conserving India's biodiversity which is so essential for providing the country with ecological and livelihood security.

3. Green outcomes from rural development schemes can help increase climate resilience of production systems, livelihoods and habitats: RD schemes can help reduce the impact of meteorological droughts by conserving soil moisture, slowing down water runoff and increasing water storage in surface reservoirs as well as aquifers. It can also improve vegetative cover in common lands, making more fodder and fuelwood available during droughts. Resilience in the face of floods can be provided by improving drainage.
4. Green outcomes will help making public expenditure more effective: RD schemes can strengthen livelihoods security for the rural poor thereby reducing demand for work under MGNREGS. Investment on source sustainability will result in greater longevity for drinking water supply systems and will reduce the number of 'slipped-back' habitations. MGNREGS and IWDP can help bridge the gap between irrigation potential created and irrigation potential utilized, for small and micro irrigation projects.

Potential green results of specific schemes

The major schemes mentioned above can potentially make a significant contribution to sustaining natural resources and ecosystem services. Some examples are:

- A vast majority of the works under MGNREGS are linked to water, soil and land. The list of 'permissible' works provide environmental services such as conservation of water, groundwater recharge, reduced soil erosion, increased soil fertility, conservation of biodiversity, reclamation of degraded crop and grazing lands, enhanced leaf manure, fuel wood and non-wood forest products supply among others.
- The Integrated Watershed Development Programme (IWDP) aims to restore ecological balance in a watershed by harnessing, conserving and developing degraded natural resources such as soil, water and vegetative cover and thereby help provide sustainable livelihoods to the local people. The scheme's potential for green outcomes is also enhanced if it supports the adoption of "green agronomy" practices and promotion of use patterns that sustain natural resources including groundwater and soil fertility
- Under NRLM the guidelines for non-timber forest produce-based livelihoods under the Mahila Kisan Sashaktikaran Pariyojana (MKSP) identify regeneration and sustainable harvesting of NTFP species as key objectives; similarly, promotion of organic and low-chemical agriculture and increased soil health and fertility to sustain agriculture-based livelihoods is an objective under the sustainable agriculture component of MKSP; increased availability of green inputs and advisory services to farmers and livestock herders and use of renewables-based energy services for processing activities have immense potential for green outcomes
- Under Indira Awas Yojana (IAY), green results include efficient use of resources, including water, energy and construction material. Further, IAY can encourage greater use of renewable and locally available construction material, and reduced use of water and energy.
- Nirmal Bharat Abhiyan – formerly the Total Sanitation Campaign (TSC) - has recently expanded its scope from eradication of open defecation to comprehensive sanitation in rural areas. Ten percent of the project funds is earmarked for solid and liquid wastes management. NBA can ensure safe disposal of solid and liquid waste, and prevent untreated wastewater from re-entering the water system. These results can substantially improve the quality of water.

- The National Rural Drinking Water Program guidelines give high priority to water supply source sustainability and water quality. Further, the potential for green outcomes is enhanced by an emphasis on safe disposal of sludge after treatment of contaminated water, and the use of renewable energy for water pumping.

The above green results can be achieved through specific measures a) at the level of the Ministry and b) for each scheme.

Recommendations for Ministry-level measures to achieve green results:

To achieve incremental green results, the Ministry of Rural Development may

1. Identify a key set of green outcomes that are feasible and have high impact; prepare Green Guidelines which will detail how to achieve these desired results. The hallmark of the Green Guidelines will be (i) a set of non-negotiable principles and goals and (ii) flexibility beyond the non-negotiable so that people and institutions are encouraged to adopt creative and innovative activities.
2. Form a network of support organizations by designating select civil society organizations, technical institutions and academic centers to facilitate the implementation of the Green Guidelines.
3. Establish an Innovations Portal for greening rural development. This portal will encourage innovative ideas, activities, technologies and processes adopted to promote and expand the greening activities.
4. Set up a Green Innovations Fund to promote and incentivize the development and extension of technologies and social processes to achieve green outcomes
5. Set up a dedicated Green Cell within the Ministry for guiding the greening agenda and for the implementation of Green Guidelines in the country. The Green Cell will develop procedures to converge actions and funding for greening activities that cut across rural development schemes.
6. Prepare an annual Green Report for the Minister of Rural Development summarizing the major green achievements and their outcomes during the year. This report should draw upon independent evaluation of schemes for green outcomes.

Recommendations for scheme-level measures to achieve green results

The green orientation of the schemes will entail specifying green principles, goals, actions, processes, desired outputs and outcomes, monitoring and evaluation procedures and systems in the scheme guidelines. Unless the green commitment and content are specified in the guidelines, implementation is likely to depend on individual initiative rather than be systemic. While most schemes have included significant green features in their recently revised Guidelines, the results are well below potential. Higher priority to be accorded to the green features, closer monitoring of green results and to strengthen implementation to achieve incremental green results across all schemes.

Priority Recommendations for MGNREGS:

- Prepare Perspective Plan for every Gram Panchayat on the basis of landscape, watershed or aquifer based planning
- Strengthen capacities of Gram Panchayats to develop green proposals and monitor green results: develop and utilize appropriate toolkits for this purpose
- Strengthen block level capacities to support implementing agencies to deliver green results
- Develop an MGNREGS green index as a part of the scheme monitoring system to track green impacts at the Gram Panchayat level

- Incentivize Gram Panchayats to achieve and surpass the threshold level on the MGNREGS green index; this incentive may be drawn from the budgetary provision for administrative expenses
- Increase focus on treatment of forest land in convergence with joint forest management and the Green India Mission

Priority Recommendations for NRLM

- Include as 'essential' outcome in Mahila Kisan Sashaktikaran Pariyojana (MKSP) guidelines, a result each on sustainably harvested produce and sustainable agricultural practices (in addition to current one on soil health) for all initiatives
- Develop protocols for sustainable harvest of non timber forest produce and sustainable agriculture and livestock management, and facilitate their adoption by SHGs
- Earmark 2% of overall budget (or 10% of provision for 'infrastructure and marketing') for work at meso level on developing niche markets for sustainably harvested produce and for green input supply chains
- Provide backloaded 'labour subsidy' to SHGs for adoption of sustainable practices to compensate for lower labour productivity (in current guidelines, there is provision only for capital subsidy or revolving funds for SHGs)

Priority Recommendations for Integrated Watershed Development Program

- Specify environmentally sustainable resource management and production systems in the work plan, with convergent support from other schemes, and develop capacities of community institutions to adopt the systems
- Use the budget allocated for 'production systems and microenterprises' to support key aspects of sustainable production systems.
- Establish indicators for soil health, biodiversity and water resource sustainability and set up resource sustainability targets using these indicators
- Formalize usufruct rights and legal entitlements to promote sustainable use practices through community involvement. The 5% budget provision for the 'consolidation phase' must be released only after these measures are adopted by the community.
- Encourage support organizations to take on action research pilots to enhance green results

Priority Recommendations for National Rural Drinking Water Programme

- Ensure source sustainability is built into the Resource Development Proposals from Gram Panchayats while sanctioning projects.
- Institutionalize participatory water quality monitoring and reporting by Gram Panchayat
- Ensure safe disposal of contaminants after the water treatment process
- Dedicate additional funds for use of green technologies.
- The Water Security Plans must take into account all relevant water demands.

Priority Recommendations for Nirmal Bharat Abhiyan

- Establish a Green Home Protocol and a Green Panchayat Protocol to be implemented in a phased manner across the country.
- Enhance the budgetary share of solid and liquid waste management component
- Increase emphasis on solid and liquid waste management in the eligibility criteria for the Nirmal Gram Puraskar
- Prepare an inventory of solid and liquid waste management technologies and disseminate widely

Launch a campaign for highlighting the tangible benefits of rural sanitation on health and livelihoods.

Priority Recommendations for Indira Awaas Yojana

- Prepare region-specific Handbooks of Green Building Designs including green construction materials that cover the life cycle of an IAY house.
- Support district level Building Resource Centres to promote green technologies and designs; link financial support to quantity and effectiveness of green services provided
- Develop an IAY Green Index to measure, monitor and report on green results on a regular basis.
- Provide additional subsidy (20 percent) to families building housing units that score above threshold on the green index
- Provide additional funds to districts committing to specified number of green housing units under IAY.

Together, these recommendations will help the Ministry's schemes to deliver green results and contribute to the national goal of 'faster, sustainable and more inclusive growth'. As the UN Secretary General's High Level Panel on Sustainability notes, there exists tremendous opportunity for a dramatic improvement in the lives of the rural poor, even while they move towards more sustainable production models. Resource users will need access to assets, technology and markets. Success will depend, in great part, on investment. Success will also depend on institutions and initiatives with capacity to effectively coordinate efforts. The above actions by the Ministry of Rural Development can succeed by directing investment and coordinating institutions and resource users to achieve green outcomes. Thereby, the Ministry will not only help overcome the constraints posed by environmental degradation, but utilize environmental resources as an opportunity to spur growth and poverty reduction.



Poverty reduction and economic growth can be sustained only if natural resources are managed on a sustainable basis. A significant segment of India's population, particularly the rural poor, depends on natural resources for subsistence and livelihoods. 'Greening RD' refers to conservation and regeneration of ecosystems and the natural resource base. 'Greening' can stimulate rural economies, create jobs and help maintain critical ecosystem services and strengthen climate resilience of the rural poor who are amongst the most vulnerable to the impacts of climate change and natural resources degradation. Ecosystem goods and services are crucial to ensuring viability of agriculture, livestock and non-timber forest based livelihoods. Besides, they are key to safe drinking water, health care, shelter and more.

In India, the Ministry of Rural Development (MORD) has been implementing a wide spectrum of programmes which are aimed at poverty alleviation, employment generation, infrastructure development and social security. MoRD programmes have significant potential for green results, both at the local and global levels. In this light, this Report on "Greening Rural Development in India" is an attempt to support the systematic internalization of "greening objectives" across the various rural development programmes in India. The Report aims to enhance the understanding of the concept of greening specific to each of the major Rural Development schemes, document good practices where incremental green results have been achieved, and provide recommendations on what the schemes need to do differently to achieve incremental green results.

1.1 Economic Growth and Environmental Sustainability

India's commitment to planned economic development reflects government's determination to improve the economic condition of its people and an affirmation of the role of the government in bringing about this outcome through a variety of social, economic, and institutional means¹. India's First Five Year Plan (1951-56) was aimed at economic stabilization and investment in the agrarian sector. This Plan supported community development aimed at transforming the social and economic conditions of the villages. The Second Five Year Plan initiated structural transformation with an emphasis on heavy industrialization. The first two plans laid the foundation for development planning in India. At the centre of India's current development strategy is raising the rates of economic growth and enabling inclusion. Raising the rates of investment is a key driver to economic growth as well as structural transformation, and investing in infrastructure is expected to remove constraints to growth. Natural capital or environmental resources are an important complement to such planned investment in achieving development goals. The Planning Commission notes in its Approach Paper to the 12th Five year Plan that "economic development will be sustainable only if it is pursued in a manner which protects the environment. With acceleration of economic growth, these pressures are expected to intensify, and we therefore, need to pay greater attention to the management of water, forests and land². These concerns are reflective of the situation in other countries as well.

Globally, environmental degradation expressed as loss of fertile soils, desertification, unsustainable

¹ Extracted from the Foreword of the Eleventh Five Year Plan (2007-12). Planning Commission (2008), Oxford University Press, New Delhi.

² Planning Commission (2011): Faster, Sustainable and More Inclusive Growth, An Approach to the Twelfth Five Year Plan (2012-17), New Delhi, pg 10

³ United Nations Secretary-General's High-level Panel on Global Sustainability (2012). Resilient People, Resilient Planet: A future worth choosing. New York: United Nations, pg 21

forest management, reduction of freshwater availability and an extreme biodiversity loss rate does not leave enough time to the environment for recovery and regeneration. Nearly two thirds of the services provided by nature to humankind are found to be in decline worldwide³.

Globally, economy-wide policy reforms designed to promote growth and liberalization have been encouraged with little regard to their environmental consequences, presumably on the assumption that these consequences would either take care of themselves or could be dealt with separately⁴. Such policies will limit growth and increase risk to economic activity and human well-being. 'Given the fundamental uncertainties about the nature of ecosystem dynamics and the dramatic consequences we would face if we were to guess wrong, it is necessary that we act in a precautionary way so as to maintain the diversity and resilience of ecosystems'⁵.

It would however be incorrect to posit growth and environmental sustainability as mutually incompatible. What matters is the content of growth i.e. the composition of inputs (including environmental resources) and outputs (including waste products). This content is determined by, among other things, the economic institutions within which human activities are conducted⁶.

Sustainable use of environmental resources can contribute to growth and stability. Global debates on green growth draw attention to the contribution of environmental resources to increasing the productivity of investment and to the effectiveness and longevity of infrastructural investment. The elasticity of substitution between natural capital and other inputs is found to be low, which implies that it may be possible to compensate for the loss of natural capital with other capital inputs in the short run but not in the long run. Moreover, while direct economic benefits from environmental policies will accrue mainly over the long term, green policies can also contribute to short-term economic growth⁷. This strengthens the case for paying attention to environmental sustainability. There have been references in the literature on the contribution of natural capital to sustained and equitable growth⁸.

The UN Secretary General's High Level Panel on Sustainability notes that there exists tremendous opportunity for a dramatic improvement in the lives of the rural poor, even while they move towards more sustainable production models. Resource users will need access to assets, technology and markets. Success will depend, in great part, on investment. Success will also depend on institutions and initiatives with capacity to effectively coordinate efforts in priority areas of agriculture, land management and water⁹. The Schemes of the Ministry of Rural Development are well located to deliver green outcomes i.e. to restoring and enhancing ecosystem services and natural capital.

There have also been extensive discussions in the literature on how to deliver on environmentally sustainable growth. Measures range from the regulatory and institutional to market-based economic instruments. Reliance on market instruments alone will not deliver environmentally sustainable growth¹⁰, with the market being unable to generate pricing signals and green responses due to issues such as externalities, the 'public-good' nature of environmental assets, information asymmetry and agency problems and missing property rights. In particular, regulating or supporting services provided by ecosystems are difficult to define, measure, value and assign. The characteristics of resources and social interaction may present condition for the evolution of effective self-governing resource institutions which could be based on design principles outlined by the path-breaking work of Elinor Ostrom.¹¹

The schemes of the Ministry of Rural Development are uniquely positioned to influence the decisions

⁴ Arrow, Kenneth et al, (1995) Economic Growth, Carrying Capacity, and the Environment, Science, Vol 268, 28th April 1995, pg 520

⁵ Ibid, pg 521

⁶ Ibid, pg 521

⁷ World Bank (2012): Inclusive Green Growth, The World Bank, Washington D. C., p.36

⁸ See World Bank (2012): Inclusive Green Growth, The World Bank, Washington D. C.; Millenium Ecosystem Assessment Board (2005), Living Beyond Our Means, Natural Assets and Human Well Being, Island Press, Washington D C; Partha Dasgupta (2010), Nature's Role in Sustaining Economic Development, in Philosophical Transactions of the Royal Society, 365, pgs 5-11;

⁹ United Nations Secretary-General's High-level Panel on Global Sustainability (2012). Resilient People, Resilient Planet: A future worth choosing. New York: United Nations, pg 38-39

¹⁰ World Bank (2012): Inclusive Green Growth, The World Bank, Washington D. C Box 2.1, pg 46

¹¹ Elinor Ostrom (1990): Governing the Commons: The Evolution of Institutions for Collective Action. [Publisher?](#) The 8 design principles include: clearly defined resource boundaries; congruence between appropriation, rules and provisions; monitoring; graduated sanctions, conflicts resolution mechanisms; minimal recognition of rights to organize; and nested enterprises.

of hundreds of thousands of natural resource managers, and to direct investment flows towards the innumerable initiatives that aggregate to the improved result of regenerating natural capital. The MoRD schemes can enable, across thousands of locations, the creation of community institutions for natural resource management; strengthening of capacity of community institutions and field level government staff on natural resource regeneration; fostering innovative green solutions; and investing directly in regenerating natural assets using location-specific strategies. It is through concerted action by resource users and resource managers (individuals, communities, enterprises and governments) that green outcomes can be delivered by the rural development schemes.

Natural capital is often valued and understood best at the local level, and local knowledge is essential for effective solutions.¹² Communities need to be active supporters of the transition to sustainable development, asserting their rights and also fulfilling their responsibilities in terms of sustainable management of natural resources.¹³ Rural development schemes provide a strong opportunity to aggregate 'small initiatives' in several locations to improve natural capital on a macro scale. These self governing institutions and their capacities will be key to greater effectiveness of regulatory and market instruments in ecosystem regeneration and improving natural capital.

1.2 Rural Development Schemes in India

The Ministry of Rural Development (MoRD) spearheads the country's efforts to reduce poverty in the rural areas. Until recently, its work was divided among three departments: (i) Department of Rural Development (ii) Department of Land Resources (iii) Department of Drinking Water & Sanitation. In July 2011, the Department of Drinking & Sanitation was converted into a separate ministry, the Ministry of Drinking Water & Sanitation.

The MoRD website states, "This Ministry's main objective is to alleviate rural poverty and ensure improved quality of life for the rural population especially those below the poverty line." Towards this end, it sponsors scores of development programmes, big and small, influencing 'various spheres of rural life and activities, from income generation to environmental replenishment.'¹⁴ A small number of programmes of the two ministries – MoRD and MDWS, however, account for a substantial share of the expenditure on rural development. Primarily, these include the following:

- 1. Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS):** This aims at enhancing the livelihood security of people in rural areas by guaranteeing hundred days of wage-employment in a financial year to a rural household whose adult members volunteer to do unskilled manual work. (Budgetary allocation in 2012-13: INR 33,000 billion)
- 2. National Rural Livelihoods Mission (NRLM):** The basic objective of the National Rural Livelihood Mission is to create efficient and effective institutional platforms of the rural poor that enable them to increase their household incomes through sustainable livelihood enhancements and improved access to financial services. It plans to cover 70 million households living below the poverty line (BPL) in rural India. (Budgetary allocation in 2012-13: INR 3,563 billion)
- 3. Integrated Watershed Development Programme (IWDP):** The main objectives of the IWDP are to restore ecological balance in a watershed by harnessing, conserving and developing degraded natural resources such as soil, water and vegetative cover, and thereby, help provide sustainable livelihoods to the local people. (Budgetary allocation in 2012-13: INR 2,744 billion)
- 4. Indira Awaas Yojana (IAY):** This scheme provides financial grants to rural BPL families and the next-of-kin of defence personnel killed in action for construction of houses and upgradation of existing unserviceable kutch houses. (Budgetary allocation in 2012-13: INR 9,966 billion)
- 5. National Rural Drinking Water Programme (NRDWP):** The goal of this scheme is to provide adequate safe water for domestic uses on a sustainable basis. (Budgetary allocation in 2012-13: INR 10,500 billion)

¹² UNDP (2012), The Future We Want Biodiversity and Ecosystems – Driving Sustainable Development, UNDP pg 27

¹³ UNDP (2012), *ibid*, pg 27

¹⁴ <http://www.rural.nic.in>

- 6. Nirmal Bharat Abhiyan (NBA):** The Total Sanitation Campaign, now renamed as the Nirmal Bharat Abhiyan, assists Gram Panchayats to achieve comprehensive sanitation coverage. (Budgetary allocation in 2012-13: INR 3,500 billion)

The major schemes listed above can potentially make a significant contribution to sustaining and regenerating natural resources and ecosystem services. Some examples are:

- A vast majority of the works under the MGNREGS are linked to water, soil and land. The list of 'permissible' works provide environmental services such as conservation of water, groundwater recharge, reduced soil erosion, increased soil fertility, conservation of biodiversity, reclamation of degraded crop and grazing lands, enhanced leaf manure, fuel wood and non-wood forest products supply.
- Watershed Development programmes (IWDP) are focused primarily on ecological restoration by reducing soil erosion, increasing water storage (*in-situ* moisture conservation, surface water bodies and groundwater recharge), improving vegetative cover, particularly on fallow lands and strengthening related livelihoods. IWDP can also encourage sustainable natural resource use particularly in watershed projects' consolidation phase.
- Under NRLM, the guidelines for non-timber forest produce-based livelihoods under the Mahila Kisan Sashaktikaran Pariyojana (MKSP) identify regeneration and sustainable harvesting of NTFP species as key objectives; similarly, increased soil health and fertility to sustain agriculture-based livelihoods is an objective under the sustainable agriculture component of the MKSP.
- The NRDWP guidelines have earmarked 20 percent of the NRDWP funds for sustainability of water supply, including long-term source sustainability. If water supply schemes under NRDWP include components to ensure water source sustainability, NRDWP will have a significant green impact. The scheme, with its commitment to safe water quality, is expected to invest in water treatment facilities to address contamination. The scheme could further invest in safe disposal of the sludge from such water treatment to augment green results.
- Nirmal Bharat Abhiyan- formerly the Total Sanitation Campaign (TSC)- is by its very nature a green programme. In recent years, its scope has been extended beyond the eradication of open defecation to comprehensive sanitation. Due to this expansion in scope, ten percent of the project funds is earmarked for solid and liquid waste management. NBA, thereby, can ensure that such waste does not contaminate the water system.

