

***Strengthening of Rainfed Production Systems for Sustainable Agriculture***

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## **Strengthening of Rainfed Production Systems for Sustainable Agriculture**

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## 1. Rainfed Agriculture - Overview

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### **Introduction:**

Rainfed India has been languishing in the rain shadow of the Green Revolution for close to four decades. The skewed public investment paradigm towards perennially irrigated areas has led to the exclusion of close to 68% of Indian farmlands. Similar has been the status of low input animal husbandry and inland fisheries. The livelihood and incomes of more than half of India's workforce depend crucially on this triad of agriculture-livestock and fisheries. Yet, there is no relevant paradigm for revitalizing these sectors. Rainfed India straddles a wide range of agro-ecological and agro-climatic zones thereby making a universal policy prescription unviable. The need of the hour is to make policy a function of typologies so as to be able to deliver the required results. Research questions suited to this end also need to be evolved so as to provide a foundation for effective revitalization.

Rainfed India has been left out of mainstream development in agriculture due to the government's emphasis on generating food surplus from intensively irrigated areas to meet food security needs of the nation. Substantial public investments have been made in irrigation, with a focus on mainly rice and wheat. These investments have gone into promoting intensive use of fertilizers, seeds and other inputs, and price support systems. The extension of policies evolved in the context of the Green Revolution to rainfed regions has only deepened the crisis in Rainfed India. Falling groundwater levels, declining soil productivity, degradation of commons and increasing costs of inputs have led to stagnant incomes and entrenched poverty in rainfed areas.

The potential for higher growth in crop productivity, incomes from livestock - in particular, goats, sheep and fisheries has not been realized for lack of relevant public investments. Therefore, there must be distinctive policy focus and substantial investments to revitalize the diverse and integrated production systems in rainfed areas. If there were parity in investment with irrigated areas, rainfed regions would have high potential for growth. If rainfed farmers received regular public investment of the magnitude that goes into per hectare of irrigated land, they would be able to improve soil productivity by regularly adding organic matter, ensure higher moisture retention and make their crop systems resilient to climate variability. The productivity gains would then be substantial.

The Revitalizing Rainfed Agriculture (RRA) aims to evolve appropriate policies rooted in the realities of rainfed areas. It advocates for increased and appropriate public investments to

strengthen Rainfed Agriculture and proposes a series of specific measures on seeds, soils, water, millets, fisheries, credit, markets and institutions.

**Need:**

- Differentiated policies for rainfed agriculture (including livestock and fisheries)
- Substantial scaling up of public investments for revitalizing rainfed areas
- Appropriate framework for public investments - rooted in a paradigm relevant for rainfed areas.

The 12th Five Year Plan working group on Natural Resource Management (NRM) and Rainfed Farming recommended for a special focus on evolving a policy and program framework for revitalizing rainfed agriculture (RRA) by integrating Natural Resource Management, Production systems and livelihoods as the core strategy of rainfed areas development.

## **2. National Mission for Sustainable Agriculture (NMSA)**

### **Operational Guidelines**

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#### **Introduction**

Sustaining agricultural productivity depends on quality and availability of natural resources like soil and water. Agricultural growth can be sustained by promoting conservation and sustainable use of these scarce natural resources through appropriate location specific measures. Indian agriculture remains predominantly rainfed covering about 60% of the country's net sown area and accounts for 40% of the total food production. Thus, conservation of natural resources in conjunction with development of rainfed agriculture holds the key to meet burgeoning demands for foodgrain in the country. Towards this end, National Mission for Sustainable Agriculture (NMSA) has been formulated for enhancing agricultural productivity especially in rainfed areas focusing on integrated farming, water use efficiency, soil health management and synergizing resource conservation.

NMSA derives its mandate from Sustainable Agriculture Mission which is one of the eight Missions outlined under National Action Plan on Climate Change (NAPCC). The strategies and program of actions (POA) outlined in the Mission Document, that was accorded 'in principle' approval by Prime Minister's Council on Climate Change (PMCCC) on 23.09.2010, aim at promoting sustainable agriculture through a series of adaptation measures focusing on ten key dimensions encompassing Indian agriculture namely; 'Improved crop seeds, livestock and fish cultures', 'Water Use Efficiency', 'Pest Management', 'Improved Farm Practices', 'Nutrient Management', 'Agricultural insurance', 'Credit support', 'Markets', 'Access to Information' and 'Livelihood diversification'. During XII Five Year Plan, these measures are being embedded and mainstreamed onto ongoing/proposed Missions/ Programmes/ Schemes of Dept. of Agriculture & Cooperation (DAC) through a process of restructuring and convergence. NMSA architecture has been designed by converging, consolidating and subsuming all ongoing as well as newly proposed activities/programmes related to sustainable agriculture with a special emphasis on soil & water conservation, water use efficiency, soil health management and rainfed area development. The focus of NMSA will be to infuse the judicious utilization of resources of commons through community based approach.

NMSA will cater to key dimensions of 'Water use efficiency', 'Nutrient Management' and 'Livelihood diversification' through adoption of sustainable development pathway by progressively shifting to environmental friendly technologies, adoption of energy efficient equipment's, conservation of natural resources, integrated farming, etc. Besides, NMSA aims at promoting location specific improved agronomic practices through soil health management, enhanced water use efficiency, judicious use of chemicals, crop diversification, progressive adoption of crop-livestock farming systems and integrated approaches like crop-sericulture, agro-forestry, fish farming, etc.

### **Mission Objectives:**

#### **NMSA will have following objectives:**

- To make agriculture more productive, sustainable, remunerative and climate resilient by promoting location specific Integrated/Composite Farming Systems;
- To conserve natural resources through appropriate soil and moisture conservation measures;
- To adopt comprehensive soil health management practices based on soil fertility maps, soil test based application of macro & micro nutrients, judicious use of fertilizers etc.;
- To optimize utilization of water resources through efficient water management to expand coverage for achieving more crop per drop;
- To develop capacity of farmers & stakeholders, in conjunction with other on-going Missions e.g. National Mission on Agriculture Extension & Technology, National Food Security Mission, National Initiative for Climate Resilient Agriculture (NICRA) etc., in the domain of climate change adaptation and mitigation measures;
- To pilot models in select blocks for improving productivity of rainfed farming by mainstreaming rainfed technologies refined through NICRA and by leveraging resources from other schemes/Missions like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Integrated Watershed Management Program (IWMP), RKVY etc.; and
- To establish an effective inter and intra Departmental/Ministerial co-ordination for accomplishing key deliverables of National Mission for Sustainable Agriculture under the aegis of NAPCC.

### **Mission Strategy:**

To achieve these objectives, NMSA will have following multi-pronged strategy:

- Promoting integrated farming system covering crops, livestock & fishery, plantation and pasture based composite farming for enhancing livelihood opportunities, ensuring food security and minimizing risks from crop failure through supplementary/ residual production systems;
- Popularizing resource conservation technologies (both on-farm and off-farm) and introducing practices that will support mitigation efforts in times of extreme climatic events or disasters like prolonged dry spells, floods etc.
- Promoting effective management of available water resources and enhancing water use efficiency through application of technologies coupled with demand and supply side management solutions;
- Encouraging improved agronomic practices for higher farm productivity, improved soil treatment, increased water holding capacity, judicious use of chemicals/ energy and enhanced soil carbon storage;
- Creating database on soil resources through land use survey, soil profile study and soil analysis on GIS platform to facilitate adoption of location and soil-specific crop management practices& optimize fertilizer use;
- Promoting location and crop specific integrated nutrient management practices for improving soil health, enhancing crop productivity and maintaining quality of land and water resources; Involving knowledge institutions and professionals in developing climate change adaptation and mitigation strategies .
- State Government may engage reputed NGOs for implementation of cluster/village development plan in case of limited govt. infrastructure is available in that area through a transparent system of selection and defined process of supervision and monitoring through a line department.
- Strong technical monitoring and feedback systems on climate change mitigation and adaptation issues to the National Advisory council for regular updates on technical feasibility of various components and their effectiveness in bringing about the climate resilience.
- Establishing platform to liaison, review and coordinate implementation of interventions outlined in Mission Document of NMSA under aegis of National Action Plan on Climate Change.

### **Mission Interventions**

NMSA has following four (4) major program components or activities:



### **Rainfed Area Development (RAD):**

RAD will adopt an area-based approach for development and conservation of natural resources along with farming systems. This component has been formulated in a 'watershed plus framework', i.e., to explore potential utilization of natural resources base/assets available/created through watershed development and soil conservation activities /interventions under MGNREGS, NWDPR, RVP&FPR, RKVY, IWMP etc..

This component will introduce appropriate farming systems by integrating multiple components of agriculture such as crops, horticulture, livestock, fishery, forestry with agro based income generating activities and value addition. Besides, soil test/soil health card based nutrient management practices, farmland development, resource conservation and crop selection conducive to local agro climatic condition will also be promoted under this component. A cluster based approach of 100 hectare or more (contiguous or noncontiguous in difficult terrain with close proximity in a village/adjoining villages) may be adopted to derive noticeable impact of convergence and encourage local participation and for future replication of the model in larger areas. Supplementary support from this component will be admissible for gap-filling resource conservation activities under converging programmes.

RAD clusters should have soil analysis/soil health card/soil survey maps to justify the interventions proposed and at least 25% of the farming system area will have to be covered under On Farm Water Management. Farming Systems recommended by ICAR's Contingency Plans and successful findings of NICRA projects shall also be considered in development of integrated project plan. Besides, creation and development of common property resources/assets/utilities like grain bank, biomass shredders, fodder bank, group marketing etc. will be encouraged under this component.

### **On Farm Water Management (OFWM):**

OFWM will focus primarily on enhancing water use efficiency by promoting efficient on-farm water management technologies and equipment. This will not only focus on application efficiency but, in conjunction with RAD component, also will emphasize on effective harvesting & management of rainwater. Assistance will be extended for adopting water conservation technologies, efficient delivery and distribution systems etc. Emphasis will also be given to manage and equitably distribute the resources of commons by involving the water users associations, etc., to conserve water on farm itself, farm ponds may be dug using MGNREGA funds and earth moving machinery (to the extent manual digging under MGNREGA is not feasible).

