Report of the
XII Plan Working Group on

Natural Resource Management and Rainfed Farming

November 15, 2011

Background and Acknowledgements

Planning Commission constituted a Working Group (Office Memorandum F.No M-12043/3/2011-Agri dated March 31st , 2011) on ***"Management of Natural Resources and Rainfed Farming"*** to deliberate and make recommendations in the context of preparation of 12th Five Year Plan (2012-2017) period. The composition of the group and terms of references are appended. The group met two times. In the first meeting held on 25th April, 2011 the subject, overall expectations and broad views were discussed and five sub-groups constituted to hold in-depth deliberations to come up with specific recommendations in respect of five identified themes. The five themes and respective chairpersons of these groups were as follows

Theme	**Chairperson**
Polices and Programmes	Dr A K Sikka, NRAA
Agricultural Production System	Dr B Venkateswarlu, CRIDA
Research and Developement	Dr A K Singh, ICAR
Institution Building and Commons	Dr P S Vijay Shankar, SPS
Climate Change Mainstreaming	Dr Arbinda Mishra, TERI

A second meeting of the Working Group was held on 25th July, 2011 where the outputs of the five thematic sub-groups were shared with a view to build overall consensus on the Group's recommendations. A report drafting team was constituted to synthesize the sub-group reports for final submission. The drafting team included the following: (Drs) B. Venkateshwarlu, Rajeswari Raina, Ravindra, Vijay Shankar and A K Sikka. The drafting team held several informal meetings and interactions where the chairperson also shared feedback based on interactions with the key States functionaries, members of Steering Committee and others. It was indeed a pleasure working with members of the drafting team but for whose understanding, insights at ground roots and dedicated efforts the assigned task would not have been possible. My sincere thanks are to Planning Commission for providing an opportunity to be a part of the effort and to all members for their support. I also owe a word of thanks and appreciation to my colleague Ms Mamta Mehra for her assistance throughout the period of the assignment. I do hope the efforts of the group will contribute to significant initiatives aimed at addressing the "Natural Resource Management and Rainfed Areas" issues vital to sustained agriculture.

I P Abrol
Chairperson
Centre for Advancement of Sustainable Agriculture
NASC Complex, New Delhi-110012

Working Group on Natural Resource Management and Rainfed Farming List of Members

1	Dr. I.P. Abrol, Chairman, CASA**, (Chairman)** Email:abrolip@gmail.com, Mob: 9810772161 ®0124-2358755/2354267
2	Dr. J. S. Samra, Chief Executive Officer, National Rainfed Area Authority,
3.	Dr. A.K. Singh, DDG(NRM), Phone No. 011-25848364 Fax No. 011- 25848366 E-mail: aksingh@icar.org.in
4	Dr Arabinda Mishra, Director, Mob. 9899809112 E-mail: amishra@teri.res.in
5	Dr. Deepak Sarkar, Director, NBSS&LUP, Mob. 09422507143 Email.director@nbsslup.ernet.in sarkardeepak@rediffmail.com
6	Dr. B. Venkateswarulu, Director, Central Research Institute for Dryland, Mob.09652988265 Director@crida.ernet.in , vbandi_1953@yahoo.com
7	Smt Aradhana Shukla, Managing Director, U.P.L.D.C., Bhumi Sudhar Nigam, Tel. 0522-2720428 Emial. aradhanashukla@hotmail.com
8	Director, National Remote Sensing Centre, Dept. of Space, Mob. 09293777535
9	Dr. K.V.Sarvesh, Director of Agriculture, Commissionerate of Agriculture, Govt. of Karnataka No.1, Seshadri Road, Bangalore – 560001.
10	Shri M P Vasimalai, Dhan Foundation, Mob.09443738587 Email.dhanfounddation@dhan.org
11.	Dr. M.M. Roy, Director, Central Arid Zone Research Institute (CAZRI), Mob.09414025601 Email.mmroyskr@gmail.com
12	Dr. D.K. Marotia, Head, Deptt. of Agri.& Natural Resource Economics

13	Dr. V. Rattna Reddy, Director, Livelihood & Natural Resource Management Institute,
14	Secretary, (MoEF) or his rep. Deptt. of Environment & Forests,
15	Smt. Savita Anand, Joint Secretary, Ministry of Rural Development Department of Land Resources
16	Adviser (Agriculture), Planning Commission
17	Dr Samsher Singh, Former Addl. Commissioner (NRM), DAC Mob. 9810285456 Email. samsher123@yahoo.com
18	Dr Veer Pal, Sr Joint Commissioner, Ministry of Water Resources , E-mail: drveerpal@yahoo.co.in
19	Dr. P.K. Joshi, In charge Director and Senior Program Manager International Food Policy Research Institute Tel. 011-25846565 Fax.25848008 Email.p.kjoshi@cigar.org
20	Dr Tej Pratap, Vice Chancellor, Sher-Kashmir University of Agricultural Sciences & Technology Tel. 0194-2462159 Email. Preyee52@gmail.com, vs@skuastkashmir.ac.in
21	Dr.A.E. Eknath, Director, Central Institute of Freshwater Aquaculture Email. cifa@ori.nic.in, ambedkar.eknath@yahoo.co.in
22	Dr R.R. Navalgund, Director, Space Application Centre Indian Space Research Organisation, Email. director@sac.isro.gov.in
23	Chwang Norphel, Chief Project Officer, Leh Nutrition Project, LEH (LNP) Mob. 09419219228 Email:lnpleh@yahoo.co.in
24	Shri R. Bandyopadhyay, C-1/41, Pandara Parck, N.D-110003 O11-23382644/9868886548 Email-vsbanerjee@gmail.com
25.	V.K Madhavan, Executive Director, Central Himalayan Rural Action Goup Ph: 09412084690, E-mail: madhavan@chirag.org.
26.	Shri Ravindra A,

	WASSAN, Ph: 9440621861 E-mail: raviwn@gmail.com
27	Shri P.S. Vijay Shankar, Director of Research, Samaj Pragati Sahyog, Email.core@samprag.org
28.	Shri PVS Surya Kumar, Deputy General Manager,NABARD, Email.pvssk@yahoo.com
29.	Shri Jagdish Rao, Executive Director, Foundation for Ecological Security Tel.02692-261303/261417 Email.ed@fes.org.in
30.	Dr Rajeswari S. Raina, Scientist, NISTADS Tel.011-25843029 (o)/ 26137061 ® Mob.9010956469 Email. Rajeswari.raina@gmail.com
31	Dr Kornel Das, CALPI, Tel-011-26868536 Email. calpi@spectranet.com
32.	Shri E.K. Majhi (Member Secretary), Joint Secretary, (RFS/NRM), DAC, Ministry of Agriculture, Tel.011-23385093, Fax: 011-23782641 E-mail. ek.majhi@nic.in
33	Shri Subrata Nath, Director, Ministry of Agriculture, Dept.of Agriculture & Cooperation, Email:subnath@gmail.com Mob:+91-95400 79673
34	Dr. Dipayan Dey, Chair, Sough Asia, Forum for Environment (SAFE)
35	Shr R. Gopichandran, PhD. LLB, Director In-Charge, Gujarat Energy Research & Management Institute
36	Shri R. P Singh, Ex-Director (Agri)/ Soil Conservation/ PPM/ATMA; Mob. 09473342250 Email. raghvendra.pal502@gmail.com

37	Shri Gopikrishna SR, Greenpeace India Society, E-mail: gkrishna@greenpeace.org
38	Shri Toki Blah, NGO
39	Dr. A.K. Sikka, Technical Expert(Watershed), National Rainfed Area Authority,
40	Shri P.K. Joshi, HOD, Deptt of Natural Resources TERI, University, Mob.09818025993 : pkjoshi@teri.res.in
41.	Shri Lalit Kapoor, Director (NRCD), Tel:24368526 (O), 25937555 ® Email.kapoor2000@yahoo.com
42.	Shri A.M. Singh, Deputy Inspector Genral of Forests Tel.2436 4624(O), 2610 8264 ® Email.arvindmsingh@yahoo.com
43.	Dr. P.K. Aggarwal, Regional Facilitator, Challenge Program on Climate Change, IWMI India Email. p.k.Aggarwal@cgiar.org
44.	Dr. H. Himanshu Pathak, Division of Environment Sciences, IARI, Tel.09899247590 Email: hpahtak.iari@gmail.com
45.	Shri D. Balasubramanian, ICT-Tetworks Specialist, French insitutte of Pondicherry, Tel.91-413-2334168/ Ext.204 Email.balasubramania.d@gmail.com, balu.d@ifpindia.org
46.	Dr. U.V.M. Rao, Project Coordinator, AICPR on Agricultural Meteorology, CRIDA, Hyderabad.

Terms of Reference

1. Critically examine the performance and impact of on going programmes by different Ministries/Departments in relation to natural resources, regeneration of degraded lands, soil and water conservation etc.
2. Identify factors contributing to instability in production system under rainfed conditions especially in the context of climate change for stabilizing rainfed production system including specific policy measures for water and seed security, crop diversification, diversification of livelihoods, reduction in cost of cultivation and minimization of risks through insurance, suggesting specific measures to enhance fish production from numerous small water bodies that occupies landscapes in rainfed regions.
3. Examine commons-livestock interface, how institutional mechanisms for governance of common property resources of land and water could be strengthened and suggest ways of strengthening livelihoods of poor dependent on commons based livelihood systems.
4. Examine current status of agricultural research and technology support systems and suggest measures specifically suited to the needs of rainfed farming and particularly research-extension linkages.
5. Identify specific features of key production systems and marketing networks in rainfed areas and suggest measures for ensuring food security to all households in rainfed areas. Examine the need for price incentives and procurement policies in achieving greater diversity in farming system including cropping pattern, livestock and fisheries.
6. Outline the ways of creating a separate dispensation within mainstream public investments, incentive support, institutions and policies for rainfed agriculture.
7. To examine the feasibility of providing incentives to the user groups for sustainable use of land and water, and involvement of PPP mode in management of natural resources.

Table of Index

List of Abbreviation

AEZs	Agro-Ecological Zones
AICRPDA	All India Coordinated Research Project for Dryland Agriculture
AMFU	Agromet Field Units
APDAI	AP Drought Adaptation Initiative
APFAMGS	AP Farmer Managed Groundwater Systems
ASI	Agricultural Statistics of India
ATMA	Agricultural Technology Management Agency
CAZRI	Central Arid Zone Research Institute
CBO	Community Based Organizations
C-DAP	Comprehensive District Agricultural Plan
CIAE	Central Institute of Agricultural Engineering
CIFA	Central Institute of Freshwater Aquaculture
CIFRI	Central Inland Fisheries Research Institute
CPRs	Common Pool Resources
CRIDA	Central Research Institute for Dryland Agriculture
CSSRI	Central Soil Salinity Research Institute
HADP	Hill Area Development Programme
ICDS	Integrated Child Development Services
ICSSR	Indian Council of Social Science Research
INSIMP	Initiative for Nutritional Security through Intensive Millets Promotion program
IWMP	Integrated Watershed Management Programme
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MNAIS	Modified National Agricultural Insurance Scheme
NAIP	National Agricultural Innovation Project
NAIS	National Agricultural Insurance Scheme
NAPCC	National Action Plan on Climate Change
NATP	National Agricultural Technology Programme
NBSSLUP	National Bureau of Soil Survey and Land Use Planning
NFSM	National Food Security Mission
NHM	National Horticulture Mission
NRAA	National Rainfed Area Authority
NRFP	National Rainfed Farming Program
NRM	Natural Resource Management
NWDPRA	National Watershed Development Project For Rainfed Areas
PDFSR	Project Directorate for Farming Systems Research
PESA	Panchayat Extension to Scheduled Areas Act
RADP	Rainfed Area Development Programme
RKVY	Rashtriya Krishi Vikas Yojana
RVPs	River Valley Projects
SLNA	State Level Nodal Agency
SRI	System of Rice Intensification
WDF	Watershed Development Fund
WORLP	Western Orissa Rural Livelihoods Project

Executive Summary

The Context

1. Spanning several agro-ecological regions constituting 60% of total cropped area, the rainfed areas represent the geography with the largest concentration of poverty and backwardness. The cumulative neglect of the rainfed areas over the earlier plan periods in terms of institutional development, support systems, availability of appropriate inputs, credit, market access, agricultural research and extension has caused widespread desperation amongst farming community.
2. The Group welcomes the Approach Paper to the 12th plan articulating a strong case in favour of breaking the isolation and exclusion of rainfed agriculture within the agricultural policy mechanisms, research and extension systems, and credit and market support.
3. Rainfed agriculture supports an estimated 40% of population (484million) and has a large share of cropped area under rice (42%), pulses (77%), oilseeds (66%) and coarse cereals (85%). Harbouring about 78% of cattle, 64% of sheep and 75% of goats rainfed areas cater to most part of the meat market in the country.
4. In spite of the cumulative policy neglect and low investments, rainfed areas are showing high growth potential. The growth in meat markets is well known. The incremental productivity contribution of coarse cereals over the last decade has even exceeded that of rice indicating the potential of rainfed agriculture to contribute to national food security.
5. That such potential for growth exists amidst people in the marginal geographies with high concentration of poverty and backwardness needs to be recognised and rainfed farming must be a priority segment for scaling up investments during the 12th five year plan.
6. Very low scales of public investments in the past and the need for an appropriate policy framework are the two major concerns flagged by the Working Group. With this background the Working Group strongly recommends a paradigm shift that would help evolve a policy framework that permits a meaningful investment in rainfed agriculture. The Working Group has indicatively laid out broader contours of such a paradigm shift.

Need for a Relevant Paradigm

7. Widespread, serious and continuing degradation of natural resource base is a serious concern. The enhanced investments in the 11th FYP on watershed development is a welcome measure and the systematic watershed development need to continue at an enhanced pace during the 12th FYP with more budgetary allocation.
8. Watershed programs constitute a sound system based approach aimed at addressing problems of natural resource management. Various programs aimed at improving crop productivity and the present support systems however, are not in sync with sustainable natural resource management with resource degradation problems continuing unabated. **Resource conservation and sustainable use and management for enhanced productivity need to be seen in unison.** The **Working Group makes a strong case for integration of productivity enhancement with NRM as the core streategy of rainfed areas development.** Given the inherent diversity of natural resources in rainfed areas, the health and dynamism of the natural resource base (land, water and biomass) are direct determinants of the productivity and incomes from economic activities using these resources.

9. Drawing from various successful field experiences, scientific literature and consultations, the Working Group report sets out the broader contours of a relevant paradigm for agricultutal development and rainfed areas in particular. This framework treats watershed development as a foundational investment, but lays emphasises on evolving a relevant policy frame to determine public investments and interventions.

Broad Contours of An Appropriate Paradigm

10. The Working Group recognises the need for enhanced, inclusive and sustainable growth in rainfed areas. It is recommended that a sizeable attempt be made during the 12th FYP for a shift towards a new and relevant paradigm the experience from which can be universalised during the 13th FYP.
11. The pivotal areas of shifts towards a relevant paradigm are the following:
    11.1. Strengthening diverse *local* production *systems* to contribute substantially to the local food and nutrition, and income security. This calls for :
        - Moving away from the present centrally determined approach of single commodity intensification to location specific farming systems intensification approach
        - Moving away from viewing growth as per ha or per animal (single commodity) productivity to system productivity and household income growth.
        - Building food security systems (including decentralized PDS) based on locally adapted food crops
    11.2. Focus on stabilising and securing diverse cropping by bringing a focus on "Rainfall Use Efficiency" as central to policy as against mere use efficiency of applied water. This shift calls for two major focal areas :
        - Promote measures for in-situ conservation and efficient use of rainwater
        - Invest in shared and protective/supportive irrigation
    11.3. Harness the inclusive growth potential in the so far untapped Agronomic and Management Innovations that are aligned to – enhancing sustainability of natural resources, reducing costs, increasing efficiency of resource use and improving total factor productivity. System of Rice Intensification and non-pesticidal management of pests (NPM) as mentioned in the Approach Paper and options evolving in conservation agriculture are some examples.
    11.4. Strengthening extensive livestock systems depending wholly or partly on commons and agriculture residues through intensive efforts in improving health care, feed, fodder, drinking water, shelter, institutions etc. The domain of public policy and intervention must shift to these from the present almost exclusive focus on high yielding breeds.
    11.5. Invest on decentralised and local institutional capacities that enable a shift away from one-time planning to 'iterative planning-implementation-learning cycles' anchored by local institutions.
    11.6. Enhancing institutional capacities in local governance and resource management, particularly related to Commons and strengthening Panchayat Raj, cooperatives and other stakeholder institutions. Such institutional base is a prerequisite for evolving location and agro-ecology specific mechanisms of program designing, credit access, filling in infrastructure gaps, marketing etc.
12. The above changes have an intrinsic positive bias towards women, land less, small holder farmers, pastoralists, and other marginalised people and bring focus on improving the production systems they are centrally involved in.

13. Available evidence suggests such integrated, comprehensive and decentralised initiative can help harness the high inclusive growth potential of rainfed production systems. Several supportive policy changes need to be brought in to usher in this relevant paradigm.
14. Recognising the complexities involved in such an overarching shift in the entire approach the Working Group suggests that a basic and firm foundation be laid during the 12th FYP in terms of a National Program on Rainfed Farming.

Program Architecture

15. The thrust of the Approach Paper to the 12th Plan towards inclusive growth, further decentralisation, Ministry of Agriculture's initiative on restructuring various schemes, breaking the isolation and exclusion of rainfed agriculture within the agriculture planning mechanisms and strong emphasis on convergence – all these were taken cognizance of by this working group while visualizing a robust framework for development of rainfed farming and NRM.
16. The paradigm shift envisaged necessitates taking Development 'Block/Taluk/Mandal' as a unit for programmatic action as it is a manageable unit for planning-implementation and convergence of various programs and human resources into a new framework.
17. While taking up an intensive and dedicated program for an iterative learning on a relevant paradigm is necessary, the Working Group strongly recommends that a 'Rainfed Investment Window' is created in each of the mainstream agriculture, water resources, rural development, food and civil supplies, and other relevant programs. This is necessary because :
    17.1. The program content needs to be consistent with local resource endowments, constraints and opportunities in tune with broad development contours.
    17.2. The need to secure budgetary resources for convergence for Rainfed Program at Block level within the mainstream programs dedicated to rainfed production systems.
18. With the above background, the specific programs recommended for the 12th FYP are as the following:
    a. A **National Rainfed Farming Agency (NRFA)** to be constituted which sets out the new policy framework and provides oversight on all programs in rainfed areas and synthesises learning. The NRAA can be restructured into such an Agency. In addition to the Watershed Development Programs, the Agency shall facilitate the following three major programs to be taken up under the 12th FYP.
        1. A **National Rainfed Farming Program**: to be taken up in 1000 blocks across different agro-ecological typologies in rainfed areas. Dedicated agency (selected through a transparent process) is envisaged responsible for planning, convergence of various programs with in the block, integrating and supplementing professional human resources in various programs, support in implementation, monitoring the outputs and capacity building. It ensures consistency of the activities under various programs with the relavant paradigm shift laid out earlier.

           The program provides an overarching framework and a (reasonably flexible) allocation pattern for all public investments under the rainfed farming program and under various programs in the block. The working group envisages an investment outlay of Rs.10 crore per block over the 12th plan period with a total outlay of Rs.10,000 crore + 5% facilitation costs at various levels on this National Rainfed Farming Program. In addition, the program will leverage

another Rs 40, 000 crore from other programs such NREGA, IWMP, RKVY, NFSM etc.

2. Creation of **'Rainfed Investment Windows'** in all relevant mainstream programs of various ministries, with flexibility to follow different guidelines (as may be detailed by the NRFA) for rainfed areas.
3. **'**Supportive **Policy Action' –** Specific budgetary allocations for the Agency to carry out detailed analysis of the policy changes needed for the new paradigm. This is to facilitate such discussion with state governments, provide support in drafting policies (decision about appropriate policy, instruments, policy process and outcome mapping etc.). More importantly, test and monitor new practices and synthesize learnings for larger application during the 13th FYP. The specific purpose is to arrive at an institutional architecture for rainfed areas; devise policies, rules and protocols for diversifying crop patterns, crop-livestock systems, soil fertility, revival and nurturing of commons, extensive protective irrigation, development of markets, etc.

19. It is also recommended that most of the **Special Area Programs** under the Ministry of Rural Development to be merged into the Rainfed Program with provision of special allocation to the Blocks falling under the special programs. It helps to get in place a uniform program architecture and a robust location-specific content for all these programs.
20. The NRFA evolves **comprehensive process guidelines** consistent with the new Paradigm detailing the principles and processes of planning, institution development, human resources deployment, strategic areas for action and convergence mechanisms. The Program Architecture envisaged maintains integrity of the respective line departments' functions and provides for a robust grass-roots convergence mechanism. It will also supposedly reduce the implementation burden of the technical line departments (as the new program will be implemented by Gram Panchayats and Community Based Organisations) and allows them to concentrate on providing technical inputs.

Organizational Architecture

21. The Unit of Planning and Implementation for the national program is the development BLOCK. The time frame extends over the plan period i.e. 5 years.
22. An independent **Block Resource Agency** whch is selected through a competitive process will provide the overarching lead within the Block. The Agency shall have a mandate to integrate and decide on the content and investment pattern of programs of various line departments operational in the block (under the Rainfed Windows). It also plans, integrates and builds capaciies in human resources deployed.
23. The Agency will partner with PRIs in implementation and facilitate formation and strengthening of appropriate community-based organizations and producer organisations into a block level coalition or consortium, which forms its foundation.
24. At the **District Level** a **revamped and strengthened ATMA** with professional teams deployed shall be the nodal organisation. It shall partner with a **Strategic Capacity Building Partner** organization (sourced by a competitive process), which provides support to the Block Resource Agencies.
25. At the **State Level** a mix of SLNA and the steering committee for RKVY shall also provide the oversight. It will partner with a **State level Consortium of Resource Organisations with an independent secretariat** anchored into one of the support organisation. All the district level strategic community based partner organisations shall be members of this learning alliance/state consortium along with key research institutions.

26. A **Special Rainfed Areas Cell** shall be created at the Dept of Agriculture at the state level to anchor the administrative work.
27. **National Rainfed Farming Agency (NRFA)** appropriately constituted as a support and learning institution and partnering with Networks of Strategic Support Organisations at the national level can provide overall leadership. Appropriate constitution of the Agency need to be evolved. It may have a 'Learning Cell' that synthesises the experiences and provide content leadership. The NRAA may be reconstituted into such an Agency. It is important that the Agency has multiple competencies and draws personnel from Civil Society, bureaucracy and scientific institutions as envisaged in the Apporach Paper.
28. **Independent Research Partnership** must be established to monitor the processes and outcomes of the entire programs. An annual 'Health Monitor' report on the outcomes need to be prepared for public consumption and debate by such research partners.