1.3 About This Report

The Approach Paper to the Twelfth Five-Year Plan notes that "as the economy gains the capacity to grow rapidly, it will come up against the constraint of limitations of natural resources and in the need to exploit these in a sustainable manner".¹⁵

Despite the concerns and the efforts of the Indian government – in the states and at the centre, of environmentalists, voluntary organizations and communities across the country, the condition of India's environment poses formidable challenges. As the official State of India's Environment Report India 2009 notes, "Land degradation is taking place through natural and man-made processes, resulting in the loss of invaluable nutrients and lower food grain production. Loss of biodiversity is of great concern since many plant and animal species are being threatened. Air quality in cities is deteriorating due to vehicular growth and a sharp increase in air pollution related diseases. The issue of availability of water, which is going to be one of the critical problems in the coming decades, needs to be addressed on priority basis. Generation of large quantity of hazardous waste from industries, along with the hospital waste has been affecting public health and environment. Climate change and energy security are major concerns which need to be addressed strategically".¹⁶

¹⁵ Planning Commission, 2011, Faster, Sustainable and more Inclusive Growth. An Approach Paper to the Twelfth Five-Year Plan. P 45

At the international level, a quarter century ago, the Brundtland Commission articulated the need for environmentally sustainable development.¹⁷ Today, there is much greater knowledge and awareness of the impacts of rising greenhouse gas emissions on global warming and climate change. In its recent report 'One Planet to Share' the United Nations Development Programme (UNDP) has proposed that governments of the Asia-Pacific region raise rural resilience since rural areas in the region are the main "food suppliers and carbon sinks".¹⁸

Recognizing the national and global imperatives for regenerating natural resources and conserving ecosystems, the Ministry of Rural Development requested UNDP to examine the environmental implications of its schemes and assess the potential of these schemes to deliver green results. UNDP has undertaken this study 'Greening Rural Development Programmes in India' in response to this request.

1.3.1 Objectives of the Report

The main objective of the Report is to examine the potential of rural development programmes to provide environmental benefits that further their developmental goals and recommend specific and generic changes in their guidelines to achieve them. Its specific objectives are to:

- (i) Define the concept of 'greening rural development' and to elaborate it in the context of the major rural development schemes.
- (ii) Review six major schemes of MoRD to understand their environmental impacts and highlight their potential to bring about incremental green benefits.
- (iii) Document good practices or models of environmentally beneficial developmental interventions by government and civil society organizations to draw lessons for the major rural development schemes.
- (iv) Recommend steps that could be taken within rural development schemes to achieve incremental green results.

1.3.2 Structure of the Report

This Report is in two volumes. The first volume presents an overview, summary and recommendations for Greening Rural Development. The second volume presents commissioned technical papers by experts on greening six major MoRD and MDWS schemes. The Report has benefited from the deliberations at the international conference organized by UNDP and the Ministry of Rural Development 'Towards Greening Rural Development Programmes in India: Lessons from International & National Experience' in May 2012. It has also taken into account the green recommendations of some of the relevant Working Groups for the 12th Five-Year Plan.

This first volume summarizes the potential of the six major rural development schemes for delivering environmental benefits. It draws critical lessons from initiatives in India that have yielded environmental benefits while addressing other rural development priorities. It provides recommendations for changes in the guidelines and implementation frameworks of the major rural development schemes to achieve the desired green outcomes.

This volume has four sections: (1) Following this first introduction are the sections on (2) Greening Rural Development (3) Potential for Greening and (4) Recommendations.

¹⁶ Varughese George C., Vijaya Lakshmi K., Kumar Anand & Rana Neelam (2009): State of Environment Report India 2009, Ministry of Environment & Forests (MoEF), Government of India, New Delhi, p. x.

¹⁷ World Commission on Environment and Development (1987): Our Common Future, Oxford University Press, Oxford (U.K.)

¹⁸ UNDP (2012): One Planet to Share: Sustaining Human Progress in a Changing Climate, Routledge (Taylor & Francis Group), New Delhi.



2.1 Defining Green Outcomes

Greening rural development refers to a variety of activities that regenerate and conserve the natural resource base, innovate and use clean materials, technologies and processes to create environment-friendly products, livelihoods, enterprises and jobs. Greening Rural Development uses green indicators and metrics for monitoring and evaluation of rural development projects and schemes. In the context of this report, greening rural development refers to five broad “green outcomes”:

- i. **Improved resource conservation:** Rural development schemes especially MGNREGS and IWDP focus on regeneration of natural resources. Conserving and regenerating land and water resources enhances their productivity, leading to increased agriculture outputs and improved livelihoods derived from agriculture, forests and pastures. These schemes can assist in reducing run-off and soil losses, recharge groundwater, increase vegetative cover and improve biodiversity, and thereby, augment the productivity of natural resources and ecosystems.
- ii. **Improved resource efficiency:** Rural development schemes can substantially improve the efficiency of natural resource use in rural livelihoods and essential services. Under IWDP, there is opportunity to support farmer groups to adopt practices that improve efficiency of irrigation water. This can be done through appropriate crop choices, farming techniques, drip and sprinkler irrigation systems and improved field irrigation methods. Under NRLM, women’s self help groups and farmers can be supported on efficient nutrient management by combining chemical inputs with organic inputs. Under MGNREGS, soil erosion can be reduced leading to lower run-off of chemical fertilizers and higher yields per unit of applied chemical fertilizer.
- iii. **Reduced negative environmental impacts:** Greening Rural Development schemes can potentially reduce the negative environmental fall-out of economic development (pollution, waste generation etc.). Solid and liquid waste management in the Nirmal Bharat Abhiyan (formerly the Total Sanitation Campaign) improves local sanitation and hygiene and thereby, the well-being and health of local residents. In the Indira Awaas Yojana, the use of locally-available resources such as rice husk ash and flyash reduces diesel required to transport manufactured materials over long distances, and thereby, environmental pollution. Organic farming and sustainable harvesting of NTFPs under NRLM and the use of renewable energy for lifting water in NRDWP are other examples.
- iv. **Strengthened climate resilience of communities:** Greening rural development schemes can potentially enhance the resilience of rural population and production systems, and reduce risks arising from climatic variations and extreme events such as droughts, floods and cyclones. Afforestation, plantations, fodder development and vegetation belts in coastal areas under MGNREGS, IWDP or NRLM build livelihood resilience and improve local communities’ coping capacity to potential impacts of climate change. They also increase biodiversity and make the local ecosystems more resilient. Flood control measures under MGNREGS and IWDP enhance resilience in flood-prone areas.
- v. **Contribution to climate change mitigation:** Large-scale forestry and soil conservation measures can sequester carbon and reduce greenhouse gas emissions. For example, afforestation, plantations and vegetation belts under MGNREGS and IWDP can help sequester carbon and contribute to national and global efforts to address climate change.

2.2 Relevance of Green Outcomes for India's National Priorities

The rationale for greening rural development emerges from the Twelfth Five-Year Plan (2012-17) strategy of 'faster, sustainable and more inclusive growth' for poverty alleviation and MoRD's mandate to reduce rural poverty and ensure a better quality of life especially for the poor. There are four major ways in which greening rural development schemes can contribute to the 12th Plan priorities:

2.2.1 Contributions to inclusive growth

A critical element in meeting the planned target of nine percent annual GDP growth is to sustain an annual growth rate of four percent in the agricultural sector. This is important for ensuring that growth is more inclusive. Although agriculture contributes to only 14 percent of India's GDP, it is the main source of income for 58 percent of the rural population¹⁹ particularly small farmers with limited opportunities for migrating to the modern growth sectors. Agriculture also has a strong influence on food security and the prices of food, and therefore, on monetary wages. Further, agriculture has a very strong multiplier effect because of its impact on rural incomes and demand, and its supply of raw materials to several industrial sectors. While there has been a marked revival in agricultural growth in India since 2004, for the 11th Five-Year Plan as a whole, the growth rate is 3.6 percent. This is lower than the target for the 12th Plan. The year-to-year variability of agricultural growth has been declining, both on irrigated and rainfed land. Yet, the importance of climate-resilient domestic production of food grains has been highlighted by the recent spikes in global food grain prices. The impact of this variability goes further, with a one percent decline in agricultural growth pulling back industrial growth and GDP growth by 0.52 percent.²⁰

A vision document prepared by the Central Research Institute for Dryland Agriculture estimates that there is a large scope for improving productivity in rainfed agriculture ranging from 200 percent to 500 percent depending on the crop.²¹ It is further estimated that rainfed agriculture requires an investment of only INR 2.7 billion for each additional million tons of food grain production. The comparative investment for an additional million tons of irrigated food grain production was estimated at INR 62.4 billion in 2010-2011.²² Rainfed agriculture's output is therefore essential for achieving higher and sustained overall growth in agriculture. Rural development schemes such as MGREGS, IWDP and NRLM can contribute substantially to sustaining agricultural growth and reducing its variability in rainfed areas.

Green activities in programmes such as MGNREGS, NRLM and IWDP target the private land holdings of the poor besides common lands. Small-scale water and soil conservation techniques that are applicable at the field level are adopted more easily by poor households. The diversion of even a small amount of water, e.g., even the grey water from the kitchen for a small domestic kitchen garden can make a significant difference to household nutrition.²³ In rural areas, most people depend on their immediate environment for their daily survival - food water, fodder firewood and shelter. N. S. Jodha's pioneering research a few decades ago showed that the rural poor in particular were heavily dependent on common property resources.²⁴ This is true even today.²⁵ Rural development schemes aimed at regenerating and conserving the rural natural resource base improve the well-being of the rural poor in several ways.

A major role that public investment plays in a backward economy is to stimulate growth by encouraging and "crowding in" more private investment. Rural development schemes have the potential to play this role

¹⁹ National Sample Survey, 2009-10

²⁰ Sastry, D.V.S., et al. (2003): "Sectoral linkages and growth prospects: reflections on the Indian economy," Economic and Political Weekly, June 14, 2003.

²¹ Ibid: p.886

²² Sharma K.D. (2011): Op.cit, 1615-1616

²³ Kijne J.J. (2003): Unlocking the Water Potential of Agriculture, FAO, Rome.

²⁴ N.S. Jodha (1986): "Common Property Resources and Rural Poor in Dry Regions of India", Econ. & Pol. Weekly (EPW), v.21 n.26, Bombay

²⁵ Recent estimates of the contribution of commons to livelihoods are provided in Marothia, D (2010) and FES Commons Study (2012)

in India. Greening rural development can stimulate local growth by providing opportunities for private investment in green businesses: renewable energy generation, organic input chains and advisory services, green product supply chains, production of environment-friendly construction materials (flyash and rice husk ash cement, flyash and limestone bricks, ferro cement products and filler slabs for roofs). Rural development schemes can help widely disseminate information on green technologies and give an impetus to environment-friendly innovations in agriculture, processing, housing and construction of rural roads. Rural development schemes such as the NRLM and IWDP could include 'new style' interventions to improve the productivity and competitiveness of selected 'green' enterprises.²⁶

2.2.2 Environmental sustainability of economic growth

The Planning Commission notes in its Approach Paper to the 12th Five-year Plan that "economic development will be sustainable only if it is pursued in a manner which protects the environment. With acceleration of economic growth, these pressures are expected to intensify, and we therefore, need to pay greater attention to the management of water, forests and land²⁷. The State of India's Environment Report India 2009 supports this by observing that "Land degradation is taking place through natural and man-made processes, resulting in the loss of invaluable nutrients and lower food grain production. Loss of biodiversity is of great concern since many plant and animal species are being threatened. The issue of availability of water, which is going to be one of the critical problems in the coming decades, needs to be addressed on priority basis".²⁸

The 2005 Millennium Ecosystem Assessment estimated that 15 out of 24 of major global ecosystem services have already been degraded. If current environmental challenges intensify, the global Human Development Index in 2050 is likely to be 8 percent lower than in the base case and 12 percent lower for south Asia and sub-Saharan Africa.²⁹ The risks include impact on production in the agriculture and allied sectors, stress induced by rising water scarcity and deteriorating resource quality. Rural development schemes can contribute significantly to conserving water resources, soil quality and biodiversity.

The Report of the Working Group on Sustainable Groundwater Management submitted to the Planning Commission for the 12th Plan quoting the Report of the Expert Group on Groundwater Management and Ownership of the Planning Commission (2007), states that, "in 2004, 28% of India's blocks were showing alarmingly high levels of groundwater use. A recent assessment by NASA showed that during 2002 to 2008, India lost about 109 km³ of water leading to a decline in water table to the extent of 0.33 metres per annum." With 80 percent of drinking water for rural India and 60 percent of irrigation water sourced from groundwater aquifers, this depletion is alarming. Rural development schemes such as MGNREGS, IWDP and the source sustainability component of NRDWP can help arrest and even reverse the decline in groundwater levels in critical regions. This is particularly useful for hard-rock regions where groundwater depletion is at its most acute.

Soil is a primary resource for generation of most renewable natural raw materials for production systems. But a study conducted by the Central Soil Water Conservation Research and Training Institute (CSWCRTI) in Dehradun estimates that India loses about one millimeter of top soil every year due to soil erosion.³⁰ This amounts to an annual loss of 16.4 tons/ha or a total loss of 5,334 million tons annually. Soil contains enormous quantities of carbon in the form of organic matter. Soil carbon provides nutrients for plant growth. There is an estimated gap of about 10 million tons of nutrients (NPK), to begin with, between the absorption of nutrients by crops and their

²⁶ Rodrick D. (2004), "Industrial Policy for the Twenty First Century", Harvard

²⁷ Planning Commission (2011): Faster, Sustainable and More Inclusive Growth, An Approach to the Twelfth Five-Year Plan (2012-17), New Delhi, pg 10

²⁸ Varughese George C., Vijaya Lakshmi K., Kumar Anand & Rana Neelam (2009): State of Environment Report India 2009, Ministry of Environment & Forests (MoEF), Government of India, New Delhi, p. x.

²⁹ UNDP (2011): Human Development Report 2011 Sustainability and Equity: A Better Future for All, Palgrave Macmillan, New York, pgs 30-31

³⁰ ----- (2010): The Hindu, New Delhi, November 26, 2010

³¹ ----- (2009): Fertilizer use by crops in India, www.fao.org/docrep/009/a0257e/A0257E02.htm

addition through fertilizers.³¹ Soil erosion depletes soil fertility and adds to global warming. Soil conservation works are a large part of MGNREGS and IWDP activities. Soil fertility enhancement is a key objective of the MKSP and sustainable agriculture components of NRLM. Together, these schemes can contribute substantially to addressing the issue of land degradation.

Biodiversity is essential for the sustenance of all living systems, i.e., it is essential for nature itself. India's phenomenal biodiversity is a store house of biological resources on which several hundred million people depend on for health care, scarcity food, supplementary nutrition, fodder, bio-pesticides, fuel, housing and other uses.³² With only 2.4 percent of the world's land mass, India is home to over eight percent of its biological diversity. Its diversity of ecosystems (forests, wetlands, grasslands, marine areas and deserts) is among the world's highest and harbors over 47,000 plants and 90,000 animals in the wilds. Crop diversities include over 50,000 varieties of rice over 1,000 of mango, over 5,000 of sorghum and over 500 of pepper. Livestock diversity is also similarly high. But in the last two centuries, India has lost over half of its forests, 40 percent of its mangroves and a large part of its wetlands. MGNREGS, IWDP and NRLM activities can play a major role in conserving India's biodiversity which is so essential for providing the country with ecological and livelihood security.

2.2.3 Increasing climate resilience of production systems, livelihoods and habitats

India is highly vulnerable to climate-related disasters. The Natural Hazards Risk Atlas 2011 compiled by the World Bank and other international agencies ranks India in the highest risk category along with six other countries (Mexico, the Philippines, Turkey, Indonesia, Italy, and Canada). Hydro meteorological disasters are the most devastating and commonly occurring disasters throughout the world, comprising more than two-thirds of all major disasters. Greening rural development can contribute to higher resilience to these natural hazards.

According to the National Commission on Floods, the area prone to floods in the country was about 40 million hectares, out of which 80 percent, i.e., estimated 32 million hectares could be provided a reasonable degree of protection. A major strategy to increased flood resilience is to improve drainage. Rural development schemes are designed to improve drainage in low-lying or flat areas, to strengthen embankments and make drainage lines (starting from higher-order streams in the catchment area) more effective in discharging excessive run-off. The possibility of using MGNREGS for alleviating the flood problem in Bihar has been reported.³³

In India, around 68 percent of the country is prone to drought in varying degrees. In 2002, India witnessed a severe drought which affected 300 million people, 150 million cattle and reduced foodgrain production by 29 million tons. The entire country was declared drought-hit in the years 1966, 1972, 1979, 1987 and 2002.³⁴ Drought-prone regions were affected more frequently. Green results from rural development schemes can help conserve water in surface water bodies and in the groundwater system, improve vegetative cover to provide more fodder and increase soil moisture. Together, these can help reduce variability in agricultural yield, and contribute to improved drinking water and fodder availability during a meteorological drought.

2.2.4 Making public expenditure more effective

A green focus will enable MGNREGS to effectively deliver on its objective of creating durable assets and strengthening the livelihood resource base of the rural poor. By thus ensuring livelihoods security, MGNREGS will increase labour absorption in natural resource-based livelihoods, and decrease demand for the employment in public works. Livelihoods security for the rural poor will be ensured even while the demand for work under MGNREGS declines. This will limit outlay under MGNREGS in the future.

³² Kohli K. (2003): The National Biodiversity Strategy and Action Plan, India, Sage Publications, New Delhi.

³³ NREGA Consortium Bihar Report, 2012

³⁴ Ministry of Agriculture (2009): Manual for Drought Management, New Delhi 2009

Green results will be delivered by investing in sustainability of sources for drinking water through NRDWP, MGNREGS and IWDP. This will result in greater longevity for drinking water supply systems and will reduce the number of 'slipped-back' habitations. The average number of slipped back habitations targeted for coverage each year in the period 2002-8 to 2009-10 under the NRDWP has been more than 100,000³⁵. The NRDWP invests considerable funds in securing drinking water supply for such habitations. This expenditure can be reduced through green outcomes of rural development schemes. Recognising this, NRDWP has recently increased the allocation for "Sustainability" component from 5 percent to 20 percent of its overall budget. This is for implementing the sustainability measures in rural water supply projects by the states. This underscores the importance of green outcomes (source sustainability) in making NRDWP expenditure effective.

The MGNREGS and the IWDP can help bridge the gap between irrigation potential created and irrigation potential utilized, for small and micro irrigation projects. These schemes can also help maintain irrigation channels at the tail-end of the systems, and to prepare farmland for irrigation, through bunding, land-levelling and field channels.

Green outcomes of rural development schemes will increase the yield response to application of chemical fertilizers. It is well known that nitrogenous fertilizers are highly soluble as well as volatile. Rural development schemes can help increase soil carbon. Increased organic carbon in soil helps hold these fertilizers for longer in soil, thereby increasing the absorption of these nutrients by crops. Further, measures to reduce water run-off will also reduce loss of soluble nitrogenous fertilizers. Phosphate fertilizers become soluble in the presence of organic carbon on soil, assisting in their uptake by crops. Rural development schemes can help increase soil moisture, thereby helping greater and continuous uptake of fertilizers by crops.

The Green India Mission aims to improve vegetative cover over ten million hectares of area. Of these, five million hectares will be outside current forest areas. The Mission will adopt a landscape-based approach and closely involve local communities in 30,000 villages. In addition, the Mission will strengthen 14,000 community conserved areas and undertake social forestry in three million hectares. The Green Indian Mission will become more effective if rural development schemes invest in these villages in soil and water conservation and in developing capacity of local institutions in managing natural resources.

³⁵ Ministry of Drinking Water and Sanitation (2012): NRDWP An Outline, http://www.ddws.gov.in/sites/upload_files/ddws/files/pdf/NRDWP-Anoutline.pdf



3.1 Mahatma Gandhi National Rural Employment Guarantee Programme (MGNREGS)

Natural³⁶ resources such as farmlands, pastures, forests and water sources (surface and ground water) are subject to degradation and loss of productivity. Satellite data showed that in 2005-2006 about 15 percent (47.22 mha) of India's land mass were wasted or under-productive lands.³⁷ Such degradation is an important factor in the loss of livelihood assets and income poverty in rural India. The MGNREG Act therefore proposes large investments in works like soil and water conservation, land development and afforestation that address the causes of chronic rural poverty. It also lays stress on creating durable assets. These key elements of the Act -- productivity enhancement and sustainability of the rural natural resource base - strengthen its potential for green outcomes.

MGNREGS is the largest rural development programme in the country in terms of its reach and budget. A vast majority of MGNREGS works are 'green' in nature given their focus on the regeneration and conservation of natural resources and ecosystems and their main emphasis being on land (farmlands, forests, pastures and waste lands) and water resources. In fact, since the initiation of MGNREGS more than 50 percent projects are related to water through implementation of water conservation works, flood control, irrigation, drought proofing, renovation of traditional water bodies and micro-irrigation.³⁸ Their main developmental consequences are higher crop productivities and production.³⁹ Drought proofing activities, floods management works and vegetation belts planted in the coastal areas also reduce the potential damage due to extreme weather events.