### **Soil Health Management (SHM):**

SHM will aim at promoting location as well as crop specific sustainable soil health management including residue management, organic farming practices by way of creating and linking soil fertility maps with macro-micro nutrient management, appropriate land use based on land capability, judicious application of fertilizers and minimizing the soil erosion/degradation. Assistance will be provided for various improved package of practices based on land use and soil characteristics, generated through geographical information system (GIS) based thematic maps and database on land and soil characteristics through extensive field level scientific surveys. Besides, this component will also provide support to reclamation of problem soils (acid/alkaline/saline). This component will be implemented by State Govt., National Centre of Organic Farming (NCOF), Central Fertilizer Quality Control & Training Institute (CFQC&TI) and Soil and Land Use Survey of India (SLUSI). Given the limitations, such as staff and infrastructure, faced by the department of agriculture at the field level, a Public Private Partnership Model may be adopted by states depending upon the private partner's strength in the field to ensure that the soil testing is done in time and in the numbers required. The private parties can be encouraged to set up soil testing labs in selected areas in the district.

### **Climate Change and Sustainable Agriculture:**

Monitoring, Modeling and Networking (CCSAMMN): CCSAMMN will provide creation and bidirectional (land/farmers to research/scientific establishments and vice versa) dissemination of climate change related information and knowledge by way of piloting climate change adaptation/mitigation research/model projects in the domain of climate smart sustainable management practices and integrated farming system suitable to local agro-climatic conditions. The dedicated expert teams of technical personnel will be institutionalized within NMSA to rigorously monitor and evaluate the mission activities thrice in a year and will inform the National Committee. Comprehensive pilot blocks will be supported to illustrate functional mechanism for dissemination of rainfed technologies, planning, convergence and coordination with flagship schemes/Missions like MGNREGS, IWMP, Accelerated Irrigation Benefit Programme (AIBP), RKVY, NFSM, NHM, NMAET etc. Such an integrated action of input and output flows across agriculture, livestock and other production systems will harness the growth potential of the rainfed production systems, imparting sustainability of local production systems while negotiating climate change risks. A consortium approach will be evolved with various stake holders including knowledge partners like State Agricultural Universities (SAUs), Krishi Vigyan Kendras (KVKs), Indian Council of Agricultural Research (ICAR) Institutes etc. by the State Government to provide

single window service/knowledge provider system for the benefit of farming community. Financial support may be provided through States to institutionalize the concept and meeting supplementary developmental activities. Climate change related monitoring, feedback, knowledge networking and skill development will also be supported under this component through State Agricultural Universities, ICAR Institutes National/International Institutes, KVKs, Public / Private R&D Organizations etc. Awarding of Studies, Documentation & Publication, Domestic and Foreign Training, Workshops/ Conferences etc. will be supported under this component.

## **Planning & Implementation**

### **Component Specific Planning (CSP)**

NMSA has four major program components e.g. 'Rainfed Area Development', 'Soil Health Management', 'On Farm Water Management' and 'Climate Change and Sustainable Agriculture Modeling and Networking'. An illustrative approach for component specific planning is outlined below:

#### **Rainfed Area Development (RAD)**

- i. RAD aims at promoting integrated farming system(IFS) with emphasis on multi-cropping, rotational cropping, inter-cropping, mixed-cropping practices with allied activities like horticulture, livestock, fishery, agro-forestry, apiculture, conservation/ promotion of NTFPs etc. to enable farmers not only in maximizing the farm returns for sustaining livelihood, but also to mitigate the impacts of drought, flood or other extreme weather events;
- ii. Depending on the type and extent of natural resources/assets/commodities already developed or supported, location-specific crops, fruits, vegetables, spices, flowers, feed & fodder, livestock, fisheries, apiculture, mushroom, medicinal & aromatic plantation and related income generating activities would be supported. Activities like construction of ponds, land treatment, wells, supply of pumps, micro-irrigation/other water saving devices, seed and sapling Support etc. would be converged/supplemented to promote value addition through a sustainable farming system;
- iii. Adoption of a cluster approach in a village or an area of not less than 100 Ha (contiguous or non-contiguous in difficult terrain with close proximity, in a village/ adjoining villages) may be preferred for injecting investments to utilize the potential of available/ created common resources;

- iv. Selected clusters will have soil analysis/soil health card as mandatory and at least 25% of the farming system area will have to be covered under On Farm Water Management.
- v. Support will be given to those who wish to add other compatible farming component(s) to their existing crops/ system. It should have the potential to introduce/merge at least one or more major components/activities apart from cropping system and water harvesting of the farming systems to qualify for the support. Support for only cropping system will not be allowed under this component unless it is diversified from the regular practice to a farming system suitable to that particular ecological conditions through effective on-farm water management and soil health care. Farmers would have the option to choose one or combination of farming systems suitable to the specific eco-system supported through local KVK, SAU, ICAR Centre, ICRISAT, ATMA etc., for maximizing agricultural productivity from the existing natural resource assets;
- vi. Support to each farm family under RAD component will be restricted to a farm size of 2 Ha and financial assistance will be limited to Rs. 1 lakh. However, construction/renovation of farm ponds, storage/processing unit and / or construction of poly house etc., are excluded from these limits. Credit support, if required, may be arranged to meet the balance;
- vii. Farmland development through location specific interventions e.g. resource conservation, rainwater harvesting, land development in river valley project and flood prone river areas, last mile connectivity etc. Farmers' Companies, Farmers' Producer Companies/ Organizations, Registered Farmers' Societies, Farmers' Cooperatives would also be eligible for developing a cluster. The support for the activities would be restricted to the eligible limits for members. The FPOs are also eligible to get support from NMSA, but as per the Policy and Process.
- viii. Guidelines for Farmer Producer Organizations issued by Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India. Due consideration should also be given to ensure that farmers rights and ownership issues are not violated.
- ix. Converging the upgraded utilities developed through watershed development programmes/NREGA in terms of water harvesting and micro water storages through effective application and distribution systems like improved conveyance, field channels, pressurized irrigation, water-lifting devices etc. to enhance the potential of

- farming systems.
- x. The farmers' producer companies may be set up to grow organic products. These farmers can come from a group of villages, preferably contiguous, forming a cluster and should be supported to achieve organic certification over a period of three years. These producer companies should be given financial support as per provisions for FPOs and subsidies for eligible components under NMSA for marketing of the organic product so that it fetches better prices and encourages others to take up organic farming. Marketing Federations existing at the state level should enter into agreement with the producer companies to market their organic product in the niche markets.
  - xi. Resource Conservation Technologies (RCT) and rainwater harvesting have been kept under the basket of eligible activities of RAD to fulfill specific requirement of farmers/localities to supplement the works undertaken under National Watershed Development Program for Rainfed Areas (NWDPR) and Soil Conservation in the Catchments of River valley Projects & Flood Prone Rivers (RVP&FPR) which have not been developed to their full potential due to limitation of resources and in some cases not completed due to discontinuation of funding.
  - xii. RCT activities will not be taken up in any developed/ongoing /proposed IWMP watershed project areas unless specifically recommended by the State Level Nodal Agency of IWMP.
  - xiii. Reclamation of problem soils (Acidic/alkaline/saline) through appropriate soil amendments, land development including bio-drainage, on-farm water management including secondary storage as may be required in the cluster, may be proposed under RAD Component adopting the norms and specifications given under SHM /OFWM components.
  - xiv. Convergence of relevant developmental programmes in project areas to be ensured for optimal utilization of resources by establishing an integrated and coordinated system involving different sectors and institutions. The upgraded utilities developed through watershed development programmes/MGNREGA in terms of water harvesting and micro water storages can be made use through effective application and distribution systems like improved conveyance, field channels, pressurized irrigation, water lifting devices etc. to enhance the potential of farming systems. Areas/Commodities developed/being developed under National Food Security Mission (NFSM), National Mission on Oilseed & Oil Palm (NMOOP), National Mission on

Horticulture (NHM), National Livestock Mission (NLM) can be supplemented with other productions systems from NMSA to make it an Integrated Farming System facilitating additional livelihood opportunities to farmers. Similarly the interventions of National Mission for Agriculture Extension & Technology (NAMET) to appropriately made use for capacity building, awareness generation, information support, farm mechanization, availability of seeds/planting materials etc.

- xv. Suitable linkage for agro-processing and Marketing may be established for the cluster. Possibilities of building post-harvest and market linkage under PPP model may be explored. Funds from schemes like NADP, National Mission for Food Processing may be dovetailed for this purpose.

### **Soil Health Management (SHM):**

#### **Guidelines for Implementation of Mission Intervention on Soil Health Management (SHM):**

Out of the 4 interventions under NMSA, Soil Health Management (SHM) is one of the most important intervention: SHM will aim at promoting location as well as crop specific sustainable soil health management including residue management, organic farming practices by way of creating and linking soil fertility maps with macro-micro nutrient management, appropriate land use based on land capability, judicious application of fertilizers and minimizing the soil erosion. Assistance will be provided for various improved package of practices based on land use and soil characteristics, generated through geographical information system (GIS) based thematic maps and database on land and soil characteristics through extensive field level scientific surveys. This component will be implemented by State Govt., National Centre of Organic Farming (NCOF), Central Fertilizer Quality Control & Training Institute (CFQC&TI) and sanctioned by INM division. Besides, this component will also provide support to reclamation of problem soils (acid/alkaline/saline) and promote appropriate land uses through State Governments, Soil and Land Use Survey of India (SLUSI)/NRM Division.