Summary Budget Proposals for the 12th Plan recommended by the Working Group

S.No.	Program Particulars	Budget Details	Budget (in Rs. Crores)
1.	**National Rainfed Areas Program**	1000 blocks x Rs.10 crore per block for 5 years	**10,500**
2.	**Separate dispensation for Rainfed areas under various line department programs**		
A	- Enhanced budgets for various programs and creation of Rainfed Investment Windows (in agriculture, animal husbandry, horticulture, fisheries, ground water, civil supplies)	- To be estimated - Approximately	**2000**
B	- Separate window within National Food Security Mission for "Local Food Security Program" for intensive area based agronomic innovations (SRI, NPM and CA) for productivity enhancement of cereals, millets, pulses, edible oilseeds specially for small holder farms. This includes field experimentation on adaptive research.	2.5 million ha x Rs. 8000 per ha with an impact area of about 5 million ha)	**2,000**
3	**Supportive Policy Initiatives (for NRFA)**		
A	- Promoting farmers' institutions and re-structuring supportive institutions (ATMA, PRIs etc.) and facilitating enabling legal framework.	- Rs. 4 cr for evolving the framework - Actual budgets to be estimated based on the strategy – approximately 500 cr	**500**
B	- Comprehensive initiative on nutritional security and crop diversification with inclusion of millets into the PDS as a lead strategy	- Pilot in 100 blocks - + special provision under civil supplies for these blocks	**550**
C	- Commons policy initiatives	-	**20**

D	- Extensive support irrigation and participatory groundwater management	- In contiguous 100 ha blocks total targeting 50,000 ha	**300**
	TOTAL		**15,870**

NOTE:

- Of the total budgetary allocation, Rs.10,000 cr shall be a dedicated program at the block level; Rs.4000 cr be used to augment the line department's programs to create separate 'Rainfed Investment Windows' in the respective programs and Rs.1362 (Say Rs.1400 cr) may be allocated for the initiatives to be facilitated by the proposed National Rainfed Farming Agency (reformulation of NRAA)
- In addition Special Area Programs and specific packages of the RD department should be integrated into the National Rainfed Areas Program along with their budgets (augmenting the Block level budgets).

Epilogue:

29. The broad directions and what the Working Group has set out as a *Relevant Paradigm* has been the core of scientific recommendations since long; reinforced often in multiple contexts of drought-management, land degradation, NRM, sustainable agriculture, sustainable livelihoods etc., and much more strongly under the Climate Change resilience, adaptation and National Mission on Sustainable Agriculture. The stronger elements of carbon sequestration and emission reduction are inbuilt into this proposed paradigmatic change. **In a way the proposition provides a platform for convergence of these multiple contexts.**
30. The available data from various sectors strongly suggests that such a paradigmatic shift will have major impact on growth in local economies, production and incomes without undermining the natural resources base; that such growth is spread across the poverty geography of the country sets a basis for an inclusive and sustainable growth. Moreover, in view of the yield stgntaion and environmental problems found in irrigated agriculture, a shift in policy and investment in favor of the rainfed areas is an imperative rather than a matter of choice.

1. Background

The natural resources base of a region includes the elements of climate, land, water, soil and biodiversity. They dictate the opportunities for livelihoods and incomes for the people of the region. In India, the prime natural resource is 328.73 million hectares of land of which 143 million ha are arable lands, 14.81 million ha are fallows and 37.16 million ha common lands and 69.63 million ha are forests, with the rest accounting for 43.22 million ha. (ASI, 2007). The next, water, is critical for agriculture. Agriculture which uses 80 percent of the fresh water resources in the country depends critically on maintaining the quantity and quality of the 1869.35 km3/year of water available (MoWR). India is also considered a biodiversity hotspot; agriculture in many ways draws from and maintains the diversity of flora and fauna in the country, including the diversity of many collected (non-cultivated) foods obtained from common lands and forests.

Widespread, serious and continuing degradation of India's natural resource base is now reflected in increasing difficulties in achieving growth rates in agriculture. Over 120 million ha have been declared degraded or problem soils (NAAS, 2010). But this seems to be a minor problem in the face of the massive and prolonged loss of organic matter and C in most of the arable lands in India, which have been under the plough for 2000 years or more (Royal Commission on Agriculture in India, 1928). Given that for the country in general, crop response or incremental yield per unit of nutrients tends to be lower with increasing fertilizer use per hectare, the evidence for soil organic matter depletion being a prime cause for declining soil health and soil productivity is mounting (Sharda et al, 2010). In addition, the water resources primarily groundwater is declining at a greater pace threatening the sustainability of Indian agriculture. The latest reports from the GRACE Mission of NASA (Rodell et al, 2010) show decline at a mean rate of 4.0+/- 1.0 cm/yr, equivalent height of water (17.764.5 km^3/yr) over the Indian states of Rajasthan, Punjab, Haryana and Delhi. During the study period of August 2002 to October 2008, groundwater depletion was equivalent to a net loss of 109 km^3 of water in northwest India. Such high rates of groundwater exploitation increased the percentage of 'unsafe' districts from 9% to 30% in a span of 9 years (1995-2004) (Vijay Shankar and Kulkarni, 2011). Other forms of loss include water lost due to salinity and alkalinity, and due to overdraft from groundwater sources, way beyond the recharge capacities of the aquifers (Planning Commission, 2010; Shah et al, 2009). Globally, there is compelling evidence about agri-environmental degradation, and consequent reinforcement of poverty and hunger by some of the policies and inputs that are designed to increase production but result in resource depletion and degradation.

In this Working Group report we address two specific challenges of this overall deterioration of the natural resource base of Indian agriculture. The first is that of sustainable natural resource management (NRM) of rainfed areas to enhance capacities to revive and manage our natural capital in a sustainable manner. The second is to stabilize the production systems of rainfed agriculture, currently being practiced in over 80 million hectares of sown area of the country. The Working Group feels that it is imperative that the XII FYP devote special attention to the issues of natural resource management and rainfed agriculture as part of its comprehensive strategy for more inclusive growth. In fact, *this report strongly argues that sustainable and inclusive growth is not possible unless the processes contributing to resource degradation and vulnerability of rainfed agriculture and production systems are squarely addressed and reversed.* It strongly advocates a paradigm shift in agricultural policy

that ensures sustainable and equitable development of rainfed areas over the next plan periods.

The Working Group takes note of some of the major changes in development policy and planning in the country. First, there is a welcome trend towards decentralization of development schemes, especially through the Rashtriya Krishi Vikas Yojana (RKVY) which bestows upon the states the function of preparing district level agricultural development plans taking into account local priorities and needs and further devolves central support to the tune of 18.3% for implementation of these decentralized plans (Planning Commission, 2010). Second, there is a welcome attempt within the Central Ministry of Agriculture to re-structure and re-order the numerous schemes with tiny allocations under the Department of Agriculture and Co-operation by merging them into larger programmes to ensure effectiveness and enhanced development outcomes (Planing Commission, Note Circulated to the Working Group, 2011). Third, the Ministry of Agriculture and the Planning Commission have made the demand that adequate agricultural research funds are devoted to address the natural resources degradation especially in rainfed areas (Planning Commission, 2010; GoI, 2008). Fourth, the Approach Paper to the XIIth plan articulates a strong case in favour of breaking the isolation and exclusion of rainfed agriculture within the agricultural policy mechanisms, research and extension systems, and credit and market support. Finally, there has been a continuous and pro-active engagement of several NGOs and CBOs with issues related to crops, land use, input management, animal husbandry, inland fisheries, horticulture, agro-processing, market access, nutrition and gender in India's drylands. Some state governments have acknowledged and encouraged these civil society groups as critical support systems for the effective functioning of the state's own delivery mechanisms. There is the need to foster more such effective, location-specific and locally accountable partnerships between the formal and informal actors in agriculture.

The Working Group report builds on such encouraging policy developments and feels that they should be further strengthened to open up a path of equitable and people-centred development in rainfed areas of India.

2. Cumulative Neglect: Natural Resources and Rainfed Agriculture

2.1. Performance of Rainfed Agriculture

Rainfed agriculture (crop and animal husbandry) is now emerging as a major opportunity in raising overall agricultural growth. Even after achieving the full irrigation potential, nearly 50% of the net cultivated area will remain dependent on rainfall. Rain-fed agriculture supports nearly 40% of India's estimated population of 1210 million in 2011. India ranks first among the rainfed countries in the world in terms of rainfed area, but ranks among the lowest in rainfed yields (<1t/ha).

Spanning several agro-ecological regions, the rainfed areas represent the geography with the largest concentration of poverty and backwardness. The key thrust in agricultural policy till now has been to extend technologies to these areas that have evolved to enhance productivity in well endowed areas. This has not led to achieve significant gains while resource degradation problems, such as loss in soil fertility, groundwater depletion, loss of

biodiversity and increase in climate associated vulnerabilities etc. have continued to exacerbate. At the same time, inadequate support for rainfed agriculture in terms of support price, availability of appropriate inputs, credit, market access and agricultural research and extension has caused widespread desperation among farmers.

A brief overview of the current features of rainfed farming reveals some of the underlying relationships between natural resources and production systems. Even with this policy neglect, the contribution of rainfed agriculture to the national economy is by no means small. The most striking feature of rainfed farming is the diversity of agricultural activities. With the cultivation of over 34 crops in a year as compared to 4 or 5 as in case of irrigated system and where livestock, horticulture, agro forestry, seed spices, medicinal & aromatic plants, fishery (in high rainfall areas), bee keeping etc., farmers and farming systems in rainfed areas reveal a portfolio of survival and production options.

TABLE 1
Share of Rainfed Area in Total Area under Crops

Crop	**Area**	**% under rainfed**	**Area under Rainfed**
	M.HA	**%**	**M.HA**
Rice	45.54	42%	19.13
Coarse cereals	27.45	85%	23.33
Jowar	7.53	91%	6.85
Bajra	8.75	91%	7.96
Maize	8.17	75%	6.13
Pulses	22.09	77%	17.01
Redgram	3.38	96%	3.24
Bengal gram	7.89	67%	5.29
Oilseeds	27.56	66%	18.19
Groundnut	6.16	79%	4.87
Rapeseed & Mustard	6.3	27%	1.70
Soybean	9.51	99%	9.41
Sunflower	1.81	69%	1.25
Cotton	9.41	65%	6.12
Total	**191.55**	**68%**	**130.48**

Source: Indian Agricultural Statistics, 2010

Rainfed agriculture accounts for 60 % of total cropped area, 48% of the area under food crops and 68% of that under non-food crops. In terms of crop groups, 77% of pulses, 66% of oilseeds and 45% of cereals are grown under rainfed conditions (**Table 1**). Foodgrain production in India grew at a rate of 1.26% per annum between 1990-93 and 2003-06. Meeting the future demand for foodgrains (estimated at 280 million tones by 2020) would require a step up in the rate of growth of food production where rainfed agriculture has to play an important role. As estimated by the Technical Committee on Watershed Development (2006), even in the best possible scenario of irrigation development, about 40% of the additional supply of foodgrains needed to match future rise in demand will have to come from the rainfed agriculture. Therefore, *a breakthrough in rainfed agriculture is an*

imperative for poverty alleviation, livelihood promotion and food security in India.

The rainfed crops have shown more impressive growth rates in recent years as compared to irrigated crops like rice and wheat as seen in **Table 2.** The compound growth rates for the period 1998-99 to 2008-09 reveal that production of coarse cereals increased at a rate of 2.73%; production of pulses continued to be an area of concern. Both area and yield didn't show any significant growth and remained stagnant and as a result the production also increased at a mere 1.08% per annum. As far as oilseeds are concerned, faster yield growth was observed in groundnut (2.29%), sunflower (2.25%) and rapeseed and mustard (2.22%) and slower growth in soybean (1.15%) and castor (1.21%). Finally, in case of cotton, the yield increased at a significant rate of about 9.60 percent per annum and led to a production growth rate of over 10 percent per annum. Growth rate in yield of coarse cereals, pulses and oilseeds taken together (2.18%) was much higher than that of rice (1.40%) and much higher than wheat (0.46%). Therefore, these crop groups, whose production is largely rainfed, witnessed significant production and productivity growth during the last decade and compared favourably with that of rice and wheat.

TABLE 2
Growth Rate in Area, Production and Yield of Major Crops in India, 1998-99 to 2008-09

Crop/ crop group	**Compound Annual Growth rate (%)**		
	Area	**Production**	**Yield**
Sorghum	-2.82	-1.19	1.77
Pearl millet	0.07	4.11	4.04
Maize	3.00	5.60	2.52
Coarse cereals	-0.52	2.73	3.26
Chickpea	1.69	2.24	0.54
Pigeonpea	0.34	0.16	-0.17
Pulses	0.61	1.08	0.47
Coarse cereals + Pulses	-0.03	2.24	2.27
Groundnut	-1.32	0.93	2.29
Castor*	0.22	1.44	1.21
Sunflower	4.94	7.32	2.25
Soybean	4.39	5.59	1.15
Rapeseed and mustard	1.97	4.24	2.22
Oilseeds	1.60	3.65	2.02
Coarse Cereals + Pulses + Oilseeds	0.51	2.70	2.18
Cotton	0.54	10.20	9.60
Rice	-0.12	1.28	1.40
Wheat	0.39	0.85	0.46

* Data used for castor refer to 1997-98 to 2007-08
Source: CRIDA (Adapted from ASI)

Rainfed areas have recorded high growth in terms of yield and production. Much of this is cultivated in multiple cropping systems. There are crop sequences and combinations tuned to undulating terrains, soil moisture, availability and use of farm yard manure (FYM) or other bio-mass and fertilizers, traditional pest management practices at times integrated with modern pesticides, and emerging markets (as evident in the case of sorghum, soyabean, cotton, etc.). Contrary to the irrigated production systems that focus on individual crops/commodities, the key feature of rainfed cropping is the attention paid to the entire farming system and what can be harvested best.

2.2. Livestock, Fisheries and Horticulture

Livestock production forms a key component of rural livelihoods in rainfed regions. The rainfed areas account for almost 80 percent of all small ruminants in the country. Estimates suggest that 70% of agricultural GDP in arid areas and 40% in semi-arid areas come from rearing of livestock- accounting for around 55% of the total livestock population, estimated to be 350 million in 2003. Livestock contributes over 20% of the annual income of rural households; the share rising to nearly 30% percentage for households with less than 1 hectare of land (CAZRI). There is evidence that livestock development and most importantly risk mitigation in this sub-sector is supported by investments in water harvesting, soil conservation, regeneration of grasslands, assured access to common lands and availability of local germplasm as well as nurturing of local breeds.

Presently, fisheries and aquaculture contribute 1.04% of the national GDP of the country and 5.34% of agriculture and allied activities (DAHD, 2009). India is now the third largest producer of fish and the second largest producer of fresh water fish in the world. Fisheries sector contributes significantly to the national economy while providing livelihood to approximately 14.49 million people in the country (Handbook on fishery statistics, 2006). The poor inland fishing communities depend for their livelihood and food security on these indigenous species. India has vast inland fishery resources in the form of rivers and canals (195210 km), reservoirs (2-94 million ha), tanks and ponds (2.41 million ha), floodplain (DAHD, 2009).

In dryland livestock as well as inland fisheries production, the two common concerns arise from (i) the acute dependence of the poorest population groups on these two sub-sectors, and (ii) the rapid rate at which the natural resources-grazing lands, commons, diversity of crop residue available, grass and local medicinal plants, common water bodies, diversity of local species of animals and fish - are getting degraded. The limited public sector support that the rainfed areas receive either add to the problem (by subsidized tubewells withdrawing water, or tractors and deep tillage eroding and denuding the precious top soil) or are oblivious of the existence of the massive potential for inclusive growth. For instance, in Orissa, a State where marginal and small farmers, together with rural landless households own 60 percent of the milch animals, 55 percent of draught animals, 75 percent of the poultry, over 80 percent of the goat and almost all the sheep and pig population, the focus is on improving the genetic stock of cows and buffaloes. There is an emphasis on cattle and buffalo as the only livestock worth technological support and production inputs. Besides, there are consistent attempts to blame goats for natural resource degradation and deforestation. The drylands are also terrains where regular battles are fought between villages and forest officials over grazing rights. The neglect of livestock-based livelihoods, resource constraints and deprivation in India's economic decision-making forums, is evident from the fact that till date, the CSO reports fodder value from forests in 17 major states as 'nil or

negligible'.

2.3. Common Pool Resources

Common Pool Resources (CPRs) or "commons" are an important component of the rainfed production systems, which is also one of the most neglected even in the schemes and programmes that purport to explicitly focus on physical resources. Though a common definition of common pools do not exist, broadly all land, water (including groundwater), seeds, breeds and diverse species of plants, which are collectively used and held, can be categorized as commons. The Committee on State Agrarian Relations and Unfinished task of land Reforms defined rural common pool resources as "resources to which all members of an identifiable community have inalienable use rights. In the Indian context CPRs include community pastures, community forests, Government Wastelands, common dumping and threshing grounds, river beds, watershed drainages, village ponds and rivers etc.".

Management of CPRs is an essential part of natural resource management in rainfed areas. Commons are not only a 'refuge' to which vulnerable households and populations can turn to when everything else fails, it is a foundation on which multiple production systems rest in a manner that strengthens their resilience. It is in the commons-livestock-agriculture interface and the larger geo-hydrological functions the commons play that the inter-connectedness of the system and its resilience can be located. Hence, we need to strengthen symbiotic relationships between commons, livestock, soil fertility, pest management, soil moisture management, watershed development and agriculture, especially in rainfed areas. Given the overall policy neglect and limited investments in rainfed areas, the subsidy derived from commons forms a critical contribution to both livestock/fisheries and agricultural production systems.

There have been many estimates of the size and significance of CPRs. The National Sample Survey Organization (NSSO) in the 54th round of survey estimated that commons constituted about 15% of the total geographical area of the country. One fourth of this area is community pasture and grazing lands, 16% is village forests and woodlots, and 61% is attributed to the 'other' category. 'Other' includes the village site, threshing floors, and other barren and wasteland. Chopra and Gulati (2001) reclassified India's Agricultural Land Use Statistics data for 1991 to estimate the extent of common pool resources in 16 major states. Their estimation is based on the 9-fold classification land. Based on this they defined common pool land resources in the country as the sum of cultivable wastes and fallows other than current fallows, common pastures and grazing land, protected and unclassified forests, and barren, uncultivable and other government lands that are being used as for common purpose. In their estimate, common pool came to around 25.61% of the total geographical area of the country. By this estimate the non-forest common pool resource constitutes around 14.81% of the total geographical area of the country. Including the protected forest and other forest the common lands (**Table 3**).

TABLE 3

Estimation of Common Pool Land Resources (Million Ha) in India

Land use type	**1990-91**
1. Total Geographical Area (ASI)	328.73
2. Owned land (AC)	165.51
3. Net sown area (ASI)	143.00
4. Current fallows (ASI)	13.70
5. Private land with common access (2 - 3 - 4)	8.81
6. Cultivable wastes (ASI)	15.00
7. Other fallows (ASI)	9.66
8. Common pastures & grazing land (ASI)	11.40
9. Land under misc. tree crops (ASI)	3.82
10. Non-forest common pool resource (5+6+7+8+9)	48.69
11. As % of total area	14.81%
12. Protected forest (SFR)	23.30
13. Other forest (SFR)	12.21
14. Common pool resource including forests (10+12+13)	84.20
15. As % of total area	25.61%

Source: Agricultural Statistics of India (ASI, 2002); Agricultural Census (AC, 2002); State of Forest Report (SFR, 1991)

The Working Group accepted the need to have differentiated perspective of commons based on its social-cultural, economic, livelihood and ecological functions. The differentiated perspective would help in defining commons based on its use regimes across different location specific contexts, and devising appropriate strategies and approach for governing common pool resources. Commons are critical for the poor households, plays a crucial role in sustaining eco-system functions, directly and indirectly contributes to agriculture production system, meets substantial proportion of fodder requirement of livestock production systems in rainfed regions, are the dominant source of firewood needs of the poorest and contributes directly and indirectly to the nutritional and food security of rural households. Further, commons play a crucial role in the coping mechanisms of rural households and through livestock and other produce collection plays a critical risk coverage function. NS Jodha's 1986 study of 82 villages from 21 districts in the arid and semi-arid zone of the country leads several studies that have now established beyond doubt the relevance of the Commons to India's rural economy at large and its criticality to the livelihoods of the rural poor in particular. *Jodha*'s study shows that around 84-100% of the rural poor depend on the Commons for fuel, fodder and food items. The study estimated that 14-23% of household incomes are derived from the Commons and they play an important role in reducing income inequalities.

The 54th round of the National Sample Survey Organisation also reports the current status of common pool resources in the country, based on a survey of 78,990 rural households in 5114 villages. **Table 4** reports data from the NSSO survey on the use of common pool resources. About half of the surveyed households reported collection from common pool resources, with the major uses being fodder for grazing and fuelwood.

TABLE 4

Extent of Uses of Common Pool Resources (NSSO, 1999)

S. No	Uses	Average value	Range
1.	Households Collecting CPR products (%)	48	13-73
2.	Average value of annual collections per household	693	230-1989
3.	Ratio of average value of collection to average consumption expenditure (%)	3.02	.91-4.89
4.	Dependence on CPR for fuelwood		
4.1	Share of fuelwood in collection of CPRs (%)	58	31-79
4.2	Households collecting fuelwood from CPRs (%)	45	10.6-70.7
4.3	Average quantity of fuelwood collected annually from CPR (in kg)	500	219-1203
5.	Dependence on CPR for fodder		
5.1	Households reporting grazing on CPRs (%)	20	1-42
5.2	Households possessing livestock (%)	56	29-86
5.3	Collecting fodder from CPRs (%)	13	1-36
5.4	Average quantity of fodder collected from CPRs (in kg)	275	26-1743
6.	Dependence on common pool water resources-Households (%) reporting usage of common water sources for		
6.1	Irrigation (%)	23	2-45
6.2	Livestock (%)	30	6-70
6.3	Household enterprises (%)	2.8	1-6
6.4	Fisheries (%)	2.5	1.5-34

Source: Dinesh K Marothia, "Technological and Institutional Options for Common Property Resource Management in Rainfed Area", International Journal of Ecology and Environmental Sciences, 36 (1), 45-57, 2010)

The 2010 study carried out by Foundation for Ecological Security, covering 3000 households in 100 villages in rainfed regions establishes that majority of the households for one or the other purpose access commonly held land and water resources. The study shows that in villages with gross irrigated area less than 40%, 53% of households collect inputs for agricultural purposes from commons, 69% graze their animals on the commons, 23% collect fodder from the commons, 62% access common water bodies for domestic and livestock purposes, 74% collect fuel-wood from the commons, 37% collect food items for household consumption and 37% are engaged in collection of other non timber forest produce from the commons. Livestock in these production systems plays a critical role in nutrient transfers and reallocation of fertility both across space and time- dung production is an important livestock production objective. These systems are geared towards increasing complementarities between different production systems and dynamic usage of available resource. Not only are the small ruminants but also other livestock species, are supported in a grazing system. Even the archetypical stall fed animals, buffaloes and crossbred cattle depend on commons for meeting more than 20% of their fodder requirement (**Table 5**).

TABLE 5

Percentage of Annual Fodder Requirment Livestock Species met from Commons

	Draught animals	Indigenous cattle	Crossbred cattle	Buffalo	Sheep and goats	Camel
Arid	33.1	62.94	44.63	65.13	83.78	68.25
Semi-Arid	31.09	40.79	29.82	29.95	51.73	29.23
Sub-Humid	67.83	74.02	11.11	58.24	79.3	0

Source: A Commons Story: In the Rain Shadow of the Green Revolution, Foundation for Ecological Security 2010.

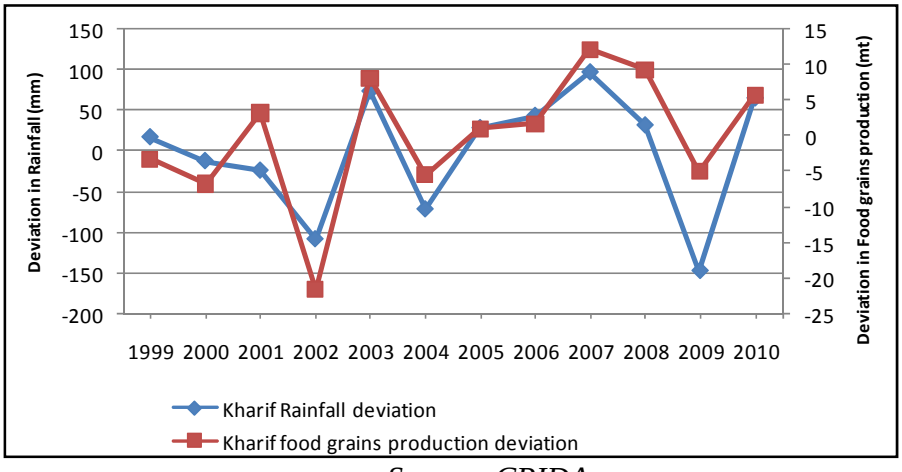
3. Factors Contributing to Instability in Rainfed Production Systems

3.1. Rainfall variation

About 58% of the net sown area is rainfed which contributes about 44% to the total foodgrains production. The growth of crops and the food production of the country are strongly influenced by the total rainfall as evident from the positive and significant correlation coefficient of + 0.78** (1999-2010). During 2002 the deviation in the amount of rainfall received and the deviation in the food production were -100 and -20, respectively, whereas, the corresponding values during 2009 were -150 and -5, respectively (**Figure 1**) indicating that we have been able to drought proof Indian agriculture to some extent due to improved practices, better logistics and timely interventions from Central and State Governments during drought years. However, rainfall aberrations during south-west monsoon continue to be major factor contributing to instability in *kharif* crops production.