There is ample evidence that even basic MGNREGS works have led to the regeneration of degraded soil, land (farms, forests and pastures) and water resources and the conservation of the assets created.⁴⁰ Their green outcomes include reducing soil erosion, improving soil fertility, increasing biodiversity, augmentation of surface and ground water resources for irrigation and household use and increasing carbon sequestration. A number of such outcomes have been highlighted in many states like Karnataka, Madhya Pradesh, Andhra Pradesh, Rajasthan, Kerala and Maharashtra.⁴¹

Some examples of the green impact of basic MGNREGS soil and water works from different parts of the country are:

- In Sidhi district (M.P.), 55 percent of 240 respondents said that construction of ponds, tanks and wells and renovation of old structures led to an increase of 372 acres in the cropped area.⁴²
- Thirty-four anicuts (stone bunds) built under MGNREGS in Rajasthan irrigated 26 ha each on an average, enhancing groundwater recharge in nearby wells and raising their water levels between

³⁶ This section is based on technical paper by NH Ravindranath and Indu Murthy in Volume II of this report

³⁷ --- (2010): Wasteland Atlas of India 2010, National Remote Sensing Centre (ISRO), Hyderabad & Dept of Land Resources (MoRD), GoI, New Delhi, p.v

³⁸ Greening of MGNREGS by Ravindranath & Murthy, in volume 2 of the report

³⁹ Shah M., Mann N., & Pande V. (2012): MGNREGS Sameeksha: An Anthology of Research Studies on the Mahatma Gandhi National Rural Employment Guarantee Act (2005, 2006-2012), Orient Black Swan, New Delhi, pp 42-44.

⁴⁰ Sharma A. (2010): Rights-based Legal Guarantee as Development Policy: The Mahatma Gandhi National Rural Employment Guarantee Act, UNDP, New Delhi.

⁴¹ Shah M., Mann N., & Pande V. (2012): MGNREGS Sameeksha: An Anthology of Research Studies on the Mahatma Gandhi National Rural Employment Guarantee Act (2005, 2006-2012), Orient Black Swan, New Delhi

⁴² Sharma A. (2010): Op.Cit, p.19.

10-40 feet. Renovation and construction of ponds under MGNREGS in Kerala led to an increase in the availability of irrigation water promoting the cultivation of cash crops like ginger and sugarcane.⁴³

- Silt excavated from MGNREGS works improved soil fertility when applied to over 36,000 acres of degraded lands belonging to Scheduled Caste (SC), Scheduled Tribe (ST) and below poverty line families in Chittoor district (A.P.).⁴⁴

In many states, water related works increased the availability of irrigation water leading to increase in the irrigated area, farm productivity and crop production.

- MGNREGS project to revive a river in Khargone district (M.P.) increased surface flows for an additional two to three months. Groundwater recharge increased by two to three meters and the crop area by 400 ha. The irrigated area rose by 26 percent and 19 percent in Ujjain and Dhar districts respectively, in M.P., as a result of MGNREGS works. In Chhindwara and Panna districts, the irrigated area increase was even higher at 35 and 30 percent respectively.⁴⁵
- Irrigation from 40 ponds along with canals, wells and bore wells in Kerala raised rice yields by 33 percent from three to four per ha and coconut yields from 10,000 to 15,000 nuts per ha.⁴⁶
- A study of MGNREGS projects in Punjab, Haryana and Himachal Pradesh reported that 62 percent of the sampled panchayats in Sirsa district (Haryana) and 75 percent panchayats in Sirmour district (H.P.) reported increase in crop productivities. Respondents in Hoshiarpur district of Punjab, however, did not see any impact of MGNREGS on irrigation and agricultural productivity.⁴⁷

There is also emerging evidence that some MGNREGS projects can have global green impacts. Activities like soil conservation, fodder development, afforestation and drought proofing works help sequester carbon. It has been estimated that tree planting activities over an area of 2,341 ha in Chitradurga district could lead to sequestration of 93 tons of carbon per ha over a 30-year period.⁴⁸ No reliable estimates have been made yet on the amount of carbon sequestered as a result of MGNREGS soil conservation works. There are also several innovative MNREGP projects going beyond the routine activities with significant green results in the country (See case study 1 - Springs revival for rural water security in Sikkim).

Simple Works Produce Big Outcomes In Chitradurga District, Andhra Pradesh

Desilting water bodies simply requires human labour. A detailed study of seven villages in Chitradurga district of Karnataka showed that between 2006 and 2009, over 122,500 cubic metres of soil was removed from the beds of water bodies. Three villages reported increases in groundwater levels from 30 percent to 77 percent. In one case the impact was also observed in nearby downstream villages. Data from five villages showed a 65 percent increase in the irrigated area from 1,470 ha to 2,430 ha.

It is estimated that 926, 890 cubic metres of soil have been removed from various tanks beds in the district in 2006-09. This increased the organic carbon content of the recipient lands two or three-fold.

Check dams under MGNREGS in Chitradurga increased water percolation and recharged groundwater. The percolation potential of check dams depends on the size of the reservoir, nature and size of the watershed and the amount of rainfall. In the study villages, the percolation potential is reported to have risen by 10,000-28,000 cubic meters per year.

-- Extracted from Tiwari et al. (2011)

⁴³ Verma S. (2011): MGNREGA Assets and Rural Water Security: Synthesis of Field Studies in Bihar, Gujarat, Kerala and Rajasthan, International Water Management Institute (IWMI), Anand.

⁴⁴ Shah M. et al. (2012) Op Cit, p. 40.

⁴⁵ Ibid.

⁴⁶ Nair N. & Sanju S. (2010): "Water Conservation and Irrigation Asset Creation Under NREGS in Kerala : Understanding the Ownership and Effectiveness of the Assets Created and its Influence in Labour Dynamics", IWMI, Anand.

⁴⁷ Bassi N., Kumar D. M., Niranjana V. & Sivamohan M. (2011): "Employment Guarantee and its Environmental Impact Are the Claims Valid?" EPW, v.66 n. 34.

⁴⁸ Tiwari et al. (2011): "MGNREGA for Environmental Service Enhancement and Vulnerability Reduction: Rapid Appraisal in Chitradurga District, Karnataka", EPW, v.66 n. 20, pp 39-47.

3.2 National Rural Livelihood Mission (NRLM)

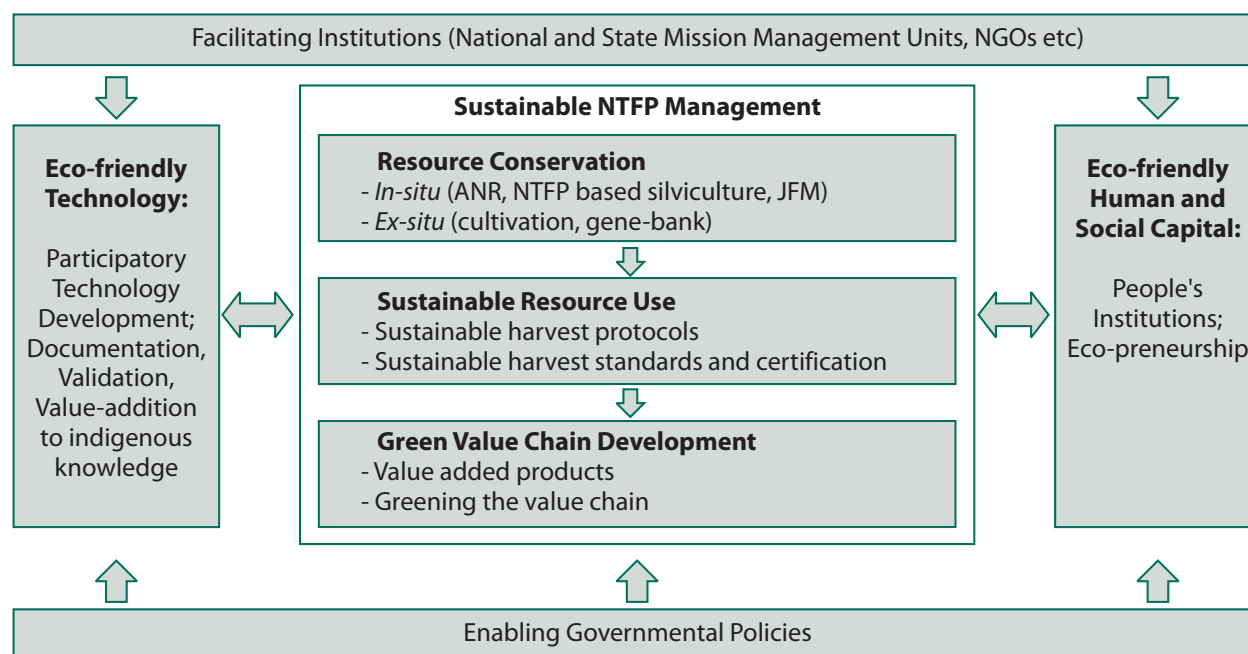
Aajeevika⁴⁹ - National Rural Livelihoods Mission (NRLM) was launched by the Ministry of Rural Development (MoRD), Government of India in June 2011. The Mission aims at creating efficient and effective institutional platforms of the rural poor enabling them to increase household income through sustainable livelihood enhancements and improved access to financial services. The sustainability and green dimensions are reflected in the NRLM document: "Respect for nature and its stewardship to ensure sustainable livelihoods for present as well as future generations" which points out "Environmental stewardship and sustainable harvest/natural resource management are central for ensuring sustainability of livelihoods of rural poor." For the purpose of greening this scheme, the focus has been on three key livelihood components of the NRLM mainly livelihoods based on non-timber forest produce (NTFP), sustainable agriculture and non-farm employment.

The NRLM is at its initial stage of deployment and state rural livelihood missions are being operationalized. Already the NRLM has a strong green emphasis. The greening strategies for the key livelihood sub-sectors that are outlined can be taken into account as the national-level activities. Additionally, the institutions of the poor being set up and strengthened under NRLM offer an excellent platform for introducing and institutionalizing green strategies.

3.2.1 Greening NTFP-based livelihoods

This entails *in situ* and *ex situ* conservation of NTFP species, sustainable harvesting and development of value-added products using sustainable production processes. A proposed agenda and approach for NTFPs-based sustainable livelihoods is shown in figure below:

Agenda for Sustainable NTFP Livelihood Development



⁴⁹ This section is based on the technical paper by Astad Pastakia, A Ravindra, and Manoj Mishra in Volume II of this Report.

Recent years have witnessed an increase in commercial pressures on NTFPs leading to non-sustainable rates of exploitation. There is an immense scope to develop sustainable harvest protocols and ensure their implementation. Many countries have created sustainable harvesting guidelines for forest produce linked to weather, location and market demands and include the optimum time and methods of harvesting their major species⁵⁰. In India, the work on developing sustainable harvest protocols is in a nascent stage. The National Institute of Rural Development has developed sustainable harvest protocols for about 20 NTFPs including important ones like gum karaya, lac, honey, tamarind and tasar.

Even where protocols for sustainable harvest exist, consumers are often skeptical about claims made by producers and suppliers. Here, establishment of standards and certification of processes provides the necessary assurances to the consumers and the public at large. In India, the Indian Institute of Forest Management had developed forest certification guidelines in 2007. This has a chapter on the NTFP certification⁵¹.

In the context of NTFPs, value chain development has assumed importance. The NRLM has already identified five major NTFPs for this purpose. Their objective is enhancing incomes of the poor, mainly tribal communities who are involved in the primary collection. Various NGOs in India are working in the NTFP sector to develop pro-poor value chains, the main ones being the Kovel Foundation that works on gum karaya value chain, Keystone Foundation on wild honey, Pradan on Tasar silk and Vasundhara on mahua. There are immense opportunities for greening NTFP value chains and greening nodes in the value chain need to be identified for each of these. For example, in the tasar silk value chain, greening can take place at different points: sustained availability and stabilization of cocoon production through conservation and plantation of host plants/trees introducing sustainable harvesting protocols as well as exploring scope for using renewable energy source at the reeling units, of eco dyes in the production of fabric and introducing standards and certification of the different processes (*See case study 2 –PRADAN’s tasar silk value chain*).

3.2.2 Greening Agriculture - based Livelihoods

An explicit green commitment under NRLM is evident in the ‘Sustainable Agriculture for the Small Producers component of NRLM⁵² and the Mahila Kisan Shashaktikaran Pariyojana (MKSP)⁵³. Community managed sustainable agriculture is emphasized with a strong focus on empowering women in agriculture. The sustainable agriculture focus of NRLM draws on the successful Community Managed Sustainable Agriculture programme of Andhra Pradesh (*see case Study 3 on this programme*) and reflects a strong green emphasis as evident:

- A shift away from using chemical inputs in agriculture that will reduce external costs of cultivation and also, help in restoration of natural processes such as replenishment of soil nutrition, higher moisture capture in soils, increase in beneficial insects etc.
- Restoration of soil health (and multiple crop-systems) that can build up soil organic carbon and help in carbon sequestration.
- Intensive knowledge inputs to farmers in closely observing and strengthening natural cycles and farm-level ecologies that will build a ‘green perspective’ to farming on a large scale.

⁵⁰ The state of British Columbia in Canada follows a few basic thumb rules that require awareness of the ecosystem and specifies how much can be harvested from a particular area. Refer Cocksedge W. & Schroeder M. (2006): A Harvester’s Handbook: a guide to commercial non-timber forest products in British Columbia, Coastal Edition, Royal Roads University, British Columbia; Scotland’s Sustainable Forest Harvest project has also identified basic principles of sustainable harvesting which are of universal appeal. It has three sets of harvesting codes that provide guidelines on what, where and how to collect NTFPs from the wilderness or forests. Refer Scotland Reforesting website, Accessed May, 2012

⁵¹ Yadav, M., Kotwal, P.C. and Menaria, B.L. (2007) Forest Certification- A Tool for Sustainable Forest Management. Bhopal: Indian Institute of Forest Management.

⁵² MoRD (2010): National Rural Livelihoods Mission: A Framework for Implementation, Ministry of Rural Development, (Gol), New Delhi, p. 26.

⁵³ <http://aajeevika.in/mksp.html>

- In this context, what is proposed here is a comprehensive approach to greening sustainable agriculture based livelihoods, a three-tiered framework for identifying greening options is proposed that entails:
 - (1) Interventions to improve the productivity of resources within the control of the poor.
 - (2) Options that focus on resources that the poor use heavily but are not in their control.
 - (3) Initiatives to encourage greening the mainstream rural production systems that will also benefit the poor.

At present, NRLM is largely focused on the first tier i.e., improving productivity of resources within the control of the poor. This can be further strengthened by:

- (i) Providing support for animal draught power which can improve soil fertility and reduce consumption of fossil fuels.
- (ii) Strengthening community-owned diverse seed systems to protect against climatic adversities and is also healthier for the soils.
- (iii) Facilitate support for comprehensive investments on water harvesting for supplementary or protective irrigation through convergence with MGNREGS and IWDP.
- (iv) Strengthening livestock-crop integration into the sustainable agriculture strategies.
- (v) Consider incentivizing farmers for sustaining the green practices in agriculture⁵⁴.

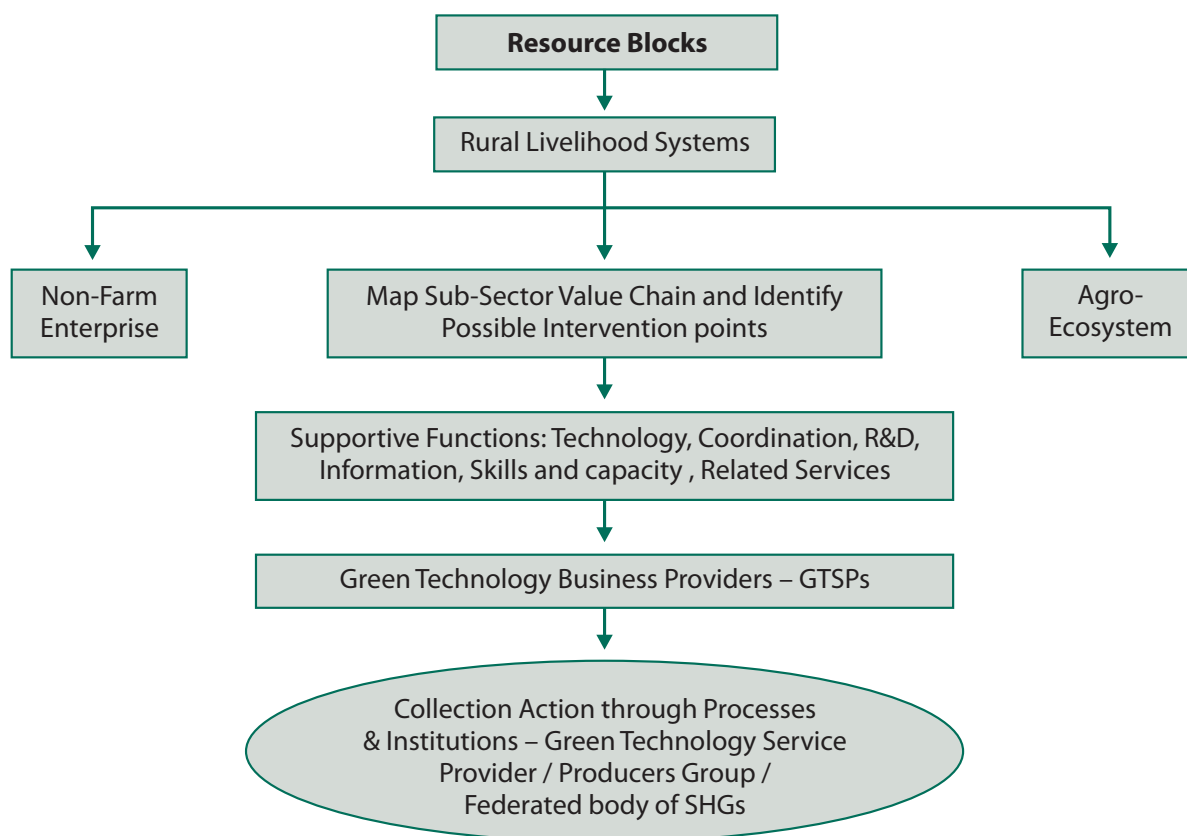
The second tier involves green interventions based on resources beyond the control of the poor. These deal with common pool natural resources such as grazing lands, ground or surface water resources, fisheries in common pool water bodies. Presently, the focus of NRLM is largely on the lands of individual farmers. A suggested approach for introducing the second tier set of green interventions would be to mobilize the rural poor into special purpose collectives (beyond SHGs) that operate at an aggregated level of a Block or clusters of Gram Panchayats.

The third tier of green interventions involves 'green shifts' in mainstream agriculture. Since the rural poor do depend on larger farmers for labour opportunities, rapid mechanization fuelled by labour scarcity and lower labour productivity are rapidly depleting wage labour opportunities in mainstream agriculture. Introducing green shifts or environment-friendly practices can generate large-scale livelihood opportunities for the rural poor. The activities proposed in this tier involve working with the resources of the non-poor. At present, such activities are outside the NRLM framework and an appropriate expansion could be an innovative step if it is done sensitively so that the poor remain substantial beneficiaries.

3.2.3 Greening Non-farm based Livelihoods

For non-farm based livelihoods, an overall strategy is proposed for NRLM which involves developing non-farm based interventions at the block level that can follow a sub sector approach along with identifying value chains that respond to the agro ecosystem context and markets. The greening dimension can be introduced as with NTFP-based livelihoods described earlier by looking at greening nodes starting from resource base to exploring green technology options and processes. This is captured in the figure ahead.

⁵⁴ For example: direct payment for environment stewardship in Australia's "Caring for the Country" natural resources management programme Hajkowicz S. (2009): "The evolution of Australia's natural resource management programs: Towards improved targeting and evaluation of investments", Land Use Policy, v 26, pp. 471–478.



As evident from this section, greening options are possible for all the three kinds of livelihoods supported under NRLM – the NTFP-based livelihoods, sustainable agriculture-based livelihoods and non-farm-based livelihoods. NRLM’s institutional platform which includes SHGs and their federations and the value chain approach to economic interventions provide the launch pad for introducing and institutionalizing the greening interventions. Further, potential for greening lies in the establishment of a fund to support innovative projects. The innovation fund is meant to support extension of tested livelihoods development innovations that substantially benefit the poor, involve end-to-end solutions, organization of the poor for livelihoods and partnership or consortia-based projects. The document specifically mentions projects that include ‘small and marginal farmers’ ecological and organic farming, livelihoods associated with NTFP collectors, coastal communities, people in ecologically fragile regions and commons. It also supports forward linkages in agriculture and livestock, both of which can be linked to greening.

3.3 Integrated Watershed Development Programme (IWDP)

The⁵⁵ main objectives of the IWDP are to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water. The outcomes include prevention of soil run-off, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table. This enables multi-cropping and the introduction of diverse agro-based activities, which help to provide sustainable livelihoods to the people residing in the watershed area⁵⁶.

There is evidence to show that IWDP projects have led to soil and water conservation, recharge of ground water, increased water availability for irrigation and hence enhanced agricultural productivity and production. The latest common guidelines for the scheme call for a focus on India’s rain-fed areas

⁵⁵ This section is based on the technical paper by M.V. Ramachandrudu in volume II of this Report.

⁵⁶ http://dolr.nic.in/IWDP_main.htm

where the challenge is to, “improve rural livelihoods through participatory watershed development with a focus on integrated farming systems for enhancing income, productivity and livelihood security in a sustainable manner”⁵⁷. The challenge in greening IWDP is to make the programme greener.