#### **It will have following approach for component specific planning.**

- SHM will support various types of soil and land resource surveys for creating a comprehensive soil database for the planning and implementation of programmes;
- Ensure quality control requirements of fertilizers, bio-fertilizers and organic fertilizers under the Fertilizer (Control) Order (FCO), 1985, including revision of standards and testing protocols keeping in view the advances in research and technology and covering

- organic inputs under quality control regime;
- Promote Integrated Nutrient Management (INM) through judicious use of chemical fertilizers, including secondary and micro nutrients, in conjunction with organic manures and bio-fertilizers, for improving soil health and its productivity;
  - Support augmentation and strengthening of soil and fertilizer testing facilities and provide soil test based recommendations to farmers for improving soil fertility and enhancing economic return to farmers. It will also support up-gradation of skill and knowledge of Soil Testing Laboratories (STL)/extension staff and farmers and their capacity building through training and demonstration including demonstration on farmers' fields on soil health care;
  - Training on appropriate measures on soil nutrient management and judicious distribution of fertilizers as per soil/crop need for enhanced productivity with reduced cost of cultivation.
  - Reclamation of problem soils (Acidic/alkaline/saline) through appropriate soil amendments and land development.
  - It is to be noted the reclamation and land use survey and planning will be implemented by SLUSI through NRM division

### **On Farm Water Management (OFWM):**

- i. OFWM will focus on enhancing water use efficiency by promoting appropriate technological interventions like drip & sprinkler technologies, efficient water application & distribution system, secondary storage and drainage development.
- ii. The unit cost of Drip Irrigation system varies with respect to plant spacing and location of the water source. Moreover, the cost of the drip system varies from state to state depending upon the volume of demand, marketing network, etc. Accordingly, the states have been categorized into three categories, viz. Category 'A', 'B' and 'C'. States where more than 20,000 hectares have been brought under drip irrigation would come under 'A' Category. This would include the States of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Punjab and Tamil Nadu. All the States except those covered under Category 'A' and those falling in the Himalayan belt would come under Category 'B'. All the North Eastern States, Sikkim, Himachal Pradesh, Jammu & Kashmir, Uttarakhand and Darjeeling District of West Bengal would come under Category 'C'. Keeping in view the level of awareness, proximity to the manufacturing units, distance

involved in transportation, potential for drip irrigation, the cost of drip system in Category 'B' States is estimated to be 15% higher than Category 'A' States while for Category 'C' States it is estimated to be 25% higher than Category 'A' State.

- iii. Location and crop specific technologically appropriate irrigation systems will be propagated ensuring least cost burden to the farmers/beneficiaries;
- iv. It may be ensured that at least 25% of the micro irrigation fund allocated to the State is used for crop sector.
- v. Support to each farm family under OFWM component will be restricted to a farm size of 5 Ha. However, beneficiaries who have already availed the benefit of central support for micro irrigation cannot avail further assistance for the same land for the next 10 years
- vi. Support for creating secondary storage at tail end of canal system to store water when available in abundance (rainy season) or from perennial sources like streams for use during dry periods through effective on-farm water management; Support for drainage development through surface/sub-surface/bio-drainage system;
- vii. Training on appropriate water management technologies, judicious use of water and agronomic & land development measures for effective water management;
- viii. Implementing Agency at the District level should follow uniform procedures and assure transparency in selecting beneficiaries and releasing assistance expeditiously. PRIs need to be consulted in selection of beneficiaries. The water resources developed through watershed development programmes/ NGNREGA in the demonstration area should invariably be linked with the activities of OFWM component for its potential use. Project areas under National Food Security Mission (NFSM), National Mission on Oilseed & Oil Palm (NMOOP), National Mission on Horticulture (NHM), National Livestock Mission (NLM) may also take the advantage of this component for improving water use efficiency, if this component has not been utilized from the parent scheme.



### 3. Towards a Paradigm Shift in India's Rainfed Agriculture

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#### Introduction

Cross-country comparisons show that the impact of GDP growth originating in agriculture on poverty reduction is twice as much as that of GDP growth originating outside. In India, rainfed agriculture (including animal husbandry) is emerging as a major constraint in raising overall agricultural growth. Rainfed areas in India are spread over in some 200 million hectares and constitute 62 percent of the total geographical area of the country. 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 until now has been to indiscriminately extend the water-intensive Green Revolution technology to these areas that have a significantly different natural resource configuration. This has led to several catastrophic ecological consequences, such as loss of soil fertility, groundwater depletion, loss of bio-diversity and an increase in climate change vulnerability. At the same time, lack of inadequate support for rainfed agriculture in terms of support price, availability of inputs, credit, market access and agricultural research has caused widespread desperation.

The most visible aspects of this desperation are farmer suicides on the one hand, and the rising tide of left wing extremism on the other. In rainfed agriculture, we need a radical shift away from the current paradigm derived from the experience of the Green Revolution. Even with this policy neglect, the contribution of rainfed agriculture to the national economy is by no means small. Rainfed agriculture accounts for 56 percent of total cropped area, 48 percent of the area under food crops and 68 percent of that under non-food crops. In terms of crop groups, 77 percent of pulses, 66 percent of oilseeds and 45 percent of cereals are grown under rainfed conditions. Food grain production in India grew at a rate of 1.26 percent per annum between 1990–1993 and 2003–2006.

Meeting the future demand for food grains (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 percent of the additional supply of food grains needed to match future rise in demand will have to come from rainfed agriculture. Therefore, a breakthrough in rainfed agriculture is an imperative for poverty alleviation, livelihood promotion and food security in India. Watershed development has been one of the important vehicles for directing public investment to rainfed

agriculture. However, to be effective, the rainfed agriculture package needs to move beyond watershed development and integrate several other components. Samaj Pragati Sahayog (SPS) has been engaged in the implementation of such an integrated watershed and rainfed agriculture package by bringing together different stakeholders in the tribal drylands of central India for the last 20 years. This work has enhanced drinking water availability, sustained employment generation and livelihood security in several villages. Decentralised water harvesting provides vital life-saving irrigation support to farmers and ensures drought-proofing of the rainfed crop.

As a result, the value of agricultural production has doubled. The immediate impact is observed on distressed out-migration from the villages, which has shown a decline of about 80 percent. There has also been a significant decline in the level of indebtedness of these households to traders and moneylenders who charge usurious rates of interest. While the experience of SPS and other civil society organizations working in similar contexts have shown the strength of this approach at a micro-level, the overall impact of the rainfed agriculture package need to be demonstrated at a scale. It is in this context that SPS joined a group of civil society organizations, researchers and policy-makers who have come together to form the Revitalizing Rainfed Agriculture (RRA) Network.

The RRA network currently has 109 members spread across rainfed areas of the country, and is emerging as an important platform articulating the issues of rainfed agriculture at the national level. The RRA network is attempting to generate large scale and field-based evidence through implementation of comprehensive rainfed agriculture pilots in different bio-physical and socio-economic contexts and typologies within rainfed India, and to develop policy advocacy on the basis of that evidence.

The network is currently putting together available experiences across rainfed typologies on various themes such as water, soil fertility, seeds, inputs, land use, livestock, marketing, credit, etc. An important aspect of the pilot efforts of the RRA network is an attempt to leverage resources from ongoing public investment programmes for grassroots implementation. Generation of such evidence will provide an opportunity to test the effectiveness of specific interventions, evolve operational strategies for scaling up, develop systems of monitoring and documentation of results, and garner important lessons for public policy that identifies the crucial agents of change in rainfed agriculture.

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**Source:** P.S. Vijay Shankar, Samaj Pragati Sahayog (SPS), Bagli Madhya Pradesh, India  
Innovation and Development, vol No.2, October, 2011, Page No 321-322

#### **4. Status and Management Scenario of Natural Resources - Overview**

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Natural resources (land, water, biodiversity and genetic resources, biomass resources, forests, livestock and fisheries) – the very foundation of human survival, progress and prosperity, have been degrading fast, and the unprecedented pace of their erosion is one of the root causes of the agrarian crisis that the country is facing. The demographic and socio-economic pressures notwithstanding, the unmindful agricultural intensification, over use of marginal lands, imbalanced use of fertilizers, organic matter depletion and deteriorating soil health, extensive diversion of prime agricultural lands to non-agricultural uses, misuse and inefficient use of irrigation water, depleting aquifers, salinization of fertile lands and water logging, deforestation, biodiversity loss and genetic erosion, and climate change are the main underlying causes.

The stipulated overall GDP growth rate of 9 per cent and agricultural growth rate of 4.1 per cent during the XI Plan cannot be achieved with the ongoing shrinking and degradation of the country's natural resources. Interlinked as producers and service providers, the resources must be judiciously conserved, developed and harnessed.

#### **Specific Resources and their Management Prospects:**

##### **Land**

Of the country's total 142 m ha cultivated land, 57 m ha, 40 per cent of the total, is irrigated and the remaining 85 m ha is rainfed. Of the total geographical area of 329 m ha, about 146 m ha is classified as degraded, although varying estimates have been provided by different agencies. As generally agreed, the resources have been degrading fast, costing 11 to 26 per cent of the GDP during the 1980s and 1990s. Land distribution is highly skewed, more than 80 per cent of the farmers are small, marginal and sub-marginal and together own about 40 per cent of the total cultivated land, and increasing proportions of the holdings are becoming uneconomical. The soil health has been deteriorating, especially widespread micro-nutrient deficiencies (hidden hunger) and fast depleting carbon content, resulting in low and decelerated TFP growth rates.

Efforts of different Ministries/Departments/Organizations should be integrated to

harmonize the delineation, codification and land capability classification. Detailed soil data (physical, biological, chemical and microbial) based on effective soil testing are prerequisites for all lands under both rainfed and irrigated agriculture to address the issues related to soil health *vis a vis* agriculture production. Such soil data will be vital for setting up Village Resource Centres for benefit of the farming community. Necessary financial and human resources should thus be assigned for the purpose.

Central and State Land Use Boards should be reorganized and empowered to lead this work. Further, we must implement the unimplemented agenda of land reform with particular reference to tenancy laws, land leasing, distribution of ceiling surplus land and wasteland, providing adequate access to common property and wasteland resources. Following the conferment of land rights to women under the Hindu Succession Amendment Act (2005), the provision of appropriate support services to women farmers has become urgent. Moreover, as far as possible, agricultural land should not be diverted to non-agricultural use.

## **Water**

Water availability at the National level is reaching close to 1700 cubic meter (cu m) per capita – the threshold line, and if things do not improve, it will drop to water scarcity line by 2025. India annually receives about 350 million hectare meter (m h m) rain water, but almost half of it finds its way back to the sea, whereas the per capita water storage in India is only 210 cu m against 1110 cu m in China and 3145 cu m in Brazil.

With nearly 60 m ha of net irrigated area and irrigation using over 80 per cent of all fresh water, India ranks first in the world in irrigated acreage. There is huge gap of 14 m ha between irrigation potential created and utilized, and the irrigation intensity is only 135 per cent which should be raised to 175 per cent or more. Besides low water use efficiency, there is high inequity in water use and irrigation development, let alone the fast receding aquifers and blocks after blocks turning “dark” and “grey” in certain parts of the country.