FIGURE 1

Rainfall *vs* Food Production in *Kharif* Season



Source: CRIDA

Increasing intra-seasonal variability of rainfall however has become a major concern now. In several meteorological divisions, the rainfall distribution is becoming more skewed with less number of rainy days, with high intensity causing more soil erosion. The coefficient of variation of decadal rainfall distribution is increasing in several meteorological divisions

indicating inter-annual variability. This has implications on length of dry spells in rainfed regions (**Table 6**).

TABLE 6

Decadal Monsoon (Jun-Sep) rainfall coefficient of variation among meteorological sub-divisions in India (1951-2010)

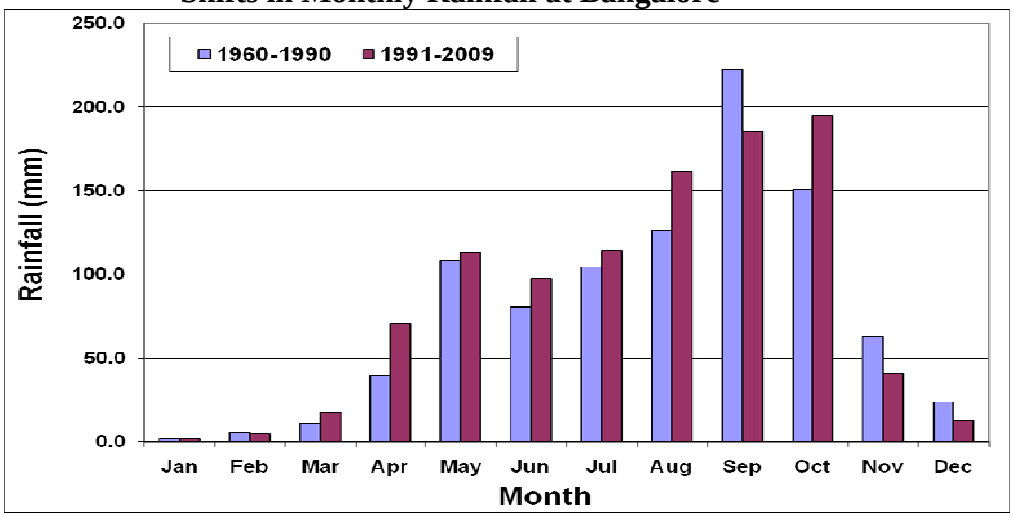
Div	1951-60	1961-70	1971-80	1981-90	1991-00	2001-10
East & North East India						
Assam & Meg	12.7	12.7	16.0	15.1	17.5	11.3
NMMT	13.5	11.3	12.3	13.2	14.5	16.7
SHWB	14.6	11.6	13.7	14.5	20.7	12.3
Ganestic W. Bengal	12.5	14.1	18.4	14.3	18.0	21.6
Jharkhand	14.9	15.6	19.7	14.4	18.0	27.7
Bihar	16.4	16.2	17.2	24.0	18.3	24.9
North West India						
East UP	23.2	17.5	31.0	15.7	12.7	26.3
West UP	15.3	21.6	25.9	24.3	16.4	27.9
Haryana	25.0	19.6	29.6	44.1	24.5	25.8
Punjab	17.6	31.0	31.3	47.1	22.9	32.6
East Rajasthan	21.3	18.9	27.4	20.3	25.5	22.4
West Rajasthan	27.1	41.1	38.1	44.1	36.4	45.8
Central India						
Orissa	13.3	11.0	14.3	10.7	19.6	18.1
West MP	16.5	21.8	22.4	16.3	19.9	17.0
East MP	11.9	21.6	20.0	15.1	18.7	19.8
Gujarat	33.1	26.7	36.2	36.7	35.2	25.6
Saus & Kutch	49.7	43.9	47.1	53.5	39.1	32.9
Konkan & Goa	18.1	28.8	25.9	21.2	25.3	23.2
Madhya Maharashtra	18.4	15.5	21.5	26.0	11.1	25.4
Marathwada	21.2	16.3	27.9	39.5	24.2	24.1
Vidarbha	18.8	18.1	20.5	26.1	17.3	16.9
Chhattisgarh	10.1	26.5	20.8	12.0	19.1	14.8
South Peninsula						
Coastal AP	18.7	23.1	26.3	27.9	22.5	25.6
Rayalaseema	23.9	24.7	23.4	32.3	30.8	34.2
Telangana	20.4	11.0	28.6	28.1	17.1	24.6
Tamil Nadu	17.1	22.4	14.9	25.5	33.1	19.2
Coastal Karnataka	31.3	23.8	21.8	15.7	8.3	19.8
N.I. Karnataka	17.5	16.0	19.6	22.6	14.1	28.8
S.I. Karnataka	21.2	20.6	17.0	20.5	15.9	30.3
Kerala	14.7	23.8	18.9	18.5	14.7	18.9

Source: CRIDA (Adapted from IMD)

Besides rainfall variations, the distribution of rainfall is also changing in key rainfed agricultural locations. For instance, there is a significant variation in the mean monthly

rainfall at Bangalore between 1960-1999 and 1999-2009 (**Figure 2**). From 1999 onwards, the mean monthly rainfall during the months March-August is higher than that received during 1960-99. There is a significant reduction in the September rainfall during 1999-2000 as compared to 1960-99. Thus such shift in the rainfall has resulted in shift in the sowing window of the major crops to the later part exposing them to terminal stress which again contributes to production instability.

FIGURE 2
Shifts in Monthly Rainfall at Bangalore



Source: CRIDA

3.2. Land Degradation and Soil Fertility

Soil fertility variation and its depletion due to imbalanced nutrition is the second important factor contributing to instability. The major soil types in rainfed regions are Alfisols (30%), Vertisols (35%) and Entisols (10%) (Virmani et al., 1991). Replacement of legumes in the cropping systems with more remunerative crops like cotton and maize in several rainfed agro-ecological zones has contributed to depletion of soil fertility. Erosion due to water is continuing unabated and currently 73.3 m.ha of arable land is affected by water erosion (Anonymous (2008). In the absence of external nutrient application, both soil fertility and crop yields show declining trend in rainfed regions. **Figure 3** illustrates the importance of integrated nutrient management in maintaining organic carbon in Alfisols. Only with integrated nutrient management practice, the organic carbon status could be maintained over a long term. Even with 100% NPK treatment organic carbon declined sharply. **Figure 4** depicts the importance of soil fertility management in ensuing stable production of fingermillet over a 30 year period at Bengaluru.

FIGURE 3

Changes in organic carbon over time under semi-arid conditions in Alfisols at Bengaluru

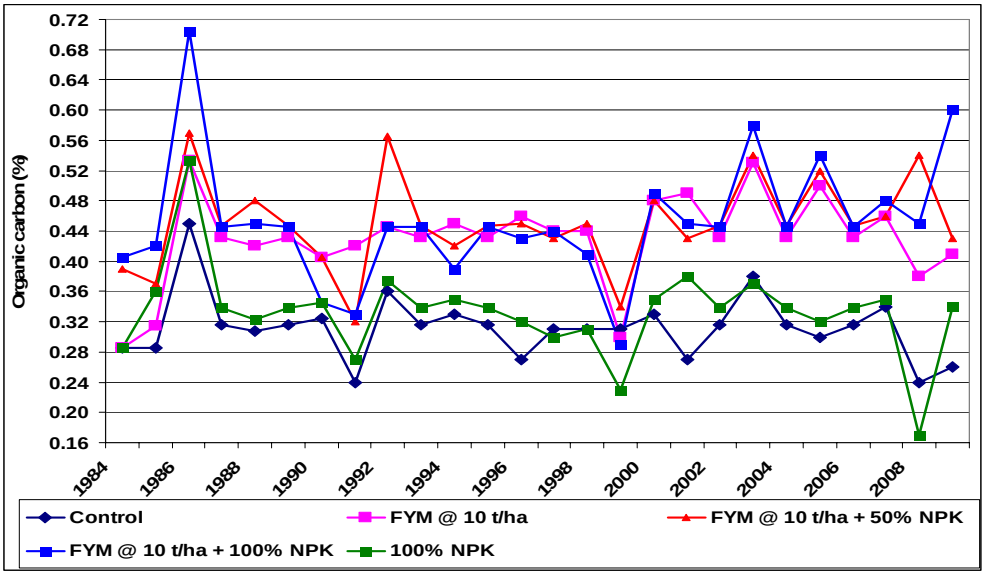
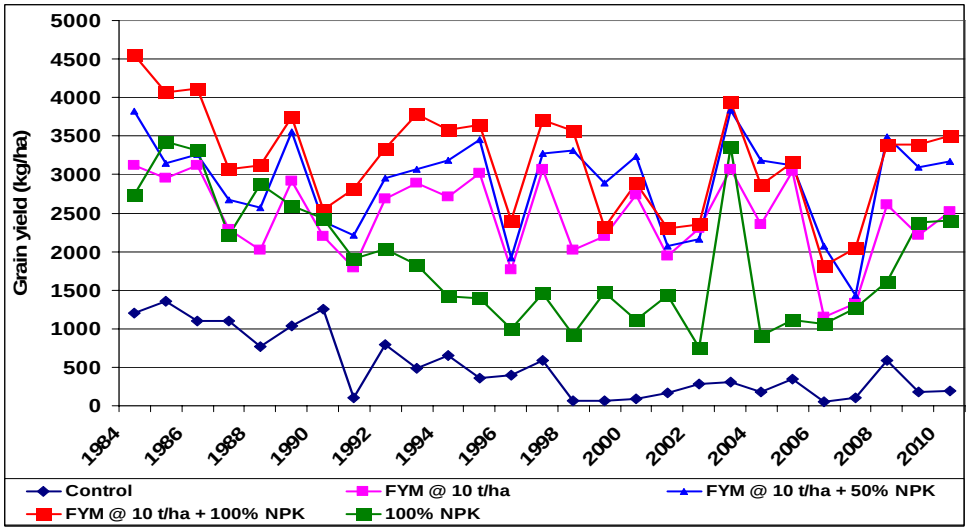


FIGURE 4

Performance of fingermillet under different Nutrient Management Treatments in Alfisols at Bengaluru over a 30 year period



Source: CRIDA

Since the Green Revolution, the national agricultural policy is driven by the need to maximize crop yield, using irrigation and intensive use of HYVs, chemical fertilizers and pesticides. The status of natural resources and the condition of rainfed farming have received little attention. As a result, the natural resource base especially in rainfed areas has been badly degraded. Degradation of land in general and the soil systems that are the basis of agriculture has been highlighted time and again (RCA, 1928; NCA, 1976; SPWD, 1984; NRSA, 1985, NBSSLUP, 2005). Soil erosion by wind and water, acidity, alkalinity/salinity and other complex problems are the principal causes for land degradation. In many states in India, anywhere between 40 to 80 percent of the land area is classified as degraded in some form or the other. As agriculture uses 141 million ha out of 328.7 million hectares of the

country, it follows that faulty land and water management practices in agriculture could significantly contribute to land degradation. There is enough scientific evidence to show how intensive irrigation and chemical (fertilizers, pesticides, soil amendments etc.) application adds to degradation and how certain resource degrading subsidies (through provision of free electricity, subsidized fuel, and free irrigation water) worsen the situation, even as alternative investments can yield much higher impacts of production and productivity (Gulati and Narayanan, 2003; Chand, 2009). Many studies echo some of the well established findings that (i) population pressure has little to do with land degradation which is a result of faulty land and water management activities, (ii) access to irrigation arrests degradation, but improper irrigation with excessive chemical use worsens land degradation (Reddy, 2003; Sehgal and Abrol, 1994; Raina and Sangar, 2002). While judicious management of common lands can lead to reduction of erosion and other complex degradation problems, little is done to enable common land regeneration and sustainability (FES, 2009; Reddy, 2003). Soils in rainfed areas are subject to a prolonged double exclusion, being unable to gain from chemical fertilizers and receiving no support for locally validated fertility enhancing practices like crop residue incorporation, composting, farm yard manure application, etc.

In addition, climate change poses a vital challenge to natural resources. Through its direct and indirect impacts-on crop yields, pests and diseases, land and water resources; climate change is expected to affect sustainable agriculture through multiple pathways, thereby having an effect on livelihoods and the overall food security situation in the country. In rainfed production systems climate risks are likely to be more intense. Vulnerability of farming systems to climate change depends on the level of exposure and sensitivity to the climate hazard along with the capacity to cope. A number of local-level environmental, social and economic factors contribute to the differential vulnerability of diverse farming systems and the communities involved. In this context, it seems rational for overall agricultural policy as well as the research system to prioritize issues related to resilience to climate risks, and strengthen the capacity of natural resources to overcome various forms of climate stress, as a critical requirement to achieve food security.

3.3. Increasing Input Costs

Productivity is dependent on the level of input use such as seed, fertilizers and pesticides. The growth in input use would contribute to productivity growth assuming other factors are held constant. However, the levels use of inputs is determined by the relative prices of inputs as well as by the response of yield to the inputs. While the latter is a function of technology, weather and environment, the former reflects the market and policy environment. For example, the prices of fertilizers witnessed a steep increase when the government chose to decontrol the prices. While the issue of continuing food and fertilizer subsidies is arguable at the macroeconomic level, at the farm level, increasing input prices are bound to reduce their use to the sub-optimum level. Similarly, availability of quality seed at right time and at affordable prices is critical. The prices of seed are increasing considerably over time and in many cases the private sector is playing a significant role.

Chemical fertilizers are highly subsidized in India and the amount of fertilizer subsidy has grown exponentially during the last three decades from a mere Rs. 60 crore in 1976/77 to an astronomical Rs. 61,264 crore in 2009/10 and likely to exceed the budgeted subsidy of Rs. 58,000 crore in 2010/11. Supported by such heavy subsidies, encouraging unbalanced soil nutrition, the overuse of chemical fertilizers has resulted in severe degradation of soil and

groundwater in many parts of the country. Since chemical fertilizer use is conditional upon assured availability of water, the water constraint in rainfed areas demands alternative ways of enhancing soil fertility. As long as the non-price factors such as irrigation and quality of seed are well taken care of, farmers will still be able to optimize the input use levels provided they have the access to credit. However, many small and marginal farmers are left out of the ambit of institutional credit for various reasons and are having to pay high cost for the capital borrowed from non-institutional sources. Thus, the cost of cultivation of most rainfed crops increased considerably over time contributing to production instability.

3.4. Marketing and Profitability

Access to input and output markets and the market information is the key to converting yield gains in to higher incomes. However, markets in India particularly in rainfed regions are underdeveloped and farmers are exposed to high price risk. Small and marginal farmers now constitute over 80 percent of farming households in India. They have only very small quantities of marketable surplus. Moreover, their staying power is low because of their extreme poverty. As a result, these farmers sell off most of their produce in the local markets at very low prices immediately after the harvest. Thus, farmers suffer even in years of a good harvest, since they are not able to get good price realization. Longer marketing channels result in farmers getting a lower share of what consumers pay for the same produce. Rainfed crops suffer a bias *vis a vis* irrigated crops such as rice and wheat in terms of infrastructure and procurement support. The low market surplus of the small and marginal farmers denies them any economies of scale and bargaining power. The production risk arising out of the very nature of rainfed agriculture coupled with the price risk results in low profitability of rainfed agriculture, low investment on technology and production instability.

As the Approach Paper to 12th Five Year Plan has noted, "basic infrastructure in rural areas for storage and marketing of produce needs to be set up to link producers with regularly functioning markets. Small multi-functional units like warehouses, providing value added services for the farming community, should be set up. Banks and other financial institutions in villages should provide the required finance to the entrepreneurs in this field. Banks can be motivated to extend credit to the setting up of such units if they receive support from the Government as such activities would be capital intensive".

4. Existing NRM and Rainfed Area Development Programmes

4.1. Programmes

A multitude of schemes are being implemented by GoI as Central sector, Centrally Sponsored and State Plan schemes. It is also observed that many components/interventions funded by different programmes have considerable overlaps. Some of these schemes are also criticized for being too uniform and rigid to accommodate local diversity. Also, there is a mismatch between ground level actions funded from different sources due to lack of coordination and convergence which leads to inefficiencies in resource use and achieving desired benefits from investments. For instance, enhancing crop productivity in isolation of actions aimed at natural resource conservation, and vice versa. Not only there is duplicity or multiplicity, but also lack of proper planning of interventions without keeping view of its

intended use(s) and user(s) and site selection in integrated manner. None of these schemes truly address the integrated and holistic development of rainfed areas.

The flagship programme of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Rashtriya Krishi Vikas Yojana (RKVY), National Horticulture Mission (NHM), Artificial Ground Water Recharge, Artificial Recharge to Ground water through Dug wells, Repair, Renovation and Restoration of Water Bodies Directly linked to Agriculture, and untied Backward Region Grant Fund are amongst other schemes for benefit of rainfed areas. Of these, Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is perhaps the strongest available instrument for investments in rainfed areas. While there are several achievements under MGNREGA, there has also been a realization that the wages are not leading to creation of durable assets that strengthen natural resource base and support the production systems in the rural areas. There have been several limitations in the planning process under MGNREGA. Moreover, there is also the need to integrate watershed approach in planning process under MGNREGA with focus on protection, conservation and development of all the components of rural landscape. Capacities at the Block, Panchayat and habitation levels have to be strengthened. This requires not only professional support for Gram Panchayats and block/district panchayats in envisioning their natural resource plans but also creating a pool of skilled persons (barefoot engineers/volunteers/para workers) at local level who can facilitate the process across the habitations.

Recently, Rainfed Area Development Programme (RADP) has been launched by DAC on pilot basis as a sub scheme of RKVY during the year 2011-12 focused on promoting integrated farming system in rainfed areas. MoA also initiated schemes for Extending Green Revolution to Eastern India (under RKVY). National Mission on Micro Irrigation, National Afforestation Programme of MoEF, Reclamation and Development of Alkali & Acid Soils, soil health related and oil seed and pulse promotion schemes.

National Mission on Sustainable Agriculture, under the National Action Plan on Climate Change (NAPCC), a new initiative, will address water conservation and enhancing efficiency and productivity of water besides sustainability of natural resources and rainfed agriculture. The National Water Mission and National Mission for a Green India under NAPCC have direct relevance to management of natural resources and rainfed areas.

Government of India took another significant initiative of setting up the National Rainfed Area Authority (NRAA) in November, 2006 as an inter-ministerial expert body in Ministry of Agriculture to provide the much needed knowledge inputs regarding systemic up-gradation and management of country's rainfed areas. It is a policy making and advisory body charged with the role of examining guidelines in various existing schemes and in the formation of new schemes, and bring about convergence and synergy among the numerous ongoing programmes.

Initiated as soil and water conservation programme, watershed management has undergone many policy changes over the years. This process of agricultural and rural development for enhancing productivity and livelihood has come a long way from initial protection and conservation oriented piece-meal/sectoral approach of soil and water conservation to restoration of degraded areas for biomass production, eco-restoration, farming system and income generating activities. Earlier generation of watershed programmes were mostly confined to biophysical aspects, viz; contour bunding, check dams, afforestation etc. but subsequently the social and institutional issues came into prominence.

Of late, the focus is shifting towards livelihood security and income generation through watershed development. Multiple ministries/departments and agencies have been involved in the growth and development of watersheds with an array of watershed schemes. Three schemes of DPAP, DDP and IWDP of Ministry of Rural Development have now been merged into IWMP. NWDPRA, River Valley Projects, Catchment Area Programme in Flood Prone Rivers, Shifting cultivation scheme of Ministry of Agriculture; Watershed Development Fund administered by NABARD; Hill Area Development Programme (HADP) and Western Ghats Development Programme of Planning Commission; various afforestation programmes and other national and externally aided projects are amongst the various watershed related schemes. Besides, national flagship program like MGNREGA is spending 65 % of its funds on watershed related NRM activities for creating durable assets to build production and livelihood system for sustained income.

In coordination with the Planning Commission, NRAA in consultation with concerned ministries/departments has come up with the "Common Guidelines for Watershed Development Projects-2008" to have a unified approach and perspective in planning and implementation of all the Government schemes with common approach w.e.f. 1st April, 2008. The new guidelines include innovativeness in approach, decentralization, dedicated institutions at various levels, social, gender and economic equity, involvement of PRIs and competent NGOs, transparency and accountability. Productivity enhancement and livelihood has been given priority along with conservation measures, together with livestock and fisheries management as a central intervention and encourage dairying and marketing of dairy products. *Implementation structure to the village level, which is the foundation to effectively manage and govern natural resources, is often the most neglected aspect in the watershed development programmes.* Crafted under a project mode the institutions rarely outlive the project cycle. There is a critical need to re-look at the strategies to nurture the institutions for a longer period.

The Eleventh Schedule of the 73rd Amendment identifies 29 areas over which the Panchayats can legitimately have jurisdiction. These include functions around agriculture, maintenance of community assets, land management, irrigation, animal husbandry, social forestry and management of minor forest produce, management of fuel wood and fodder, poverty alleviation, and social inclusion programs, among others. *There is a need to pro-actively undertake a series of steps in 12th Plan to strengthen the institutional and technical capacities at Gram panchayat level*. The Panchayat Extension to Scheduled Areas Act, 1996 (PESA) provides that the State legislation on the Panchayats in the Scheduled Areas be made in consonance with the customary law, social and religious practices and traditional management practices of community resources. PESA enables a significant role of Gram sabha in local governance. The Biodiversity Act, 2002 provides for the constitution of a Biodiversity Management Committee by every local body within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animals and micro organisms and chronicling of knowledge relating to biological diversity. It also provides for maintenance of Local Biodiversity Fund for conservation and promotion of biodiversity in the areas falling within the jurisdiction of the concerned local body and for the benefit of the community in so far such use is consistent with conservation of biodiversity.

4.2. Agricultural Research and Extension

Research and extension in NRM and rainfed agriculture is more challenging in the sense that the target domains represent more diverse (in terms of agro-ecological regimes, crops, soil types, etc) and harsh (variable and undependable rainfall, poor and degraded soils, low investment capacity of farmers, inadequate infrastructure, etc) environments. The ICAR and the SAUs devote almost 80-90 percent of their budget on commodities (crops, livestock, fisheries etc.) and the remaining of natural resources, economics and marketing and such areas (Beintemma et al, 2008). Many of the conventional components of agricultural production, i.e., assured irrigation, credit, markets, transport and other services are either extremely limited or non-existent in rainfed agriculture. It is estimated that the rainfed areas in India receive 6-8 percent of the total national subsidies in agriculture (including irrigation, fertilizer and chemical and fuel subsidies) (Acharya and Jogi, 2007).