3.3.1 Improving Soil Health

Soil conservation is only the first step in regenerating soils and has to be followed by a comprehensive approach for improving soil health that involves (i) applying organic inputs; (ii) enhancing soil fertility by using easily adaptable good agronomical practices; (iii) creating an incentive systems for producing organic fertilizers and their use; (iv) establishing support systems for capacity building, market linkages and storage facilities. Some noteworthy examples are:

- CROPS in Warangal district, Andhra Pradesh, has promoted interventions such as application of tank silt or farm yard manures and diversified farming systems.
- Fodder plantations on common lands and farm bunds have led to better nutrition for livestock and yielded more manure (Himmoththan Society’s interventions in Uttarakhand).
- IWDP project implementation agencies have encouraged local groups to produce and sell composts, manures and decoctions from locally available biomass and animal wastes (AKRSPI (Gujarat), AKRUTI (Kadapa, Andhra Pradesh) and KVK (Nalgonda, Andhra Pradesh).
- Agro-forestry or diversified farming systems can be linked to manure production systems (COFA in Maharashtra and Odisha and WASSAN in Andhra Pradesh have promoted bunds of compost pits used to plant a variety of fast-growing trees which can quickly yield manures).

3.3.2 Going beyond Increasing Water Availability to Water Security

The IWDP has successfully promoted rainwater harvesting to augment water availability but there is a need to move towards water sufficiency or security. This includes assessment of groundwater potential, mapping of aquifers, drainage lines and surface water bodies and assessment of current water resource use demand of all kinds. Further, the irrigation action plans should aim at providing critical protective irrigation to a maximum number of farmers rather than providing intensive irrigation to small pockets of lands.

Since water resources augmentation is a major outcome of IWDP, there are examples where the foregoing concepts have been practiced and some of the significant ones are:

- Comprehensive planning using a watershed approach has been demonstrated in village of Hivre Bazar in Ahmednagar district of Maharashtra where 12 handpumps installed at various points provide water for drinking and other household uses to all.
- PRADAN’s five percent model demonstrates that rainwater can be harvested on each plot by reserving a small share (five percent) of its total area and these small farm ponds provide critical irrigation during dry spells and also help in improving the soil moisture regime.

3.3.3 Biomass and Biodiversity Conservation

A priority objective of watershed development is to regenerate and restore the productivity of degraded lands. So far, the focus has been largely on soil and water conservation works, afforestation and plantations have not received adequate attention. The planting activity is done without much

⁵⁷ NRAA (2011): Common Guidelines for Watershed Development Projects – 2008, Revised edition 2011, National Rain-fed Area Authority, Planning Commission, Gol, New Delhi, p.2.

participation of the main stakeholders, i.e., the local communities, leading to very poor survival rates. Inadequate efforts at institution building, community participation in planning or selecting the species for planting, specifying usufruct rights and establishing remunerative links with livelihood activities are at the root of the stakeholders' alienation. Fortunately, there are a few examples of good works:

- Natural regeneration of common lands promoted by local communities (Foundation for Ecological Security in Gujarat, Rajasthan and Ananta Paryavarana Parirakshna Samiti Network in Andhra Pradesh and the WADI programme of NABARD – BAIF in Maharashtra).
- Promotion of dry land horticulture (Rural Development Trust/Accion Freterna, Andhra Pradesh).
- Promotion of biomass plantations as part of “tree-based farming systems” protected and nurtured by farmers (BAIF, Karnataka).

3.3.4 Green Livelihoods

Agriculture and livestock-based livelihoods have been the main beneficiaries of watershed development programmes in India so far. Soil and water conservation have increased irrigation water, which in turn, has helped enhance agricultural production and productivity. Increased fodder availability from farms and newly afforested areas has increased dairying activities and incomes.

However, many of these successes have been based on high chemical inputs particularly fertilizers and pesticides, besides major dependence on irrigation. Greening IWDP would mean a shift towards low external inputs environmentally sustainable agriculture (LEISA). Generic practices like LEISA or low carbon farming do not compromise the productivity of farm lands while strengthening their ecosystems. Profits at farm level are also higher as the inputs costs are fairly low. Examples of green agricultural livelihoods are now emerging and some of these are:

- A large number of women self-help groups in Andhra Pradesh stopped using chemical pesticides and started using local decoctions for pest control and management.
- Farming coalitions of NGOs promoting sustainable agricultural practices through SHGs and farmers' cooperatives (e.g., Navdanya in north India).

Distribution of livestock is a common watershed activity. With controlled grazing through appropriate community-based institutions and diversified crops on farm lands livestock nutrition increases. Under these conditions, investments in livestock show rapid and high returns through good availability of fodder. Some examples of such initiatives are:

- Women self-help groups of PRADAN in tribal areas of several central Indian states where SHGs' members have formed another institution for promoting poultry on a large scale.
- Networks of livestock rearers are established and support systems are developed for better livestock management (WASSAN and Inter Cooperation, Andhra Pradesh).

It may be seen from the foregoing review that a greener IWDP requires much greater collective functioning. Formation of village-level institutions is a basic feature in the programme guidelines but most such institutions remain on paper. Norms, rules and regulations and functional procedures are rarely defined or adhered to. Consequently, participatory or collective functioning suffers. Hence, a greener IWDP will require that much greater attention be paid to participatory processes.

3.4 National Rural Drinking Water Programme (NRDWP)

The⁵⁸ goal of NRDWP is to ensure that the basic minimum requirements of safe water for all rural household needs and cattle are met on a sustainable basis. The overall objective is to ensure permanent drinking water security in rural India.⁵⁹ The Working Group on Rural Domestic Water and Sanitation for the 12th Plan has recommended that 55 percent of the rural households be covered by piped water supply with house connections wherever possible. It also recommended that these systems supply a minimum of 55 lpcd.

The present NRDWP guidelines give high priority to water supply source sustainability and water quality. Greening rural water supply projects is, therefore, an imperative of the programme. Wherever possible, multi-source systems are preferred to ensure reliability, safety and sustainability, even in times of calamities⁶⁰. An elaborate water quality monitoring and surveillance system has been conceptualized in an attempt to ensure supply of safe drinking water. Due to the dispersed nature of water resources, source sustainability requires a primary role for rural communities in planning, managing and maintaining water resources and systems.

For greening NRDWP, therefore, the critical components will include: (i) Regeneration and conservation of the resource base through roof rain water harvesting; (ii) Renovation of traditional water harvesting structures; (iii) Treatment of the recharge zones of springs, groundwater aquifers and streams; (iv) Water quality monitoring and treatment to minimize contamination and ensure potable drinking water supply and (v) use of renewable energy sources for pumps and higher resource use efficiencies.

3.4.1 Rainwater Harvesting

Rainwater harvesting (RWH) reduces the demands on surface and groundwater sources. Excess rainwater can be used to recharge depleting groundwater aquifers. It is fairly widespread, largely as a result of the national watershed development programme. In western India, particularly in Gujarat, people have harvested rainwater and recharged groundwater under watershed projects. Dysfunctional surface water tanks are being revived in south and central India through rainwater harvesting.

The NRDWP guidelines and the Report of the Working Group on Rural Domestic Water and Sanitation for the 12th Plan have prioritized provision of drinking water in rural schools and anganwadis along with community ownership of supply systems. The Barefoot College in Tilonia has demonstrated this by installing roof rainwater harvesting in rural schools and other public buildings and handing over the management to trained village water management committees in Rajasthan (see Case Study 4 – Barefoot College promotes roof rainwater harvesting). A similar but more sophisticated (and expensive) system has been demonstrated by Sustainable Innovations in the state's Jhunjhunu district.

RWH is especially useful in post-disaster situations where it can become a self-help water source. Polythene sheets, which are common relief materials, can be tied to the roofs of adjacent houses, or between bamboo poles and the collected water can be led into some container. This has been improvised and promoted on a wide scale in flood-prone regions of Bihar.⁶¹

3.4.2 Renovating Traditional Water Harvesting Systems

India's geological and ecological diversities have led to a profusion of water harvesting structures built to meet different needs. Many of these are maintained by communities and used even many years after

⁵⁸ This section is based on the technical paper by Depinder Kapur in Volume 2 of this Report

⁵⁹ ----- (2010): National Rural Drinking Water Programme: A Framework for Implementation, Department of Drinking Water Supply, MoRD (GoI), New Delhi, p. 1.

⁶⁰ The typology of rural water supply systems includes traditional water harvesting systems, shallow dug wells, hand pumps, tube wells or bore wells with pumps, local streams or other water bodies, river water supply and tanker supplies during water shortage emergencies

⁶¹ Mishra D.K. (2008): TRAPPED! Between the Devil and Deep Waters, PSI (Dehra Doon) & SANDRP (New Delhi), p. 200.

their construction, e.g., baoris in Himachal Pradesh⁶² and naula (a shallow stepped well) in Pithoragarh and Gaurikund in Pauri Garhwal districts of Uttarakhand. Renovation and revival of similar traditional systems are still being undertaken, e.g., johads by Tarun Bharat Sanghin Alwar district, Rajasthan; traditional tanks by Srijan and Vikalp Bundelkhand; tankas, khads in and nadis by Gravis in western, Rajasthan; ooran is by Vivekananda Kendra in Tamil Nadu; and naulas by Doodhatoli Lok Vikas Sansthan and People's Science Institute in Pauri Garhwal district of Uttarakhand. Used in conjunction with rural water supply systems, traditional water harvesting structures can provide year-round water security to the local populations.

3.4.3 Groundwater Recharge and Management

Groundwater depletion is a major challenge. A range of response measures are being undertaken to recharge and manage it sustainably.⁶³ For instance, India's Central Ground Water Board has conducted recharge experiments in various parts of country. In Kurnool district of Andhra Pradesh, percolation ponds and check dams constructed in an experimental recharge project increased the duration of local spring-flows, and the post-monsoon water table (*also see case study 5 - Farmers collectives manage groundwater*).⁶⁴ In Gujarat, wells have been altered to recharge the groundwater, and at the same time, thousands of ponds, check dams to harvest rainwater and recharge the aquifers have also been constructed.⁶⁵

Storing a fraction of rainwater annually that flows into the sea could also significantly recharge groundwater supplies. While this kind of storage is relatively easy in the alluvial aquifers of the Indo-Gangetic plains, it is difficult in the hard rock areas of the Deccan shield. An approach that can be showcased in this regard is the case of Abdasa taluka in Kutch, Gujarat. The Water and Sanitation Management Organisation (WASMO), Sahjeevan and ACT and other local organizations developed the water resources of a taluka wherein village youths were trained in basic hydro-geology. Community mobilizers trained local institutions to manage the new resources in a sustainable manner.

3.4.4 Groundwater Quality

The supply of safe potable water is a major challenge for NRDWP. Surface water sources suffer mainly from the presence of bacteriological pathogens, pesticides and nitrates from agricultural runoff and at times chemical pollution from local industries. Shallow aquifers are mainly affected by bacteriological pathogens due to inadequate or improper sanitation resulting in the mixing of sewage or infiltration from latrines. The deeper aquifers which are accessed by bore or tube wells are affected by geogenic contaminants.

Fluoride and arsenic mitigation in particular has been attempted by several organizations and successful approaches are largely based on elimination of contaminated sources and reliance only on safe sources inside or outside the village; treatment of the contaminated water by simple methods like the Nalgonda technique at the household or community levels or more technologically sophisticated methods like reverse osmosis plants at the community level as in villages in Gujarat. Finding alternate sources of safe supply, preferably external sources, seems to be a popular choice. Sanitary dug wells that tap only the shallow aquifers which are less likely to have harmful geogenic contaminants become a cost-effective and technologically simpler choice for rural water supply systems. PRADAN has promoted this approach in Jharkhand and West Bengal.

⁶² Chopra R. (2003): Survival Lessons: Himalayan Jal Sanskriti, People's Science Institute, Dehra Doon, p.10.

⁶³ Shah T. et al. (2000): The Global Groundwater Situation: Overview of Opportunities and Challenges, International Water Management Institute, Colombo, Sri Lanka offers a range of responses in this regard.

⁶⁴ Ibid

⁶⁵ In Gujarat, the watershed development program has led to a people movement. Based on the principle "water on your roof, stays on your roof; water on your field stays on your field; and water on your village, stays in your village," people have altered about 300,000 wells to recharge the ground. Simultaneously they have constructed thousands of ponds, check dams to harvest rainwater and recharge the aquifers.

3.4.5 Renewable Energy for Pumping Domestic Water Supplies

Groundwater, the main source of rural water supplies, has to be lifted up and conveyed to the point of use. Government water supply agencies prefer to use electricity operated pumps to lift groundwater. With electricity supply in rural areas being often unreliable, communities and individual households choose diesel-operated pumps to lift groundwater mainly for agricultural purposes. In this regard, a shift to renewable energy sources for rural water supply systems needs to be encouraged. The economic viability of these systems will be a critical factor in their adoption. Some of the successful renewable based water supply systems include: the pilot project of Sahjeevan Trust demonstrating a solar powered submersible pump lifting water and transported it over a distance of 1.8 Km to a water tank in the village. Many hydrams have been installed in Himachal Pradesh and Uttarakhand with mixed results⁶⁶. Hydram schemes that are community owned show better physical and socio-economic benefits.

3.5 Nirmal Bharat Abhiyan

The⁶⁷ Total Sanitation Campaign (TSC) launched in 1999, has been now renamed as Nirmal Bharat Abhiyan (NBA) with the objective “to accelerate the sanitation coverage in the rural areas so as to comprehensively cover the rural community through renewed strategies and saturation approach”. The NBA aims to promote rural well-being through environmentally safe disposal and utilization of rural household wastes, and therefore, is inherently a green programme. The NBA can improve the rural environment by converting rural household wastes to organic fertilizer, fuel and water for irrigation and groundwater recharge (refer to the table below).

In the 12th Five-Year Plan Approach paper, it is proposed to implement all the basic components – safe disposal of human and livestock excreta and complete solid and liquid waste management – in all Panchayats in a phased manner. The case of Aasgaon village located in a semi-arid area illustrates that this can be done with convergence of funds from different rural development schemes (see case study 6 – Asagaon becomes Greengao).

Green outcomes of NBA

Rural Household Wastes	Treatment	Output	Green Outcomes
Human excreta	Eco-san	Fertilizer	Improved soil fertility
	Biogas plant	Fuel + Fertilizer	Reduced pressure on forests for fuelwood; improved soil fertility
Animal excreta	Biogas plant	Fuel + Fertilizer	Reduced pressure on forests for fuelwood; improved soil fertility
Urine	Fertilizer	Fertilizer	Improved soil fertility
	Large scale treatment	Fertilizer	Improved soil fertility
Kitchen wastes	Composting	Fertilizer	Improved soil fertility
Domestic grey water	Irrigate kitchen garden & DEWATS	Irrigation water, groundwater recharge	Sustenance of local water bodies
Inorganic wastes	Segregation and recycling	Reduced non bio-degradable waste	Cleaner environment

⁶⁶ Hydrams use the kinetic energy of water falling from a small height to lift a fraction of that water to a much greater height. In this way, water from a spring or stream in a valley can be pumped to a village at a higher elevation. It operates automatically and continuously with no other external energy source. Renewable energy and a single moving part reduce its operational costs to a minimum. Hydrams are simple to operate and maintain.

⁶⁷ This section is based on the chapter on ‘Greening NBA’ by Nitya Jacob in volume 2 of this report.

3.5.1 Safe Disposal of Excreta

The thrust of NBA is to make rural communities open defecation-free as open defecation has significant health⁶⁸ as well as economic impacts⁶⁹. This is sought at the individual household, institutional and at the public level. The goal is to move from open defecation to a hundred percent sustainable use of toilets.⁷⁰ Eco-sanitation as proposed under the scheme guidelines offers an effective way to segregate and utilize human wastes.⁷¹ Further, greening may be achieved by using green materials for constructing toilets and green sanitation technologies including biogas units and ecosan toilets. Biogas digesters are also useful for safe disposal of animal dung and kitchen wastes. Ecosan toilets allow a shift away from flush toilets which is particularly important in areas with high groundwater tables as water borne sewage can contaminate surface water bodies and groundwater, e.g., the flood plains of Ganga, flood-prone areas of Bihar and areas where underlying ground stratum is either highly porous or permeable. All elements of NBA must move in this direction.

IEC campaigns play a major role in motivating villagers to use toilets. Village organizations and government agencies have adopted a wide variety of approaches including mass media, wall writings, posters and promotional events. Experience shows that person-to-person communication is quite effective. Individuals who are self-motivated to see their villages defecation-free and are good communicators are often used as 'champions' or motivators.⁷² In other places, SHGs or women's groups like Mahila Samakhya have been the champions. Sometimes, an entire community imbibes the message and becomes a champion (see case study 7 - Community-led total sanitation story of Asiragre village in Meghalaya).

3.5.2 Effective Solid & Liquid Waste Management

(i) Rural Solid Waste Management

The NBA guidelines state "Panchayati Raj Institutions (PRIs) are required to put in place mechanisms for garbage collection and for preventing water logging. Up to 10 percent of the project cost can be utilized for meeting capital costs incurred under this component. Under this component, activities like common compost pits, low cost drainage, soakage channels/pits, reuse of waste water, system for collection, segregation and disposal of household garbage etc may be taken up." Looking at this provision, it appears that the focus is on minimizing garbage to prevent water logging and the options provided are means to that end. This needs to change. The objective of solid waste management must be specified as closing the waste cycle and treating organic waste at the local level. It has to be a mandatory part of a district sanitation plan, without which the rest of the plan will not be passed.

Household organic wastes can be converted to fertilizers by composting or using a biogas digester, converted into fertilizer and fuel (see case study 8 – Schools convert waste to wealth in Kerala). Manure from composting is a steady income source for the composting agency, whether individual or panchayat. Inorganic wastes can be segregated and recycled. Recycling and reuse reduces the need for

⁶⁸ Almost a third of over half a billion pre-school children in developing countries have stunted growth. One-fifth of them die under five years of age and many of the rest grow up to be slow learners with lower economic productivity in adulthood. These problems are related to poor nutrition, as well as frequent bouts of diarrhea and tropical enteropathy caused by bacteria found in faeces (Humphrey J.H. 2009. "Child undernutrition, tropical enteropathy, toilets and handwashing," The Lancet, September 19, 2009, p.1032)

⁶⁹ World Bank (2010): Inadequate Sanitation Costs India INR 2.4 Trillion (US\$ 53.8 billion), Water and Sanitation Programme, the World Bank, New Delhi.

⁷⁰ The online reporting data of the Ministry of Drinking Water and Sanitation (MDWS) indicates a sanitation coverage of 68.4 percent of rural population at the end of FY 2010-11. The 2011 Census data, however, reported sanitation coverage of only 32.7 percent of the rural population. It is, therefore, clear that in rural India, a majority still lack access to a toilet and ending open defecation is a big challenge.

⁷¹ Excreta contain nitrogen phosphorus and potassium (NPK) - NPK are extremely valuable nutrients for agriculture.

⁷² The World Bank (2010): From Dreams to Reality: Compendium of Best Practices in Rural Sanitation in India, Water and Sanitation Programme, The World Bank, New Delhi, p.69

virgin material. By closing the waste cycle a major portion of waste is prevented from just being dumped in the open or going to landfills. This prevents water and land contamination through leachates. Proper solid waste disposal also reduces the impact on forests and grasslands that are often used as dumping grounds in rural areas. Less wastes going to landfill also reduces GHG emissions and the threat of global warming. Proper solid waste management reduces the number of disease vectors and consequently morbidity and mortality.

ii) Rural Liquid Waste Management

Waste water from rural homes comprises grey (from household processes such as washing dishes, laundry and bathing) and black water (from toilets)⁷³, and the choice of domestic wastewater management strategy depends on the end use of the effluent. Treated grey water not only reduces contamination of local water sources but also the use and dependence on them. Untreated grey water should not be allowed to mix with any other water – surface or ground. Therefore, the planning of such management systems has to be done with the reuse in mind and should be adapted to a specified purpose, such as agricultural reuse, ground water recharge or discharge into inland or coastal waters.

A simple and cost-effective approach is to use grey water for irrigating kitchen gardens and is ideal for rural households that have homesteads and space for kitchen gardens. The planted bed breaks down organic compounds and recovers nutrients. Another method is to construct small-scale wetlands for the treatment of domestic grey water. They utilize plants, soils and their associated micro-organisms to mimic natural wetland ecosystemic processes to mechanically filter pollutants in the wastewater, chemically transform them or biologically consume them. Such wetlands do not require power, chemicals or much money as land is readily available. The water processed by the wetland can be used for farming or discharged into surface water bodies since it will be free of organic matters and chemicals.

(iii) Ecological Sanitation

Ecological sanitation focuses on preventing pollution, on sanitizing urine and faecal matter and using the safe treatment products for agricultural purposes,⁷⁴ often characterized as the ‘sanitize-and-recycle’ approach. It reduces water pollution, the spread of disease and degradation of natural resources caused by unsafe disposal of human excreta. Ecological sanitation treats human waste as a resource and decomposes human faeces so that the end product can be used as manure. Human-derived compost helps reduce the environmental impacts of chemical farming, and is in fact richer in phosphorous.