The XI Plan aims to give thrust to irrigation expansion. Accounting for the 7 m ha through the trend scenario, the additional 10 m ha irrigated area under Bharat Nirman by the year 2009 and the stipulated additional 14 m ha to be brought under pressurized irrigation, by the end of the XI Plan, the country would have an additional 27 m ha under irrigation. The Planning Commission should urgently firm up these figures and, in consultation with the concerned Ministries, should delineate the areas to be brought under additional irrigation. Considering that 70 per cent of the groundwater in the East Zone is unexploited, and the region has high poverty intensity, larger allocations and technical support should be provided by the

Centre to this zone for judiciously developing and utilizing water resources towards increased, sustained and inclusive agricultural growth.

**The following water management strategies and actions are recommended:**

- Undertake scientific and comprehensive assessment of water resources, monitor and evaluate water extraction, storage and use, and enhance income per unit of water consumed.
- Prevent/ discourage unsustainable use of groundwater resources in critical zones, develop the resources in unexploited zones, and increase awareness of farmers and other stakeholders about the value and scarcity of water and negative fallouts of improper use.
- Develop and adopt water use efficient cost-effective and eco-friendly crops, cropping patterns, farming systems and technologies.
- Integrate rain, surface and ground waters and promote conjunctive use of poor quality and polluted waters.
- Institutionalize participatory management of water (Water Users Associations, including proactive women's participation), rationalize water pricing and operational and maintenance charges and distribution of irrigation water and equitable access to water as a common resource.

**Biodiversity and agricultural genetic resources**

Rampant loss of biodiversity and agricultural genetic resources has greatly enhanced genetic vulnerability of our agricultural systems besides losing invaluable gene pools, such as Tharparker in Western Rajasthan. The two recent National initiatives in this field, namely, National Biodiversity Board and Plant Variety Protection and Farmer's Rights Authority are supposed to address this issue, but there is little coordination between the two. Participatory breeding, integrated germplasm and indigenous knowledge conservation and benefit sharing, particularly involving women and tribals, should be promoted through transparent modes of accessing the National Gene Fund and increasing gene and IPR literacy. Establishment of living heritage of livestock germplasm (mostly at State Farms), village gene banks, offshore quarantine centres for germplasm screening against serious diseases and pests and maintenance and trade of pedigreed animals and elite medicinal and aromatic plant landraces by farm science graduates should be strongly supported.

## **Forests**

Forests, the green cover, are the natural resource infrastructure for agriculture/primary production and rural economic growth. India, harboring 16 major forest types – tropical, temperate, alpine etc., is one of the 17 mega diversity centers and two biodiversity hot spots of the world. Per capita forest area in the country (0.064 ha) is one-tenth of that of the world's average, and 41 per cent of the country's forest cover is degraded. Despite the high importance of forests as source of food, fuel, fodder and fiber, and of linking conservation with community based forestry, allocation to the forestry subsector has rather been meager, less than 1 per cent of the Plan size. Moreover, most of the budget has to come from the State Governments which seldom meet their commitments and the forests continue to suffer. The share of the Central Government should be increased to at least 50 per cent of the total requirement, and the Tribal Bill, 2005 should be fully implemented and linked with the NREGA.

Through the watershed system, the Joint Forest Management (JFM) should be changed to Community Forest Management (CFM) and the concerned Committees, in collaboration with Watershed Committees, should ensure maintenance of the forest profile through large scale tree plantations deploying the nearly 140 thousand frontline staff trained in natural resource management. State Forest Departments should serve as the Project Implementing Agencies and Village Panchayats should play the coordinating role. MoRD, MoEF and MoA should jointly invest in agroforestry and bio-energy and biomass plantations covering degraded forest lands, wastelands and common property resources, duly supported with producer-friendly regulations for harvesting, processing, and value addition, grazing and marketing.

## **Livestock**

Livestock accounts for about 27 per cent of the Agricultural GDP and is positively egalitarian in its distribution and in ownership by women, and is a major pillar of income, food and employment security. Possessing the world's largest livestock population, India ranks first in milk production, fifth in egg production and seventh in meat production. Total livestock output has been growing at a much faster rate of 3.6 per cent per annum against only 1.1 per cent registered for the crops sub-sector during the past decade. The targeted overall agricultural annual growth rate of 4.1 per cent during the XI Plan is stipulated to be achieved through a growth rate of about 8 per cent in the livestock subsector. In order to double the current growth rate to achieve the XI Plan target, constraints to increased livestock production and productivity (which is one-third of that of the world average) must be properly identified and addressed.

Institutional supports and policy actions such as livestock insurance, market and price support, Livestock Feed and Fodder Corporation, Fodder Banks, Small Holder's Poultry Estates, etc. are needed towards achieving the rapid and inclusive growth.

## **Fisheries**

Fisheries (53 per cent of the production from aquaculture) contribute significantly to food, nutrition, economic and employment securities, and fortunately are one of the fastest growing agricultural sub-sectors during the last three decades. Currently, fisheries contribute 4.6 per cent of the agricultural GDP, provide employment security to about 11 million people and annually earn foreign exchange worth Rs. 7,300 crore – about one-fifth of the value of the National agricultural export. The overall growth rate of fish production could be doubled to about 8 per cent towards achieving the overall agricultural growth rate of 4.1 per cent during the XI Plan. The following constraints should, however, be addressed to harness the potential: siltation and pollution of water bodies, poor management of production-processing-distribution chain, poor quality control of fish seed and feed, under-exploitation of available species such as cold water fishes like trout and Mahseer and air-breathing fishes like Mangur. Weak infrastructure for landing and marketing and inadequate access to water bodies/tanks, multi-user conflicts and inappropriate leasing policies are other important constraints. Suitable leasing policies, reduced duties on feed and lower power tariffs can help accelerate production of scampi (prawn) in inland saline waterlogged areas, brackish water areas and other aquaculture systems, thus greatly contributing to employment, income and food security.

The newly established National Fisheries Development Board, among other things, should strongly support Integrated Coastal Zone Management and Aquarian Reforms, as also suggested by NCF.

## **Major Strengths and Weaknesses of the Past NRM Programmes**

During the last two decades, primarily through the watershed programmes, considerable emphasis has been placed on natural resources management. Up to the X Plan, nearly 51 m ha has been developed through integrated approach (i.e. simultaneous development of multiple natural resources on watershed basis) with an investment of Rs. 19,251 crore. Besides, 1.6 million ha has been developed through situation specific approach (i.e. development of one type of natural resource at one time) with an investment of Rs. 9,500 crore. The Ministry of Rural Development accounted for 63 per cent of the "treated" area spending nearly 50 per cent of the total funds and the Ministry of Agriculture "developed" the remaining 37 per cent of the area,

but used slightly more than 50 per cent of the total funds. The Ministry of Forest and Environment and the National Planning Commission had only limited involvement.

Often, the treated areas have reverted back to the original status and the impact of the development on productivity, equity and sustainability is generally invisible at larger scales. This was ascribed primarily to the lack of focus on productivity enhancement and on livelihood component under the watershed programmes. Sustaining people and their interest in conserving the natural resources for their livelihood, and not merely in land and water conservation, is a necessary precondition for management of natural resources, particularly in rainfed areas.

Participatory approach has been promoted through JFM, PIM and PWM etc. for the last 10 to 15 years, but more than 30 per cent of NRM programmes continue to be under top-down approach even at this stage. Institutionalization of participatory approach has thus not yet taken place on large scale even in programmes where participatory guidelines are used. This has resulted not only in continued over exploitation of the natural resources due to low emphasis on proper management of the resources, but also in non-inclusive growth and greater inequity.

Post project sustainability continues to be a challenge. This appears to be mainly due to: (i) inadequate delivery mechanism at National, State and District levels, (ii) low capacity building at Community level, (iii) lack of sustainability of CBOs, (iv) low attention towards allocation of users' right over CPR, (v) lack of payment of genuine contribution by actual users, (vi) delay in fund flow particularly under those programmes which are funded by MoA and (vii) lack of proper modality for carrying out repair and maintenance of CPR, etc.

Development of farm production systems as well as off-farm livelihoods continue to receive low attention under natural resource development programmes. Likewise, convergence between inter-related schemes of different development departments could not take place due to various reasons. Poor implementation of the watershed programme at field level may partly be ascribed to the differences in guidelines of different Ministries/ Departments.

The scientific concept of watershed based development could not be properly adopted in majority of cases due to scattering of 500 ha micro-watershed units over the entire block / district. It is now being recognized that though a unit of 500 ha may be adequate for development of land resources, it is quite inadequate for development of water resources as well as management of common lands / forest department lands.



The space for NGOs has been gradually reducing (particularly in govt. funded watershed programmes) in spite of the fact that good results have been obtained by several of them. Likewise many of the innovative experiences generated under the externally funded projects could not be up-scaled even in the concerned States. These maladies must be remedied towards sustained and humanistic development of natural resources.

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**Source:** Report of the XII Plan working Group on Natural Resource Management and Rainfed Farming, November 2011.

## **5. Case Study on Community Seed Bank in Doultabad Mandal,**

### **Mahabubnagar of Andhra Pradesh State**

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#### **Introduction**

Mahabunagar district in Andhra Pradesh state has 64 mandals comprising of 1550 revenue villages and 1348 Gram Panchayats. The district has a total population of 35.14 lakhs (accounting for 4.61% of the total state population) comprising of 17.82 and 17.32 lakh males and females respectively. Of the total population, rural and urban areas have registered 31.42 and 3.71 lakhs, respectively.

#### **Climate and Rainfall**

The regions are characterized by hot summers with low rainfall and relatively moderate winters. The average rainfall of Mahabubnagar district is 604 mm, most of it received during south west monsoon period (June – September). Seasonal rainfall distribution indicates low precipitation from the northeast monsoon and is more drought-prone in the later part of crop-growing season.