Public investment in research and extension has been an important part of India's agricultural development strategy. Knowledge support for NRM and Rainfed Farming is provided by CRIDA along with its AICRPDA network, CAZRI, CSWCRTI, PDFSR, NBSSLUP, and IISS. These institutions have a substantive but generic understanding of the problems of NRM and rainfed farming and have developed a number of technologies that help raise productivity of rainfed crops. The dedicated organizations for rainfed farming are mainly soil and water conservation oriented, with only CRIDA having a broader commodity and livelihoods focus built into its vision. Besides these, the ICAR research complex for the North-East, and Goa, as well as several of the leading crop sciences institutes devote research resources to address the production problems of rainfed crops, crop-livestock systems etc. Diversification of cultivation practices like zero tillage, rainwater harvesting through farm ponds and in-situ rain water conservation by land levelling, ridge-furrow systems, mulching etc. are some examples of the demonstrated results with vast scope of their expansion. Many publications document the technologies released by these research institutes for rainfed farming – see CRIDA, 2009.

These institutions and support agencies follow the research approach broadly based on the Green Revolution paradigm of yield maximization and food security through use of irrigation and bio-chemical inputs. This is evident from the fact that majority of the conventional irrigation + bio-chemical technologies are not appropriate for the rainfed production systems (See, CRIDA, 20010 for the low level of input use in rainfed production systems). Moreover, the budget allocated to NRM and rainfed farming, is a small fraction of the total agricultural research allocation within the ICAR in various years in the 1990s or 2000s (**Table 7**). In addition to the minimal research on natural resources and the resource-crop interactions in each agro-ecological context, the public sector R&D system devotes minimal attention to the crops of rainfed farming system – the predominant crops numbering 32, the range of crop-layouts or sequences, and the crop-livestock systems. The public sector supply driven technology generation puts technologies on the shelves with little understanding of local contexts and farmers demands and depends on a linear and weak extension effort.

TABLE 7

Share of NRM Research and approximate research expenditure (Rs. Crore) on Rainfed Farming in total research expenditure in the ICAR

Year	NRM Research Expenditure	Share of NRM Research Expenditure in total ICAR Research Expenditure (%)	Approximate Research Expenditure on Rainfed Farming*	Share of RF Research Expenditure in total ICAR Research Expenditure (%)
2000-01	9.00	0.68%	185.22	13.99%
2009-10	279.41	8.57%	419.07	12.85%

Source: DARE/ICAR Annual Report (various years)

* Note- On estimating approximate research expenditure on rainfed farming and NRM. Roughly 50 % of ICAR institute expenditure is on crop science, with livestock accounting for 16 % (in the DARE financial statement – animal husbandry and dairy dev), fisheries and post-harvest accounting for 10% each, roughly 86 percent of research expenditure is allocated to commodity research. Given that 5-6 crops and cattle dominate these commodity research allocations, and that irrigation-chemical intensive production systems receive the maximum attention in all research institutes and crops, a rough estimate would place allocations to rainfed crops (about 32 predominant crops) and rainfed farming systems at about 15 percent maximum Therefore, the total allocation to rainfed farming research within the mainstream crop, livestock, fisheries and post-harvest technology institutes is calculated as approximately 12.85% (i.e., 15 percent of 86 percent) of the total ICAR expenditure.

While public investment in rainfed research has been low, there has been a visible increase in private research investment in rainfed farming systems – in seeds, water and pest management areas (Planning Commission, 2010). The presence and effectiveness of private sector research in NRM and rainfed areas makes the challenges for public sector research more acute. Many highly diverse and location-specific private sector actors exist, whose capacities to cater to the provision of key agricultural inputs like drip irrigation systems, bio-fertilizers, dairy development, poultry and inland fisheries; provision of agricultural services like credit, information services, extension, export, etc.; and agro-processing especially in some crops like cotton, sugarcane, fruit-pulp, agro-forestry/NTFP products based industry. Many civil society organizations have improved the quality of natural resources, revived and enhanced livelihood opportunities and productivity of watershed, and enabled a transformation of rainfed production systems, even while working with the poorest and most harsh and vulnerable eco-systems. Several leading CSOs have established expertise and community level acceptance, in watershed management, grain banks or seed banks, rural credit (SHGs, co-operatives, etc.). Most crucial however, is the fact that minimal (highly inadequate) expertise exists in the country on CPR management systems and on the relationships between variables (soil quality, percolation, and soil moisture or carbon sequestration).

In sum, within the public sector, there is inadequate research effort on the part of the ICAR and the SAUs to address issues relevant for rainfed areas. Extension effort, given this weak technology support, is highly inadequate and follows the same package of practices approach for commodity production, with little attention to the multiple- and inter- cropping

systems and risk-averse on-farm choices made by dryland farmers. The state government supported extension system is fairly uniform across all rainfed areas, with the same scheme disbursement mode and linear 'transfer of technology approach'. Given that the extension system is now reduced to a mechanism for disbursement of agriculture sector schemes or programmes, there is little opportunity for the extension system to study and provide the feedback necessary to the research system. In effect, the greatest inadequacy of the extension system is not in poor transfer of technology (as discussed in many academic and policy papers) but in its limitations in in providing the feedback about the diverse agro-ecological and socio-economic contexts to the research system. The Mid-Term Appraisal of the XI FYP notes the need for greater attention to rainfed agriculture given the impressive performance of some rainfed areas and the commitment of some state governments to sustainable NRM and rainfed farming.

The Working Group discussed the strengths of the current R&D system in the light of (i) the cumulative neglect of the rainfed farming systems (ii) the degradation of natural resources in irrigated and rainfed tracts, and (iii) the emerging contexts of climate variability and change. The Working Group strongly recommends some fundamental changes in the way NRM R&D and extension is organized and conduced. *It is high time to revisit the basic tenets of R&D for sustainable resource management to put in place appropriate strategies to arrest continued degradation and ensure productivity enhancement.* There is a need to move from the current replication of the approaches to R&D and extension in irrigated monocultures. And there is a need to move from soil and water conservation to land husbandry based on an Agro-ecological Knowledge Framework (Box 1).

Box 1: Agro-ecological Knowledge Framework

This framework is distinct from the agro-ecological zones (AEZs based on bio-physical criteria and variables) that India already has developed. Agro-ecological knowledge is the application of ecological sciences and their principles to the design and management of sustainable agro-ecosystems. It transforms the content of current research disciplines/sub-disciplines, say soil sciences – soil chemistry or soil micro-biology or pedology.

Agro-ecology involves a context specific set of principles and methods to understand and analyse agro-ecosystems. The focus is on the dynamism of ecological and social processes. There is no universal formula or silver bullet for maximizing the productivity, well-being and sustainability of an agro-ecosystem. The fundamental principles of agro-ecological knowledge offer a framework for analysis and design of technologies and policy interventions. The framework emphasizes the continuous evolution of knowledge along with changes in ecological and social systems, and the multiple roles and functions of farms and farmers. Drawing from the ecological sciences, it makes a case for recognizing and promoting both collaborative behavior and competitive behavior across scales and diverse agro-ecosystems.

The importance of agro-ecological knowledge generation and the access that farmers have to this knowledge base is crucial. *Currently there is limited capacity within the agricultural research and extension system for resource characterization and understanding of causal relationships between bio-physical and socio-economic variables in different agro-ecosystems.*

Since establishment in 1976, National Bureau of Soil Survey and Land Use Planning

(NBSS & LUP) of ICAR has made significant contribution in characterizing and inventorizing soil resources, delineation agro-ecological zones, quantifying degradation at national level, highlighting the needs for resource based management strategies towards optimal resource use for sustainable agriculture. However the high spatial variability in NR base and the specific nature of issues that need to be addressed towards sustainable use and management demanded a detailed characterization and understanding of the variability of resources. This will call for greatly strengthening state/SAU level institutions responsible for this. In this effort a strong synergy will need to emerge between SAUs and the state level remote sensing centers established by the Department of Space and the ICAR Institutes responsible for coordinated efforts and methodological issues which will guide up scaling and a basis for national level priorities and actions.

Issues of sustainable use of land and water resources have particularly been assuming critical dimensions due to greatly enhanced pressure from other users in view of the overall improving and widening of growth perspectives. There is urgent need to put in place strong research agenda to address many of pressing land use issues impacting sustainability of agriculture. In the past several of the ICAR institutes (CSSRI, CSWCRTI, CAZRI etc.) have developed and successfully promoted technological interventions aimed at rehabilitating degraded lands. Mass of evidence however point out while site specific improvement in resource base can contribute to immediate gains, issues of NRM have to be viewed and solutions found within an overall context of land and water system (watershed, river basin etc). Understanding natural resources variability and linked use and management issues are therefore fundamental to defining technological needs and options for sustainable use. Characterizing and monitoring the state of natural resources essential for developing and promoting sustainable use and management practices is a grossly missing component of research agenda. In the past research system efforts have mainly focused on nutrient issues. Issues of NRM extended far beyond defining nutrient needs and relate to how agricultural practices are impacting overall resource productivity including issues of land, soil, water and biodiversity use and management and particularly in the context of increasing climatic variability related resource management issues.

Addressing problems of smallholder farmers and particularly in rainfed areas calls for much better understanding of the farming system in which he operates and takes day to day decisions. Understanding natural resource related and other constraints and translating these into research agenda constitute an important step in defining research for development priorities. There is need therefore to put in place a strong component of characterizing and monitoring of farming system which includes biophysical features and the way resources are being used i.e resource use dynamics. This information is fundamental to understand the need and the nature of technological interventions required for sustainable resource use.

5. Strategic Framework for Development of Rainfed Agriculture

Rainfed agriculture is showing high growth potential in spite of the cumulative neglect over time both in terms of investments made and appropriateness of such investments. Increasing demand for and prices of livestock products (meat, fish, etc.), and pulses and millets are opening up immense potential for inclusive economic growth; as much of these products are produced by the poor in extensive systems on common pool natural resources and in rainfed lands that they cultivate.

The imperatives of an inclusive growth however, need to be seen from the following perspectives:

1. Subsistence orientation of production:
   - High emphasis on increase in productivity of food crops, in these regions with chronic hunger, directly contributes to household food and nutrition security.
   - Increasing average productivity on an extensive scale (larger coverage of area and households irrespective of their potential productivity) will have larger social dividends rather than focusing only on high marketed surplus from few 'progressive-farms' or intensive systems or districts.
   - Internalising the inputs within farming systems and local natural resources reduces costs and strengthen household resilience to increasingly volatile price and climate vulnerability contexts.
2. Investing on rainfed production systems simultaneously addresses the issues of marginalization of tribal communities, threat of extremism, high incidence of distress leading to farmers' suicides and adverse impacts of climate change.
3. Many of the interventions proposed have high potential for carbon sequestration and can contribute substantially to climate change mitigation and adaptation in these areas.
4. Diversity in production systems is a built-in livelihood-resilience mechanism in rainfed areas providing substantial insulation from climate change and market vulnerabilities.
5. Majority of the farmers being small holders, household level economic security and growth comes from increasing productivity of multiple sources of livelihoods/ assets that they depend upon rather than increasing per ha productivity of any crop in a potential area.
6. Labor intensity and labor productivity must be seen together as the local economy needs to generate incomes to vast majority of population till the time they shift to non-farm sectors.
7. Women play a critical role in the production systems as producers, decision makers and knowledge keepers – their role in the local institutions and support systems need to be prominent
8. Production systems in rainfed areas, livestock in particular, depend substantially on common pool resources collective access to which needs to be protected and strengthened.
9. Intensive public investments in these regions gives spurt to private investments up the value chains and enhance institutional development.

The above calls for a '***paradigm shift'*** in public policy as productivity of diverse and integrated systems (at household and area level), with greater resilience and lower risk need to be promoted rather than the conventional narrow sectoral productivities in single commodities in an input intensive and high input-response framework.

The Working Group's deliberations have clearly brought out ten strategic elements for harnessing the inclusive growth potential of rainfed areas consistent with the imperatives laid above:

1. Need for *comprehensive and adequate investments in an integrated and relevant institutional and technological framework.*
2. A shift away from a *'single commodity approach' to 'NRM based farming systems*

approach' focusing on producing diverse products that mutually reinforce and can be supported by the available natural resource base without undermining its sustainability.

3. Efforts to *build resilience of the system along with capacities for adaptation to climate variability and change* should not be compromised as the rainfed areas are ecologically fragile and highly vulnerable to vagaries of climate.
4. Focus on strengthening and improving productivity of **extensive** livestock and crop systems through improved service delivery and knowledge management and harness the potential of agronomic and management innovations such as System of Rice Intensification, NPM, conservation agriculture etc., .
5. *Invest on and strengthen institutional capacities to handle high local variations in the natural resources endowments and production systems,* through *decentralized planning, implementation and governance* anchored in Panchayati Raj Institutions.
6. Making '*Rain Water Use Efficiency'* central to the paradigmatic shift.
7. Strategic *shift towards 'supportive/protective irrigation' for kharif* crops from the present limited access, intensive irrigation for few, thus, extending the safety net.
8. *Put in place robust Commons Policy* empowering community level institutions to manage, improve, and use products and services that form substantive basis for the production systems.
9. *Strengthening responsive support structures and infrastructure* such as diverse seed systems, improving the fodder base, technical services, and common facilities for aggregation etc. that involve higher transaction costs. Reducing the higher transaction costs and risks is essential to foster private investment by farmers and organized private sector.
10. Creating *budgetary and institutional instruments for convergence* rather than expecting it to happen in the myriad of schemes and departmental actors that operate in vertical tunnels.

There is a clear need to break from the past and evolve policy framework within the context of rainfed areas rather than extending the approach adopted thus far.

The Working Group calls for such a *paradigm shift* to be the focus of the 12th FYP.

5.1. Strategic Framework for Action in the 12th FYP

1. First and foremost is the need to recognize the need for and, the nature of investments required. Rainfed farming systems development is equated with watershed development in the past plans. Experience within watershed program suggests the need for investments on production systems improvement even to realize productivity gains out of the conservation investments in watershed programs. Secondly, natural resources management needs to be integrated into the land, crop husbandry and animal husbandry in annual cycles. Thirdly, at any given point in time only certain minor percent of area will be under watershed development. Substantial public investments over and above the crucial watershed development need to be made on revitalizing the production systems in rainfed areas on a sustainable basis.
2. Given the ecosystem specificities, the working group strongly felt that extension of intensive external input focussed, mono-species, agriculture paradigm evolved in the context of intensive irrigated areas to rainfed areas would be highly unsustainable,

even in the short run. A separate policy dispensation must be evolved (in the lines argued in this report) that guides public investments, technology and institution development in rainfed areas. This needs a fresh outlook on the policy, institution, program and investment architecture, which is not readily available.

3. The Strategic Action Areas for the 12th FYP:

   a. *Evolving a comprehensive architecture for rainfed areas development:* It is recommended that a larger comprehensive **National Rainfed Farming Program** (NRFP) be tried out as a learning ground in the 12th FYP to understand and establish a new paradigm of development of rainfed areas.
      i. Such a program also builds a grass-roots level convergence experience across RD, Panchayat Raj, Agriculture and Water Resources ministries' programs (RKVY, MGNREGS, BRGF, NRLM, NFSM and other programs).
      ii. Some of the Special **Area Programs** (Special state packages such as Bundelkhand package, Prime Ministers Relief, HADP etc.) can also be integrated with this program with provision for special assistance. The location specificities are inherently taken into account in the programs framework suggested by this Working Group.
      iii. This program needs to be tried out as a convergence model in 1000 selected blocks across different agro-ecological regions to generate a working experience that can be universalized in the 13th FYP. The exact number of blocks and their selection criteria need to be further discussed.
      iv. The program also aims at converging actions from civil society, research, and line departments.

   b. ***Creating a separate, flexible investment window for rainfed areas in each of the mainstream line-department programs***: This is necessary as many of the mainstream programs have an overarching design bias in favor of irrigated systems (be it agriculture, horticulture, animal husbandry, water resources or fisheries). A separate window for rainfed areas with separate program guidelines will help in promoting a relevant paradigm. Soil organic matter, critical irrigation, diverse crop systems, small ruminants, fisheries in small seasonal water bodies are but few examples for illustration. These special investment windows in all mainstream programs must be accessible for all rainfed areas, even beyond the 1000 blocks taken up for intensive development. Such special focus also needs to be brought into ICAR and SAUs' budgets.

   c. ***Supportive Policy Action*** is needed in the areas of evolving and strengthening institutions for rainfed areas, Common pool land and water resources and restructuring Groundwater use and management, particularly in aligning and making them consistent with the relevant paradigm.
      i. *Evolving an institutional architecture for public interventions in agriculture and allied sectors in rainfed areas*
      ii. *Diverse Crop Patterns with a focus on millets and minor pulses:* The much required diversity of crop patterns can be protected only if the traditional rainfed crops – millets and minor pulses in particular, are

brought back into the farming systems through demand generation and easing production and processing constraints. The strategy must be a combination of appropriate price incentives, inclusion of these in the Public Distribution System, MDMP and other food related programs, and promotion of value added products. The target for 12th plan is to restore the area under these crops to the level of 2001. A shift towards 'localizing the food security program' with a built in objective of bringing diverse food crops into cultivation and consumption can be a strategic instrument.

iii. *Commons:* Mapping of common lands in the districts where they are substantial, characterizing them, identifying various legal provisions in the states is one area of action. The second area is to evolve and get broader consensus on Commons Policy within states duly backed up by appropriate legislation. The case of Rajasthan where such a process has been spearheaded by FES is an example.

iv. *Groundwater:* In the groundwater dependent rainfed areas, appropriate policy focus need to be brought in to institutionalize participatory groundwater management, promote critical life-saving irrigation based systems (through creating positive incentives for sharing of groundwater) backed up by appropriate legislation and institutional support for implementation of the legal provisions. Such draft legislation is being actively considered by the Rural Development Department, Government of Andhra Pradesh.

It is *recommended* that a separate program "Protection of Rainfed Crops from Climate Vagaries" be taken up on a pilot basis jointly by the Ministry of Rural Development and Ministry of Water Resources to promote protective irrigation for farmers having no access to groundwater. Participatory Groundwater Management (anchored at Gram Panchayats) can be incentivized with investments from this scheme.

All the above programs and supporting actions need to be taken up under an overarching facilitating and enabling National Rainfed Farming Agency. This Agency can be made responsible for the specific output envisaged under various programs detailed below.

5.2. Summary of the Program Recommendations with Budgets

The following Table summarizes the action areas, their scale and approximate budget requirements recommended by the Working Group.

Recommended Programs with approximate Budget Details for the 12th FYP:

S.No.	Strategic Area of Action	Program Details	Indicative Budget (Rs. In crores)
1	**National Rainfed Areas Program**	• To be taken up in 1000 blocks in different agro-ecological regions • @ Rs.10 crore per block direct investment that leverages Rs.40 cr per block over the 12th FYP from other programs and private investments i.e. Rs.10,000 cr & leveraging Rs.40,000 cr. The details are presented in Table in the Annexure. • 5% facilitative and institutional grant i.e. Rs. 500 cr • Special area programs be merged with this program – allocating their present budgets as an additional allocations to those target blocks.	10,500
2	**Separate dispensation for rainfed areas within mainstream programs** of respective departments **"Rainfed Investment Windows"**	**A.** Enhanced budgets for various programs and creation of Rainfed Investment Windows (in agriculture, animal husbandry, horticulture, fisheries, ground water, civil supplies) o This is to be estimated in detail – enhancing the budgets of these programs by 25% and earmarking an allocation of 50% to rainfed areas is recommended	2000
		B. NFSM : Create separate window with in the National Food Security Mission for "Local Food Security in rainfed areas'" – focusing on intensive area based **Agronomic Innovations** (CA, SRI and LEISA/NPM) where local food security through increasing productivity of all subsistence food crops (rice, millets, pulses and edible oil seeds) of small holders be taken up. This is also meant for climate resilience. • Target 5 million ha as impact area by investing on 2.5 million ha @Rs.8000 per ha	2000

S.No.	Strategic Area of Action	Program Details	Indicative Budget (Rs. In crores)
		C. The plans of the following programs must specially mention the plans for Rainfed Agriculture & livestock • RKVY • BRGF • National Horticulture Mission • The process and content of all the programs (above) need to be flexible to enable local specificities and be consistent with the new paradigm of development of rainfed areas envisaged.. • MGNREGS and IWMP are targeted (in content) and flexible enough and may not need any special window.	-
3	**Supportive Policy Initiatives**	This budget will be under the proposed National Rainfed farming Agency	
a)	Evolving institutional architecture for rainfed areas	• Promoting farmers' institutions and re-structuring supportive institutions (ATMA, PRIs etc.) and facilitating enabling legal framework. • The actions involve Constitution of an expert committee to analyse the institutional requirements at farmers level, evolve a strategy for promotion and propose restructuring of the present agriculture administration/ extension institutional framework to be consistent with the new paradigm of decentralization, participation and location specific action. • Implementation of the recommendations (Restructuring and professionalizing ATMA, strengthening PRIs & promoting institutional base at community level) – on a pilot scale.	500
b)	Diversified crop patterns and comprehensive initiative on millets and minor pulses including integration of millets into PDS	• Mapping the traditional millets and minor pulses producing and consuming blocks and undertaking a diagnostic study on the time trends to identify the potential drivers for reclaiming their area – policy analysis and formulation through a consultative process • CRIDA may be assigned the task within the existing programs.	
		• Larger pilot on inclusion of millets into PDS, MDMP and other food- programs in 100 blocks in different regions. This shall serve as a ground for evolving a robust policy and operational procedures for universalizing millets production, procurement and introduction into PDS.	550

S.No.	Strategic Area of Action	Program Details	Indicative Budget (Rs. In crores)
		• Dedicated budgets for facilitation @ 10 lakhs per year per block ~ Rs.10 cr for 100 blocks i.e. Rs. 50 cr over the plan period • Supplementary budgets for PDS inclusion pilots @ Rs. 1 cr per block per year ~ Rs.500 cr. • Special provision under Ministry of food and civil supplies programs for subsidy for millets (to be leveraged). • Continuance of the investments under INSIMP program – subsumed under this program with necessary modifications in its design.	
c)	Commons pilot initiatives and facilitating policy at state levels	• Mapping and characterizing common lands • Evolving and promoting state level policies and programs on commons through a national consultative process & design of convergence programs	20
d)	Wider extension of support irrigation to secure kharif rainfed crops and Participatory Groundwater management	• Institutionalising participatory groundwater management, evolving consensus on appropriate legislation for community regulation of groundwater and promoting such legislation in states. (Rs.50 cr) • Piloting common access to groundwater for providing critical irrigation *"Protection of Rainfed Crops from Climate Vagaries"* program • Pilot in a target area of 50,000 ha @Rs.50,000 per ha (in individual blocks of about 100 ha) - i.e. Rs.250 cr. • The program can converge on resources from groundwater related programs envisaged during the 12th FYP.	300
	TOTAL		**15,870**

5.3. Specific Deliverables of the National Rainfed Farming Program

The National Rainfed Farming Program, the Special 'Rainfed Investment Windows' to be created in relevant line departments' programs, and the Supportive Policy Actions to be facilitated by the NRFA together are expected to deliver the following specific outputs at the local and national levels.

At the Local (Block and Panchayat) Level:

1. *Inclusive Growth Plans* for the block are prepared through :
   - Mapping the production systems (agriculture, livestock, fisheries, forest etc.), analysis of constraints and estimating their growth potential.
   - Assessing the institutional environment, creating appropriate primary stakeholder platforms, organize technical interactions and series of consultations for strengthening local institutions and for evolving appropriate interventions.
   - Profiling the Block level allocations under programs of various line departments
   - Arriving at planned interventions through interaction between primary stakeholder institutions, Gram Panchayats, respective line departments and research institutions.
2. *Strengthening of primary stakeholder institutions and their federations* and establishing platforms for dialogue, knowledge managemnet, service delivery and innvoations at block level. Establish linkages among these platforms, service providers and research institutions.
3. *Integrating the planned interventions* arrived at through a consultative process with various programs operational at the block level – leading to a *matrix of operational plan* with sector specific actions on the horizontal axis spread across different programs operational in the block along the verticle axis. This results in operational plans to be implemented by Gram Panchayats, CBOs and various line department programs.
4. *Implementation of the sectoral planned interventions* by the local institutions, lessons learnt and strategic reorientation of the plans.
   The above is an iterative process undertaken annually leading to further refinement and addressing higher order issues as the momentum picks up.
5. Establishment of specific support sytems, infrastructure and institutional norms for various production systems such as for seeds, knowledge, mechanization, livestock health care services, processing, marketing, management of commons etc., at Gram Panchayat, cluster and Block levels as appropriate.