Several eco-san projects are being executed in different parts of India to introduce the concept (*see case study 9 – Kaliyapalayam adopts ecological sanitation, Tamil Nadu*). This approach is particularly suitable for providing safe sanitation facilities in perennial flood-prone areas like north Bihar or the Brahmaputra valley. Many versions of floating or raised toilets are now being demonstrated and experimented with.

3.6 Indira Awaas Yojna

The⁷⁵ Indira Awaas Yojana (IAY) was launched in 1985-86 under the Rural Landless Employment Guarantee Programme (RLEGP) and later extended as a programme under Jawahar Rojgar Yojana in

⁷³ Grey water is not contaminated with wastewater from toilets (black water). Grey water originating from bathing and washing may be contaminated with small concentrations of pathogens and chemicals from detergents. Kitchen grey water on the other hand is high in nutrients and suspended solids.

⁷⁴ In today's societies the flow of plant nutrients is linear: nutrients are taken up from the soil by crops, transported to the market, eaten, excreted and discharged – often in water. In a sustainable society, the production of food must be based on returning the plant nutrients to the soil. Ecological sanitation tries to close the nutrient loop in a safe and hygienic manner (Nitya Jacob's paper in volume 2).

⁷⁵ This section is based on the technical paper by P.K. Das in volume 2 of this report.

April 1989. It became an independent programme of the Ministry in 1996. The objective of the IAY is primarily to “help in construction/upgradation of dwelling units of rural BPL householders belonging to members of Scheduled Castes/Scheduled Tribes, freed bonded labourers, minorities and other non-SC/ST by providing them a lump sum financial assistance.”⁷⁶

There is limited reference to green results in the guidelines; however, there is significant scope for greening the scheme. In the production of building materials and the process of using them in construction, large amounts of raw materials including natural resources, energy and water are consumed. There is significant potential to green the scheme by encouraging the use of green building materials, construction methods and building environment-friendly designs. The IAY guidelines in fact do emphasize using low-cost, environment-friendly and disaster-safe construction technologies.

As greening should be integrated through the entire lifecycle of a building, greening the IAY requires:

- 1. Reduction in the amount of manufactured building materials:** The main manufactured building materials used in rural housing are cement, steel and bricks. All of them are produced by processing ores or soil with intensive use of commercial power or energy and the release of pollutants into the surrounding environment. These can be substituted with naturally available construction materials like mud, stones, timber or bamboo. Mud walls or mud mortar is, however, identified with kutcha (weak) structures. With the guidelines emphasizing that the house should be a pucca one, mud tends to be ignored in IAY. But there are options to enhance the durability of mud by adding small amounts of cement or straw. Bamboo poles tied together can make a strong and ductile beam. Resource conservation can also be achieved by using flyash cement or rice husk ash cement. In both cases, the use of ‘waste’ products, i.e., flyash from thermal power stations or rice husk ash from burning the husk reduces the need for lime stone.
- 2. Intelligent construction processes for conservation of resources and reduction in the development footprint:** The use of local materials reduces the consumption of fossil fuels that are normally used for transporting manufactured materials to construction sites. Secondly, in a typical IAY house, a solid brick wall can use 480 bricks and 65 kg cement whereas rat trap bonded masonry requires 400 bricks and 6 kg cement. The consequent non-renewable energy embedded in the wall reduces from 486 Mega Joules per cum to 388 Mega Joules/cum in a rat trap wall. The CO₂ emission of solid brick wall is 327 kg/cum against 254 kg in rat-trap bonding. Use of labour instead of machines and less water also help conserve resources (Also see case study 10 - From Research to Scaled up Practice in Andhra Pradesh)
- 3. Resource conservation during inhabitation:** Intelligent building designs like passive solar architecture, roof rain water harvesting and ecosan toilets can reduce resource consumption during inhabitation. Recycling waste water and organic wastes from the kitchen are other possibilities.

Ongoing initiatives by many organizations have provided many lessons on greening, which have the potential to be upscaled. Some of these initiatives include :

- Development Alternatives has promoted a wide range of green technologies for rural housing such as production and use of compressed stabilized earth blocks (CSEB) for walls, micro concrete tiles (MCT) for roofs, ferrocement channels (FC) for roofing, and manufacture of bricks from fly ash and sponge-iron wastes. Some of DA's centers can serve as models for building resource centres.
- COSTFORD has popularized low-cost, green and disaster-safe housing by eliminating structural redundancies and expensive finishes. It promotes resource innovative approaches such as rat trap bond masonry, jaali walls, filler slabs, arches and frameless doors and windows, and bamboo shelters.

⁷⁶ ----(2012): Indira AwaasYojana (IAY) Guidelines, MoRD (Gol), New Delhi, July 2012, p.3

- Auroville Earth Institute advocates green architecture primarily by building with mud and mud-based products. It uses compressed stabilized earth blocks for low-cost, environment- friendly houses.
- Advanced Materials and Processes Research Institute (AMPRI) has developed several innovative, cost-effective building materials using industrial wastes like fly ash and organic fibres like sisal fibre as reinforcement in polymer matrices. Its composite doors and panels possessing properties comparable to natural wood can be used as wood substitutes for doors, windows, ceilings, flooring, partitions and furniture.



The preceding section shows that there is a tremendous potential for greening across the six major rural development schemes and that many potential green activities also have positive development impacts, particularly on livelihoods. Some have a broad range of impacts across resources, geographies and communities like MGNREGS, NRLM and IWDP. The others like NRDWP, NBA and IAY have narrower direct impacts, though the indirect impacts are significant. While most schemes include significant green features particularly in their recently revised guidelines, the incremental green results achieved are below potential. Higher priority needs to be accorded needs to the green features, closer monitoring of green results and to strengthen implementation to achieve incremental green results across all schemes.

In this section, the critical greening recommendations are detailed at two levels - for the Ministry of Rural Development and specifically for each scheme. These recommendations are likely to have wide applicability across the country and will have significant impacts in terms of environmental well-being and poverty alleviation, the twin mandates of the Ministry of Rural Development. At the same time, they have accompanying impacts on economic development in terms of stronger and faster growth which is sustainable and inclusive. Volume II of the Report details greening recommendations for each scheme.

The recommendations in this section address specific green actions that need to be implemented on the ground so that there are visible impacts as well as how these can be implemented. The recommendations begin with generic ones that are better addressed at the ministry level followed by others that are specific to the schemes.

4.1 Greening Actions for MoRD

4.1.1 Green Guidelines

The green orientation of the schemes will entail specifying green principles, goals, actions, processes, desired outputs and outcomes, monitoring and evaluation procedures and systems in the scheme guidelines.

Unless the green commitment and content are specified in the guidelines, implementation is likely to depend on individual initiative rather than be systemic. Hence, the Ministry may consider initiating a process of (i) identifying a set of key green outcomes that are most likely to succeed and will have the broadest impacts and then (ii) adding an annexure on Green Guidelines to the Scheme Guidelines which will detail the procedure and propose supporting actions towards the desired results and outcomes. The hallmark of the Green Guidelines will be (i) a set of non-negotiable principles and goals that must be met in each state (ii) flexibility beyond the non-negotiable so that people and institutions are encouraged to adopt creative and innovative activities that will later expand the Green Guidelines.

For effective dissemination of the Green Guidelines for all the schemes, it is recommended that a national dissemination workshop be convened with participation from senior rural development officials from each state along with civil society organizations, research institutions and academic centers with a performance record of commitment, competence and creativity. The key green results to be achieved in each scheme and the procedures to be followed should be highlighted. Each state can then hold a state level workshop (or more than one for the larger states) where district officials in charge of administering

the relevant schemes are present. These workshops can follow the pattern of the national workshop. Each workshop will be facilitated by officials of the Ministry of Rural Development and a designated support organization.

4.1.2 Support Organizations

The Ministry should form a network of support organizations by designating select civil society organizations, technical institutions and academic centers to facilitate the implementation of the Green Guidelines. These support organizations will develop resource materials in local languages, train implementing agencies, provide hand-holding support to the states for implementation and undertake monitoring and evaluation tasks. They should report, on a continuing basis, success stories and innovations taking place in their respective geographical areas.

4.1.3 Innovations Portal

An Innovations Portal for greening rural development may be established with the objective to (i) encourage people and institutions to develop and publicize innovative ideas, activities, technologies and processes adopted to promote and expand the greening activities and (ii) provide information and news about the progress of the Green Guidelines. The Innovations Portal will register demand for green solutions to specific problems; invite technology developers and social processes innovators to develop solutions; serve as a national data bank for green technologies and processes and publicize success stories that have been verified and reported by the support organizations.

4.1.4 Green Innovation Fund

A Green Innovation Fund may be established to promote and incentivize the development and extension of green technologies and social processes. Priority may be given to fund action research proposals that seek to experiment with or replicate innovative ideas in response to demands for solutions to problems emerging in the field.

4.1.5 Green Cell at the Ministry of Rural Development

A dedicated Green Cell, adequately empowered, should be set up within the Ministry for guiding the greening agenda and for the implementation of Green Guidelines in the country. It will submit an annual Green Report to the Minister for Rural Development summarizing the major green achievements and their outcomes during the year. Its specific functions will include:

- Finalization of the Green Guidelines for each scheme.
- Formation of a network of support organizations dedicated to facilitating the achievement of the Green Guidelines.
- Managing the Innovations Portal and the Green Innovations Fund.
- Developing a capacity development programme for local communities, panchayats and field staff at state and district levels to implement and monitor green results.
- Establishing indicators for monitoring and evaluation of the different schemes and their projects and evolving green indices for measuring the impact of the scheme/projects on the environment. Further, discussion on the green indices is provided in annexure 2 along with the identification of measurable indicators of green impacts and initial methods for calculating green indices for MGNREGS, NBA and IAY which can be used as a basis for developing the indices for various schemes.

- Facilitating evaluation of the greening results across the schemes by commissioning select institutions for conducting monitoring and evaluation exercises.
- Recommending activities and procedures to states from time-to-time based on emerging experiences.
- Establishing a suitable Green Awards scheme to recognize the outstanding performance in achieving green results across the schemes.
- Production of the Annual Green Report.

4.1.6 Convergence of rural development schemes

The Green Cell will develop procedures to converge actions and funding for greening activities that cut across rural development schemes. This will be especially useful for activities that are common to different schemes. For example, afforestation and plantations are common to MGNREGS, NRLM and IWDP, as are soil and water conservation works. The source sustainability component of NRDWP overlaps with IWDP activity portfolios.

Priority Recommendations for the Ministry of Rural Development

- Develop Green Guidelines for schemes
- Set up a Green Cell in the Ministry to guide and support greening across schemes
- Establish a Green Innovations Fund and an Innovations Portal
- Establish and use a network of support organizations to strengthen capacities of communities, panchayats and field staff to formulate and implement green plans and monitor green results
- Develop green indices, and conduct external evaluation of green results on a regular basis
- Promote convergence across schemes to deliver green results
- Publish and present an Annual Green Report

4.2. Greening Actions for Select RD Schemes

4.2.1 MGNREGS

MGNREGS is one of the greener schemes owing to its focus on soil and water conservation and its extent gives the size and outreach. The new scheme guidelines display a green or natural orientation with the addition of activities that will help enhance and sustain soil fertility with the use of manures, composts or organic fertilizers.

For achieving greener results especially in rainfed areas:

- Measures to raise soil fertility that increase agricultural productivity.
- Ensuring sustainability of domestic water supply sources through rain water harvesting and recharging groundwater aquifers.
- Sustaining high survival rates in plantation and afforestation projects.
- Greater focus on common pool resources development and sustainable use.
- Enhancing durability of assets created.

A significant part of the above priorities address regenerating the commons – forest lands, pastures, groundwater. To ensure the durability of the regenerated assets community action is required. Hence, MGNREGS funds should converge with NRLM and IWDP projects when necessary because these projects involve working with village-level institutions and community-based organizations.

To ensure the above priorities, it will be necessary to prepare Perspective Plans for every Gram Panchayat that include an assessment of natural resources and climate vulnerability and strategies to strengthen climate resilience and maximize ecosystem services on a sustainable basis.

Support organizations can undertake broad planning on a landscape, watershed or aquifer basis to inform the Perspective Plan of constituent gram panchayats. They can strengthen the capacities of gram panchayats, implementing agencies and district officials in preparing the Perspective Plan, developing appropriate proposals for works and monitoring green results. Real time monitoring, evaluation and reporting can help improve the quality of the greening works. Besides support organizations, a pool of agencies/professionals needs to be empanelled by the Green Cell for monitoring and evaluation purposes. Finally, a provision of financial incentives for Gram Panchayats would help in achieving green results especially with respect to community assets.

Priority MGNREGS Recommendations

- Prepare Perspective Plan for every Gram Panchayat on the basis of landscape, watershed or aquifer based planning
- Strengthen capacities of Gram Panchayats to develop green proposals and monitor green results: develop and utilize appropriate toolkits for this purpose
- Strengthen block-level capacities to support implementing agencies to deliver green results
- Develop a MGNREGS green index as a part of the scheme monitoring system to track green impacts at the Gram Panchayat level
- Incentivize Gram Panchayats to achieve and surpass the threshold level on the MGNREGS green index; this incentive may be drawn from the budgetary provision for administrative expenses
- Increase focus on treatment of forest land in convergence with joint forest management and the Green India Mission

4.2.2 NRLM

The NRLM promotes the formation of self-help institutions of the poor - SHGs and their federations – and builds their capacities to improve their livelihoods on a sustainable basis. The Mission has a strong sustainability orientation as reflected in the Mission Framework: (i) institutional sustainability by providing resources for reducing the financial vulnerabilities of the livelihoods institutions of the poor and (ii) environmental sustainability through a specific sub component programme, the Mahila Kisan Sashaktikaran Pariyojana (MKSP) and a sustainable livelihoods innovations fund that reaches out to tribal communities, forest produce collectors, coastal communities, ecologically fragile areas and the commons.

There is immense potential for further greening through:

- Regenerating the resource base – e.g., assisted natural regeneration of degraded forests and pastures, ecological stewardship services and strengthening community-owned diverse seeds systems.

- Reducing the negative impact of livelihood development activities by using renewable energy sources for off-farm enterprises, value chains and establishing off-farm enterprises that promote the use of renewable energy, e.g., assembling solar cells panels or solar lamps.
- Enhancing biodiversity and livelihood resilience by increasing resources for multiple livelihood options.

The above activities go beyond the sustainability orientation of NRLM to exploit the scheme's potential to regenerate natural resources, improve the quality of the environment and reduce the negative impacts of economic development activities.

Recommendations for further greening include:

- (1) The Green Cell at the Ministry should encourage the State Mission Management Units to facilitate development of green projects by:
 - i. Bringing SHGs and their institutions together with Forest Departments under Joint Forest Management rules to regenerate degraded lands and allow sustainable harvest of non-timber forest produce.
 - ii. Developing sustainable harvesting protocols, educating SHGs and the concerned departments about them, so that NTFPs can be sustainably harvested as a base for value addition and value chain development activities.
 - iii. Expanding sustainable agriculture activities such as non-pesticide management, soil management, water productivity enhancing methods, ecological cultivation and multi-crop bio-diverse models.
 - iv. Promotion of community-based rural tourism, as an off-farm livelihood where the communities improve the local environment through total sanitation in the village and protection and conservation of local ecosystems.
 - v. Development of enterprises that promote the use of renewable energy.
 - vi. Developing budgetary and financial incentives for green results.
- (2) The Green Cell and the State Mission Management Units should leverage convergence with other schemes, MGNREGS and IWDP in particular, to either expand the portfolio of green livelihoods or make them more sustainable. Thus, MGNREGS can provide a 'labour subsidy' for green activities like building protective walls/fencing for assisted natural regeneration of degraded lands, application of tank silt to farms, etc. SHGs can offer to gather inorganic wastes in rural panchayats, segregate it and dispose it off. Payments can be made under the Nirmal Bharat Abhiyan.
- (3) Support the formation of special purpose collectives of the poor (beyond SHGs) to improve access to the commons, and actively converge with IWDP and MGNREGS to enable these institutions to regenerate degraded lands and revive water bodies.
- (4) Support organizations should be encouraged to assist SHGs and their federations to establish value chains and niche-markets for non-timber forest produce - based products and sustainable agricultural produce that are specific to their region.

Priority NRLM Recommendations

- Include as 'essential' outcome in Mahila Kisan Sashaktikaran Pariyojana (MKSP) guidelines, a result each on sustainably harvested produce and sustainable agricultural practices (in addition to the current one on soil health) for all initiatives
- Develop protocols for sustainable harvest of non-timber forest produce and sustainable agriculture and livestock management, and facilitate their adoption by SHGs
- Earmark two percent of overall budget (or 10 percent of provision for 'infrastructure and marketing') for work at meso level on developing niche markets for sustainably harvested produce and for green input supply chains
- Provide backloaded 'labour subsidy' to SHGs for adoption of sustainable practices to compensate for lower labour productivity (in current guidelines, there is provision only for capital subsidy or revolving funds for SHGs)

4.2.3 IWDP

The IWDP is inherently a green rural development scheme. The activities proposed by its guidelines are very comprehensive and environment-friendly, though in practice the focus remains largely on regenerating land and water resources. Greater attention is paid to enhancing productivities, though often without adequate concern for sustainability. Fortunately, in most cases, resources are first regenerated or augmented before their exploitation in the project. Hence, the challenge of greening IWDP is to make the scheme greener.

A shift is required in the scheme's emphasis from quantitative to qualitative aspects - from regenerating or augmenting resources to their sustainable use. Thus, the scheme activities must shift focus from soil conservation to soil fertility enhancement, from augmenting water resources to their conservation and sustainable use, from merely planting saplings to their survival rates and species diversity and from unsustainable high external input agriculture to low external inputs sustainable agriculture.

Key aspects of a sustainable production system include a nutrient/pest management approach that increases the use of organic or biological inputs, cultivation practices such as minimum tillage, soil mulching, ploughing back crop residue, crop rotation and companion cropping, seed banks, integration of livestock husbandry with agriculture, and post harvest storage and processing. These shifts will make the farms more productive, will sustain the natural resource base, increase biodiversity on the commons and the farms, reduce ecological vulnerabilities and pollution due to agricultural chemicals. All of this entails a revision of the scheme objectives, activities and desired results. As also redesigning the capacity building processes for stakeholders' groups to include greener watershed approaches that are reflected in the new project plans or detailed project reports.

The new green results for IWDP will need to include (i) ecological and economic aspects (ii) quality of life for the watershed communities (iii) institutions and their capabilities (iv) planning and implementation and (v) convergence of resources. The desired ecological and economic end result will include among others:

- Waste lands are brought into productive use.
- A variety of tree species important for livelihood needs – fuel wood, fodder, fruit – and for ecological purposes are planted on degraded commons along with grasses.
- Cultivable fallow land is brought into use in integrated farming systems.
- Crop diversification takes place and crop intensity is increased.

- Groundwater resources are recharged and maintained.
- Surface water resources are augmented.
- Access to water (critical irrigation) increases for resource poor families.
- Production and productivity of crops, livestock, forests and other enterprises is increased.
- Green jobs are created and employment opportunities increased.
- Use of external inputs in agriculture are minimized.
- Farm ecology improves and revival of predator complexities takes place.

To ensure constant progress in deepening the green content of IWDP, support organizations must demonstrate proof of the concept by undertaking action research pilots in different agro-ecological regions of the country. To monitor and track the progress of the scheme, the Ministry must develop an inventory of indicators that quantify the changes in green impacts of watershed management projects. There is also a need for developing effective monitoring systems and protocols for tracking the inputs and processes.

Priority IWDP Recommendations

- Specify environmentally sustainable resource management and production systems in the work plan, with convergent support from other schemes, and develop capacities of community institutions to adopt the systems
- Use the budget allocated for 'production systems and microenterprises' to support key aspects of sustainable production systems
- Establish indicators for soil health, biodiversity and water resource sustainability and set up resource sustainability targets using these indicators
- Formalize usufruct rights and legal entitlements to promote sustainable use practices through community involvement. The five percent budget provision for the 'consolidation phase' must be released only after these measures are adopted by the community
- Encourage support organizations to take on action research pilots to enhance green results

4.2.4 NRDWP

Most rural development water supply systems depend on ground water sources at a time when there are heavy competing demands from industry and agriculture. Despite impressive figures of coverage of habitations with water supply systems, slippages continue to dog the sector due to drying up of sources, reduction in discharge or contamination. At the same time, the Working Group on Drinking Water and Sanitation for the 12th Plan has recommended piped water supply, preferably with house connections to 55 percent rural households up from 35 percent at present.

Greening requires the following set of activities:

1. **Regeneration and augmentation of water resources:** Rainwater harvesting is an important activity for NRDWP. It can reduce the pressure of demand on ground water by being an alternate source to meet household water needs or by recharging groundwater aquifers. Rain water harvesting in surface water bodies like ponds and tanks can also be used to provide water for livestock. Schools and public facilities must be covered to a maximum extent with adequate water supply through rain water harvesting. Convergence with MGNREGS and IWDP are recommended for rain water harvesting.