#### **Soil**

Andhra Pradesh has eight sub agro-ecological regions (National Bureau of Soil Survey and Land Use Policy (NBSS&LUP 1996–97). Deep loamy and clayey mixed red and black soils dominate Mahabubnagar district. The major portion of the land is covered by sandy and sandy loam soils (70%) which have got characteristic feature of less water retention capacity, there by most of rain water goes as run off. In Doultabad mandal, it is further high i.e., 76%

#### **Irrigation**

Net area irrigated under different sources of irrigation in the district is 1,66,606 hectares accounting for as low as 3.8% of the state net area irrigated (43,92,303 hectares). Gross area irrigated is 2,11,454 hectares. Area irrigated more than once has registered as 26.9% of the net area irrigated in the district. Tube wells has emerged as dominant source of irrigation which has occupied a lion's share of net area irrigated to the extent of 66.4% followed by canals (12.5%), other well (11%), tanks (6.7%) and other sources (3.4%)

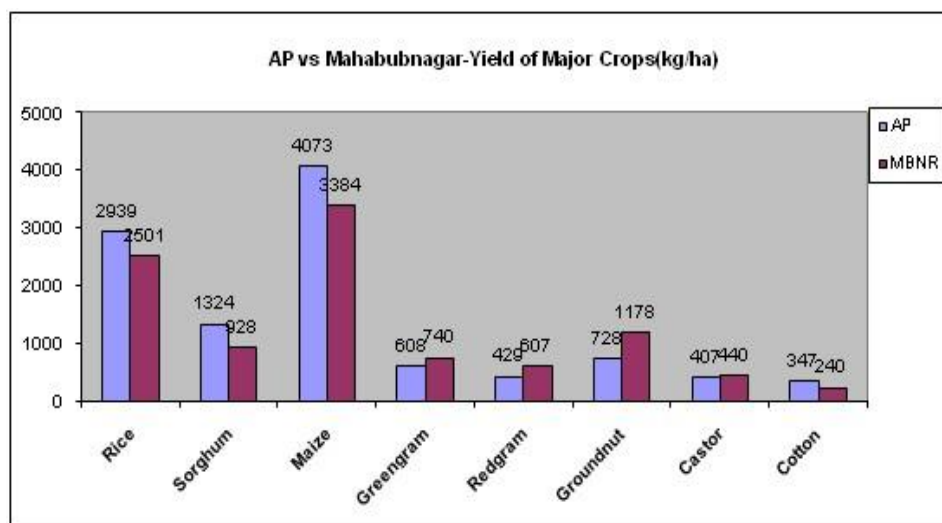
#### **Agriculture and Cropping Pattern**

Agriculture is the most important occupation of the people of the district. The prominent crops cultivated are rice, sorghum, bajra, maize, pigeon pea, horse gram, groundnut, castor,

sunflower, cotton and chillies. The district stands first in the production of pigeon pea and castor, second in maize, green gram; third in terms of production of sorghum, bajra, ragi, horsegram, oilseeds; fourth in the contribution of groundnut, onions and fifth in terms of total pulses, sunflower and chillies. Pigeon pea, pearl millet and sorghum are commonly grown as intercrops in the groundnut cropping system. In Mahabubnagar pigeon pea is widely intercropped with sorghum. Crops grown in these traditional cropping systems are primarily for subsistence. The cropping system survey undertaken as a part of this study between 2002-06 indicated that sorghum, pearl millet, foxtail millet, groundnut and pigeon pea were raised using own-saved seed of traditional varieties sown year after year. (Seed System Innovations in the semi-arid tropics of Andhra Pradesh)

### Productivity of Crops:

The productivity of maize has occupied first position (3384 kg/ha) among major crops grown in the district while rice attained second (2501 kg/ha) and groundnut (1178 kg/ha), sorghum, green gram, pigeon pea, castor and cotton being third, fourth, fifth, sixth, seventh and eight positions respectively (figure 1).



**Figure 1: Yields of Major Crops in AP Vs Mahabub Nagar District during 2005-06**

The area under total food crops is 57.4% in the district compared to the 65.9% under the state while non-food crops contribute about 42.6% and 34.1% respectively.

In this regards, some efforts have been made in Doultabad mandal of Mahabubnagar district in Telangana state under Comprehensive pilot of Revitalization of Rainfed Agriculture (RRA) network. Showing the interest and commitment of the RRA Network, it was therefore thought to study such initiatives and to determine the scope for replication of this program in similar rainfed areas across the country.

## Review of Literature

New institutions on organized seed collection, storage and exchange of seed, and are made up of Individually and collectively stored, locally multiplied, modern and farmer varieties of seed, ensuring that village seed committee members undertake the responsibility of producing quality seed. Seed costs can be kept low if locally produced seed stays non-processed and non-certified. The statutory standards of commercial seed are too expensive for the informal sector. Evolving a policy to certify village/community-based seed production without taxing smallholder farmers would offer greater scope for production of quality seed. Community- or village-based seed production and distribution schemes have gained popularity in recent times. The concept of village seed banks involves improved seed and technical assistance focused on 'pilot' villages in order to train farmers in seed production, storage and distribution. (Reddy, C. R. et al. 2007)

The reality is that there is some commercial seed supply, but without hybrid technology the incentives for the private sector remain limited. Use of hybrid seed by small and medium-scale farmers remains a dream due to lack of access, availability, timely supply and affordability. The most important aspect of hybrid technology is that the farmer has to buy seed every year. He cannot save his own seed and use it in the next season. Non-governmental and other local organizations have begun to experiment with a wide range of seed provision innovations, but these are limited in scope. The most effective strategy will involve a combination of public, commercial and local participation, but much work remains to be done to identify the most effective and equitable formulation. In the meantime, farmers have inadequate access to improved seed and are unable to take advantage of new varieties developed by national and international agricultural research. Uncertain production environments, particularly the threat of drought, add to the instability of the current seed provision. Policies that seek to diversify local agriculture systems are difficult to implement because of this inadequacy. Therefore, there is an urgent need to identify appropriate policies and strategies to expand and diversify national seed systems. (Reddy, C. R. et al. 2007). Seed is retained on-farm by millions of separate farming households throughout the world. This is by far the most prevalent method of storing seed. (Lewis, V. and Mulvany, P. S., 1997).

The concept of 'individual farmer as seed bank' has the potential to be a successful innovation in local seed systems. By giving the support of scientific tools to a traditional system of seed exchange, this innovation can be sustainable in disseminating improved varieties and improved production technologies at the village level. (Reddy, C. R. et al. 2007).

Collective seed storage occurs when farmers, either self-organised, or assisted by outside organisations coordinate the storage of the seed they need for planting. Although, this type of seed storage does have roots in indigenous cultures, there has been an increase of NGO-led, farmer-participatory collective seed storage projects in the last decade or so (Berg, 1996a)

### **Methodology**

Looking at the time and resource availability, it was decided to make a successful case study from the Doulthabad mandal on community managed Seed Bank. Since presently 14 villages with 48 farmers' groups is under the Cooperative as part of the WASSAN as a Comprehensive Pilot partner under Revitalization of Rainfed Agriculture network in India. It was decided that 6 villages will be taken for the study that are getting benefits of Seed Bank Program. From each village 6 farmers selected randomly and interviewed individually with the pretested interview schedule and 2 Focus group discussion with two farmers' groups were conducted. Since, there was one group present in one of the villages of study area i.e., Chellapur village, total 11 farmers participated in focused group discussions.

Secondary data regarding district and mandal profile including climate and agricultural data was collected from agriculture department and mandal office, departmental website and NGOs/CBOs. Primary data regarding seed bank development and management process and impact was collected from the farmers in Seed Bank, Seed bank managers, staff of WASSAN, concerned government officials such as Asst. Director of Agriculture, Kodangal Division, Agriculture Extension Officer, Doulthabad mandal, etc.

## **Discussions**

Past Trends of the Area : Mahabubnagar district is affected with severe droughts many a times affecting the agriculture sector very badly. The farmers are affected with various issues in their livelihood. Cropping pattern found in Doulothabad mandal has gradually changed over time. Around 10 years back, there were not much irrigation facilities. Most of the crops grown were rainfed such as paddy, jowar, bajra, finger millets, foxtail millets, green gram, red gram, ground nut, etc. Farmers were using their own farm saved seeds. There was traditional method of conservation practices of seeds for different crops. Farmers had to extract best variety of crops from the total yield and after processing and cleaning manually and with the use of bullocks, it was mixed with the neem leaves and ashes from the wood used for cooking. Then the seed was stored in the burned clay pots for longer period without any damage. Ragi, foxtail. Jowar, green gram, red gram, bajra, horse gram were cultivated in rotational basis. Earlier, there was mixed cropping of red gram, green gram and cow pea. There was also mixed cropping of red gram, jowar and inter cropping of red gram and ground nut.

### **Change in Agriculture Scenario**

Gradually there was change in cropping pattern. Now major crops found are paddy, red gram and ground nut with the increased use of ground water. There was change in the food habit of the people. Earlier Jowar roti which was taken as main course in dinner has been changed to paddy. The support price for Jowar has not increased so much as compared to paddy. The demand has also been shifted with government supply of paddy in PDS. Due to wild boar problem, in millets, and less market price there was a shift in cropping pattern with less millets. Genesis of HYV seed in paddy, ground nut and jowar, people are demanding more HYV varieties. Inter and mixed cropping has been changed into mono crop. Farmers go for double and triple crops in irrigated areas and one crop in rainfed areas. Mainly, paddy and ground nut are taken in the irrigated fields with red gram and jowar in rainfed land. Gradually, the process has been changed to mono cropping like only red gram or only ground nut. However, there is mixed cropping of ground nut and cow pea in some areas. Now the incidence of high pest and insect attack is prominent in crops like red gram, paddy, and green gram due to change in cropping pattern and followed by more use of insecticides and pesticides. The seed availability of different crops has been limited to some of the preferred varieties due to its taste and productivity. In paddy, the seed has been limited to Hamsa and 1010 variety. Farmers have to get paddy seed mainly from the market and produce twice with own saved seeds from their field. Then once again they have to purchase the seed from the market or procure from the

government department. Red gram with red variety seed is still from own sources. The farmers are taking seed from the neighbors with the traditional system of nagu. Green gram storage is difficult due to more pest attack. Mostly, the farmers have to purchase green gram seed from market or procure from the government department. The farmers are still using own farm saved seed of jowar, but they are preferring HYV of jowar available in the market and from the government department. Ground nut seed is generally conserved by the farmers and taken in nagu for the use from the neighbors if seed is available in the village and in some cases HYV of seed is purchased from the market and government departments.

### **Need for Seed Bank**

Many attempts were made on to revive the age-old concept of seed self-sufficiency. Community seed banks bring together seed-producing farmers, seed-using farmers and organize them to work in conditions of utmost transparency, mutual trust and social responsibility under peer supervision. An attempt was made at Timmareddipalli village in Mahabubnagr district of Andhra Pradesh, in the year 2013 to promote the concept of community seed bank with technical backstopping provided by WASSAN with support from Revitalizing Rainfed Agriculture Network Consortium under Comprehensive Pilot program. Its objective was to ensure timely supply of quality seed of improved varieties to all groups of farmers as an approach towards increasing productivity and creating income generating opportunities for better livelihoods to villagers. This is an effort towards, self-reliance in the seed system by the farmers with the support from government addressing various problems in the system. Much prior to this intervention, a conscious effort to understand the sustainability of existing community seed systems was made to assess the needs of the stakeholders and to plan and develop appropriate seed bank model.