The major outcomes of this exercise are a) institutions with capacity and necessary linakages including innovation platforms at block level and b) they realizing the production and income potential of all the production systems in a sustainable manner i.e. realizing an annual growth not less than 6%.

Deliverables at the Secondary Level

1. Location (agro-ecology) specific <u>strategic</u> areas for action and policy requirements evolving from intensive interaction with primary stakeholder plantforms, civil society, research and administrative systems strongly rooted in the successes on ground. Such strategic areas integrated into the local policy and decision making.
2. Outcome monitoring reports (reporting at block level aggregation) for all the blocks taken up – looking at specific indicators available in the web.

3. Synthesis reports on various pilot initiatives and policy learnings.
4. Specific Rainfed Investment Windows created in all relevant line departments with clearly defined processes for participatory planning, decision making, implementation and monitoring- refined with experiences emerging.
5. An economic and institutional assessment of the program (mid-term and at concluding stages)
6. An overall architecture for a Paradigm Shift in the 13th Plan.

The Working Group recommends the above generic program structure for the 12th FYP. *The National Rainfed Farming Program recommended for trying out in 1000 blocks in different rainfed agro-ecological regions can be an intensive learning process to evolve sets of institutional, technological, financial and human resources protocols for a relevant paradigm of development for rainfed areas. Such protocols can be universalized during the 13th FYP.*

The facilitating budgets in the above table along with additional core operational budgets can be allocated for the recommended National Rainfed Farming Agency. Augmenting specific budgets of various relevant programs under Animal Husbandry, Fisheries, water resources etc., and creating special Rainfed Investmnet Windows in the respective programs – will enable the technical departments to have a special focus on rainfed areas issues and to evolve location specific programs.

The specific content of these programs is detailed in the next sections. It is important that considering the diversity (ecological and demographic) in rainfed areas – decentralized planning and operational flexibility must be maintained and such decision making must be devolved to Block and Panchayat levels. Strategic planning is crucial at Block level within the scope of which Panchayat level detailed plans can be generated. The 'Agency function' is most critical to facilitate multiple actors, programs and investments to be integrated both in planning and in implementation at the Block level. Decentralised planning must not be a one time effort; it must rather be an ongoing process of iterative learning at multiple levels facilitated by a dedicated agency having accountability to development objectives and with a locus in Gram Panchayats and Community Organisations. Planning must be organically linked to implementation.

A Block and sub-Block level Human Resources plan need to be worked out integrating different programs and institutions.

5.4. Institutional Architecture for Implementation

A larger oversight and proactive pursuit of development of rainfed farming shall be brought under a **National Rainfed Farming Agency** (NRFA). The NRFA shall have three strategic focal areas as detailed under Strategic Areas for Action above. These are a) overseeing implementation of a dedicated program – National Rainfed Farming Program, b) ensure creation of a *Rainfed Window* in all mainstream programs of ministries of Agriculture, Rural Development, Panchayati Raj and Water Resources c) pursuance of supportive policy changes required.

The institutional architecture for the overall rainfed farming systems programs can be structured around the following:

National Rainfed Farming Program

(A) Block Resource Agency (at Block and Sub-Block Level) :

a. The program must have Block as a unit for strategic planning, while one or a cluster of Gram Panchayats can be the units for operational planning and program implementation.
b. The 1000 blocks can be allocated proportionally to different agro-climatic regions based on a composite index of total area, net cultivated area and population. Blocks with relatively higher urban concentration must be avoided. The actual selection of the blocks can be made by the districts from out the prioritized blocks listed by the Planning Commission.
c. A Block Resource Agency – as a strategic partner agency can be identified (through a competitive process) to hold the responsibility for i) strategic block level (iterative) planning ii) facilitate convergence iii) capacity building iv) field support. Detailed contractual guidelines can be evolved. The Agency shall deploy a professional team for the entire plan/program period.
d. While the development functions are vested with the Block Resource Agency, the technical line departments (AH, Fisheries etc.) may focus on the effective provisioning of technical services. The Agency shall interface with the PRI institutions.
e. The strategic rainfed farming development planning and implementation process to be followed by the facilitating agency shall be as follows:
    i. First identify the potential within the sectors for growth- in agriculture, livestock, fisheries and others. The potential will be mapped with detailed production potentials, resource inventories with estimates involving all line departments, community organisations and PRIs.
    ii. It then identifies the critical service, infrastructure, technological, financial, human resource and institutional bottlenecks/ gaps through participatory processes.
    iii. The Agency then can facilitate intense interaction among various stakeholders and draw detailed strategic areas for action and investments in a convergent mode.
    iv. The detailed budget will be arrived at along with sources of the budget in consultation with all departments, banks and exploring various options for private investments. This shall be the convergence plan to be implemented. Such a plan will be consistent with the Content Guidelines of the rainfed areas development program that defines a new paradigm (to be developed by the Mission). Flexibility must be provided by the respective line department programs to accommodate the content within a separate budget Window for Rainfed Areas, provided at the GoI level.
    v. The Agency will be responsible for operationalizing the Plans over the plan period in coordination with the respective implementing organisations under various schemes.
    vi. The agency will also develop federated/apex institutions of various community/stakeholder organisations and eventually capacitate them to provide services.
    vii. Institutional arrangements for capacity building shall be appropriately made. Development of Community Resource Persons as a core

strategy shall be followed.

viii. The above institutional arrangement ties up the development planning process with implementation and thus, pins down the ultimate responsibility to an Agency without centralizing the power or budgets. It allows for the technical departments to focus on technical services.

(B) <u>At the District Level:</u>

a. ATMA, though not very strong at present, has the mandate for interfacing with line departments – Animal Husbandry, fisheries etc. Being a Society, it can hire people and manage programs. It is also envisaged as an autonomous agency facilitating planning and capacity building; independent from the routine regulatory functions of the agriculture department.[1]

b. It is recommended that a revamped and strengthened ATMA be the nodal anchor for the program at the district level. A special cell may be opened within ATMA with a full-time professional staff- selected through a competitive process. A *Rainfed Programs Management Cell* constituted in ATMA shall provide *administrative anchorage* for the program responsible for sanctioning of the proposals, enabling inter-department convergence, maintaining MIS, social audit, general reporting, issuing contracts etc. The planning processes for all the line-departments programs and RKVY – Rainfed Window must also be vested with ATMA – so that convergence is institutionally enabled. It would be in a better position to integrate various programs of the MoA. The relation between ATMA and the DPC need to be appropriately worked out to bring in the accountability to PRIs.

c. Strategic Capacity Building Partner Agency can be chosen at the district level through a competitive process for supporting/ backstopping the Block level Agencies in planning and implementation. Such an agency will *anchor supportive and capacity building functions* and also, engages in documentation and monitoring. This agency will be intensely oriented and trained in various strategic shifts envisaged in the new paradigm.

d. Ideally, a common strategic district partner capacity building agency both for DRDA (for MGNREGS, IWMP, NRLM etc.) and ATMA (Agriculture, RKVY, NFSM) can ease convergence between RD and Agriculture programs relevant to rainfed agriculture; pooling of capacity building resources helps in hiring quality human resources.

(C) <u>At State Level:</u>

a. The institutional arrangements for approval of IWMP and RKVY (an integrated SLNA) can also be responsible for the approval of the plans.

b. The Strategic CB Partner Agencies along with key Agriculture research institutions in the state can form a *State Level Consortium* with an independent Secretariat officially funded out of the program budget. This Consortium backstops the district partner agencies, develops CB modules and material, undertake action/problem solving research, monitors and grades the performance of the District CB Partners and take up such other measures.

[1] This mechanism allows for division of regulatory and subsidy administration roles and development roles within the Agriculture Department.

c. A special Rainfed Areas Cell need to be created within the Department of Agriculture that integrates AH and fisheries. This Cell looks after all the special Rainfed Window programs of the MoA and also facilitates convergence with RD programs. This Cell must be free of any regulatory functions in the Department and will be staffed by professionals selected through competitive process (including those working within the Department).
d. Such an institutional arrangement in the form of a consortium can bring in elements of self-regulation, mutual support and accountability in the professional institutions.
e. The independent programs of the line departments shall be managed within the respective procedures/ institutional arrangements and reporting systems.

(D) <u>At National Level:</u>

f. It is important to infuse fresh thinking at the national level as the entire paradigm shift needs some detachment with the past. Also, it is important to bring in the thematic expertise in participatory, community institutional development, integrated planning, NRM and water management, enterprise and markets along with the core expertise in agriculture. Specialization in integrated systems perspective and policy acumen is more important at the national level than reductionist technical expertise in one area. Grass-roots experience in rainfed areas would be a crucial requirement.
g. A *National Rainfed Areas Agency* needs to be created for the overall management of a) the Dedicated Rainfed Areas Program b) facilitating content development of 'Rainfed Investment Windows' within the mainstream programs c) identify and steer the supportive policy changes.
h. The National Rainfed Areas Agency can effectively complement various flagship programs of the 12th plan in terms of providing effective production systems improvement orientation to the IWMP, MGNREGS, BRGF and other programs in the RD. In addition, it can provide a convergence platform at the top among various MoA programs.
i. The NRFA need to have a *Rainfed Areas Learning Cell* – consisting of professionals drawn from action-research, advocacy and civil society who can provide *content leadership* – in terms of synthesizing various emerging experiences in different agro-climatic regions, field testing various hypotheses through commissioning action- research and impact assessment studies. It is important that this team has diverse experience and is drawn from civil society, administrative, media and research backgrounds.
j. One of the important functions of the Mission and the Learning Cell is enabling development of institutional capacities in the states and districts to provide analytical and administrative leadership to instill dynamism in rainfed areas development.
k. As envisaged in the Approach Paper to 12th FYP, the NRFA must have pooled competencies across scientific institutions, bureaucracy, civil society and markets - in its overall human resource structure.

a. Research Partnerships:

i. Research partnerships on an ongoing basis at block and district levels with ICSSR, SAUs, ICAR and Management institutions would provide a platform for iterative learning.
ii. A separate Rainfed Farming Cell may be created within an ICAR

institution such as CRIDA as a single point clearing house of information, experience sharing and coordination/liaison for participatory technological development.

6. Setting out the Relevant Paradigm Shift

The following sections outline some of the potential areas for inclusive growth and requirements of the strategic framework for action; these are indicative areas and by no means comprehensive enough to capture all the diverse requirements of the country. The purpose is to underscore the magnitude of the systemic shifts required. This is to specifically illustrate the need for a separate policy dispensation for rainfed areas, rather than extending the conventional agriculture policies evolved for irrigated areas.

The National Rainfed Farming Program, the Rainfed Windows to be created in various mainstream programs and the support policy initiatives suggested earlier need to build on and effect the paradigmatic shifts detailed as below.

The Paradigm Shifts envisaged are categorized under the following themes:

1. Natural Resource Mangement
2. Agriculture
3. Strengthening rainfed livestock system
4. Fisheries in rainfed water bodies
5. Risk minimization and resilience building
6. Strengthening R&D and extension in rainfed farming
7. Institutional development, credit and markets

The specific action points for the 12th FYP are summarized at the end of each theme along with how to go about.

6.1. Natural Resource Management

6.1.1. Strategic Area 1: Enhancing Soil Health and Productivity

The Working Group strongly recommends that incentivizing farmers for generation and addition of bulk organic matter to soils be one of the core areas for investment in rainfed areas in the 12th five year plan as envisaged in the Approach Paper. Soil is a living resource. The term soil health refers to the state of soil resources in relation to their capacity to perform a range of interconnected and interdependent functions that include as a substrate for crop production, as a medium which regulates hydrological cycle involving retention, storage and regulation of flows within the root zone of crops and in the ecosystem, nutrient cycling within the soil (soil-crop-livestock system) and in landscapes/ecosystems, as a habitat of a large variety of biodiversity bringing about transformation fundamental to range of functions, as a regulator of greenhouse gas emissions and sequestration.

Issues of soil health have been understood and interpreted so far largely from a limited view point of decline in soil fertility, relating to emergence of increasing deficiencies

of macro (N, P, K) and micro (Zn, Mn, Fe etc) and secondary (S) nutrients with implications for cost of production. Little attention was given to issues of maintaining and improving hydrological and biological soil properties which are critical to the functions of essential processes that impart good health. For this reason the more fundamental and integrating element, soil organic matter has been greatly discounted as the key element for enhancing and maintaining soil health.

During the 11th Five Year Plan DOAC (2008) initiated *National Project on Management of Soil Health and Fertility* with main objectives setting up of Soil Testing Laboratories, strengthening fertilizer quality control, promoting integrated nutrient management and balanced use of fertilizers, micronutrients etc. While these efforts are a beginning of the recognition of a serious problem; the programs have left out addition of organic matter to soils, the fundamental corrective action required from their scope. The most important practices which can contribute to enhancing and maintaining soil organic matter are:

- Minimizing soil disturbances through practices such as tillage, ploughing etc. (by adopting No till seeding)
- Leaving crop residues on soil surface or applying organic materials eg farmyard manure
    - Generation of biomass for bulk addition of organic matter in the soil to maintain proper soil health.
    - In situ decomposition of biomass generated through cropping/inter-cropping/bund cropping of green manure crops.
    - Recycling of farm and household waste through use of intensive nutrient recycling methods through appropriate composting techniques,
    - Producing and encouraging use of bio-fertilizers at regional and local levels
    - Crop rotations to enrich soil (e.g. to include pulses and leguminous crops). Multiple cropping which enriches soil should be encouraged instead of mono-cropping.
    - Pooling existing soil testing data into a System of Soil Nutrition Management (SSNM), which will enable much better-informed soil nutrition management and quality extension work.

Despite its proven benefits, organic matter management and recycling necessarily hinges upon two fundamental elements:

- Availability of organic material.
- Economic incentives for conserving, generating and recycling organic matter

The Approach Paper for the 12th Five Year Plan emphasized the '*addition of bulk organic matter to soils*' as a priority. Various ways of making this possible and the critical incentive systems required are synthesized by RRA network with support from CRIDA (see www.rainfedindia.org). Inter-crops, green manures and cover crops are the cheapest ways of soil fertility improvement in combination with others. There must be comprehensive measures to soil health improvement centered on addition of soil organic matter in substantial quantities over time, rather than promoting any singular measures.

Investing even 5 to 10% of the total fertilizer subsidies on soil organic matter will also improve the efficiency of, and returns on fertilizer subsidies. Soil investments will also have a

significant impact on both mitigating and adapting to climate change. Such a program will benefit the rainfed areas much better owing to its cumulative impact on breaking soil encrustation, increasing capacity of soils to harvest and hold moisture, reducing surface runoff and such other hydrological properties of soils. Enhancing biological life in soil substantially contributes to healthy crops.

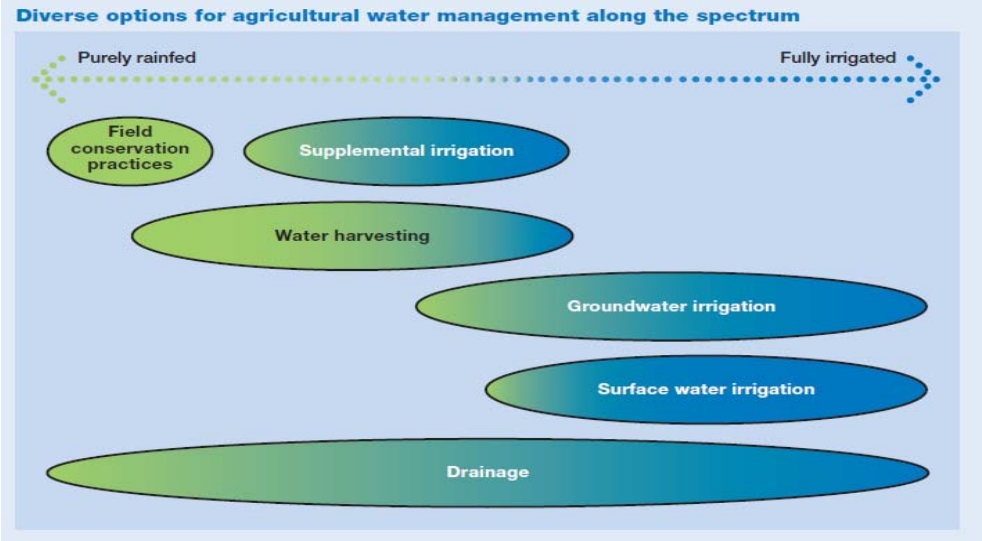
What to achieve? :
Bring comprehensive measures of enhancing soil organic matter and managing soil productivity as a public good.

How?
- Support farmers for 5 years in the form of incentives for practicing agronomic measures, crop patterns and application of organic matter eg. leaving crop residues on soil surface, adopting No-Till/reduced tillage options that enhance soil productivity. Support is required in the form of *additional labor costs* and *seed material.*
- Invest on regeneration of biomass within and nearer to the agriculture areas to reduce costs of harvesting and transport. Support required is on labor costs, plantation material, and on protection.
- The above can be integrated into MGNREGS if special provisions are created. Support additional transaction costs of implementation – particularly monitoring, measurement and payment.
- Incentives/ investments required are in the range of Rs.2000 per ha per year.

6.1.2. Strategic Area 2: Enhancing Rainwater Productivity (Soil Moisture Management and Protective / Supplemental Irrigation)

The rainfed areas need an appropriate paradigm of irrigation that extends security to millions of rainfed farmers and increase productivity while maintaining the integrity of the ecosystem. *A Comprehensive Assessment of Water Management in Agriculture* taken up by the International Water Management Institute (IWMI, 2009) calls for abandoning the "obsolete divide between irrigated and rainfed agriculture" and to acknowledge rainfall as the key freshwater resource. *The 12th Plan needs to take strong and decisive action in developing a paradigm for water use relevant rainfed areas.* Better management of rain water, soil moisture, and supplemental irrigation is the key to helping the poor in securing crops against dry spells and droughts and to provide security of investments. The rainfed systems need to be 'upgraded' through better soil moisture and water management practices that can increase water productivity. It is in this area that a strong policy leadership is required.

FIGURE 5



Source: IWMI (2009)

The present paradigm operates on the either of the extremes of rainfed or irrigated. Groundwater recharge and erosion control are the dominant elements of public investments in watershed development in rainfed areas while a 'full-irrigation' centricity dominates the other end. Several studies suggest that better management of rainwater, soil moisture and supplemental irrigation holds the key to high water productivity. It is estimated that a 35% increase in water productivity could reduce additional crop water consumption from 80% to 20%. (Molden D, 2007). A study of over 500 districts in India concludes that provision of critical irrigation during the mid and terminal drought periods has the potential to improve the yields by 29 to 114 percent for different crops (Sharma *et al.*, 2010). The high levels of marginal productivity of water (through supplemental irrigation) in rainfed agriculture offer immense potential for national food security, an area that is hardly explored so far.

With one time supplemental irrigation of about 100 mm (using harvested run-off) inducing adoption of improved agronomic practices, Sharma *et al., 2010* estimates that the overall productivity level in the identified rainfed districts covering an area of 27.5 M ha in the country can be enhanced to a level of 2.65 t/ ha (cereals- 3.64 t/ha; oilseeds-1.75 t/ha, pulses- 1.93 t/ha) from the existing aggregated level of 1.2 t/ha. As one can see these potential production levels are only marginally less than current fully irrigated national productivity levels of about 3.1 t/ha. Out of the total of about 92 M.ha of rainfed cropped area of the country the studies suggest, only 30 M.ha lies in <500 mm rainfall zone and the rest of 68 percent of rainfed cropped area lies in medium to high rainfall regions with very high potential for supplemental irrigation through capturing run-off. A participatory research program of ACIAR with PRADAN in East India Plateau, illustrates the potential of harvesting the run-off and creating moisture regimes that enable farmers to expand their crops and crop season (Marino and Braidotti 2010). The project demonstrates the potential of a flexible adaptive approach of working out soil-water balances along with farmers. Kharif stabilization program in the eastern and central India through diversion channels is another such example.

Substantial experience is now available on re-defining groundwater use and management with farmers' participation. The World Bank supported AP Drought Adaptation Initiative (APDAI), the FAO supported AP Farmer Managed Groundwater Systems

(APFAMGS) and initiatives of CWS and its partners have demonstrated the possibilities of expanding scope of supplemental irrigation providing crop-security to many rainfed farmers who do not own borewells; thus, expanding groundwater access to rainfed crops. These experiences reported higher net incomes to farmers and stabilization of kharif crops.

Considering all these experiences across the country and the intensive research results backing up the propositions, *the Working Group strongly recommends the 12th FYP to lay down the roots of a new paradigm of 'Supportive Irrigation and Moisture Management' in rainfed areas.* The main elements of such a paradigm could be:

1. Bring the concept of rainwater use efficiency to the center stage of water resources management in rainfed areas. This warrants a greater emphasis on security and critical support to rainfed crops on an extensive basis.
2. Upgrade the rainfed agriculture along the spectrum illustrated in the above figure to include
   - Soil and water conservation: through expanding the speed and scope of watershed development programs
   - Comprehensive moisture capture and in-situ rainwater retention in soil profiles: through positive and indicator based incentivisation of addition of biomass to soils, inter-crop and cover crop systems and other agronomic measures
   - Fully harness the potential of surplus runoff at farm level and supplemental irrigation by strengthening traditional water harvesting structures, promoting farm ponds and other such measures
3. Invest on and incentivize groundwater sharing and usage for supplemental and support irrigation for kharif crops.
4. Promote agronomic innovations that can reduce costs and usage of water and other inputs, while increasing productivity (eg vegetative barriers, mulching practices, intercropping, improved water management in rice cultivation etc.).

The shift in the paradigm of public investments on 'water' as detailed above is consistent with natural resources management and strengthens the positive interactions among soil, rainfall, crop and livestock building a robust basis for sustained and inclusive growth.

What to achieve?

- Develop strategic components for 'increasing rainwater use efficiency' and prepare plans for harnessing most of the potential. Include modules on soil moisture management/ soil water balance. Provision for drinking water for livestock needs to be integrated into the overall strategy.
- Pilot a comprehensive program on Participatory Groundwater Management and Securing Rainfed Crops through supportive irrigation – with investments on supportive irrigation using groundwater and surface water bodies. Evolve a larger policy framework based on these experiences.

How?

- Integrate part (a) above into the National Rainfed Farming Program.
- Allocate separate budgets for a pilot initiative as envisaged in the Policy Support component of the Mission through special allocations.

6.1.3. Strategic Area 3: Revitalizing Common Pool Land and Water Resources

Commons provide natural resources for the poor (land less, small and marginal farmers) not having land of their own. Large part of the livestock in the country is still dependent on common pool resources. Degradation and decline of common pool resources has adverse economic, equity and ecological consequences for rural areas, where survival, sustenance and growth are intimately linked to health and productivity of the surrounding natural resources. It has been a major causal factor in enhancing and perpetuating poverty, particularly among the rural poor, when such degradation impacts soil fertility, biodiversity, phytomass availability, water availability, pastures, forests, wildlife and fisheries.

Though the proximate factors for degradation and decline of commons are often attributed to intensification of agriculture and land distribution, these are manifested through deeper causal linkages of institutional failures resulting from lack of clarity of rights of access, use and management of common resources and lack of policies governing commons. There is also a general lack of appreciation of the role of commons in the local economy and ecology. The need to act on these issues related to commons in the 12th FYP is acknowledged in the Approach Paper.