- 2. Ensuring sustenance of sources:** This can be done by reducing demand and enhancing groundwater source sustainability through treatment of the recharge zone. Demand reduction can be done by exploiting an alternate source of water (rain water harvesting is a green alternative) or managing demand with the help of Water Security Plans. It is, of course, advisable to have multiple local sources wherever possible. Capacity building of local communities for preparing Water Security Plans is essential to map local aquifers, establish water availability and demand and prepare water budgets. The Water Security Plans must take into account all relevant water demands on the source. For this, Gram Panchayats (GPs) will require technical support from a Support Organization and can be taken up in a phased manner. The funds for physical works in NRDWP's source sustainability component may be converged with MGNREGS and IWDP.
- 3. Address water contamination issues:** Water quality monitoring at Gram Panchayat level needs to be institutionalized. It is desirable that participatory monitoring is undertaken at least twice a year for groundwater and daily for pipe water, as in urban areas. The main drinking water contaminant in rural areas is bacteriological. Weaning people away from contaminating sources will require an IEC campaign and convergence with Nirmal Bharat Abhiyan. Technologies for treating contamination can also be established to ensure zero sludge generation and safe sludge disposal. Floods and droughts affected areas may be considered on a priority basis for piped water supply from safe sources. In the short term, reliance may be placed on safe dug well sources.
- 4. Promote green technologies:** Efforts must be taken to promote and incentivize use of green technologies such as energy-efficient systems, renewable energy-based systems, rain water harvesting, recycling or treatment of waste water, shifting to gravity flow systems, solar or wind power or hydrams as appropriate.

Priority NRDWP Recommendations

- Ensure source sustainability is built into the Resource Development Proposals from Gram Panchayats while sanctioning projects
- Institutionalize participatory water quality monitoring and reporting by Gram Panchayat
- Ensure safe disposal of contaminants after the water treatment process
- Dedicate additional funds for use of green technologies
- The Water Security Plans must take into account all relevant water demands

4.2.5 NBA

In principle, the Nirmal Bharat Abhiyan is an inherently green scheme as its activities improve the quality of the rural environment. Like rural water supply, however, rural sanitation has been implemented largely as an engineering exercise aimed at improving rural sanitation and hygiene conditions through the end of open defecation. Relatively very little attention has been paid to other aspects, especially solid and liquid waste management. In the green context, the time has come to accord a higher priority to the latter.

A campaign for greening of the NBA is required to change public perceptions, attitude and behavior for rural sanitation. So far, IEC materials have focused on the intangible benefits of sanitation, i.e., the dignity and status of women. New IEC materials must also promote tangible benefits by highlighting the impact of sanitation on health and livelihoods, e.g., how improved sanitation and hygienic drastically reduce the number of lost livelihood days. The campaign must aim to demystify the value of faeces and urine as replacements for chemical fertilizers and the resultant cost savings. In fact, toilets can be projected as a way to harvest nutrients from human excreta and urine with a known payback period.

As per the recommendations of the Working Group on Rural Drinking Water and Sanitation for the 12th Five-Year Plan, the campaign must focus on inter-personal communication, motivation and peer influence. It can involve civil society organizations for using tools such as folk media for conveying the desired messages in the Gram Panchayats.

A Green Home Protocol could be instituted to encourage rural families to implement basic steps for improving sanitation and hygiene in a village. The basic principle is to adopt green disposal of solid and liquid wastes within a minimum distance of their generation. Thus:

- (i) There should be 100 percent individual household latrine coverage. NBA provides financial support for this.
- (ii) All kitchen solid wastes should be composted within the homestead space.
- (iii) All grey water must be channeled to kitchen gardens, or trees, green hedges, or flower beds in the homestead space.
- (iv) All inorganic solid wastes are segregated for disposal by the Gram Panchayat. The implementation of the Green Home Protocol should be supervised by the village committee and may be linked to the Nirmal Gram Puraskar or other state awards.

In addition to the Green Home Protocol, a Gram Panchayat Protocol should also be established for the following practical actions that can be implemented by the Gram Panchayats:

- (i) Installation of ecosan toilets in all schools, public buildings and public facilities.
- (ii) Collection and disposal of inorganic solid wastes from homes.
- (iii) Treatment of grey/black water that cannot be disposed off at the homestead level. Such liquid wastes will need to be conveyed through properly constructed drains to a central treatment facility.
- (iv) Maintenance of basic cleanliness in the village.

Each Gram Panchayat will prepare plans to implement this protocol which must be included in the district Solid and Liquid Waste Management plans and implementation ensured in phased manner over time. To support the Gram Panchayat Protocol, an inventory of effective solid and liquid waste management technologies will need to be developed centrally and should include technical parameters, costs and suitability assessment for different climatic or agro-ecological regions of the country.

Funding the greening activities under NBA may be met largely from the Central Plan funds. The state funds should be used to ensure 100 percent coverage and use of individual household latrines. The Ministry of Drinking Water and Sanitation should also consider enhancing the funds for solid and liquid waste management in the overall NBA allocations.

Priority NBA Recommendations

- Establish a Green Home Protocol and a Green Panchayat Protocol to be implemented in a phased manner across the country.
- Enhance the budgetary share of solid and liquid waste management component.
- Increase emphasis on solid and liquid waste management in the eligibility criteria for the Nirmal Gram Puraskar.
- Prepare an inventory of solid and liquid waste management technologies and disseminate widely.
- Launch a campaign for highlighting the tangible benefits of rural sanitation on health and livelihoods.

4.2.6 IAY

The concept of greening needs to be built into the entire life cycle of a house and would require use of:

- (i) Natural materials (timber, bamboo, stones and mud) for construction purposes and reduce the use of manufactured materials like burnt bricks, cement, steel, glass and aluminum.
- (ii) Recycled waste products like fly ash and rice husk ash to make bricks and cement.
- (iii) Environment-friendly construction processes to cut down the use of materials, water and energy during the construction processes.
- (iv) Environment-friendly building designs, e.g., roof rain water harvesting, passive solar architecture elements, ecosan toilets, etc., to minimize the use of energy and to optimize the use of recycled wastes.

The following recommendations may be considered:

Energy-efficient and green construction materials and designs could be promoted for which the Ministry may prepare a handbook of Green Building Designs. The handbook should provide estimations for energy savings, water savings and reduction of emission of various green building designs relative to the conventional IAY designs. On the basis of the handbook, the building codes may need to be revised.

It is recommended that Building Resource Centres, e.g., those set up under HUDCO could serve as support organizations for construction of green IAY houses in the villages. These Centres can offer consultancy to IAY beneficiaries for obtaining construction loans, mapping available materials and supplies and choosing the feasible green technologies. A team of community organizers/mobilizers may be attached to the Centres for disseminating knowledge on green designs to the IAY beneficiaries. The Building Resource Centres and other institutions can be supported under the IAY programme to train rural masons in building low-cost, environment-friendly, disaster-safe houses. Financial support to the Building Resource Centres should be largely contingent upon achievement of service delivery targets. The Green Cell at the Ministry should seek convergence with other schemes and programmes, facilitate development of a training curriculum and evolve incentives to promote greening of IAY.

Priority IAY Recommendations

1. Prepare region-specific Handbooks of Green Building Designs including green construction materials that cover the life cycle of an IAY house.
2. Support district-level Building Resource Centres to promote green technologies and designs; link financial support to quantity and effectiveness of green services provided.
3. Develop an IAY Green Index to measure, monitor and report on green results on a regular basis.
4. Provide additional subsidy (20 percent) to families building housing units that score above threshold on the green index.
5. Provide additional funds to districts committing to specified number of green housing units under IAY.

Annexure 1: Case Studies

Case Study 1: Springs Revival for Rural Water Security in Sikkim

The villagers of ChubaPhong Gram Panchayat in Namthang block of south Sikkim district have transformed a community which used to suffer from regular droughts about 120 household level water storage tanks of 10,000 litres capacity each has been constructed. These tanks are filled from revived springs and used to meet their household water requirements. The panchayat's investment in water storage infrastructure has paid immediate dividends.

ChubaPhong Gram Panchayat is one of many gram panchayats in Sikkim that have benefited from the Dhara Vikas programme launched by the state's Rural Management and Development Department. Pilot projects to recharge an estimated 500 million litres of groundwater annually costing about INR 26,000 per ha have enhanced the natural ground water recharge in drought prone zones in the south and west districts. Between 2010 and 2012, groundwater recharge works have been undertaken on nine hill top forests in drought-prone villages extending over a total area of 300 ha. A sum of INR 75 million has been invested so far under MGNREGS. The volume of water harvested annually can provide for the drinking water requirements of about 6,850 families based on the present supply norms.

In Sikkim, 80 percent of rural households depend on springs for their water security. Rural households access water from these springs either manually or through gravity-based piped systems. Catchment degradation and climate change have emerged as twin threats to the survival of springs. Climate change studies indicate a trend towards warmer nights and cooler days, with increased rainfall except in winter which are becoming increasingly warmer and drier. October to February is the exceptionally dry period. The implication of this is that mean discharge from springs reduces from over 50 L/min in the post-monsoon months (September–November) to less than 10 L/min in spring (March–May). The drying up of mountain springs adversely impacts rural water security. Women have to manage with less water for domestic use and walk longer distances to fetch water.

The solutions lie in storing rainwater either above the ground in natural or artificial reservoirs or underground in natural aquifers. The natural ground water recharge in mountain areas is only 10-15 percent of the total precipitation. As a result of the steep terrain, much of the region's rainfall flows away and causes soil erosion, landslides and floods. The natural ground water recharge can be supplemented by making artificial recharge structures like staggered contour trenches and ponds in appropriate locations. This can help revive the dry season discharge of springs and streams. Sloping forest lands above villages are ideal locations for ground water recharge. Spring water is directed to specially constructed water storage tanks at the household, community and village levels.

Farmers store the night time spring flows that were earlier going to waste, and filling up these tanks. These are vital sources of water for domestic use and to irrigate kitchen gardens or green house crops. Roof water harvesting and water storage tanks have transformed many villages facing acute drinking water shortages. Hundreds of water storage tanks of 10,000, 34,000 and 40,000 litres capacity have been constructed with funds from MGNREGA and the NRDWP among other sources.

In Sikkim's mountain terrain, lakes also play an important role in naturally recharging ground water. Reviving dried up lakes by improving their catchment, de-silting them and piping water from a perennial source has been initiated. Healthy lakes recharge ground water, which in turn, supplements the base flows (dry-period) of springs and streams located downstream. The largely dry Nagilake in Namthang Block was recharged by piping water from a water source five km away. This has converted Setikhola from a seasonal stream to a perennial one.

Text & pictures provided by the Rural Management & Development Department, Government of Sikkim

Case Study 2: PRADAN's Tasar Silk Value Chain

Extensive work over two decades by PRADAN has enabled forest communities to strengthen and expand tasar sericultural-based livelihoods. PRADAN supported rearers produce over 60 million cocoons, almost 12 percent the total production of the country and significant strides have been made in breaking traditional taboos against women rearing tasar silkworms.

Tropical sub-humid forests are the natural habitat for the insect called *Antheraea mylitta* Drury which produces tasar silk. The beige coloured tasar silk fibre has a subtle luster, is strong and amenable to dyeing. Tasar is mainly traded in three forms-cocoon, yarn and fabric. Producer groups have formed around each of these tradable items. In India, forest dwelling tribals are the main rearers of silkworm or cocoon producers. An estimated 120,000 tasar cocoon rearers live in Chhattisgarh, Jharkhand, Madhya Pradesh and Odisha. These are amongst the poorest regions in India with very low agricultural productivity.

The rearers physically mount the worms on fresh food plants and protect the caterpillars from predators and diseases. Tasar rearing is seasonal. All the members of a rearer's family are involved at different stages of the production process. Typically, a family spends about 70-80 days annually in rearing tasar silk worms and earns around INR 5,000.

The role of the forest dweller is typically limited to producing cocoons which involves family labour, requires simple technologies and yields quick returns. It is an ideal source of secondary income for tribal people living in central India's forest belt. Being an age-old practice among tribals, their culture itself sustains their interest despite often low and unpredictable economic returns. The yarn producers are mainly women from the households of weavers who use the silk yarn to weave fabric on handlooms.

Tasar sericulture involves a series of interdependent activities with a complex value chain. PRADAN has done extensive work over the past two decades to strengthen and expand tasar sericulture-based livelihoods for forest dwellers in Jharkhand, Bihar and Odisha. Key highlights of PRADAN's interventions include:

- 6,750 ha of tasar host tree plantations raised (*Terminalia arjuna* and *Terminalia tomentosa*) in fallow uplands owned by 8,600 families. A one hectare plantation on an average yields an annual income of INR 25,000 through the sale of cocoons.
- Traditional rearers organized to rejuvenate about 15,000 ha of tasar host flora in natural forests through developing collectives.
- Young members of families that rear cocoon are trained to manage 300 grainages that annually produce 1.5 million DFLs.
- Traditional taboos against women rearing tasar silkworms are being addressed through enabling women SHGs to take part in this activity and earn livelihoods. The enhanced productivity of cocoons in PRADAN's project areas is widely attributed to the hard work of women. Over 1,000 women also produced yarn – a new activity for them.
- On an average, about 15-18 tons of tasar yarns are produced in the project areas that meet the specifications of discerning markets.
- The collaboration between PRADAN and the Central Silk Board (CSB) has resulted in significant policy changes, large-scale public investments in the tasar sector and the creation of a community-based model for livelihood promotion.

According to the Working Group of the 12th Plan, annual demand for raw tasar silk is estimated to be about 2,000 MT. Domestic production of raw tasar silk meets only 25 percent of total domestic requirement which is growing at 7 to 8 percent annually. This rate of growth in demand is estimated to create sustainable livelihood opportunities for an additional 30,000 households annually in the tasar sector. Inadequate replacement of degraded forests and aging host trees points to an growing gap between demand and supply. Market and demand trends are other key determinants.

An estimated eight million hectares of tropical forests are available in the states of Jharkhand, Odisha Chhattisgarh, Madhya Pradesh, parts of Andhra Pradesh and eastern Maharashtra for raising tasar host flora for expanding the livelihood activity. Vast tracts of fallow or wastelands in this region add to the potential for promoting sericulture.

Based on a note prepared by PRADAN

Case Study 3: Community-Managed Sustainable Agriculture in Andhra Pradesh

Community Managed Sustainable Agriculture (CMSA) approaches in Andhra Pradesh are demonstrating equal returns to farmers, at lower costs than those incurred by modern agricultural practices. Modern agriculture is capital intensive and based on the use of high-yield variety of seeds, chemical fertilizers, irrigation water, chemical pesticides and machines that run on commercial power. Small farmers in rain-fed areas who use chemical fertilizers and pesticides are often trapped in debt. The situation has been particularly grave in Andhra Pradesh, which has witnessed a wave of suicides by farmers in the recent past.

CMSA was supported by the Indira Kranti Patham (IKP), a state poverty reduction programme owned and managed by federations of women's SHGs. Beginning with 400 acres in 12 villages in 2004, by January 2009 it extended to 1.3 million acres with over 318,000 families in 3,171 villages spread across 18 of the state's 23 districts. By the end of 2008, the federations had a corpus of about INR 4,000 billion, which enabled poor women farmers to access an estimated INR 20,000 billion over a nine-year period from commercial banks.^[2]

The basic technologies and processes followed in CMSA are summarized below:

- Farmers learn about pest prevention and integrated pest management (IPM).
- Pesticide use is replaced with physical instruments to control pests such as traps and biological methods such as neem extracts.
- Increased soil fertility through gradually replacing chemical fertilizers with microbial formulations (*Panchgavya* and *Jeevamrutham*), composting, vermiculture and bio-fertilizers.
- Scale up and intensification of CMSA practices by replacing conventional fertilizers with tanks' silt, green manure crops, soil inoculation with *Azospirillum* and *Azotobacter* – nitrogen fixing bacteria and vermicomposting.
- Introduction of inter-cropping or multi-cropping to maintain soil fertility and pest incidence.

By the third year, farmers had replaced chemical fertilizers and pesticides with sustainable technologies and practices. Introducing these practices over geographically large and contiguous areas has led to organic agriculture, certification and development of niche markets to obtain higher prices by satisfying the demand for organic products.

The CMSA support system includes (1) extension through farmer fields schools (2) research and development of technologies based on farmers' experiences and innovations (3) scaling up with community resource persons (4) provision of support services such as credit inputs, seed banks, community centres for agricultural implements, value addition, procurement centres for marketing outputs, milk chilling stations, insurance schemes and so on.

The end result has been a 'favorable economic system for profitable agriculture.' Data from 400 families in five districts showed that CMSA yields are equal to or slightly higher than those of modern agriculture but that farmers' costs are lower by 33 percent, prices higher by 14-33 percent, leading to higher net incomes.

This section is based on Vijay Kumar T. et al. (2009); Ecologically Sound, Economically Viable Community Managed Sustainable Agriculture in Andhra Pradesh, India, The World Bank, Washington D.C.

^[2] Monetary values in the original text are in US dollars. A conversion factor of INR. 50 = US\$ 1 is used here.

Case Study 4: Barefoot College Promotes Roof Rainwater Harvesting

The Roof Rainwater Harvesting Programme (RRHP) at the Barefoot College of Social Work and Research Centre in Tilonia, Rajasthan, helps communities harvest rainwater in schools, dispensaries and other public places to benefit communities. Since 1986, more than 550 rooftop rainwater collection systems have been constructed, demonstrating that in drought-prone areas or where the groundwater is saline, RRWH is the only sustainable local alternative for safe drinking water.

The Barefoot College approach involves linking together roofs via a network of pipes so that any rainwater falling on the surfaces is channeled into a central cistern, typically built underground, say, in the centre of a compound. The first rains of the season are used to flush dirt from the rooftops and silt from the cistern. Thereafter, rainwater is collected and stored. If needed, a chemical treatment such as chlorination can be used to decontaminate the water.

The college trains architects and craftsmen, many of whom may be neo-literate, in construction techniques. The training is carried out by a collective of 20 to 25 people, including women. Each resource person has spent around 15 to 20 years developing the programme and constructing rainwater harvesting structures. The college has seven field centres, each of which works with 20 to 30 neighbouring villages. The members of the collective :

- Organize village meetings where the communities have submitted written requests for building rainwater harvesting tanks. During these meeting, sites are selected. If the proposed land belongs to a private party, the title of the land is transferred to the village by the owner so that it becomes common property.
- Create Village Water Committees (VWCs) with equal numbers of men and women.

The collective members train the VWC members to operate a bank account and maintain their books of accounts. They select the construction sites of the rainwater harvesting tanks and with the help of the VWCs and barefoot architects design them and monitor their construction. They hand over functioning rainwater harvesting tanks to the villagers and the VWCs after a social audit has taken place and the accounts approved. Villagers contribute about 10 percent of the total construction costs in cash contributions or in the form of voluntary labour.

VWC members select supervisors who are trained as “barefoot managers” at the Barefoot College. They allot and measure the work, maintain muster rolls and labour cards, disburse wages and keep financial records. VWC members are responsible for inviting tenders for the purchase of construction materials, approving the design of the system developed by the barefoot architects and finally giving a written guarantee of the longevity and durability of the system.

The programme has trained more than 1,250 barefoot architects, including women. Building the RRWH systems has provided gainful employment to 20,000 villagers reducing out-migration of local workers. It has benefited nearly 200,000 people in 18 Indian states. Some 33 million litres of rainwater have been collected every year from the roofs of rural schools and community centres in 492 villages. It has assured access to drinking water for five months of the year. During the rest of the year, water tankers replenish the cisterns when required.

The impact on women and children has been considerable. The VWCs have brought rural women into decision-making processes and the availability of safe drinking water has increased the attendance of girls in schools substantially. The Barefoot College has also established the Global Rainwater Harvesting Collective (GRWHC) registered in Jaipur, Rajasthan and Amsterdam, the Netherlands.

Excerpts from www.tcdc2.undp.org/GSSDAcademy/SIE/Docs/Vol11/SIE.v11_CH4.pdf accessed October 2012.

Case Study 6: Aasgaon becomes Greengaon

Aasgaon is a village in Satara district of Maharashtra with a total area of 22.5 hectares. It is a small resettlement colony of 217 households with a population of 1,032 persons according to the Census 2001. Close to 14 percent people belong to Scheduled Castes, and two percent to Scheduled Tribes. The primary occupation is farming, followed by work in nearby towns.

At the time of resettlement, Aasgaon was a wasteland without any source of water. For 17 years, the villagers were completely dependent on tanker water supply for their daily needs.

In 2000, under the Total Sanitation Campaign (TSC), Aasgaon adopted efficient water management that involves rainwater and grey water segregation and management. It constructed storm water drains through which the rainwater is channeled to maximize recharge. No grey water reaches these drains since it is completely used for kitchen gardens or tree plantations. The villagers have made contour bunds and gabions for watershed treatment and to maximize water recharge.

The community also tackled solid waste wisely. Each house has a biogas plant fueled by human faeces and cow dung. Almost every house has a vermi-compost pit where inorganic and non-compostable solid waste is recycled. There is 100 percent toilet coverage and use. Community toilets have been constructed for those without individual toilets and visitors. Villagers have also planted over 10,000 trees and tended them through irrigation with grey water.

As a result of people's participation and dedication, the village is today environmentally and socially transformed.

Excerpts from the chapter on 'Greening NBA' by Nitya Jacob in volume 2 of this report.