Evolution of the Farmers' Organisation and establishment of Community Seed Bank: Formation of Farmers' Cooperative - Three years back, farmers have decided to address their problem in agriculture and motivated to form groups with the support of WASSAN. The groups were formed in the villages with the objective of addressing farming issues collectively. Diversified Farmers Groups were formed in 2007 with AP Drought Adaptation Initiative scheme (APDAI). Two villages in the mandal initially started farmers' cooperative and later 73 groups having 15 members in each of 14 villages are federated to form Mutually Aided Cooperative Farmers' Society. The Society is involved in the agricultural services, use of different government schemes like NPM, procurement, dal processing unit, soil fertility enhancement, thrift and credit, dry land horticulture, compost making, getting license for fertilizer procurement and distribution, etc. Currently, 48 farmers groups are operational in the cooperative. Realising seed availability and viability problem in the past, farmers group started conceptualizing seed bank. Initially the groups started contributing monthly saving within the group for internal lending. The membership criteria of the group are: The person should have been a land owner of 1 to 5 acre of land. He/she can save Rs 50/- per month in the group.

Since there was already having base from APDAI project and responsible group leaders came forward to have the collective action on agricultural issues. A resolution was made in cooperative for the formation of Seed bank after so many meetings and discussion regarding agricultural issue in the mandal. It was resolved in the meeting that there will not be any free provision of services. It took one year because of the condition of not availing any service freely, but later due to the initiatives of 3 to 4 resource persons from the villages who regularly talk with the farmers in groups and able to convince about the benefits of Seed bank programme. The selection of these group leaders was crucial for the mobilization of people for the Seed bank programme. Hence, 48 farmers' groups from 14 villages of the cooperative used to arrange meeting every month and discuss about the issues regarding seed. It was evolved from the discussion to set up a Seed bank by the cooperative for addressing the issues on seed. There was discussion of contribution from the groups in the form of share capital for the initial fund mobilization. Three clusters are identified for Seed bank namely; Timmareddipalli, Chellapur, Kowded. In order to qualify for seed bank, the group has to deposit Rs 3000/- share capital with the farmers' cooperative. The members have to pay towards service as per the provision.

The village Timaredypalli has taken lead in establishing Seed bank in spite of having various developmental issues such as water scarcity for agriculture, drainage system in the village, sanitation, electricity and road on a priority basis. The major crops grown in the village



are red gram, green gram, jowar, paddy, ground nut in kharif season. However, the preference of ground nut cultivation in rabi season as it can be protected from wild boars by watch and ward mechanism by the villagers. Cotton crop is also growing in these area. The prominent problems faced in agriculture by the farmers are reduction in soil fertility, pest attack, increasing cost of cultivation by use of equipment's. Soil fertility has been intensive application of chemical fertilizers without knowing the need for soil minerals. Earlier the quality of harvested food was having good nutritive value as there was less use of chemical pesticides. The cost of cultivation has risen with more investment on use of equipment's. There was problem of getting quality seed. Seven years back they were using their own farm saved seeds. They faced a problem of storage for their own seed and government provision of new seeds to the farmers for better productivity led to leaving own seed conservation and increased dependency on government supplied seeds. The farmers are facing many problems on seed i.e., timely supply of government seeds, insufficient supply of seeds, and lower quality of seeds, especially K-6 variety of seed in ground nut. There was problem of getting seed subsidy in time. The seed price is more for the farmers, than selling price of own seed.

The office bearers were selected on the basis of following criteria. Two managers should be responsible person; they should be educated persons (read and write); they can motivate and negotiate with the farmers, able to motivate and resolve issues. They can collect the seed from the farmers through nagu system for the seed bank. Other three persons are representatives of cooperative.

The managers have to collect seed requirement data, submit proposal of seed requirement, purchasing seed with the 3 cooperative members, seed collection with quality check,, maintain seed quality at the seed bank, manage seed storage, seed germination test, distribution of seed and do the book keeping activities as per the requirements of Seed bank. Other three office bearers are nominated by the cooperative to build linkage with the cooperative for getting fund and other support for the seed bank and also simultaneously deal with timely purchase of quality seed, negotiate for sourcing foundation and breeder seeds, collection of seeds from the farmers and make arrangement for trainings regarding seed bank operation. The seed committee has the role and responsibility of supervising, monitoring and advising seed bank office bearers in addition to the involvement in operational aspects directly.

### **Membership Criteria:**

The person should be small and marginal farmer. He should be land owner. There should not be any dual membership. The person should not be corrupted and convicted. The person is willing to obey the resolution and terms and condition of the cooperatives.

Bye-Law Formulation: Exposure visit was made to similar initiatives that have already taken place. Discussion about the initiatives along with roles and responsibility of different members and office bearers of the organisation. Later cooperatives was registered under Mutually aided cooperative societies act of 1995.

### **Rules and Norms:**

Regular meeting will be conducted every month, The seed agreement is made by the Seed bank with the condition that after seed germination test, the responsibility goes to farmers, so that they have to pay back the required amount of seed as per the agreement. There is quality check by the seed bank while getting back the seed from the farmers. There is a norm that the seed producer farmers given breeder and foundation seed and they return the produced seed based on Nagu system. Remaining seed farmer can use accordingly.

### **Seed Procurement**

In the cooperative, there are different committees for different themes. The seed committee members in the cooperative deal with Seed issues. Seed requirement plan of the village will be prepared. Initially indents will be collected from the farmers within groups and placed in cooperative board meeting to procure seeds after taking stock of the situation. Accordingly, negotiations are made with different institutions for seed procurement. The seed committee members along with WASSAN staffs do the negotiation for the seed procurement. Seed bank manager along with a Seed bank cooperative representative and a cooperative service provider procure the seed. They check the seed about its purity, moisture content, and viability. Then they will distribute to the farmers and cultivate seed. Technical backstopping will be given by the department of Agriculture and WASSAN. Seed procurement from the member farmers was done as per the nagu system within 20 to 30 days of harvesting. In case, there is crop loss in one season, the farmers have to pay back seed through nagu system for the next season. Sometimes, different millets or pulses can be alternatively repaid.

### **Seed Production**

Breeder and foundation seeds procured are given to the seed producer farmers for the cultivation. Seed producer farmers are given training on seed production methods, crop management practices, etc. 25 farmers in groundnut and 50 farmers on paddy received training

from WASSAN on seed production management with the support of ATMA. Farmers do the roughing in the production management of crops from their field. 17 kathra farmers were chosen for 22 demo plots of 22 acre land. The selected farmers should have irrigation facilities in summer for the seed cultivation. The farmers got training regarding seed production methods including rouging. After the seed was purchased by rabi farmers, 20% of the cost is paid to farmers in advance and rest 80% paid at the time of selling to other farmers. Office bearers of Seed bank go to the kathra farmers for quality check. 30kg to 40kg packets are made sealed with label, with information about seed variety, quantity, name of the producer farmers and germination test findings. Seed bank managers collect seed from the farmer at the proportion of 1:1.5 with the existing nagu system. The rest of the seed are left with the producer farmer with the label and then cooperative will inform to the seed user farmers about the availability of seed from the producer farmers at the market rate.

### **Seed Distribution**

Initially, the foundation or breeder seed is distributed to the identified seed producer farmers. Seed bank distributes the seed procured from the seed producer farmers, and other sources as per the indent of seed requirement. While, in the distribution of seed, the previous record of the farmer in fulfilling the condition of regular saving in the groups and returning the seed in time as per the agreement is referred. The seed is distributed in time before the sowing season for both kharif and rabi crops. The Seed bank maintains the record on availability of seeds with the member farmers for selling. The Seed bank has the distribution register specifying details of seed distribution through the Seed bank. Group discussion about seed demand and expected seed demand as per the seasonal climatic condition of the area and accordingly seed distribution is made.

Seed distribution is made with the condition of repayment as per Nagu system for different crops listed below **Nagu System.**

**Table: 1**

<b>Sl. No.</b>	<b>Crops</b>	<b>Proportion of Repayment</b>
1	Paddy	1:1.5 (one bag of paddy farmer has to give 1.5 bags)
2	Groundnut	1:1.5
3	Redgram	1:2
4	Green gram	1:2
5	Cowpea	1:2
6	Jowar	1:2

7	Millets	1:2
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In every three year, there is seed replacement mechanism by the seed bank.

### Seed Storage

A building has been hired for Seed bank at Rs 300 per month in Timmareddipalli village. The seed is stored in the Seed bank in the gunny bags. The managers have to look after the maintenance of the seed. In every 15 days, the bags are to be put in sun light to protect from pest attack. Excess seed will be stored with producer farmer.

**Seed treatment** is done by the farmers when they use seed. Last year, there was treatment of green gram and red gram seed with Trichoderma.

**Seed Quality Test:** Seed bank has to do quality check at the time of seed procurement from outside sources where there is no labelling. The seed bank has to do germination test while distributing its own seed. There is group discussion among the farmers about seed maintenance. Seed bank has following equipment's with support from RRA-CP project and want to have some more equipment's for its management:

**Table 2**

Sl. No.	Stocks of Equipment's	Requirement of Equipment's for Seed Bank
1	Weighing machine	Electronic weighing machine
2	Gunny bags	Gunny bags
3	Separator	Tarpoline
4	Plastic tray	Seed treatment drums
5	Jalleda (telugu) (sieve)	Stitching machine
6	Chata (telugu) (winnow)	Display board for stock and distribution register
7	Thread	Small packing bags of 1 to 5 kg weight

The seed bank maintains following registers:

- Stock register
- Minute register
- Agreements

- Seed requirement formats for survey
- Monthly seed stock details report
- Distribution register

### **Capacity Building Programme**

There was continuous capacity building on seed production was given. The seed growers were trained in basic seed production techniques, seed selection technique, seed health management and seed storage management. The seed bank managers underwent training on business skills, record keeping and group dynamics and leadership skills, etc..