During the 12th FYP period an overarching policy direction on commons must be facilitated with various state governments to recognize the various social-cultural-economic-ecological functions of CPRs, clarifying rights of access, use and management of these resources. Evolution of appropriate legal and administrative mechanisms to devolve and decentralise governance of common pool resources to Gram Panchayat and Gram Sabha must be facilitated by the proposed National Mission.

The overarching policy direction must encompass the following:

- All common pool land and water resources are brought under the custody of Gram Panchayat/Gram Sabhas.
- A community led process of claim, verification and consolidation of rights on common lands is initiated for clarifying community rights and such rights are recorded in Record of Rights at Gram Panchayat level.
- Management and use rights of common land and water resources are devolved to village/habitation institutions where the primary users of the resource reside
- Secure property rights of communities over commons and putting up institutional mechanisms through which they can claim, consolidate and verify their rights would be a key step in strengthening the resilience of rural livelihoods and providing incentives to communities to invest in productive technologies and sustainable management of resources in the future.

The efforts of the Government of Rajasthan in evolving a comprehensive policy on commons can provide a lead to such an effort by the Mission.

Further, recognizing that most of the common lands due to continued neglect are in degraded condition, increased public investments with a clear programmatic focus is required to revitalize common land and water resources. While a large proportion of these investments can be met through channeling MGNREGS funds towards activities for common land development, due to absence of a clear programmatic focus, unclear property rights and weak

planning process this has remained neglected with review of expenditure pattern showing minimal investments on common lands. A clear programmatic focus with adequate and continued investment on protection (from grazing, fire etc.) is crucial to regenerate the biomass in commons, in the absence of which, the investments will be restricted to mere soil conservation. The experiences of Foundation for Ecological Security across several states, APPS in AP and other organisations have generated adequate experience in the above regard.

What to achieve?

- Map and delineate the common pool land and water resources across various states.
- Evolve state specific comprehensive policy on common pool land and water resources with specific provisions as mentioned above.
- Bring in programmatic focus to regenerate the commons with appropriate devolution of rights on ownership, use and management with time bound targets.

How?

- Map and delineate the common pool land and water resources with appropriate partnerships across multiple agencies as a special funded exercise during the 12th FYP.
- Establish a separate cell with required expertise within the proposed National Mission to map the policies across states and evolve an overarching policy framework through a consultative process.
- The Commons Cell at the proposed National Mission may also engage with various state governments to evolve appropriate policies, programs on commons and legislative measures. Necessary funds to be allocated for this purpose.
- Integrate the Commons Program with the proposed national program in the 1000 blocks.

6.2. Agriculture

6.2.1. Strategic Action Area 4: Appropriate Seed Systems

Seeds are a critical input for long-term sustained growth of agriculture. Timely availability of quality seeds with good yield potential continues to be a major problem, particularly of diverse crops. In India, more than four-fifths of farmers rely on farm-saved seeds leading to a low seed replacement rate. Concerted efforts are essential in ensuring timely availability of seeds as well as increasing the Seed Replacement Rate (SRR). Protecting, strengthening and improving the diverse major and also 'minor' crops occurring in a given area is important. *Maintaining a strong local-seed system that is well linked to the agriculture research system is a necessity for productivity enhancement,* for the following reasons:

- Timely sowing (within the short window of sowing allowed by rainfall) is important in rainfed farming; local access and availability of seeds is crucial for timely sowing.
- Maintaining seed buffers for all contingencies – for repeat sowing forced due to initial dry spells and for change of variety or crop (contingency crop) due to delayed onset of rainfall and loss of seed due to crop failures resulting from droughts.
- Many of these diverse crops/ locally adapted seeds do not find a place in the formal

seed markets as they are not profitable. Groundnut is a classic example for the chaotic situation in seed sector.

- Many of the locally adapted indigenous varieties need to be purified and improved.
- Seeds and planting material for commons – fodder grasses, fodder trees, horticulture etc., need to be made available locally.

The 12th FYP must consider adequate investments on establishing robust seed systems tailored to rainfed areas. It is important to subsidize the costs of maintaining buffer-seeds and seeds of diverse crops. In addition, investing on the skills and knowledge of farmers/ farmer groups on seed replacement, improvement and seed production is important. Strong state support is required and these systems are best managed by the local communities and larger number of local seed enterprises.

What to Achieve?

- Seed systems (with seeds of diverse crops) managed by communities and local enterprises which receive government support for infrastructure, maintenance of buffer seeds, risk coverage and transaction costs.

How?

- Establish such seed systems at cluster of Panchayats; provide infrastructure through MGNREGS and allocate some labor days for maintaining the seed stocks
- Dovetail the present seed subsidies targeted to individual farmers into capital or annual grants to seed systems managed by communities.
- Rework on the policies on seed subsidy – to enable the above conversion of seed subsidies to capital/ annual grants to seed systems.

6.2.2. Strategic Action Area 5: Farm Mechanization

Timely operations are important in rainfed agriculture as the farm operations are linked to the soil moisture regime. The limited 'sowing time-window' available at the onset of monsoons places heavy demand on the available draft power. Though the total farm-power availability has increased over time, commensurate increase in appropriate farm-implements has not taken place. Declining bullock power in several states makes the small-farmers much more vulnerable as they will be the last priority for tractors on hire services. The problem deepens with increasing rainfall uncertainties due to climate change.

Experience from the Mission mode project on "dryland mechanization" and others has shown that crop based mechanization system with appropriate implement use increases productivity of rainfed crops by 12 to 34 percent; in addition, substantial saving in seed and fertilizers help increasing cropping intensity by 5 to 22%. The productivity gains range from 15 to 59% in the rainfed crops. (*Final report of NATP Mission mode project on "Use of improved tools for mechanization of Dryland agriculture: 2005-2006.)* Availability and access to appropriate farm-power and implements greatly increases rainfall use efficiency as farm operations like sowing can be done at appropriate moisture levels, a critical requirement for productivity enhancement. Access to locally adapted seeding/seed-cum fertiliesr drills increases fertiliser use efficiency as they are placed at appropriate depth where moisture is available.

Draft animals numbering 56.5 million have contributed 21.5 (23%) million kw/h compared to 2.81 million tractors contributing 73.39 million kw/h in 2004-05 (Kulkarni

(undated)[2]). Animal power still remains a major source of farm-power for agriculture operations in the undulating marginal terrains of rainfed areas. There are also niche tasks that are performed by bullock-power even in the mechanized areas. In spite of such overwhelming contribution to agriculture there are no promotional/supportive investments to strengthen animal-farm-power in this segment.

Declining animal-power and lack of access to farm power for small and marginal farmers need to be addressed comprehensively. Prices of bullocks have increased sharply over recent years indicating the heavy supply gap. With many commercial banks also not encouraging loans to bullocks, the crisis is deepening at times resulting to keeping the land fallow. This call for institutional innovations to create access to farm-power for small and marginal farmers that involve asset creation in adequate numbers, fodder allocation, off-season maintenance, technological innovations in bullock-drawn implements and in transport. There are opportunities to integrate some of the services such as 'manure transport' with MGNREGS, providing off-season employment for animal-power; at least these units can be subsidized to the extent of annual subsidy on diesel for tractors. Being accessible for small plots they keep the paid out costs low making agriculture at the margin viable. The bullock-power has a very high degree of carbon-neutrality at an aggregate level.

The options of increasing farm-power access to small and marginal farmers in rainfed areas must also be pursued, where appropriate, through promotion of tractors and power-tillers. Though several farm-implements are developed, their uptake in rainfed areas is rather poor. 'Custom hiring centers' are tried in several places by CRIDA and other organisations. The subject calls for high levels of local adaptation and institutional innovations. Several farmer innovations (like those documented under National Innovation Foundation) do not find promotional support in the mainstream programs.

In view of its overarching significance, the **Working Group** recommends the 12th five year plan to consider an action- research pilot program at scale on evolving suitable models for appropriate farm-mechanizations in partnership with farmers and civil society organizations with experience.

What to Achieve?

The suggested program must have focus on the following:

- Access of farm-power, particularly to small and marginal farmers with an equal emphasis on tractors/ power tillers and bullocks, as per the local context.
- Institutional innovations on strengthening bullock power including ways of finding off-season employment.
- Supporting local innovations at block level involving farmers' organizations, local industry and building on the already existing innovations with a strong linkage with modern science.
- Heavy emphasis on developing farm implements and transport.

[2] (Kulkarni SD. Mechanisation of Agriculture- Indian Scenario. CIAE, Bhopal.

How?

Such a program must be an integral part of the Rainfed Mission that the working group is proposing rather than being a separate scheme in itself. Without formal active involvement of farmers and local industry and facilitating organizations, such local innovations will not come by.

- Promote custom hiring centers for farm-implements/ machinery with appropriate capital investment
- Pilot specific innovative institutional mechanisms to strengthen animal power as per the location specificities.

6.2.3. Strategic Area 6: Harnessing Growth Potential of Sustainable Agronomic and Management Innovations

Several agronomic innovations are taking roots across the country with several successes that improve soils, increases water use efficiency and produces more with less of external inputs reducing costs. Several location specific agronomic practices have been recommended since long by the agriculture system that show growth potential.

Three major innvoations emerging prominantly in the rainfed landscape are Conservation Agriculture, System of Rice Intensification and Non-Pesticidal Management. These are evolved in a systems framework and are promotes integrated actions that are consistent with sustainable NRM.

6.2.3. (a) Conservation Agriculture and Production systems (Rice, Millets, Soybean, Cotton, Pulses etc. based) enhancement (adopting integrated soil, crop, water, nutrient and pest management)

Since sixties efforts have been made globally to understand and develop production system aimed at reducing cultivation cost, reducing runoff and associated losses of soil, water, inputs, organic matter and improving the use efficiency of water, fertilizer and enhancing soil organic matter. Conservation Agriculture is an umbrella term that has come to describe a system that involves application of a few scientifically sound principles to achieve progressively more sustainable production systems. The principles include:

- Causing minimum disturbances to the soil through practices such as ploughing, tillage etc and preferably adopting zero-till methods for seeding etc
- Keeping the soil surface covered to the extent possible by growing crops/crop combination, leaving crop residues on the soil surface, agro-forestry practices, growing cover crops etc
- Adopting crop rotations in the spatial (field, farm, landscape) and temporal (seasonal, annual, perennial) domain

The concept of Conservation Agriculture (CA) is now well accepted as a way towards ecologically sustainable agriculture and millions of hectares are now adopting these practices (FAO, 2011). In India the principles of CA are now well routed in technological elements being already promoted eg. zero till seeding of crops, mulch based practices, intercropping/agro-forestry practices etc. through various programs. The need now is to mainstream CA through adaptive research linked development

program. Agricultural practices which build upon these basic principles in an integrated way in response to location specific problems have the potential to enhance productivity in a sustainable way while arresting/minimizing resource degradation. CA practices benefit the farmers in many ways. In the short term cost and energy savings prove attractive while in the medium and long term CA practices contribute to improve productivity, improved use efficiency of inputs (fertilizers, water, pest control etc), natural resource conservation (improvement in soil health, reduced erosion and runoff and improved water quality, improvement in farm level biodiversity (below and above ground) and overall environmental issues. CA practices would appear a sound field/farm and watershed level entry point towards an integrated approach to address twin concern of resource conservation and sustainable productivity increases. The approach constitutes a sound intervention as an adaptive and a mitigation strategy in the face of increasing climate change induced variability. CA practices hold considerable potential to reduce GHG emissions, sequester carbon dioxide and improve the overall stability of production system, over a period of time.

What is to be achieved?

- Laying a foundation for adaptive research and widespread adoption of integrated management approaches to achieve sustainable agriculture goals
- Improved efficiency of inputs while optimizing use and conservation of farmers limited resource base
- Operationalizing paradigm shift at ground level to understand and address location specific issues/constrain to sustainable resource use and enhancing productivity
- Strengthening research-development interface while providing a feedback mechanism to scientists
- A way to progressively build ecological foundation for sustainable agriculture

How?

- Prioritize and identify major production System eg Rice, Millets, Cotton, Soybean Pulses etc. within identified blocks
- Undertake Adaptive research cum demonstration trials involving teams of scientists of Regional Research Station/KVKs, and key extension agencies including NGOs in all the chosen blocks
- Put in place a strong component of training, experience sharing and documentation
- Facilitate wider uptake of technologies by extension agencies by involving local NGOs
- Build monitoring and evaluation at block/district levels as an integral part of the program

6.2.3 (b) System of Rice Intensification (SRI)

SRI is showing promise in improving yields while reducing water and other inputs. SRI is an agronomic innovation where early and single rice seedlings are transplanted at wider spacing; an alternate wetting and drying method of irrigation is followed in place of the conventional inundation. Its principles are now extended to millets, pulses and other crops.

In the Rainfed Rice system it is reducing inputs and contributing to yield enhancement ranging from 20 to 50% as reported from the states of Jharkhand, Orissa, Himachal, Tripura and Uttarakhand. More than half the rice area in the country is rainfed, this has good potential to increase household food security in all the humid areas that have entrenched hunger.

In semi-arid areas rice and sugarcane have become dominant users of groundwater often precipitating crisis –in terms of expanding 'dark zones' of groundwater. Promotion of SRI in these regions is showing substantial saving of water to an extent of 21000 cu.m per ha. Encouraging location specific adaptation of the basic principles of SRI, expansion of these to millets and pulses can contribute substantially to productivity growth and sustainability. It is important to make dedicated investments on the spread of knowledge and skill base in SRI principles across the rainfed areas along with incentives for transformation duly allowing location specific adaptation.

What to Achieve?

- Since NFSM does not cover much of the rainfed areas, a special dedicated program to be taken up under NFSM to promote the principles of SRI in rainfed areas across rainfed rice, millets and pulses. The program can target 50% of the rainfed rice area and about 50% of rice under groundwater and lift irrigation systems during the 12th FYP. Shift to an 'area approach' where comprehensive efforts are made to 'convert the entire area' into sustainable agronomy with necessary labor market adjustments can be effective.

How?

- Create a special stream under NFSM for Productivity Enhancement Through Sustainable Agronomy targeting rainfed rice, millets and pulses allowing for location specific program interventions with an exclusive focus on agronomic innvoations.

6.2.3. (C) Cost Reduction / Low external input sustainable agriculture (LEISA)

In a high risk situation, low paid out costs in cultivation is a risk minimization strategy as envisaged in the Approach Paper to the 12th FYP. Paid out costs on pesticides, seeds and fertilisers by the individual farmers can be substantially reduced if focused public investments and interventions are made in creating enabling conditions for farmers to take up sustainable agriculture practices. Pest surveillance, silt application, seed banks, biomass regeneration and soil productivity enhancement are some of the needed interventions that will have substantial cost-reduction impact. Practices like NPM (non-pesticidal management of pests) are taking roots in several parts of the country. Adhoc schemes of Agriculture Department centered promotion of IPM taken up sporadically are not helping in the establishment of sustainable agriculture practices. ***Integrated interventions in the mode of Farmers' Field Schools anchored in community/ farmer institutions sustained over a period of at least 3 years with dedicated human resources are to be supported.***

What to achieve?

- Targeted conversion of blocks of areas into sustainable agriculture practices that reduces costs substantially and promotes utilization of local resources.
- Pest surveillance is a common public good. Establish pest surveillance systems and based agro-advisories anchored into Gram Panchayats that also promote local material based control (such as NPM methods) with low paid out costs.

How?

- Integrate this program into the recommended National Rainfed Farming Program's core program establishing pest surveillance systems at GP level in all the blocks where the program is taken up.
- The modalities of such a program need to be piloted initially building on similar initiatives taken up in Maharashtra (by CRIDA) and elsewhere.

Budget allocation for Agronomic Innvoations:

The 12th FYP must pioneer enabling transition of rainfed agriculture at substantial scale into sustainable agronomic practice. Though these approaches reduce cost while increasing yields, they do require substantial investments for effecting this transition to a new system. It is important to allocate budgets in the range of @ Rs.8000 per ha targeting 5 million ha of agriculture area where such intensive work will be taken up. With a target of 5 million ha area to be converted these sustainable agronomic practices during the 12th plan the investment requirement would be in the range of Rs.2000 cr. Part of this budget to an extent of Rs.500 cr may be provided under Adaptive Research.

Appropriate mechanisms of partnership with experienced NGOs anchored at ATMA can be the administrative mechanism for such a program as being tried out in Andhra Pradesh.

6.2.4. Strategic Area 7: Focus on Millets

Millets occupy an important place in natural resource management and in human and livestock nutrition in rainfed areas. Requiring less water many of the millets are short duration crops that come to maturity early and thus avoid late season day spells giving resilience to cropping systems. Many of the minor millets are grown in the marginal up lands. Inspite of the promising outlook the area under sorghum and minor millets has been declining – this underscores the need for measures to ameliorate the situation. At present, though minimum support price is announced for some millet, there is hardly any procurement.

There is, therefore, need for investments to generate demand through better infrastructure for processing, support price with well laid out procurrent in inclusion in Public Distribution System are critical intervention to be tried out in the 12th Plan. Substantial experience is available on the ground for sealing up efforts. The scope of such a program should needs to be enhanced to increase local consumption of value added products and bulk grains, demand generation by establishing local processing facilities in addition to increasing productivity.

<u>The integrated strategy for promotion of millets would centre on:</u>

- Generating large scale demand through inclusion of millets in government's food-related programs such as PDS, mid-day meals, ICDS and others.
- Appropriate price policy and establishing mechanisms for procurement and storage of millets are important.
- Large scale campaign on the nutritional values and traditional millet recipes designed to stimulate (re)inclusion of millets into the diets to an extent of 25% of the cereal consumption.
- Improving productivity through special investments in Agricultural Research

Systems for millets – (development improved, locally appropriate seed varieties to cater to multiple uses of millets in rainfed areas, agronomic practices such as SRI – are proving promising to increase productivity).

- Innovations in processing – at household level and at an aggregate level

Enhancement of household entitlements under the proposed Food Security Act also provides an opportunity to include millets. Local production and procurement with appropriate incentives could be central to such promotion to get more area under millets.

What to achieve?

- Reclaiming the millets area in select districts to the levels of 2001 and 1991 in phased manner through an integrated approach of demand generation through inclusion in PDS and large scale consumer awareness programs, establishing processing facilities, announcing minimum support price backed up by procurement and enhancing productivity. A comprehensive effort is needed at least in limited number of districts.

How?

- Initiate such a comprehensive program in about 100 blocks in the core millet consuming/ producing areas.
- Such a program is of utmost importance in many of the tribal regions where nutrition security is under serious threat following penetration of PDS rice and wheat, and decline in millets area. Universalize the program in tribal areas.
- Expand the scope of INSIMP and NFSM programs to include the above as appropriate.

6.3. Livestock

6.3.1. Strategic Area 8: Strengthening Rainfed Livestock Systems

Rainfed areas supports most of the meat markets in the country hosting 78% of cattle, 64% of sheep and 75% of goats being concentrated in the rainfed areas. The sector is growing at a higher rate. Assured and high growth meat markets, higher rates of return and liquidity of the assets make the small ruminants much preferred in poverty reduction programs. Backyard poultry sustained its space and markets in spite of the industrial poultry taking over the larger market share. It provides small incomes of Rs.2000 to 4000 per year to women spread across numerous households. Camels, several indigenous breeds of buffaloes and cattle permeate the rainfed landscapes.

These *extensive systems* of livestock dominate the rainfed landscape providing valuable sources of income and agriculture services. The annual value of output of goat and sheep meat and dung for example, were estimated at 11,844 and 15,596 crore rupees at current prices by the Central Statistical Organisation in 2008. Much of this economic value is created without any dedicated allocation of water and land resources.

In spite of such large economic value accruing to the disadvantaged, public investments on support systems for these extensive livestock production are meager. The following points come out sharply:

- The predominant engagement of the public investments and efforts have been on upgrading or introducing new breeds commonly across irrigated and rainfed areas. The major issues facing the livestock in rainfed areas however, are seasonal scarcity and access to fodder, quality drinking water and health care services etc., streamlining of which, will increase productivity of large numbers of livestock. Without addressing these issues, even the improved breeds fail to perform as experience shows.
- With many vacancies in the Animal Husbandry department, the health care services are poor resulting in high mortality rates. As much of the economic value in the small ruminants and cattle is created by the increment in 'stock' of animals, mortality of animal assumes greater significance in the economy of extensive systems.
- Much of the focus of the mainstream programs is on promotion of irrigated fodder that is accessed by the few well endowed farmers with access to groundwater irrigation. Improvement of pastures and fodder trees needs much greater focus and so are investments in strengthening extensive rainfed livestock systems; there are hardly any public investments made in this direction at present.

  Intensifying fodder base in extensive systems requires intensive effort and innovations in institutional aspects related to protection, management and sharing of usufructs. Mere distribution of seeds of *Stylo hamata* or other fodder seeds as widely practiced in watershed development and other programs will not be sufficient. Pasture and fodder development needs sound technical inputs, robust institutional designs and comprehensive investments to make any meaningful impact.

The Working Group recommends strong support to be extended to the animal husbandry programmes in rainfed areas, especially in terms of management of natural resources, common pool and animal health care services. Specific investments are required in improving the generic fodder base (pastures, shrubs and fodder tree biomass) in commons and private fallows. Investment on creating assured drinking water sources for livestock and accessible and functional primary health care services can give quick returns as they provide impetus to individual farmers to invest more on quality animals. Thrusting of external animals and exotic breeds in harsh environments make farmers more indebted, as the experiences of Prime Ministers' relief programs (to address farmers' distress) in Vidarbha and Andhra Pradesh reveals (Bhagya Laxmi and Ravindra, 2011).

The choice of breeds in harsh environments where livestock rearing is a balancing act among many variables is better left to local communities and individual farmers. The domain of public investments must encompass intensification of the fodder base in the extensive systems, improving the climate resilient local breeds, more research on small ruminants and cattle in extensive systems, *in situ* conservation of local breeds, ecosystem-livestock interactions and effective health care and service delivery.

What to achieve?

- Shift the investment and programmatic focus from 'introducing improved animals' (in cattle, buffaloes or small ruminants or backyard poultry) and stall-fed livestock enterprises to strengthening the livestock support systems (fodder, feed, health care, breeding, shelter, markets etc.) in general and the emphasis must be on improving the extensive grazing systems rather than wishing them away.
- Moving away from the *ad hoc* distribution of fodder seeds etc., to more systematic

strengthening of natural resource base, infrastructure and health care systems on an **'***Area' basis* where the outputs are clearly measurable. Within such area focus, invest on livestock shelter, drinking water, silage and chaff-cutting facilities and other infrastructure requirements.

- Undertake reforms in Animal Husbandry department- for it to focus on disease surveillance and extension of preventive health care services to all livestock, especially to large numbers of non-descript animals, small ruminants, backyard poultry etc., which are the wealth of vast majority of the poor. This may require suitable amendments to the Veterinary Council Act to permit developing and using cadre of trained animal health workers in preventive health care including vaccination and deworming.

How?

- Constitute a committee to assess the access to, and effectiveness of livestock health care services to 'all livestock' in different agro-ecological regions and provide clear institutional reforms required at various levels.
- Pilot a larger program as envisaged in the above as part of the National Program in 1000 blocks to establish support systems for livestock. Learning from this experience with due reforms in AH department and the protocols evolving can pave way for universalization in the 13th FYP.

6.4. Fisheries

6.4.1. Strategic Area 9: Fisheries in Rainfed Water Bodies

Fisheries in rainfed areas have immense potential. Small reservoirs, tanks, water harvesting ponds created as a part of watershed development or MGNREGS and wetlands in Bihar, Uttar Pradesh and West Bengal etc. that dot the landscapes of rainfed areas have potential for fisheries development. An estimated 1.2 million ha of water spread area exists with fishery potential across the country (**Table 8**).