Case Study 7: Community-Led Total Sanitation Story of Asiragre Village in Meghalaya

Asiragre, a village comprising 51 households, was the first village in Meghalaya to achieve 100 percent sanitation through the community-led total sanitation (CLTS) approach. Before the intervention, only six households had safe toilets. Another 42 had unsafe toilets and members of three households defecated in the open. When the facilitator team first visited Asiragre, most of the villagers felt that sanitation was not a concern. The challenge for the facilitator team was to make the community understand that their existing toilets did not provide for the safe disposal of excreta and that they were as good as non-existent.

The concept of a 'toilet' as the sub-structure with a pan, a water seal and a properly sealed pit allowing for the safe disposal of excreta was reinforced through innovative training tools developed by the facilitators. Village water and sanitation committee (VWSC) was formed which secured funds for safe toilets. The entire community contributed their labour. Two youths trained as master masons ensured that all households constructed safe toilets. The master masons were paid wages amounting to the one-day MGNREGA wage of all the households.

Today, the village has 100 percent Improved Household Latrines (IHLs). Every villager knows and understands the concept of a safe toilet. Since the toilets were built by the people themselves, there is little doubt about their continuing use and sustainability. The President of the Asiragre VWSC, a CLTS champion, is also a trained master mason. He is now spreading the CLTS story and safe sanitation practices to other villages in the district.

Excerpts from "CLTS Story of Asiragre Village," in From Dreams to Reality: Compendium of Best Practices in Rural Sanitation in India, Water and Sanitation Programme, The World Bank, New Delhi, 2010, p.69.

Case Study 8: Schools Convert Waste to Wealth in Kerala

Tirur Block in Malappuram district of Kerala has adopted an innovative approach to convert waste into wealth by establishing bio-gas plants in schools.

The block panchayat has constructed a bio gas plant where the remains of the mid-day meal of 2,300 children are turned into bio gas. Nearby hotels also use this facility to dispose of waste. The energy from this unit provides part of the fuel needs for cooking the mid-day meal. Its slurry is used as manure for the school garden. Seventy-five percent of the project cost of INR 1.2 million was met from the waste management fund of the Total Sanitation Campaign (TSC) and the rest from the yearly plan of the block panchayat.

This bio-gas plant was intended to be a display unit to demonstrate to children and others how waste can be scientifically managed and turned into a useful resource. Its proposal was evolved at a meeting of the working group of the block panchayat to prepare an annual action plan. It was vetted by the district-level Technical Advisory Group on Drinking Water and Sanitation. Discussions were held with representatives of the school parent-teacher association (PTA) and their support ensured. A government-approved agency with a good track record in this field was selected for implementation.

Sustainability is key to such demonstration plants, and as a result, operation and maintenance plans were carefully developed. Under the supervision of the PTA, health club/green club members formed maintenance committees. They are now successfully operating the plant with the help of several dedicated teachers. After the success of the project, Tirur's block panchayat constructed four more bio-gas plants in 2009–10.

Excerpts from "Waste to Wealth: An Experiment in Schools," in From Dreams to Reality: Compendium of Best Practices in Rural Sanitation in India, Water and Sanitation Programme, The World Bank, New Delhi, p.70.

Case Study 9: Kaliyapalayam Adopts Ecological Sanitation

Kaliyapalayam village is located near the Cauvery river, in Tirupur district of Tamil Nadu, approximately 374 km from Chennai. An ecological sanitation initiative in Kaliyapalayam launched by the Society for Community Organization and Peoples Education (SCOPE) in 2002 reduced water use in sanitation and prevented water pollution due to open defecation (as the water table is high).

Initially, the gram sabha passed a resolution to construct eco-san toilets in 18 households. Stakeholders were consulted at each stage of the project. The concept was quickly accepted by residents. Initially a 2-in-1 model was adopted where the wash water and the urine were collected in one chamber and faeces were collected in the other chamber.

After one year, a study was conducted to elicit the views of the residents regarding this experiment. The study revealed that users were by-and-large satisfied with the system. Based on their feedback, however, the 2-in-1 model was replaced with a 3-in-1 model in which the urine, faeces and wash water were collected separately. Urine is collected in a mud pot with holes buried in the ground and wash water is collected in a filter bed.

The human faeces and urine were used as fertilizer and the wash water is used for kitchen gardens and plants. The high initial cost of the eco-san toilet was offset by long-term socio-economic and health benefits. Wash water applied to banana trees next to the toilets assured irrigation at no cost. The sale of manure and urine for agriculture contributed towards the overall income of the village. It is estimated that these benefits provide 200 percent return on the investment over the lifespan of a toilet.

The programme has not only contributed towards environmental sustainability but has also proved to be extremely beneficial in social and economic terms.

Excerpts from the chapter on 'Greening NBA' by Nitya Jacob in volume 2 of this report.

Case Study 10: From Research to Scaled up Practice in Andhra Pradesh

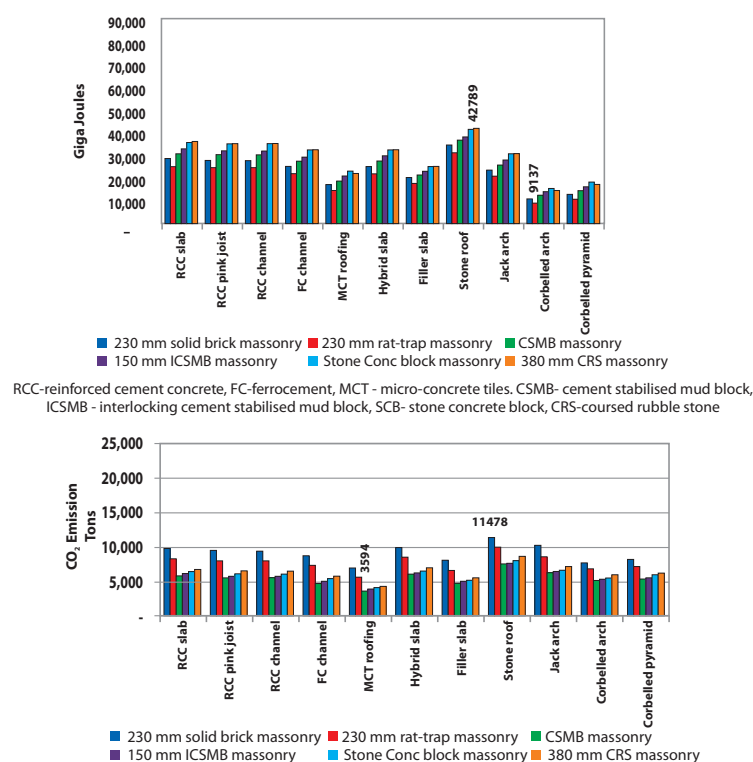
In the mid 1990s, DFID and the Government of Andhra Pradesh undertook a joint project to do a comparative analysis of the costs and environmental implications of various technologies for different building parts. A nationwide review of cost effective and environment-friendly technologies identified 11 different kinds of roofs, six types of walls and three types of foundations. The technologies were shortlisted on the basis of (i) durability (ii) availability of materials and skill (iii) energy consumption (iv) cost (v) income generation (vi) acceptability and (vii) maintenance requirements.

Later, 56 buildings were constructed in Ranga Reddy district (A.P.). The use of renewable energy and low CO₂ emissions were favoured. Thus, brick making for these buildings used rice husk as a fuel and the ash from the kiln was used as one of the materials in the bricks. The left over ash was used as manure. These buildings were also used to prepare reliable information on the life cycle costs and environmental impacts.

The research provided very valuable comparative data on the greenness and costs of the different technologies. The Figures below compare (a) the embedded non-renewable energy and (b) the CO₂ emissions of 66 different walling and roofing systems if 1,068 rooms (25 sq.m.) are built. The data show that (a) the minimum non-renewable energy is consumed for 230 mm rat trap masonry and corbelled arch roof (9,137 GJ) and the maximum for 380 mm coursed rubble stone masonry with stone roof (42,789 GJ); (b) the maximum CO₂ emission is for 230 mm solid brick masonry wall with a stone roof (11,478 tons) and the minimum for cement stabilized mud block masonry with a micro concrete tiles roof (3,594 tons)

The cost savings ranged between 10 to 35 percent of a typical cement, steel and brick structure. Ultimately, the DPEP programme in Andhra Pradesh built 69,000 education buildings and 53,000 additional classrooms based on the data produced by the above research. A mathematical model was developed to balance between the greenness of the technologies and their cost effectiveness. This model has also been used in Sri Lanka, Bangladesh, Myanmar, Iraq and South Africa. The APPEP data can be used for IAY housing also. A book 'Vidyalayam' was published by DFID giving all the data for the different technologies. Three cost-effective and environment-friendly primary health centres were also built later in Odisha based on the data of APPEP.

Figure (a) Comparison of embedded non-renewable energy in 66 combinations of walls and roofs for 1,068 rooms (25 sq.m.)



Annexure 2: Green Indices

Green Indices for rural development schemes can be complicated, particularly in the case of very large schemes such as MGNREGS and NRLM. The development of green index for any scheme may, therefore, be required to be undertaken by a multi-disciplinary team that can address the technical, social and statistical aspects of the measurement. The field staff who will be undertaking the measurements will also have to be closely consulted and involved in this process. The indices would also have to be field tested before they are finalized.

There are two issues that may be critical in this context. First, it is important to know the objective for which the index is being prepared or the parameters that are being measured; i.e., what is to be measured and why. This will determine the nature and type of measurement itself – should it be quantitative, semi-quantitative or qualitative. Second, as most methods contain an element of subjectivity, particularly the qualitative ones, the index may be designed to limit the variability of the measurement from one investigator to another.

Indicative Green Indices for three schemes are detailed below. These can be the basis for developing the guidelines across all schemes.

1. Green Index: MGNREGS¹

The aim is to develop a Green Index for the MGNREGS at a Gram Panchayat level. This is the smallest administrative/governance unit for which funds are released.

Assume that N works are undertaken in a GP. Then, a Green Value can be computed for each work. The Green Index (GI) for the Gram Panchayat's MGNREGS is given by the formula below:

$$GI_{GP} = \frac{\sum_{i=1}^{i=N} (GV)_i}{4N}$$

This formula implies that the Green Values of all the N works are summed up and normalized by a factor 4N, the latter being the maximum score that N works can have.

The Green Value of each work is a product of its Green Potential and the Effectiveness of that work, or

$$GV = \text{Green Potential} \times \text{Effectiveness}$$

The Green Potential of any work is related to the conceptual framework of greening rural development that has been identified in Chapter 1 of the report. The framework is based on four elements:

- (1) Enhancing the productivity (P)/quality of the local natural resource base or eco system.
- (2) Increasing the sustainability (S) of the local natural resource base or eco system.
- (3) Reducing the negative impact (I) of local developmental activities.
- (4) Enhancing resilience (R) to climate change impacts.

Each of the above four factors may be given a value 1 or 0 depending on whether an MGNREGS work has the potential to fulfill that objective or not. Thus, if an MGNREGS work fulfills only one of the above four objectives, its Green Potential will be 1; or if it fulfils all four objectives, its Green Potential will be 4.

¹ Prepared by Dr Ravi Chopra

The Effectiveness of any work is based on a semi quantitative assessment of its coverage and durability/ quality. It may be determined on the basis of pre-defined parameters and expressed as:

- (1) High (H) = 1.0
- (2) Medium (M) = 0.5
- (3) Low (L) = 0.25
- (4) Minimal (m) = 0.1
- (5) Worthless (W) = 0.0

Since the maximum value of the Green Potential of any work is 4 and of Effectiveness is 1, the maximum Green Value of any work will be $4 \times 1 = 4$. The maximum score for N works in a Gram Panchayat will be 4N.

Application to Water Conservation/Harvesting works [ponds, check dams, earthen dams, percolation tanks]

(1) In principle, all the Water Conservation/Harvesting works identified above have the potential to fulfil all the four objectives of greening rural development. Hence, their Green Potential is 4.

(2) The Effectiveness of any such work will be based on :

- Coverage – is the quantity of water harvested/conserved adequate or not in terms of the peoples' and livestock's requirement.
- Durability – has catchment area treatment (CAT, minimum 400 saplings surviving per ha) been done or not, does the structure have durability features (stone pitching for dams, greening of dams slopes).

H (The work has CAT, adequate coverage, durability features) = 1.0

M (CAT, adequate coverage or durability) = 0.5

L (adequate coverage + durability) = 0.25

m (adequate coverage) = 0.1

W (none of the above) = 0.0

Application to drought proofing works (afforestation or plantations)

(1) Again, both afforestation and plantations have the potential to fulfil all the four objectives of greening rural development. Hence, their Green Potential is 4.

(2) The Effectiveness of these works will be based on :

- Coverage – is based on whether the work is done on community lands or not; at least 400 saplings/ha are surviving, though 600 surviving saplings/ha are desired; the area covered should provide for at least one fruit tree per family and one fodder tree per head of cattle.
- Durability – plantation/afforestation area has a protection wall; grasses are also planted or allowed to regenerate naturally and harvested from time to time in a regulated manner. Trenching in the same area will be an added plus.

H (on community land, 600 saplings/ha surviving, grasses, protective wall) = 1.0

M (on community land, 400 saplings/ha surviving, grasses, protective wall) = 0.5

L (on community land, <400 saplings/ha surviving, protective wall) = 0.25

m (on encroached common land, <400 saplings/ha surviving, protective wall) = 0.1

W (on encroached common land, <400 saplings/ha surviving) = 0.0

Application to Contour trenches

(1) Contour trenches enhance the productivity of sloping lands and subterranean flows. They also increase the sustainability of downstream springs and stream flows and provide resilience in times of climate change. Hence, their Green Potential is 3.

(2) The Effectiveness Value (VE) of trenches is based on :

- Coverage – do the trenches cover most of the watershed slopes prone to soil erosion and rainwater run-off, some of the slope or only a small part of the slopes? It must be noted that trenches require regular desilting so that the storage volume is not reduced.
- Durability – has catchment area treatment (CAT, minimum 400 saplings surviving per ha) been done or not; Depth at least 0.5m; Continuous (CCT) where rainfall is <1000 mm, otherwise staggered contour trenches (SCT).
- VE (large coverage, CAT done, good durability features) = 1.0

V_E (CAT done, moderate coverage or durability features) = 0.5

V_E (moderate or low coverage + moderate durability) = 0.25

V_E (moderate or more coverage but poor durability) = 0.1

V_E (none of the above) = 0.0

Application to Contour bunds

(1) Contour bunds reduce soil erosion and run-off velocities and enhance soil moisture in the vicinity of the bunds. They also increase the sustainability of arable lands. Hence their Green Potential is 2.

(2) The Effectiveness Value (VE) of contour bunds is based on :

- Coverage – do the bunds cover most of the watershed land prone to soil erosion and rainwater run-off, some of it or only a small part of it?
- Durability – Height should not be less than 0.5 m after compaction; a waste weir must be provided; successive weirs should not be in a line. Slope of the land should be less than 10 percent and rainfall less than 1000 mm. Vegetative cover enhances their durability.

V_E (large coverage, CAT done, good durability features) = 1.0

V_E (CAT done and at least moderate coverage or durability features) = 0.5

V_E (moderate or low coverage + moderate durability) = 0.25

V_E (moderate or more coverage but poor durability) = 0.1

V_E (none of the above) = 0.0

Application to Loose Boulder Check Dams (Nala Plugs) :

(1) Loose boulder check dams or nala plugs reduce soil erosion and run-off velocities in small drainage lines. By trapping silt, they reduce the siltation rate in water harvesting structures. They also recharge the groundwater by enhancing infiltration. They may, therefore, be assigned a Green Potential of 2.

(2) The Effectiveness Value (VE) of loose boulder check dams is based on :

- Coverage – do the loose boulder check dams cover most of the drainage line (s) that is prone to soil erosion and rainwater run-off, some of it or only a small part of it?
- Durability – Height should not be more than 1.0 m after compaction; Catchment area (CA) <25 ha for regions with rainfall <1,000 mm; CA <10 ha for regions with > 1,000 mm rainfall. CAT enhances their durability.

V_E (large coverage, CAT done, good durability features) = 1.0

V_E (CAT done and at least moderate coverage or durability features) = 0.5

V_E (moderate or low coverage + moderate durability) = 0.25

V_E (moderate or more coverage but poor durability) = 0.1

V_E (none of the above) = 0.0

Application to Farm Bunds

Similar to contour bunds

Application to Gabion Structures

(1) Gabion structures also reduce soil erosion and run-off velocities in small drainage lines. By trapping silt, they reduce the siltation rate in downstream water harvesting structures. They also recharge the groundwater by enhancing infiltration. They are, however, usually unable to withstand flash floods, particularly in high slopes areas in the event of very intense rainfall. They may, therefore, be assigned a Green Potential of 2.

(2) Their Effectiveness Value (VE) may be based on :

- Coverage – size of their catchment area which may range from 50 to 500 ha.
- Durability – Key trench must be provided (approx. 1/4th of ht). The structure should be embedded in both banks. Round boulders preferred for construction. A spillway should be provided at the centre. The base of an upstream gabion and the top of a downstream one should be at the same level. CAT is a must. Use of 14-16 gauge GI wire.

V_E (large coverage, CAT done, good durability features) = 1.0

V_E (CAT done and at least moderate coverage or durability features) = 0.5

V_E (moderate or low coverage + moderate durability) = 0.25

V_E (moderate or more coverage but poor durability) = 0.1

V_E (none of the above) = 0.0

Application to Underground Dykes

(1) Underground dykes impede the flow of sub-surface water and make it available to wells downstream, thereby increasing farm productivities. Surface flows in the drainage lines last longer and CAT adds additional green potential. Hence, its Green Potential can be taken as 3.

(2) The Effectiveness Value (VE) of an underground dyke is based on :

- Coverage – size of its catchment relative to the size of the watershed
- Durability – Depth ≤ 6 m, ht ≤ 1.5 m. Preferably only on first and second order streams. Constructed preferably within 50 m of downstream irrigation wells (either present or proposed). Increase in water levels of nearby wells is an indicator of its effectiveness. CAT needed.
- VE (CAT done, large coverage, durability features) = 1.0

V_E (CAT, moderate coverage or durability) = 0.5

V_E (moderate or low coverage + durability) = 0.25

V_E (moderate or more coverage but poor durability) = 0.1

V_E (none of the above) = 0.0

Application to Earthen Dams

(1) By storing rainwater and run-offs, earthen dams provide effective drought-proofing. Since they can have large catchments, CAT ensures that negative effects of development can also be mitigated by the added green cover. Green Potential is 4.

(2) The Effectiveness Value (VE) of any such work will be based on

- Coverage – Check dams on main watershed stream provide more coverage than those on lower order streams.
- Durability – CAT (minimum 400 saplings surviving per ha) is essential, does the structure have durability features (stone pitching for dams, greening of dams slopes). Environmental flows to be released downstream.

V_E (The work has CAT, large coverage, durability features) = 1.0

V_E (CAT, moderate coverage or durability) = 0.5

V_E (moderate or low coverage + durability) = 0.25

V_E (moderate or more coverage but poor durability) = 0.1

V_E (none of the above) = 0.0

Application to Dugout Ponds

(1) Dugout ponds are made on private lands to provide protective irrigation to *kharif* crops. Generally made on flatter land. Amenable to multiple uses like fish farming and irrigating rabi crops. Green Potential is 4.

(2) The Effectiveness Value (VE) of any such work will be based on

- Coverage – On private lands at least five percent farm plot.
- Durability – Ponds should be either puddled with clay soil or lined with LDPE

V_E (The work has CAT, large coverage, durability features) = 1.0

V_E (CAT, moderate coverage or durability) = 0.5

V_E (moderate or low coverage + durability) = 0.25

V_E (moderate or more coverage but poor durability) = 0.1

V_E (none of the above) = 0.0

Application to Stop Dams

(1) Stop dams are barrage type structures that are usually constructed on perennial streams or those with large catchment areas (>1000 ha). They are meant to store the post monsoon flows. They can enhance farm production and maintain its sustainability. Green Potential value may be considered as 2.

(2) Their Effectiveness Value (V_E) will be based on :

- Coverage – Effectiveness is indicated by the increase in recharge of downstream wells. Hence, number of wells reporting significant increase in recharge.
- Durability – Usually a masonry structure with metal plate gates. During the monsoons, the gates are kept open to flush out the silt.

V_E (Most downstream wells report significant recharge, good quality of structure) = 1.0

V_E (A moderate number report significant recharge, good quality of structure) = 0.5

V_E (low coverage + moderate durability) = 0.25

V_E (low coverage but poor durability) = 0.1

V_E (none of the above) = 0.0

Applications to other works like springshed development, Nadep composting, vermi composting, etc. in the list of 30 works given in the latest MGNREGS guidelines can be similarly prepared.

In the succeeding table, a few sample calculations are presented. Once such a table is finalized for all the different types of MGNREGS works, then the Green Potential of each type of work becomes pre-determined and a Gram Sabha meeting can do the Effectiveness assessment based on the H, M, L, m, W parameters that are described in the attached note. Calculating the Green Index for all the MGNREGS works in a Gram Panchayat can be determined by using a fully-filled sheet like this in a Gram Sabha meeting. It also becomes an instrument for participatory evaluation of the MGNREGS implementation in the particular Gram Panchayat.