### **Administration Costs of Seed Bank**

Out of total profit of Seed bank in terms of seed, 25% is given to two managers of Seed bank; 25% is given to seed collectors. Rest 50% of the profit in terms of seed is kept in the Seed bank owned by the cooperative. The Seed bank managers can spend below Rs. 500 for the operation of Seed bank and in case of requirement of more money the manager has to take approval from the cooperative.

After 3 years, the corpus of the cooperative is Rs. 4.00 lakh and availed most of the benefits from government schemes. Now the cooperative is able to get timely seed in advance from the government which was delayed earlier. The cooperative got fertilizer license with 40 metric ton of fertilizer purchased and sold within the group members.

As a plan of this year, 150 quintals seed to be given 22 farmers and 50 metric ton of fertilizer demand for the kharif crops. In its future plan, the Seed bank has to produce sufficient seed for meeting the seed demand with more seed stocks available in the bank. The Seed bank has to make arrangement for seed certification and start seed business in paddy and groundnuts to meet local seed requirements.

The Seed bank need at least 2 years hand holding support in seed certification process, continuous support of GO/ NGOs for proposal making and building linkages with various agencies is required. The Seed bank needs regular government support with seed outlet and procuring extra from the Seed bank. The Seed bank managers need regular market information regarding prices of seeds, training on storage, pest management, seed maintenance, management, with future seed demand estimation, training on book keeping, facilitation and problem solving skills, etc.

## **CONCLUSIONS**

Finally, farmers expressed that timely availability of seed, timely sowing, good quality seed and good liaising with government departments for the farmers through seed bank. There would be proper planning with the seasonality aspect of crops in mind. A good linkage between seed producers and seed users was established. Price reduction of seeds was made for the accessibility of all the farmers. Strengthening farmers' organizations is crucial for sustainable agriculture.

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**Source:** Paper Published by B. RENUKA RANI, V. P. SHARMA & BHAGYALAXMI

## 6. Millets under Rainfed Agriculture

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### Introduction

The conscious pursuit of an agricultural policy since the 1960s to meet national food security with paddy and wheat has led to a decline in millet production and consumption. Also, crop patterns have changed in a big way due to unfavourable climatic conditions, market opportunities and the cost of inputs. Rather than cultivate for self-consumption, farmers lean heavily towards market-oriented agriculture to meet the heavy input cost and to keep pace with the market economy. The high yielding varieties of various crops and market opportunities associated with them have forced farmers, especially small and marginal farmers who were the main producers of millets for local consumption, to give up cultivation of millets.

Besides reducing crop diversity, this shift has caused nutritional imbalances, persistent food insecurity and hunger in rainfed areas. Compared to other crops, millets need less water, are drought resistant, provide a healthy and nutritious food. But the reality is that millets have begun to disappear from the modern agriculture scenario. Millet cultivation declined from 37.5 m ha in 1970 to 19.8 m ha in 2008. Millets need to be brought back into local production and consumption, at least in areas where they have been traditionally grown. There was a tremendous demand for the sorghum products in the local market because so many varieties of food made from sorghum were new to the area and the items were tasty.

### CASE STUDY:

#### **The Role of Millets in Climate Risk Reduction: Evidence from Anantapur, Andhra Pradesh**

##### **Introduction**

Amidst a growing concern about the threats posed by climate change for rural livelihoods, scholars and policy makers have given increasing attention to the need for more climate-secure agriculture (Wheeler and von Braun 2013, Davidson, 2016). This is a notable departure from the past. In countries such as India, dominant development agendas have focused largely on maximizing productivity through high input intensification (Pingali 2012). While these trends have certainly improved productivity at the aggregate, growing dependence on scarce water resources has simultaneously brought new patterns of exposure to climate risk while also accelerating groundwater depletion in many regions (O'Brien et al. 2004, Rodell et al.

2009). More water efficient crops have been proposed as a focus of policy support, particularly in arid and semi-arid areas where water resources are scarce (Millet Network of India 2015).

Of course, all agricultural production is susceptible to various kinds of adverse climatic conditions. As a wide body of scholarship has documented, rural societies already have numerous strategies to confront climate risk (Mortimore and Adams 2001, Nyong et al. 2007, Kattumuri et al. 2015). Scholars have argued that it should be possible to identify strategies that effectively mitigate exposure to risk in order to develop a policy architecture that can encourage these strategies (Agrawal 2010, Osbarh et al. 2008). As we argue below, providing support for crops that are utilized by farmers for their capacity to confront climate challenges could provide an effective means to promote more climate secure livelihoods.

This paper aims to study the prospects and challenges of incorporating more drought-resistant crops into a regime of climate secure agriculture through a study of millets. Millets are a class of coarse grain cereals that are grown extensively in semi-arid tropics of Africa and Asia. They come in a number of varieties, including the commonly consumed finger millet, pearl millet, and sorghum as well as a number of other varieties often collectively referred to as minor millets such as kodo millet, foxtail millet, proso millet, little millet, barnyard millet, and others. (Names are myriad across different languages and regions in India. To avoid confusion, this paper will use the Standard English terms for each millet.)

To date, millets have largely been overlooked by agricultural policy, but have gained increasing attention among activists and non-governmental organizations working in India in recent years. Millets are drought-resistant and water efficient: they tend to withstand prolonged exposure to drought and their relative water needs are still far less than other cereals such as wheat and rice. It is no surprise, therefore, that millets are especially common in unirrigated tracts of land, where they make up approximately 35% of area under cereal production, as compared to approximately 3.5% of area under cereal production in irrigated lands (Agricultural Census 2010-2011). Millets are desirable for other reasons as well. They are nutritious when compared to rice and wheat, and they generally require few chemical inputs; thus, investments in production tend to be low. To the extent that millets are often grown in areas that have not benefitted from dominant agricultural growth trajectories, support for millets may also help to provide growth in areas struggling with high levels of poverty. Yet because they are lacking the broad array of price supports and subsidies that many other crops receive, millet production has seen a steady decline over the past several decades. To date, there is little scholarship on opportunities and challenges of encouraging millet cultivation as a means to build more climate secure livelihoods.





**Figure 1: Field of sorghum (*jowar*)**



**Figure 2: Pearl millet (*bajra*)**

This paper reports the findings from a short study of millet production in the Anantapur District of Andhra Pradesh, India. Anantapur is a very dry district which receives less than 600mm of rain on average, with a high degree of variability. It also has a history of production of a variety of millet varieties—especially sorghum, finger millet, pearl millet, and foxtail millet. It is also the site of extensive efforts by a variety of NGOs to promote millets in recent years. In October of 2015, we led a team of field assistants to conduct surveys and qualitative fieldwork on millet production within five panchayats (local village units) spread across three mandals (secondary-administrative units) of the district. Study sites were selected to vary according to socio-economic conditions, the distance from the nearest market center, and whether an NGO is active in the village. During the study, our team undertook detailed discussions with residents in the study villages about changes in agricultural production strategies over the past ten years, perceived risks associated with different crops, and changes in millet consumption patterns. Although the sample is small, our data nevertheless reflect some of the diversity of current millet production trends in the area.

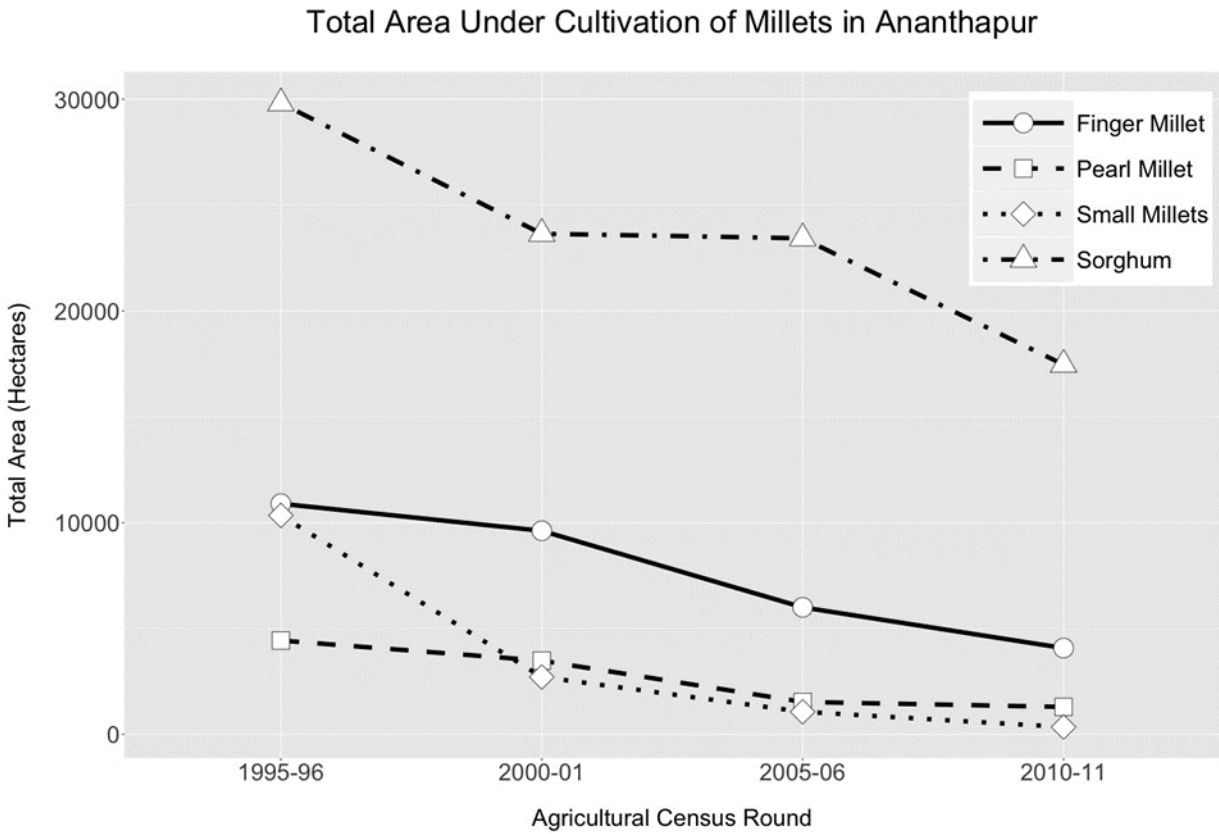
Millets, we found, play an important role in mitigating households' exposure to climate risk, both by diversifying production portfolios and as a contingency crop to confront delayed rains at planting time. Nonetheless, there remain important limitations in the viability of millets due to their low income-generating capacity. In the following sections, we discuss the role of millets in household production strategies in the area. In the discussion, we explore some of the

ways that structural changes in the millet economy could make them more viable in the coming years.