TABLE 8

Small Reservoirs and Water Spread Area with Potential for Fisheries Development

State	Number of small Reservoirs	Area (000 Hectare)
Andhra Pradesh	3056	295.60
Bihar	11	1.68
Chhattisgarh	1668	47.48
Jharkhand	137	21.14
Karnataka	4651	228.66
Madhya Pradesh	2409	90.00
Maharashtra		119.52
Orissa	130	22.21
Rajasthan	412	65.66
Tamil Nadu	9187	315.62
Uttar Pradesh	118	24.26
Total		**1231.83**

Source: CIFA

These water bodies are mainly fed by surface run-off from local catchments. Varying water spread area, pronounced seasonality of filling, high dependence on rainfall, conflicting use with irrigation and common pool regime of property rights are some of the relevant distinct characteristics of these water bodies making fish production a complex endeavour. There is a large gap in the potential and actual yields in these rainfed water bodies and there is scope for enhancing the fish production by about 3 to 5 times considering the present low productivity levels. (**Table 9**)

TABLE 9

Present productivity and potential of different water bodies

Water bodies	**Present productivity (kg/ha/year)**	**Potential yield status with scientific management (kg/ha/year)**
Small reservoirs	50-100	250-300
Floodplain wetlands	250	1500-2000
Tanks	300-500	2000-4000
Ponds	400-600	3000-5000

Source: CIFA

Adopting culture based fisheries with advanced fingerlings (100 mm and above) at stocking rates of 500-1000 fingerlings per ha can substantially increase productivity of the 1.2 million ha of water spread area in the small reservoirs. Appropriate landscaping of the bed of the water body to suit fish production and provision of nursery ponds with assured water for rearing fry to fingerlings are much needed. The production potential of various types of rainfed- water bodies and the appropriate technological options are detailed in **Table 10**.

TABLE 10

Technology options for enhancing fish production under different water resource in rainfed areas

Resources	**Resource Developments**	**Technology options**	**Aquaculture potential**
Seasonal water bodies	Facilitation of the maximum storage of water	Seed production Culture of minor carps Early stocking	1.5 – 2.5 tons/ha
Perennial water bodies	Weed clearance, water exchange, bund development	Hatchery development Carp culture Mixed farming	2.5 – 3.5 tons/ha
Water harvesting structure	Ensuring minimum water level for 6 months	Culture of carps or small cat fish like magur, murrels	1 – 1.5 tons/ha
Community pond	Development of institutions for community management	Carp culture	2 – 3 tons/ha
Farm pond	Deepening of pond, water storage	Seed production Freshwater prawn Composite culture	1.5 – 2 tons/ha

Paddy fields	Field modification	Paddy-cum-fish culture Integrated farming	1 – 2 tons/ha
Small irrigation tanks	Maintenance of minimum water level	Culture based fisheries	0.5 – 1 ton/ha

Source: CIFA

The process of developing water bodies under various schemes (watershed development/MGNREGS etc.) must be integrated with fisheries development. Such integration will maximize the livelihood potential.

The Working Group recommends the following actions to realize the vast potential of fish production in rainfed water bodies in a potential area of 1.2 million ha. The following steps are recommended:

1. Creation of **database** using remote sensing and preparing an inventory of water bodies for fish production at block level. Such technical protocols are already developed on pilot scale by NRSC, Hyderabad and need to be administratively integrated.
2. A **special program** may be initiated in the 12th FYP for realising the fish production potential in 1.2 m. ha over the next five years. Such a program can be launched with three main objectives viz.,
   a. Upgrading the **existing fish production** where it exists – in terms of completing the infrastructure requirements and institutional reforms to reach the optimal productivity
   b. Initiate **fish production where it does not exists**, with appropriate institutional arrangements
   c. Create **new water bodies where potential exists**, using various rural development programs.
3. The salient features of a such program could be as follows:
   a. **Identifying and inventorying water bodies** suitable for fisheries at block level using remote sensing tools with appropriate technical protocols of suitability assessment.
   b. **'Landscaping' of these water bodies** to make them suitable for fish production – cleaning the bed areas, ensuring dead-storage, protecting the spill-ways, digging nursery ponds for rearing fingerlings etc.
   c. **Reforming the institutions**: being a state subject the proprietary rights on water bodies (management and usufruct rights) are a contested domain. It is important to bring the Fisheries Cooperatives where exists, into the legal framework of self-reliant cooperatives making them autonomous and delinked from the control of the Fisheries Department. The legislative reforms in Orissa are in good direction- assigning usufruct rights to groups of poor. Fishing communities still dependent on these water bodies and their traditional rights must be duly respected.
   d. **Engage with NGOs and CBOs**: being in the domain of common pool resource with multiple stakeholders (irrigation, fish, etc.), any technical interventions can not yield results without clear institutional arrangements. Given the complexities of institutional relations the Fisheries Department must work along with Community Base Organisations and capable facilitating organizations.
   e. **Fund the transactional costs:** Fish production in rainfed water bodies has high transaction costs owing to multiple claims on water and common pool nature of the resource. Without evolving proper institutional norms in partnership with the community, technical interventions will not sustain. These transaction costs are critical requirement for production and must be adequately funded.

f. **Technical backstopping- Fisheries Resource Centers** : Given the magnitude of the effort dispersed in numerous water bodies, it is important that special technical backstopping arrangements are made in line with the district level **'Fisheries Resource Centers'** anchored in NGOs or KVKs for intensive capacity building and technical support. The fisheries department need to work along with such resource centers.

g. **Ensuring supply of fish seed and establishment of nursery ponds** with assured water supply are the critical infrastructure requirements needing planned investments for a cluster of water bodies. The hatcheries are best promoted as private enterprises while the nursery ponds are integrated into the production system of individual/ cluster of water bodies. The technologies are already available with CIFA, Bhuvaneswar and CIFRI, Barrackpore and and well tested as a part of the WORLP. It is important to balance between native and stocked fish species.

h. **Staggered harvesting and strengthening Local Fish Vending:** The water bodies being dispersed across the rainfed areas, there is high local demand for fish, which are normally met from import of cultured fish from intensive areas. Introducing staggered harvesting techniques (i.e. harvesting linked to local demand) and investments in fish-value chain with women fish vendors at the center stage – can generate substantial livelihoods and internalize the value.

i. **Other infrastructural investments:** investments on appropriate fish-harvesting gear, nets, ice-boxes etc., need to be planned.

A separate dispensation for fish production in water bodies in rainfed areas must be created and adequate investment allocations be made in the 12th FYP with Block as a unit. With investments in the range of Rs. 10000 to Rs. 15000 rupees per ha it takes Rs. 1200 to Rs. 1800 crore rupees over the entire plan period to exhaust the potential. At least, half of the total potential area can be targeted in the above lines during the 12th plan.

6.5. Risk Minimization and Resilience Building

6.5.1. Strategic Area 10: Weather Based Crop Insurance

Small and marginal farmers, particularly rainfed farmers face partial or total crop losses due to risks associated with farming. Of these, risks associated with weather fluctuations are beyond their control. While diversity of crops and farming and supplementary irrigation measures help to cope with the risks to a large extent, farming would be still vulnerable to longer-drought spells. **Crop insurance** has come up as an important tool for risk mitigation for small and marginal farmer households in particular. It is well known that only less than 10 percent of the farmers in India are covered with currently prevailing crop insurance products. The key weaknesses of current crop insurance products arise from the nature and distribution of risks associated with farming. For instance, climate risks are often highly spatially correlated and an area-based approach comes up with estimates of huge losses which could be beyond the capacity of the insurer to pay. The long-tailed distribution of risk, with events of high severity occurring at a low frequency, puts the price of conventional crop insurance products beyond the reach of small and marginal farmers.

The principal crop insurance scheme is the **National Agricultural Insurance Scheme, (NAIS)** which presently encompasses subsidy on 10 percent of the premium to

small and marginal farmers, with the expense on the subsidy being equally shared between Centre and State Governments. The scheme is demand driven and although a large number of farmers (11.4 million in *kharif* 2010) availed of this programme (with the total sum insured being Rs. 25,500 crores), the fact is that not enough farmers are availing of this scheme. The reasons are believed to be a combination of lower subsidy, delayed claim settlement, lack of awareness and operational issues. In response to this a modified NAIS has been implemented on pilot basis in 50 districts covering most states, with a slightly different design, including higher subsidy and accelerated settlement. The MNAIS scheme is yet to be rolled out in the rest of the country.

All these point to the need for innovative insurance products such as weather-based crop insurance based on a deficit rainfall approach. Since rainfall is an objective parameter measured independent of the insurer as well as the clients, the moral hazard associated with conventional products does not exist here. Effectiveness of the product largely depends on synchronizing the policy initiation date and the sowing date and in calculating compensation based on actual rainfall in each village. We need to increase the density of rain gauge stations to get good insurance products capable of offering customized services at a village scale. Crop insurance as a risk mitigation measure is effective only in combination with risk reduction measures like soil and water conservation, use of seed varieties with good yield potential, adoption of sustainable agricultural practices, inter-cropping and diversification of cropping pattern. Hence, the pre-requisites for good crop insurance models are:

- Research to evolve location specific insurance products;
- Capacity building of various stakeholders like farmers' organizations, SHGs, cooperatives, banks and insurance companies to offer viable and robust crop insurance products;
- Insurance education for the small and marginal farmers;
- Investment in infrastructure like automatic rain gauges and data collection systems;
- Favourable regulatory environment for various insurance delivery institutional mechanisms; and
- Adoption of a comprehensive agricultural package for reducing risk associated with farming in rainfed areas.

What to Achieve?

- Evolving a comprehensive risk mitigation strategy that encompass measures such as diversification (crops and livelihoods), easing constraints for timely sowing, cost reduction, soil moisture management to sustain shorter dry spells, access to supplementary irrigation and managing the residual and/ or catastrophic risk through location specific insurance products. Similar strategies also need to be evolved for livestock.
- The above also forms an important strategic package for making the rainfed farming systems climate resilient.

How?

- This must form an integral part of the suggested National Program; it is important to evolve different insurance products linked to the sustainable practices on ground and try them on pilot basis in partnership with insurance companies.

6.6. Strengthening R&D and Extension in Rainfed Farming

There are lessons for R&D from successful NRM research projects, watershed management efforts, soil moisture management, fertility enhancement and resource conservation experiences like conservation agriculture, integrated pest management, and minor millet production systems, etc. We need,

- **Enhancement public investment** in agricultural research and extension,
- This enhancement must be accompanied by **a shift from commodity to Agro-Ecological Knowledge Framework** for research and extension efforts (where commodity production and productivity become goals within knowledge of and technology generation for conservation agriculture in the context of farming system, watershed management, etc.)
- A strong dynamic **meso-level information system** should be set up, with documentation of farming systems and research on sustainable improvements of existing farming systems
- These must be accompanied by **institutional reform,** public sector, private sector and civil society actors engaged in agricultural and rural development with research to bring expertise to the field and enable learning from the field;
- This reform must also involve **farmer participatory adaptive research capacities** for extension systems, input supply and service sector (like rural banks) actors too.

The success and sustainability of these interventions for rainfed farming depends on reform and renewed emphasis on natural resource management and rainfed farming within the main arms of the Ministry of Agriculture – the DoAC, DARE, DoAH, and the DoF. An inter-departmental and inter-Ministerial Empowered Committee, with participation of CSOs and private actors, is the mode to initiate these two specific action plans in this strategic area.

A. Farming systems research – within an agro-eccological knowledge framework

Defining and promoting integrated solutions calls for scientists from a range of disciplinary background to work together with farmers, adapting and refining resource management and connected productivity issues in participatory way (Adaptive Research). Adaptive research at present is the most critical systemic gap in understanding and in finding solutions to NRM related issues. Towards this there is an urgent need to put in place a strong program of adaptive research involving NRM and production system specialist at the Zonal Research Station of SAUs, with competencies in systems approaches.

Systems approaches must be envisaged across a range of organizations in agriculture in order to ensure effective NRM and rainfed farming. This involves changes within the agricultural research systems and between agricultural research and various development programmes

- **A.1. Within agricultural research system**: Typologies based on economic activities have been identified in the districts with more than 70% rainfed area. Of these about two-thirds are closely associated with dairying. In addition, agroforestry, horticulture and similar such interventions cut across typologies. These diverse agro-based activities need to be integrated in a farming systems mode for risk distribution and reducing climate variability impacts. The challenge

in the rainfed agricultural typologies is to maximize returns in each system, from various components of the farming system comprising of livestock and crop. In order to be able to meet the future knowledge base and the technological needs for NRM and rainfed agriculture, the research system should be strengthened in terms of quality and quantity of human resource, more flexible, responsible and responsive research environment and more stakeholder participatory decision making processes. Further, these efforts in understanding and responding to local natural resources or agro-ecosystem features and generating technological solutions should be well complemented by appropriate institutional arrangements for local learning capacities, technology transfer and market linkages and appropriate policy measures.

- **A.2. Systems research and changes between research and development interventions:** Agricultural research support is the key for successful implementation of natural resource management programmes at farm level. R&D must be tailored to respond to local and regional NRM contexts and policy instruments and investments to support or up-scale resource conserving technologies must be enabled. Some key examples where such convergence is possible are:
  - In-situ conservation and re-charging of rain water in upper catchment, water harvesting and re-cycling for limited irrigation has tremendous potential for enhancing productivity of rice and introducing a second crop of oil seeds, pulses, vegetables and fodder to expand basket of livelihood. More than 11 million ha of the cultivated land remain fallow in rabi season after kharif rice in the high rainfall regions of Orissa, Bihar, MP and several other pockets. NRM R&D in ICAR and SAUs to provide technical backstopping for all DoLR programmes on IWMP. R&D should provide technical inputs for livelihoods plans in each IWMP cluster and C-DAP in each district, as well as enable monitoring and evaluation in collaboration with suitable local authorities.
  - Promotion of livestock in rainfed areas - especially ruminants which convert non-human feed and roughages into human consumable products. Rearing of animals, value addition collectively through dairying and marketing have tremendous potential of generating employment and providing regular flow of cash and income for households. Livestock rearing and dairying has 4-5 times more employment generating potential compared to crop cultivation and is advocated especially for small holders, and adds the much required FYM in the organic matter starved soils of rainfed areas.

B. Agri-Advisories and Action Research Coalitions

From the formal agricultural research organizations as well as from the private sector and field based NGOs and communities, there are several options available to ensure sustainable natural resource systems and rainfed farming systems. The key area of concern is why this knowledge does not reach and influence the practice of millions of marginal and small farmers and a majority of the large farms in rainfed areas. Weakness of systems of agricultural extension is universally acknowledged as the prime reason. In the analysis of agro-ecosystems in participation with local actors and other national or global stakeholders, there is no scope for agri-advisories that will merely transfer advices to the poor passive farmers**.** Agri-advisories with action research capacities and a wide range of communication and learning skills that work in collaboration with leading expert groups and professional

support groups are the need of the hour.

Though present district level agro-advisory service has given impetus and generated considerable interest in the farming community at large, there is a need to further improve these services specifically through preparing the weather forecast at a level smaller than a district, i.e. block level and opt for more aggressive extension, outreach and agro-met advisory dissemination system. As the country is having cultivable area under rainfed condition around 60 percent, the ATMA and KVK of different districts have vital role in disseminating agro advisory services to the farmers. The agri-advisory will have active teams conducting action research and communication activities, involving coalitions of the KVK and ATMA, along with CBO (Community Based Organisations), womens SHGs, farmers associations, co-operatives, rural banks, etc. These coalitions of agri-advisories should be strengthened with adequate action research capacities, with continuous professional support from the local experts/members and national advisory board (proposed) School of Agro-ecological Systems Analysis.

Once this public sector base in agri-advisory services is established, the private sector can play an effective role in commercializing and disseminating the agro-advisory bulletins to reach out to end users. There are also options for effective collaborations with CSOs – both in generating and monitoring the information.

In this connection, the agri-advisories may also enable:

- Development of practically useful, location specific crop-weather-pest-disease relationships or Decision Support Systems for major pest/disease of particular locations (District/block) by the AMFUs consisting of scientists, entomologists, plant pathologists and agro-meteorologists.
- Disseminating information about sudden changes in the weather like heavy rainfall, high wind speed and heat/cold waves and possible management activities through different media especially FM radio stations/AIR, newspapers, internet and SMS to the concerned block level authorities or village head/sarpanch.
- Developing crop contingency measures to manage the unforeseen drought/flood situations.
- Meso-level and micro level information about quantity and quality of irrigation water/crop water requirement for different crops especially horticultural/plantation crops during dry season to utilise the water judiciously.
- Establishment and propagation of local seed banks, and effective collaboration with Seed Corporation of India/State Seed Farms/State Agricultural University for making availability of seeds or seedlings of different of varieties of a particular crop or different crops by widening the network at least during starting of cropping season.
- Making easy availability of chemical fertilisers, bio-fertilisers and bio pesticides through collaboration with concerned organisations.
- Interacting with different stake holders regarding dissemination of agromet advisory bulletins by AMFU in stipulated intervals to narrow the differences and make the system more effective.
- Conducting Farmers' interface programs by AMFU before starting of cropping season to explain the facilities available for farmers and also get feedback/demands of farming community.
- Making awareness among farmers about crop weather insurance to reduce the

losses against abnormal weather conditions like heavy/deficit rainfall and high/low temperature. In this connection, development of various insurance products for field, horticultural, vegetable and plantation crops in collaboration with Agricultural Insurance Corporation.

In order to facilitate wider dissemination of agromet advisories through mobile, local cable and other sources the information may be provided free of cost to disseminating agencies. In this linkage, KVK should play major role in providing agromet advisory bulletin on regular basis (weekly / bi-weekly) as well as information about severe weather conditions at any time of the year. The farmers group under ATMA and KVKs can be effectively used for getting the feedback about agro-advisory bulletins and their expectations.

6.7. Institutional development, credit and markets

6.7.1. Developing Farmers or Producers Organizations

Rainfed areas suffer from low institutional development as a result of cumulative neglect over successive planning periods. Such neglect reflects in the low density of financial institutions, inadequate storage and market infrastructure, poor extension systems and delivery of livestock health services etc. Subsistence orientation in several parts of the rainfed areas, lack of single vibrant commodity/ surplus etc., resulted in low market access. The central India tribal areas suffer the most due to this neglect also due to low density of roads and access to communication. These are most often not the places where government staff would like to be posted resulting into lots of unfilled vacancies in several technical departments.

The low institutional development constrains the economic growth of these regions. It is important to establish a comprehensive institutional architecture for these regions. Investment on organising farmers/producers at primary and secondary levels, strengthening and supporting their institutions can provide an institutional basis for development and service delivery. Strengthening a cadre of grass-roots professionals employed by producers' organisations, linking them with the government services (and referrals) may effectively streamline the technical service delivery. Infrastructure investments can be carefully planned integrated with farmers' institutions and value chains.

In the past though several attempts were made, the investments on institution development and their capacity building are grossly inadequate and are *ad hoc*. An attempt at organizing women into SHGs and their federations through NRLM is a welcome measure but whether the same institutions can serve the needs of agriculture, livestock, fisheries and other production systems is to be assessed. It is also important to directly reach out to the primary stakeholders having common interests and organizing them; appropriate investment allocations and program design are crucial for this purpose.

The purpose of establishing ATMA at district level has not been achieved. Redesigning ATMA as an institution that builds and interfaces with farmers' or producers' organisations, responsible for their nurturing and capacity development can give substantial impetus to institution development in rainfed areas. It can also develop partnership with civil society organisations. This initiative may help in separating the input/ subsidy delivery,

quality control and other governance functions of the Department of Agriculture from the knowledge management, institutional strengthening and advisory functions.

Vibrant interface of ATMA with the Block and sub-block level farmers' institutions will bring in stakeholders participation in decision making. The issues of credit (appropriate instruments), markets etc., can be built on such institutional platforms that may lead to financial inclusion of the rainfed areas in the long run.

It is important to re-look at the legal forms of such organizations, the cooperative laws and initiate appropriate corrective measures. The Fisheries Cooperative Societies, Dairy development societies, sheep and goat rearers societies etc., formed under an old Cooperative Act make them subservient to the respective line Departments and has led to capture of elite and non-primary stakeholders. The liberal cooperative acts such as the Mutually Aided Cooperative acts provide more autonomy to the cooperatives. These issues need to be comprehensively re-looked into.

What to Achieve?

- Establish an effective and overarching institutional architecture for rainfed farming founded on farmers' or producers' organisations and Gram Panchayats.
- Evolve various methods of integrating technical services, infrastructure investments, farmers' incentives and credit with these farmers' institutions.

How?

- Constitute an expert group to have wider consultations on ***Appropriate Institutional Architecture for rainfed areas with the following broad terms:***
    a. Reconstituting ATMA as a professional agency responsible for promoting and strengthening producers' organisations and their federations.
    b. Suggesting appropriate organization structure for producers' institutions and their federations.
    c. Arrive at program design and cost-norms to organize and establish farmers' organisations.
    d. Evolving effective technical service delivery systems (vaccination and deworming, weather advisories, pest surveillance etc.) anchored in producers' organisations and/or Gram Panchayats including advisories using ICT.
    e. Methods of inter-departmental collaboration and convergence in various programs
    f. Conceptualise various farming-support systems required and their institutional mechanisms such as seed systems, cyclical and port-folio credit instruments, marketing etc. and lay down their institutional requirements.
    g. Arrive at ways of infrastructure funding to the farmers' organisations
    h. Look at the policy and legal requirements in all the above aspects.

- If the above is completed in the first year of the 12^{th} FYP – a dedicated program with clearly earmarked funds be taken up with support from professional organisations to institutionalize the recommendations and establish farmers' organization base across different rainfed areas.

6.7.2. Strengthening Institutional Capacities and Decentralized Planning

The larger trends of public policy point towards decentralised governance of natural resources with increasing emphasis on district (and downward) level planning. While the 11th Plan has laid a considerable emphasis on district planning across the country and has clearly indicated its persistence with the bottom-up planning in future, the plans formulated have been sectoral and mostly a compilation of activities of various departments. Most often these plans are either prepared by independent agencies or by line departments. They are also one time/single point exercises. A shift is necessary in seeing decentralized planning as an iterative planning-doing-learning-planning cycle rather than a one time activity to be completed and to ensure that the Agency facilitating planning also has accountability in the overall outcome. Also, the planning was taken up without a strategic location specific policy framework. The challenge is to institutionalize this process. This could be the logical next step to the process of decentralization initiated in the 11th FYP.

Natural resource management being a cross cutting theme across the various departments/sectors has not derived the requisite importance. The planning continues to be undertaken in the absence of a clear and comprehensive land and water use policy that includes all natural resources as well as the inter-linkages between them. *The 12th plan needs to emphasise on the preparation of a comprehensive land and water use policy based on the agro-ecological characteristics at the district level and provide flexibility in determination of programmes and schemes.*

Further, while the envisaged outcome of decentralised planning process has been to increase participation of communities in determining the activities which are most crucial in their setting and enable greater ownership, in absence of requisite technical capacities and institutional arrangements which can facilitate participatory planning process this has remained weak.

The Working Group recommends a concerted action in 12th plan to strengthen capacities at village, Gram Panchayat, Block and district levels and evolve common programme architecture to strengthen decentralized planning and governance, within the overarching direction of Panchayat Raj Institutions. The architecture should aim to develop appropriate governance and institutional structure at different landscape and administrative layers from habitation to District level which can help in setting up a strong natural resource management agenda, improve planning process, strengthen capacities at different levels, address issues of community rights and undertake natural resource management activities in an integrated manner. The structure would also help in developing coherence and strengthen convergence between different programmes and schemes (Rashtriya Krishi Vikas Yojana, Nationa Rural Livelihood Mission, MGNERGA, Green India Mission, Rainfed Area Development programme etc).