S. No	Type of Work	Green Elements				Green Pot (PG)	Effectiveness Parameters		Effective -ness Value* VE	Green Value VG = PG x VE
		P	S	I	R		Adequacy/Coverage	Durability/Quality		
1.	Water Conservation/ Harvesting works	✓	✓	✓	✓	4	Ade. Quantity for peoples' & livestock's needs.	CAT, 400 saplings surviving per ha, structural durability features	1.0 to 0.0	GV1
2.	Drought proofing works (afforestation or plantation)	✓	✓	✓	✓	4	On community land Min. 400 saplings/ha surviving; 1 fruit tree/family, 1 fodder tree/cattle head.	Grasses in addition to trees and a protective wall	1.0 to 0.0	GV2
3.	Village roads/paths	-	-	-	✓	1	-	No trees cut, hedge or trees planted along the edges, no disruption of the catchment of local water bodies	1.0 to 0.0	GV3
4.	Irrigation (micro & minor)	✓	-	-	✓	2	30 percent BPL/SC/ ST/FHH lands are irrigated.	See row 1	1.0 to 0.0	GV4
5.	Contour trenches	1	1	-	1	3	Most of the area prone to soil erosion by water, part of it or only a small portion is covered.	CAT done;		
6.	Contour bunds	1	1	-	-	2	Most of the area prone to soil erosion by water, part of it or only a small portion is covered.	Ht should not be less than 0.5 m after compaction; A waste weir must be provided; successive weirs should not be in a line. Slope of the land should be < 10 percent and rainfall < 1.00 m Vegetative cover on bunds required.		
7.	Loose boulder check dams	1	1	-	-	2	Most of the drainage line(s) prone to rapid run-off, part of it or only a small portion is covered.	Catchment area (CA) <25 ha for regions with rainfall <1,000 mm; CA <10 ha for regions with > 1,000 mm rainfall		
8.	Farm bunding	1	1	-	-	2		Ht not less than 0.6m after compaction		
9.	Gabion structures	1	1	-	-	2	Catchment area may extend from 50 to 500 ha.	Key trench must (approx. 1/4th of ht). Structure should be embedded in both banks. A spillway should be provided at the centre. Round boulders desirable. The base of an upstream gabion and the top of a downstream one should be at the same level. CAT is a must. Use 14-16 gauge GI wire.		

S. No	Type of Work	Green Elements				Green Pot (PG)	Effectiveness Parameters		Effective -ness Value* VE	Green Value VG = PG x VE
		P	S	I	R		Adequacy/Coverage	Durability/Quality		
10.	Underground dykes	1	1	-	1	3	Construction desirable within 50 m of irrigation wells (present or proposed).	Depth <6 m, ht< 1.5 m Preferably only on first and second order streams :		
11.	Earthen dams	1	1	1	1	4	Check dams on main watershed stream provide more coverage than those on lower order streams.	Properly designed spillway is essential. Key trench required. CAT is a must. Pitching on the upstream side must for dams with CA>50 ha Sodding on d/s side slope No trees on the dam.		
12.	Dugout farm ponds	1	?	-	1	2	At least on five percent of the farm area.	Ponds should be either puddled with clay soil or lined with LDPE.		
13.	Stop dams	1	1	-	?	2	On streams with perennial flows or with a catchment > 1,000 ha. Increase in water levels of d/s wells indicates effectiveness.	Barrage type masonry structure with sheet metal gates.		
14.	Springshed development	1	1		1	3		CAT At least 150 SCT of 0.5kl capacity per ha Sodding over the bunds on all three sides At least 300 saplings to be planted Regular desilting of trenches.		
15.	Nadep composting	1	1	1	1	4	Quantity of compost .	Ratio of tank dimensions important. L=3.6 m, W=1.5 m and H=0.9 m Corners prone to cracking due to expansion should be reinforced. Sprinkling water at regular intervals improves the manure quality.		
16.	Vermicomposting	1	1	1	1	4	Quantity of compost.	Corners prone to cracking due to expansion should be reinforced. Should be under a shade.		

2. Green Index: NBA

The table below may be developed to monitor green results at village level (with high scores for green aspects)

S.No.	Parameter	Green Value	Coverage	Weightage	Max. Score	Villag Score
1.	Percent houses with sanitary latrines/toilets	Ecosan toilet: 1.0 Flush pour latrine: 0.5 Pit latrine: 0.2 No latrine: 0.0	76-100%: 5 51-75%: 3 26-50%: 2 1-25%: 1 0%: 0	3	15	
2.	Percent public places with sanitary facilities	Ecosan toilet: 1.0 Flush pour latrine: 0.5 Pit latrine: 0.2 No latrine: 0.0	76-100%: 5 51-75%: 3 26-50%: 2 1-25%: 1 0%: 0	2	10	
3.	Percentage of live-stock owning families accessing bio-gas digesters	1	76-100%: 5 51-75%: 3 26-50%: 2 1-25%: 1 0%: 0	1	5	
4.	Percent households composting kitchen waste	1	76-100%: 5 51-75%: 3 26-50%: 2 1-25%: 1 0%: 0	2	10	
5.	Percent households reusing grey water	1	76-100%: 5 51-75%: 3 26-50%: 2 1-25%: 1 0%: 0	2	10	
6.	Does the village have an inorganic solid wastes management system?	Collected, sorted and recycled: 5 Collected, sorted, re-cycled and landfill: 4 Collected but unsorted, landfill: 2 Collected and dumped at one location: 1 No system: 0	-	3	15	
7.	Does the village have a liquid waste management system?	DEWAT system:1 Fully covered drains: 0.5 Partially covered drains: 0.2 Uncovered drains: 0.1 No system: 0	76-100%: 5 51-75%: 3 26-50%: 2 1-25%: 1 0%: 0	3	15	
8.	Village paths are free of dung	1	Totally free: 5 Largely free: 3 Partially free: 1 Not free: 0	2	10	
9.	Village paths are free of other trash	1	Totally free: 5 Largely free: 3 Partially free: 1 Not free: 0	2	10	
Total					100	

3. Green Index: IAY²

A simple Green Metric System has been developed here that could be used by the Block officers/engineers to measure greenness of different options of technologies. This will enable them to promote the concept of greenness and its related incentives to the IAY beneficiaries. The Green Metrics will also help them calculate both the quantum of environmental impacts and greenness indices of all the IAY shelters built annually in a Block. With this, the state can review the speed and direction of their green movement towards the set target.

Energy & Emission Handbook

The first and foremost action for developing green metrics would be to publish Energy & Emission Handbook for architects, engineers, planners, contractors, etc. The Handbook will provide information on the method of calculations, assumptions such as the boundary conditions, etc. It will show, in simple tables, the embodied energies and emission of CO₂ of each building material owing to the use of different types of fuel such as coal/petrol, electricity, wood, non-wood, agriculture waste, etc. It should also provide data on depletion of soil, consumption of water and transportation of the finished materials from production units to the construction sites. The architects, engineers, etc. will first calculate the quantities of materials for a particular building based on the building design. Following that she/he will multiply each quantity of material by the unit embodied energy, CO₂ emission, etc and get the total quanta of impacts on environment owing to the construction of one unit of an IAY shelter.

Since, it will take time to appoint multidisciplinary experts to develop the Handbook, as an intermediate action, data on embodied energy and emission of CO₂ could be adopted for calculating greenness of IAY buildings based on the Energy Directory of Building Materials (DA, 1995) and the data from the experience of APPEP. To kick start the green drive, one needs a very simple model for calculating environmental impacts that will suit the capacity of a block-level junior engineer. Therefore, only the embodied energies and emission of CO₂ of each construction material at production yard has been considered. This will enable the block-level engineer to report the environmental impact of different technologies in IAY. The environmental impact due to the on-site process has been ignored right now since field experience revealed that only a very small quantity of energy and emission were involved in the onsite process.

Database

Robust database on RCC and brick-based systems are available with all the government engineering departments. The recent Web Portal of MoRD, which is under process, will provide a wide range of database on construction technologies for all types of rural housing. These databases are from different contexts and under different conditions. Hence, the web portal has to homogenize the data in course of time by conducting and in-depth research.

Measuring Environmental Impacts

The government has targeted quanta of annual reduction in emission and embodied energy to achieve greenness in India. Therefore, it necessary to examine the extent to which IAY could help in reducing the energy and emission by adopting socio-culturally suitable materials and technologies in shelter construction. This could be done by analyzing the embodied energy and emission by different technologies in a context by using data on construction systems and energy handbook. The following Figure 5.1 and Figure 5.2 show the different impacts one IAY unit can have owing to the use of different technologies.

²Relevant sections extracted from the Paper on IAY in Volume 2

Figure 1 shows that the maximum embodied non-renewable energy of one IAY unit is 44,394 Mega Joules if one adopts stone roofing and 230 mm solid brick wall. Stone has negligible embodied energy, however, the use of brick bat coba as roof waterproofing has made it energy intensive. The combination of micro concrete tile roof with CSEB has the lowest embodied non renewable energy (11,920 mega Joules). Therefore, if micro-concrete tiles and CSEB are used in 10,000 IAY units, there will be a saving of 324 trillion joules of embodied energy equivalent to 90 Giga watts of electricity with respect to the option of solid brick wall and stone roof.

If one constructs 10,000 IAY units with micro concrete tile roof with CSEB wall, there will be a reduction in CO₂ emission by 52,000 tons compared to that of the emission by stone roofing and 230 mm solid brick wall.

The quantitative aspect of different construction technologies shown in the below Figures is useful for measuring IAY's speed of approaching greenness. However, one would need a process of calculating the greenness index of each IAY shelter based on which appropriate incentives could be given to the deserving HHs. The following section presents a simple process that measures how green an IAY shelter could be.

Figure 1: Pattern of embodied non-renewable energy: Different walling & roofing technologies

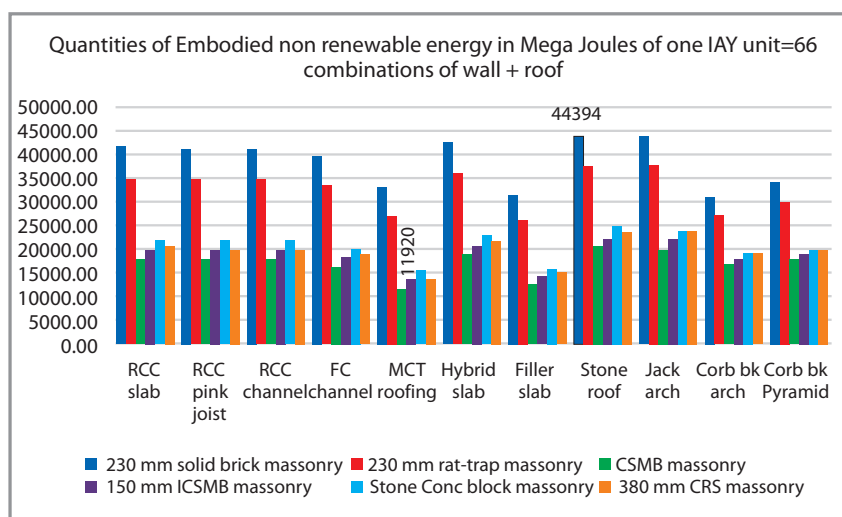
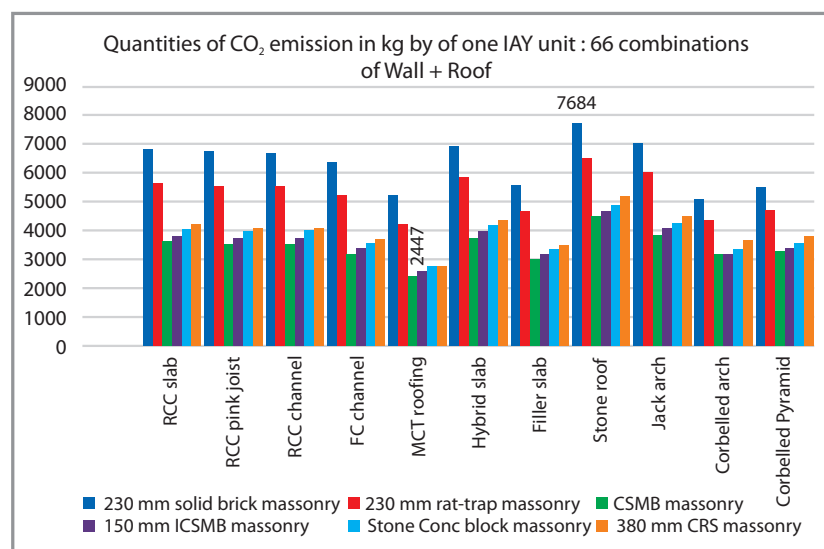


Figure 5.2: Pattern of CO₂ emission: Different walling and roofing technologies



Proposed Green Index Calculator

The Greenness of an IAY unit will be calculated with reference to a building constructed with RCC roof and 230 mm solid brick wall (20 sq.m. covered area). This combination of wall and roof is highly energy and emission intensive and will be assumed to be of zero green. The other extreme point of the scale is 100 percent green technology indicating that it has no embodied energy neither leads to any CO₂ emission. It is clearly a hypothetical case though bamboo-based building would be close to 100 percent green. Therefore, the greenness will be zero for RCC roof and brick wall tapering to zero as shown in the following Figure 5.3 ("B"). If one adopts a different construction technology in a shelter, its negative impact on the environment will be calculated and placed in the diagram (shown in dotted line X-X).

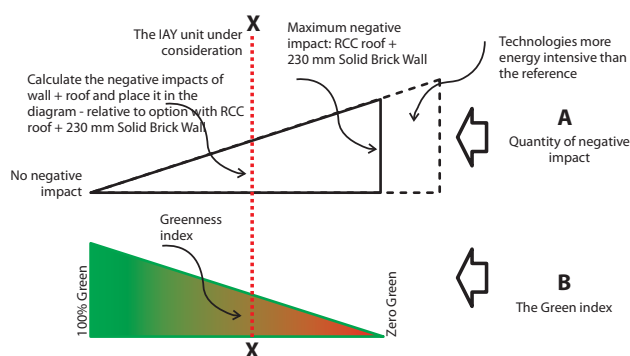


Figure 5.3: A simple model of calculating greenness of an IAY unit

In order to make the calculator simple, only the wall and roof have been considered since these two components of a building account for 60 percent to 70 percent of the total cost of a building and also have the major impact on environment. Table 5.1 and 5.2 show robust data based on the energy emission by Development Alternatives and BMTPC (1993), TEDDY(1993)14 and updated by Das(2005). This database provides a simple table showing the embodied energy and emission of a few roofing and walling technologies. The values in the following Tables exclude the energy and emission due to transportation.

Table 1: Environmental impact data of roofing systems: Basic Structure + roof waterproofing/insulation+ ceiling finishing and painting (wherever applicable)

	Roofs	Embodied Non-renewable energy MJ/Sq. m.	Embodied renewable energy MJ/Sq. m.	CO ₂ Kg/Sq. m.
RF01	RCC slab	511.82	137.26	85.14
RF02	RCC plank-joist	498.04	37.04	79.99
RF00	RCC channel	498.41	37.04	79.38
RF04	FC channel	430.30	17.62	60.95
RF05	MCT roofing	235.45	10.39	33.35
RF06	Filler slab	328.95	284.67	73.16
RF07	Stone roof	640.82	214.41	127.61
RF08	Jack arch	633.74	102.97	96.89
RF09	Corbelled brick arch	615.09	149.91	99.89
RF10	Corbelled brick pyramid	620.56	144.50	97.14

Table 5.2: Environmental impact data of walling systems: Basic structure, external plastering, pointing, internal plastering, internal and external paining (wherever applicable)

	Roofs	Embodied Non-renewable energy MJ/Sq. m.	Embodied renewable energy MJ/Sq. m.	CO ₂ Kg/Sq. m.
W1	230-thk solid brickwork	529.57	209.65	86.11
W2	230 thk rat-trap	421.46	172.04	66.86
W3	230-thk CSMB masonry	134.54	64.06	33.15
W4	150-thk ICSMB masonry	181.77	26.47	38.97
W5	150-thk SOB masonry	206.16	61.30	40.76
W6	380-thk CRS masonry	153.00	74.50	37.70

Let us now see how this model works. First of all, calculate the wall perimeter of the IAY building plan of 20 sq. m. plinth area. For a simple square plan-form, it will be 22.42 m. Assuming a wall height of 3 m, the surface area of the wall will be 22.42X3= 67.26 sq. m. Assuming a 300 mm projection beyond wall, the total roof area will be 25.73 sq. m. Let us now use the database from Table 5.1 Table 5.2 to calculate the environmental impacts of, say, micro concrete tile roofing with 150mm thick ICSBM wall against brick wall with RCC roof. The following table shows the process of calculation

Table 5.3: Process of calculating Greenness Index
Option-1

	Roofs	Embodied Non-renewable energy MJ/Sq. m.	Embodied renewable energy MJ/Sq. m.	CO ₂ Kg/Sq. m.
RF01	RCC slab → value in Table 5.1 (RF01) multiplied by 25.73 sq.m. - the roof area	13169.13	3531.70	2190.65
W1	230 - tnk solid brickwork → value in Table 5.2 (W1) multiplied by 67.25 sq.m. - the wall area	35618.88	14101.10	5791.76
	TOTAL OF WALL + ROOF OPTION 1	48788.01	17632.76	7982.411

Option-2

	Walls	Embodied Non-renewable energy MJ/Sq. m.	Embodied renewable energy MJ/Sq. m.	CO ₂ Kg/Sq. m.
RF05	MCT roofing → value in Table 5.1 (RF05) multiplied by 25.73 sq.m. - the wall area	6056.3858	267.3347	858.0955
W4	150 - tnk sICSBM masonry → value in Table 5.2 (W4) multiplied by 67.25 sq.m. - the wall area	12225.85	1780.3722	2621.1222
	TOTAL OF WALL + ROOF OPTION 2	18284.24	2047.707	3479.218

Greenness Index

	Embodied Non-renewable energy MJ/Sq. m.	Embodied renewable energy MJ/Sq. m.	CO ₂ Kg/Sq. m.
Index of MCT roof ← 150 ICSMB wall with respect to RCC roof ← 230 solid brick wall	= (28284.24/48788.01) * 100 = 33%	= (17632.76/2047.707) * 100 = 12%	= (7982.411/3479.218) * 100 = 44%
Savings	100-33 = 67%	100-12 = 88%	100-44 = 56%
Greenness index → Average Savings	Savings in two types of embodied energy and CO ₂ emission of option 2 with respect to option 1. Average saving = (67 + 88 + 56) / 3 = 70.33%		

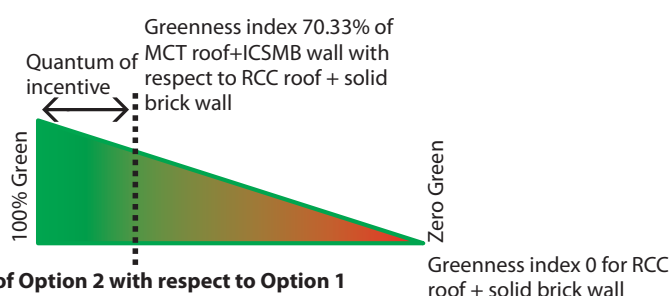


Figure 5.4: Greenness index of Option 2 with respect to Option 1

Weights

One can assign weights to the parameters, i.e., embodied non-renewable and renewable energies and emission of CO₂. If it is assumed that on a scale of 10, weights of non-renewable, renewable energy and emission of CO₂ are 2, 9 and 5, respectively, the revised greenness index will be as follows;

$$\text{Revised Greenness Index} = (67 \times 2 + 88 \times 9 + 56 \times 5) / (2 + 9 + 5) = 75\%$$

Notes on the Green Index

The proposed model of greenness index calculation is very simple and could be introduced right away. However, in course of time, the model should be transformed to a sophisticated level to capture all the important aspects of greenness. For example, every 8 sq. m. of RCC slab requires 500 litres of water for mixing and curing. Such water should be equivalent of drinking water. Therefore, it is important to consider water intensity of different construction technologies while calculating greenness, especially in areas where it is scarce. If the act of curing is ignored due to lack of water, strength of cement concrete will get reduced significantly leading to high cost of future maintenance along with less life-span.

Greenness of a building could be controlled at planning, design, materials and technologies and construction management levels. For example, perimeter of an octagonal plan form is less than that of a square one for same internal area. Thus, one can reduce material consumption in wall and foundation by adopting appropriate geometry. For areas with poor road condition, procurement of materials in good seasons will save on transportation energy and emission (management control). Table 4 shows the whole gamut of parameters for greenness calculation of IAY shelter.

Table 4: Showing control points, parameters, weights regulating greenness of IAY shelter

TEN PARAMETERS OF GREENNESS											
Control Points	Non re-newable	Re-newable wood	Non wood waste etc.	Recycle Industrial Waste	Water Consumption	Liquid waste	Solid waste	Depletion of soil	CO ₂ Emission	Re-newable material - bamboo etc.	Control point weights
	KWH	KWH	KWH	TONS	LITRES	TONS	TONS	SQ. M.	TONS	TONS	
Planning	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	WI (1)
Design	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	WI (2)
Materials & Technology	MT1	MT2	MT3	MT4	MT5	MT6	MT7	MT8	MT9	MT10	WI (3)
Management	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	WI (4)
	PW1	PW2	PW3	PW4	PW5	PW6	PW7	PW8	PW9	PW10	
PARAMETER WEIGHT											



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