7. Summary Recommendations

1. A comprehensive **National Rainfed Farming Programme (NRFP)** should be initiated, incorporating various aspects of rainfed area interventions and putting these together as a package. This new NRFP could initially be implemented in 1000 most backward rainfed blocks of the country. Blocks with high levels of poverty, natural resource degradation predominantly rainfed and risk prone cropping systems and high levels of migration would be prioritized for the programme. An allocation of Rs. 10 crores could be provided per block for this programme during the 12th Plan period, taking the total allocation for the NRFP to Rs. 10,000 crores. This programme could leverage substantial amounts from the other ongoing centrally sponsored rural development programmes as well as state-level programmes for agricultural and rural development. In our estimate, the total leverage by the NRFP could be at a ratio of 1:4, meaning that an annual expenditure of Rs. 50,000 crores over 1000 blocks would be facilitated by the outlay of Rs. 10,000 crores for the programme. Tentative budget for the Mission and possible leverage from ongoing programmes are shown in Annexures 1 and 2.
2. In each of the 1000 blocks, about 10,000 hectares would be chosen for implementation of the NRFP under the guidance of a **National Rainfed Farming Agency.** This Mission would steer the NRFP and converge it with other ongoing NRM programmes like MGNREGA, IWMP, NRLM etc. Funds for the Mission would be routed through the SLNA to ATMA at the district level and to the block level key facilitator (any organization with local presence, relevance, and capacities to draw and deploy the manpower, inputs and services required for NRM and rainfed farming in the block), and ultimately to the Gram Panchayats. The block level facilitator may be a CBO/CSO, or a consortium of local organizations capable of implementing the Mission.
3. The block level facilitating agency will make a comprehensive **block level rainfed area plan**, which will then be implemented in a Mission mode in convergence with other ongoing natural resource management and rainfed area programmes. Strengthening capacities for block level and Panchayat level planning is imperative for this programme. This must be done with flexibility for each block to specify the allocation for each NRM and production activity.
4. The following specific **activity components** could be pursued as part of this new NRFP:
   a. Enhancing Soil health and productivity
   b. Enhancing Rainwater Productivity (Soil Moisture Management and Protective/Supplemental Irrigation)
   c. Revitalize Common pool Land and water resource
   d. Seed System
   e. Farm Mechanisation
   f. Conservation Agriculture and Production systems (Rice, Millets, Soybean, Cotton etc based) enhancement (adopting integrated soil, crop, water, nutrient and pest management)
   g. Strengthening Livestock
   h. Fisheries in Rainfed water bodies
   i. Crop Insurance /price support /including PDS systems
   j. Institutional development
5. The **Natural Resource Management component** of Integrated Watershed Management Programme (IWMP) as well as MGNREGA should be strengthened and linked with interventions in rainfed agriculture for these programmes to realize their full potential. Capacities of local self governments and community-based people's institutions should be

developed to undertake full NRM-based area planning.

6. The Working Group recommends the following measures to **revitalize common pool land and water resources**:
   a. Formulating **Policy on Commons** and Securing tenure; a National Commons Policy should be drawn up, incorporating recording of community rights over commons, tenurial security of users and decentralized commons governance mechanisms under the overarching direction of Panchayat Raj Institutions.
   b. Increasing **public investments** for revitalising common land and water resources
   c. Developing **programme architecture** at district level (and downwards) aligning interventions on CPRs within the larger natural resource management actions.
   d. Strengthening **Information systems** and creating a database on common land and water resources.
7. **Land-use policy** protecting land and laying out specific guidelines on using land for non-agriculture purposes (particularly bring in the role of commons and its protection); and
8. Specific initiatives on **agricultural research** in rainfed agriculture and NRM planning including
   a. Enhancement public investment in **agricultural research and extension**;
   b. Shift from commodity to **Agro-Ecological Knowledge Framework** for research and extension efforts;
   c. Specific support to **agricultural knowledge extension systems** and development of Agri-Research Advisories and Action Research coalitions;
9. Building and strengthening of **capacities** at village, Gram Panchayat, Block and district levels and evolving a common programme architecture to strengthen decentralized planning and governance within the overarching direction of Panchayat Raj Institutions

8. References

Abrol, I.P., and Sangar, S., 2006. Sustaining Indian Agriculture – conservation agriculture the way forward. *Current Science*, 91 (8), pp. 1020-1025.

Acharya, S.S., and Jogi, R.L., 2007. Input subsidies and agriculture: Future perspectives. In: Institutional Alternatives and Governance of Agriculture, Ed: Vishwa Ballabh, *Academic Foundation*, New Delhi, pp. 95-118.

Adusumilli Ravindra, and BhagyaLaxmi, S., 2011. Potential of the system of rice intensification for systemic improvement in rice production and water use: the case of Andhra Pradesh, India. *Paddy and Water Environment*, 9(1).

Annual Report., 2009. *Department of Animal Husbandry. Ministry of Agriculture. Government of India*. New Delhi.

Anonymous, 2008. Harmonization of Wastelands/Degraded lands Datasets of India. *National Rainfed Area Authority (NRAA), Ministry of Agriculture, Government of India,* NASC Complex, DP Shastri Marg, New Delhi-110012, 5 p

Beintema, N, M., and Stads G.,J., 2008. Measuring agricultural R&D investments: A revised global picture. *ASTI background note. International Food Policy Research Institute,* Washington, D.C.

Bhumbla, D,R., and Khare, A., 1984. Estimate of Wastelands in India. *Society for Promotion of Wastelands Development.* New Delhi

Chopra, K., and Gulati S., C., 2001. Migration, Common Property Resources and Environmental Degradation: Inter-linkages in India's Arid and Semi-arid Regions. New Delhi: *Sage Publications India Pvt. Limited*.

David, M., Fraiture, C.D, and Rijsberman, F., 2007. Water Scarcity - The Food Factor. *Issues in Science and Technology*, PP. 39-48

Deoghare, P,R., 1997. Sustainability of on-farm income and employment through livestock production in Mathura district of Uttar Pradesh. *India Journal of Animal Sciences,* 67, pp.916-919.

Dwivedi, R.,P., and Ramana, D.,B.,V., 2002. Livestock production through grassland management. *Employment News* 27 (11), pp. 1-2.

FAO 2000. Agriculture Towards 2015/30. Technical Interim Report, April 2000. *Economic and Social Department*, FAO, Rome.

GOI. 2005. Annual Report 2004-05, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India, New Delhi,

Gulati, A., and Narayanan, S., 2003. The Subsidy Syndrome in Indian Agriculture. Delhi: *Oxford University Press*

Jodha, N,S., 1985. Population Growth and the decline in Common property resources in Rajasthan, India. *Population and Development Review,* 11(2), pp. 247-64.

Jodha, N,S., 1986. Common Property Resources and the Rural Poor in Dry Regions of India. *Economic and Political Weekly*, 21(27) pp.1169-1181.

Kulkarni, S,D., www.unapcaem.org/activities%20 files/A09105th TC/PPT/in-doc.pdf

Marino, M., and Braidotti, G.,2010. Research Networks: Livelihoods Lift with DIY Water Supply. *Partners in Research for Development*.

Misra A, K., Reddy B. M. K., Rekha M. S., Reddy, G. S. and Singh, H. P. 2000. Sheep and goat farming in rainfed areas: Constraints and options for improvement on smallholder production systems. In: Thomas, C.K and Sastry, N.S.R. (Eds): Smallholder livestock production in developing courtiers. *KAU*, Thrissaur, pp. 133-144.

Mohammed, O., Wani S.P., Vineela, C., and Murali, R., 2009. Quantification of nutrients recycled by tank silt and its impact on soil and crop – A pilot study in Warangal district of Andhra Pradesh. Global Theme on Agroecosystems Report no. 52, Patancheru 502 324, Andhra Pradesh, India, *International Crops Research Institute for Semi-Arid Tropics*, p.20.

NAAS 2010. Degraded and Wastelands of India; Status and Spatial Distribution, *Directorate of Information and Publications of Agriculture*, ICAR, Pusa, New Delhi.

National Remote Sensing Agency.1985. Wasteland Mapping of India using Landsat False Colour Composite on 1.1 Million Scale. Project Report, *National Remote Sensing Agency*, Department of Space, Government of India.

NRAA 2011: Challenges of Food Security and its Management 2011. *National Rainfed Area Authority*, Government of India.

Planning Commission Report. 2010. *Planning Commission*, Government of India. New Delhi.

Raina, R., and Sangar, S., 2002. Water Quality, agricultural policy and science, Knowledge, *Technology and Policy*, 14(4), pp.109-125.

Rangnekar, D.V., 2006. Livestock and livelihoods of the underprivileged communities in

India: A review. *International Livestock research Institute*, Nairobi, Kenya. pp. 72

Rao, P., Brithal, P. S., and Ndjeunaga, J., 2005. Crop-Livestock Economies in the Semi-arid Tropics: Facts, Trends and Outlook. *International Crops Research Institute for Semi-Arid Tropics*, p. 68.

Report of the National Commission on Agriculture. 1976. *Ministry of Agriculture and Irrigation*, Government of India, New Delhi.

Rodell M., Velicogna I., and Famiglietti 2010. Satellite Based Estimates of Groundwater Depletion in Indi', *Nature*, 469, pp. 999-1002.

Royal Commission on Agriculture in India. 1976. *Agricole Publishing Academy*, New Delhi, India

Sankar, M., Sharma, G.R., Dhanapal, K.L., Shankar, G.N., Mishra, M.A., Venkateswarlu, P.K., Kusuma B., Grace, J., 2011. Influence of soil and fertilizer nutrients on sustainability of rainfed finger millet yield and soil fertility in semi arid alfisols. *Communications in Soil Science and Plant Analysis*, 42, pp. 1462-1483.

Sehgal, J., and Abrol, I.P., 1994. Soil Degradation in India: Status and Impact. Indian Council For Agricultural Research. New Delhi, Oxford, and IBH Publishing Co., PVI, Ltd., pp.80.

Shah, T., Gulati, A., Hemant, P., Shreedhar, G., and Jain, R.C., 2009. Secret of Gujarat's Agrarian Miracle after 2000, *Economic and Political Weekly*, Review of Agriculture, 44 (52), pp. 45-55.

Shah, T., Kishore, A., and Hemant, P., 2009. Will the impact of the 2009 drought be different from 2002?" Commentary, *Economic and Political Weekly*, 44(37), pp.11-14.

Sharda. V.N., Dogra, P., and Prakash, C., 2010. Assessment of Production Losses Due to Water Erosion in Rainfed Areas of India. *Journal of Soils and Water Conservation*, 65(2), pp. 79-91.

Sharma, B.R., Rao, K.V., Vittal, K.P.R., Ramakrishna, Y.S. and Singh, A., 2010. Estimating the potential of rainfed agriculture in India. Prospects of water productivity improvements, *Agril. Water Mngt*. 97, pp 23-30.

Singh, H. P., Sharma, K .D., Reddy, G. S., and Sharma, K. L., 2004. Dryland agriculture in India. In: Challenges and strategies for dreyland agriculture. *CSSA Special Publication, (*32) Madison, USA pp. 67-92

Vijayshankar P.S., Kulkarni H., and Krishnan S., 2011. India's Groundwater Challenge and the Way Forward, Economic & Political Weekly, 44(2), pp. 37-45.

Virmani S.M., Pathak, P., and Singh, R., 1991. Soil related constraints in dryland crop production in Vertisols, Alfisols and Entisols of India, *in Soil Related Constraints in Crop Production. Bulletin 15, Indian Society of Soil Science*, pp. 80-95

World Bank, 1999. India: Livestock Sector review: Enhancing growth and development. *The World Bank and Allied Publishers*, New Delhi.

9. Annexures

9.1.Suggested Budget Break-up for the National Rainfed Area Mission

Budget heads	**Percentage allocation**	**Allocation @ Rs. 10 crore per block**	**Additional support/ funds – @ Rs. 50 crores per block, to be leveraged from**
Planning, M&E*	4%	0.4	C-DAP budgets/State Agrl Planning – under RKVY
Research and technical backstopping	5%	0.5	SAU-ICAR system +NABARD + RKVY
Facilitation and salaries**	20%	2.0	
ICT- communication	1%	0.1	SAU-ICAR system, NRSA + CGWB+ Commodity boards
HRD & capacity development for community involvement***	5%	0.5	Specialized research and planning institutes, universities, ATMA, KVK, MANAGE, SIRDs, NAFED, CSOs,
Total facilitation expenditure	35%	3.5	
Support for strengthening NRM	10%	1.0	MGNREGA, IWMP, RKVY, NRLM, Statel Level Rainfed Area Initiatives
Support for input systems-seeds etc.	20%	2.0	IWMP, RKVY, DAC funds and schemes
Support for community managed services	15%	1.5	NRLM, RKVY
Risk management and Financial systems	5%	0.5	NRLM, RKVY
Infrastructure	5%	0.5	MGNREGA, NABARD- RIDF, BRGF
Innovation and rapid response	9%	0.9	DST, CAPART, SAU-ICAR systems, local universities, other public, private, and civil society research and development initiatives, etc.
Policy learning	1%	0.10	RKVY, NRLM
Total NRM and RF Systems investment	65%	6.5	

Notes:

**dedicated support for PME at the block level is missing and must be enabled by the block level facilitator, in partnership with key stakeholders. Choice of panchayats, village/farmer organizations, decisions about soil biomass and moisture conservation activities, infrastructure etc. will come from active monitoring inputs and their assessments - used for planning future activities.*

***facilitation /salaries marked at Rs.20,000 per person per month for 4 personnel in each block, employed in the facilitator organization, with capacities for integration based on NRM constraints in location-specific rainfed tracts, must be provided separately.*
**** HRD within the ATMA, line departments, resource governance groups, credit and input (seeds, biomass generation, etc.), with community level capacities for decision-making on soil health, risk proofing, etc.*

9.2.Indicative Activity wise allocation of NRFP

Activity	Leverage	NRFP
Natural Resource Management		
Enhancing Soil health and productivity	2.0	1.5
Enhancing Rainwater Productivity (Soil Moisture Management and Protective/Supplemental Irrigation)	9.5	0.5
Revitalize Common pool Land and water resource	8.5	1.5
Agriculture		
Seed System	3.0	1.0
Farm Mechanisation	2.0	1.0
Conservation Agriculture and Production systems (Rice, Millets, Soybean, Cotton etc. based) enhancement (integrated soil, crop, water, nutrient and pest management)	4.0	1.0
Livestock		
Strengthening Livestock	3.0	0.5
Fisheries		
Fisheries in Rainfed water bodies	1.0	0.5
Risk Minimization and Resilience Building		
Crop Insurance /price support /including PDS systems	4.0	1.0
Institutional development		
Institutions	3.0	1.5

9.3.Summary of the Indicative Relevant Paradigm Shift

S.No.	Theme	Present Paradigm	Anomalies in Rainfed Areas	Relevant Shift for Rainfed Areas
	Overall emphasis	• Input intensification led productivity growth in specific commodities, generating surplus in few well-endowed areas and achieving 'national food security'.	• Continuing degradation of natural resources, and loss of local capacities for production and resource management.	• Strengthening diverse production systems, intensifying system productivity and achieving local food security through an integrated farming systems approach.
i.	**NATURAL RESOURCES**			
1	Soil Health and Productivity	• Soil conservation focused. • Soil productivity equated with supply of nutrients to crops. • Incentives for fertilisers and micro-nutrients. • Soil-testing facilities.	• Hydrological (retention of soil moisture and others) and biological functions of soils are as important in rainfed farming and will add more value. • Substantial reduction in annual organic matter addition and such agronomic practices reduced fertiliser use efficiency. • Increasing erosion of precious top soil.	• Stepping up investments in soil conservation and preserving top soil. • Make improving hydrological and biological functions of soil central to policy. • Support and incentivize comprehensive soil productivity enhancement measures that return organic matter to soils. • These investments must be over and above soil conservation.
2	Water/irrigation	• Public investments are in watershed treatment (soil and water conservation) at one end and full-irrigation in limited area on the other extreme.	• Neglect of life-saving "protective irrigation". • The productivity potential and security of rainfed crops with supplemental irrigation is not exploited. • Access to water is getting limited and competitive – resulting into disinvestment (failed bores etc.).	• Bring 'Rain Water Use Efficiency' and 'Moisture Management' into centre stage in planning for water management in rainfed areas. • Invest on large scale protective/supportive irrigation. Subsume micro-irrigation investments into this paradigm. • Build location specific structures and norms for common access to ground

S.No.	Theme	Present Paradigm	Anomalies in Rainfed Areas	Relevant Shift for Rainfed Areas
				water and surface water. • Appropriate legal changes to facilitate common access.
3.	Revitalise common pool land and water resources	• Only negative focus of privatising commons.	• Erosion of livelihoods base of the poor; particularly of those not having access to private agriculture production. • No focus on securing community rights and tenurial security over commons. Hence they get degraded.	• Evolve and support community level institutional mechanisms for protection, use and management of commons. • Establish favourable Tenure and access rights from commons'. • Institutionalize community rights and security of tenure by bringing them under the overarchninf purview of Gram Panchayats. • Systematically invest to regenerate commons and related livelihoods
II.	**AGRICULTURE**			
4	Seed System	• Focus on few crops and few varieties/hybrids with centralised planning and control anchored at Department of Agrl and seed industry. • Supply external seed through market or Department.	• Non-availability of seed of diverse varieties and crops that are not profitable for markets to supply – resulting in loss in diversity. • Acute seed shortages particularly for intercrops, repeat sowing and contingency crops. • No systems to protect rainfed farmers from rainfall variations through provsion of seeds of contingency crops.	• Decentralised and local seed systems / enterprises responding to local requirements, with quality control assurances. • Public investments in establishing and maintaining local **seed-buffers** managed by farmers' organisations. • ICT based rapid response capacities in seed supply – in the event of increasing intra-seasonal variability.
5	Appropriate farm mechanization	• Exclusive focus only on large-size/ scale mechanization.	• Timely sowing is a major issue for lack of access to farm-power and appropriate machinery for many small holders.	• Locally relevant farm mechanisation to be supported – to enhance forward and backward labour absorption and labour productivity in new

S.No.	Theme	Present Paradigm	Anomalies in Rainfed Areas	Relevant Shift for Rainfed Areas
				investments. • Strengthening the custom-hiring services in cooperative sector particularly targeted to small and marginal farmers.
6	Crop diversification	• Intensive support to few crops. • No support for diverse range of crops with potential like millets and minor-pulses. • Market (price) driven rather than policy directed crop diversification.	• Narrowing and unsustainable food-grain basket and increasing dependency on few crops. • Huge decline in area of millets and other crops, limited processing and value addition options. • Loss of markets for many nutrient rich crops (millets, minor-pulses etc.). • Cropping patterns in-appropriate to the natural resource endowements of rainfed areas.	• Area specific intensification of cereals/ millets, pulses (minor- major) and oilseeds in place of centrally decided crop specific approaches. • Introduce Millets into PDS, MDMS, ICDS and other food schemes; invest in processing and value addition.
7	Sustainable agriculture practices	• Emphasis on yield maximization through intensive use of inputs.	• Escalating cost of production and subsidy burden. • Larger unsustainable trends, soil fatigue and resurgence of insect pests. • Loss of horizontal resistance to a range of pests/diseases, and manageable threshold levels.	• Investment on agricultural research on sustainable agriculture practices that improve efficient use of inputs, cost reduction while enhancing productivity. • Promote integrated soil, crop, water, nutrient, and pest management strategies through Conservation Agriculture approaches. • Larger investments on enhancing farmers' knowledge and establishing institutional mechanisms and information through ICTs.
III	Livestock systems	• Mainly centred around dairy development and introducing	• Poor service delivery and access to health care – high mortality	• Recognise and support of extensive grazing based livestock systems in

S.No.	Theme	Present Paradigm	Anomalies in Rainfed Areas	Relevant Shift for Rainfed Areas
		external breeds while the farmers have to manage the rest (feed, fodder, water etc.). • AH Department centred service delivery. • Little support to improve situation in ranfed areas.	rates resulting in loss of assets of poor (whose dependence on small ruminants is ignored) • Inadequate attention to harnessing livelihood growth potential, and climate friendly production potential of meat markets. • Neglect of common fodder/ grazing sources resulting into acute stress on the production system; neglect of crop-residue and livestock-residue relationships.	rainfed areas – especially risk proofing and resilience offered. • Focus on area based attempts at streamlining service delivery, particularly preventive health care – with community based monitoring and support. • Need to focus on access to nutrious fodder, health care, market etc.
IV	Fisheries in rainfed water bodies	• Focus is on large scale commercial inland fisheries with perennial assured water supplies, mainly in private properties.	• Inland fisheries potential in numerous village ponds, seasonal and semi-perennial water bodies is under utilized- their nutritive value and livelihood potential is lost.	• Evolve systems of 'rainfed fisheries' where the potential of seasonal rainfed bodies can be exploited; invest in small pond/local water bodies with PRI /CBO support. Ensure local revenue generation for PRIs through leasing or community managed fisheries. • Establish required support systems - from ensuring availability of fry to pond health diagnostics to marketing. • Support local marketing through staggered harvesting to harness livelihood potential.
V	Risk minimisation and resilience building	• Promotion of intensive systems that enhance risk while heavily depending on insurance products to deal with risk	• Insurance can at best cover the risk of investment but never could compensate for loss livelihoods. • Local systems for risk proofing or resilience building are not understood and supported.	• Systemic and comprehensive interventions (such as all the above) must be supported to minimise risk • Residual risk to be managed by location specific and effective insurance products (weather based

S.No.	Theme	Present Paradigm	Anomalies in Rainfed Areas	Relevant Shift for Rainfed Areas
				etc.).
VI	Strengthening R&D and extension services	• Low investments on R&D in NRM and farming systems. • Extension system is used to disburse inputs/information about technology adoption. • Highly centralized research decision-making and linear transfer of technology mode.	• Rainfed cropping systems and NRM issues are under-researched; poor contextual understanding. • Systems concepts missing - Diversity of crops and crop-livestock systems – under-researched and lack of location specific expertise to support these systems. • No feedback from extension to research, and minimal linkages between extension system and local stakeholders. • Regional/district level R&D and extension capacity is weak and results in limited capacities for planning for local agriculture (C-DAPs).	• Set up the share of research funding for rainfed crops and farming system. • Shift to agro-ecological systems knowledge framework & farming systems research with increased R&D funding. • Invest in decentralized action research capacities – based on farmer participatory adaptive research protocols in various farming situations. • Build and sustain dynamic linkages between actors - extension, input supply, credit and service provisio, markets, research etc. • Promote agri-advisory and action research coalitions.
VII	Institutional development	• Near absence of investments on organising farmers' institutions. • Cooperative movement crippled by political control and government intervention. • Department centred extension systems. • Technical departments heavily into management of subsidies and input distribution programs.	• Very low penetration of formal institutions (government / cooperative) and market based institutions. • Poor infrastructure; poor service delivery of technical departments • High transaction costs for individuals and enterprises deterring private investment. • Institutions and programs captured by non-stakeholders.	• Decentralisation of decision making and service delivery. • Shift in a structured way to community based institutions and Panchayats. • Establish service delivery systems accountable to community based organisations, PRIs and linked to technical departments.
VIII	Strengthening decentralised	• One-time district based planning most-often anchored in an	• In adequate strategic planning and stakeholder interests and lack of	• Invest inAgencies (at different levels) and develop their capacities for

S.No.	Theme	Present Paradigm	Anomalies in Rainfed Areas	Relevant Shift for Rainfed Areas
	capacities and decentralised planning	external agency not responsible for outcomes. • Lack of local database – meso-level information (acquifer transmission capacity, pest emergence, etc.), leads to blanket recommendations.	transparency – resulting into poor outcomes. • Grossly inadequate human resources, data bases and institutional capacities – the diversity and coping mechanisms in rainfed areas is not supported.	structured iterative planning-implementation-learning. • Invest in grass-roots governance institutions and their capacities – local databases to be owned and operated by local (Block level) resource centres, with capacities for integrated planning, monitoring and evaluation.