### Agricultural Change in Anantapur

The Anantapur District is situated in Southern part of India’s state Andhra Pradesh. One of the driest districts in all of the country, low rainfall and high variability is a significant constraint on agricultural production in the region. Historically, millets were an important staple crop due to their resilience in the face of drought.

There has been a general decline in area under millet production over the years (figure 3). Over the past several decades, state extension has given extensive support for high value crops, especially groundnut, which today is the dominant crop in the area. Additionally, the past two decades have seen growing investment in bore well construction, which has also made it possible to grow other water-intensive crops such as rice and vegetables. India’s *Public Distribution System* of subsidized wheat and rice seems also to have played a role in shifting focus away from subsistence production toward growing marketization.



**Figure 3: Changes in the area under cultivation of millets in Anantapur, 1995-2010. Data derived from India’s Agricultural Census.**

Table 1 provides a list of the crops that are grown in each of the study villages as well as the total land under millets, as estimated in focus group discussions with farmers. In each village, groundnut is the dominant crop. While a significant proportion of household income comes from agriculture, most households draw income from other sources as well, including wage labor, trade, various kinds of services, and seasonal migration.

Contrary to popular narratives of millet decline, we found that millets do remain an important focus of local production. However, while sorghum, pearl millet, and foxtail millet are common in rainfed tracts of the landscape, finger millet is generally not considered viable without at least some irrigation in the exceptionally dry landscape of Anantapur. The villages also reveal diversity in the relative investment and land devoted toward millet production. While several villages reported that area under millets had declined over the past decade, others estimated it had moderately increased for a variety of reasons, as we will soon discuss.

Each of the study villages have a strong market orientation. Almost all groundnut and other cash crops produced are sold in the market. However, farmers' marketing decisions for millets vary. Some farmers prefer to sell most or all of the millets they produce, however most retain a significant proportion (if not all) for personal consumption or fodder. Farmers sell their produce to traders that come directly to villages or transport them for sale in regional towns. Importantly, inputs are often purchased on the market as well, and many farmers also receive credit from agricultural shops or traders.

**Table 1: Summary of millet production in study villages**

	<b>Households</b>	<b>Total Land</b>	<b>Area under millets</b>	<b>Millets grown</b>	<b>Other crops grown</b>
<b>Gurrabbadu</b>	380 households	1800 acres	790 acres (approx.44%)	sorghum, foxtail millet, pearl millet	Groundnut, castor, green gram, red gram, vegetables, onion
<b>Malkapuram</b>	300 households	750 acres	180 acres (approx.24%)	primarily sorghum (limited pearl millet and foxtail millet)	Groundnut, red gram, green gram, horse gram, lobia, papaya, Mango, flowers, chili
<b>Masakavankapalli</b>	415 households	795 acres	75 acres (approx.9.5%)	sorghum, foxtail millet, pearl millet, little	Groundnut, red gram, horse gram, green gram, paddy, flowers

				millet	
<b>Tallakaluva</b>	130 households	640 acres	24 acres (approx. 3.8%)	sorghum, foxtail millet, finger millet, pearl millet, sorghum	groundnut, red gram, horse gram, paddy
<b>Vannedoddi</b>	330 households	1500 acres	150 acres (approx.10%)	foxtail millet, pearl millet, sorghum	groundnut, red gram, green gram, castor, cotton
<b>Vasanthapuram</b>	400 households	2040 acres	320 acres (approx.16%)	foxtail millet, pearl millet, sorghum	groundnut, horse gram, red gram, green gram, vegetables, castor, paddy

### **New Patterns of Vulnerability**

On the one hand, growing cash crop production has brought new income generating opportunities; some have even profited substantially. Yet basic living expenses have also grown, and majority of households struggle to get by. Poverty remains significant. Moreover, investment in seeds and inputs for cash crop production is also high, which can result in debt in bad production years.

Debt is also linked to climate stress, which farmers report has been especially acute in recent years. Our fieldwork coincided with the harvesting season of fall 2015, which was a drought year in Anantapur— and by all accounts, the most recent in a sequence of low rainfall years. For those without irrigation, the groundnut crop was of low quality, if it survived at all. Some farmers reported that traders have become increasingly reluctant to give credit due to uncertainty of returns. At the same time, growing investment in bore wells has brought forth a crisis of groundwater over-exploitation which appears to have worsened by these climate trends. Desperate farmers have often invested large sums of borrowed money in bore wells that are unviable long before investment is recovered.

In these conditions, existing growth trajectories are unsustainable and are threatening the very viability of rural livelihoods, which were already highly precarious. It is here that several prominent NGOs and activists working in the region have situated their efforts to revitalize the millet economy. Millets, it is hoped, would make farmers more resilient in the face of drought and mitigate the over-exploitation of groundwater resources. But to understand the potential role of millets as a basis for more secure livelihoods, we must first ask: how do millets fit within existing production practices?

### **The Changing Place of Millets in Society**

In fact, although farmers do continue to invest in millets (table 1), we found that few farmers view the production of millets to be a livelihood priority. To a large extent, the changing place of millets in rural livelihoods parallels the decline of subsistence production in the area. Millets were once a foundational crop of the subsistence economy. Today, even millets are sold on the market to a significant degree (see above), yet their income generating capacity remains limited. At the same time, expansion of entitlements for highly subsidized rice and wheat under India's Public Distribution System (PDS) has gradually substituted millets for these grains in local diets. Today, rice is by far the dominant cereal in household consumption practices.

The peripheral status of millets in society is not purely a matter of changing economic incentives. It is also inscribed in social dimensions of consumption and production (see also Finnis 2007). Most of the people we interviewed view millets as an inferior good: they are associated with poverty and, for many, a history of labor exploitation. Some lower caste households described how millets were once their primary source of food grains, derived from 'payment in kind' for labor provided to landlords. For others, millets evoke a time when most households had few income opportunities and poverty was severe. Even today, millets remain a marker of low status in the community. Several individuals told us that the act of growing millets, especially in prime land, would indicate that a farmer lacks the ability to invest in more lucrative crops. There is also a gendered component to the disfavor of some millets, especially minor millet varieties that require arduous hand processing. Women avoid cooking these varieties where possible, and few households consume them at present.

Although the consumption of millets has declined, they have certainly not disappeared. Major millets—finger millet, sorghum, and pearl millet (all of which can be processed in standard grinding machines) — do remain an important part of local diets. Older generations, we found, are often especially fond of millets, perhaps due to a lifetime of eating them. Even younger generations often view millets as a source of dietary variety. Many individuals we interviewed

indicated that they still consume millets at least several times in a month, while some consume them as much as several times in a week. We also found that NGO extension efforts to educate households about the nutritional benefits of millets elicited a favorable response; some household even reported increased household consumption as a result of these events. Among households that do continue to consume millets, some report substituting declining self-production by purchasing them on the market.

These findings suggest that there remains demand for the consumption of millets. It seems conceivable that more extensive investment in education efforts as well as greater local availability could stabilize or increase demand over time. Yet, the low market returns from millets still present a fundamental challenge to scaling up production. Repeatedly farmers told us that groundnut, above all, was their most important crop due to its potential to generate income—even despite its significant risk. The limited marketability of millets constrains production in other ways as well; to the extent that millets are viewed as a low profitability crop, there are few avenues to access credit. This can be an impediment for poorer farmers to invest in production, for example by purchasing seeds.

In a context of significant poverty and few economic options, investment in high value crops may be as much a result of opportunity as necessity. The ability to generate profits through the sale of high value crops provides the means to purchase food as well as satisfy a range of other needs. Indeed, farmers' prospects for a better life are intimately tied to the market and the ability it can provide to invest in education, health, and other consumer goods. Retreat into subsistence is not viewed as a viable option (see Louis 2014). Orientation toward the market underscores just how difficult it is for millets to be a genuine alternative to other more risky crops.

### **Climate Risk, Millets, and Livelihood Diversification**

If the broad trajectory of millets has been that of decline, this trend had been slightly reversed in the several years preceding our study. The land devoted to millet production had increased in several of our villages and several farmers even indicated that they have even been growing them in more fertile lands in recent years. This resurgence seems to have been driven by several factors, including NGO support and changing terms of marketability (see below). But the most significant driver of increasing millet production seems to be growing water stress, experienced through the combined effects of drying bore wells and erratic rain in conjunction with several years' low rainfall conditions.

The resurgent interest in millets is rooted in their favorability as a strategy to mitigate exposure to climate risk. Of course, millets are a diverse group of species, and not all have the same risk mitigation properties. As noted above, finger millet, is generally not viewed as viable without some irrigation in Anantapur; the single village in our study that cultivated finger millet 10 years ago has since abandoned production due to heightened water stress.

Nevertheless, sorghum, pearl millet, and foxtail millet remain prominent in rainfed tracts. These millets, we found, serve several important functions for mitigating climate risk. To begin with, these millets are widely used as a contingency crop when conditions are unfavorable for groundnut. Farmers report that groundnut is particularly susceptible to loss and damage when rains fail at the beginning of the season. Farmers thus wait for rains to arrive before planting, however the relatively long growing season of groundnut means that they cannot be planted too late in the season. Millets, in contrast, have a much shorter growing season and can be planted far later and still be harvested at an appropriate time in the fall. Farmers thus employ a sequencing strategy to cope with variable rainfall at the start of the season. Most farmers make arrangement to plant groundnut, but if the rains do not arrive within the planting window they can usually return seeds to suppliers (at a partial loss) and plant millets—especially pearl millet and sorghum—thereafter. In the direst of circumstances, should the window for millets also pass, horse gram is often grown as a last resort. The role of millets as a contingency crop is likely the largest reason why millets have seen an increase over the past several years of water stress.

Millets are grown for other reasons as well. They are relatively common as an intercrop. This enables farmers to partially invest in production of more lucrative crops such as groundnut, while also hedging their bets against the risk of losing the main crop. Other farmers told us that they had been using millets as a border crop as a strategy to control pests. Millets are also common in less fertile lands. Maintaining diversity across the landscape also helps farmers to mitigate against the risk of agriculture loss from a single crop; moreover, since millets require limited investment and inputs, they offer a low-risk option for increasing production in tracts that are believed to be less productive in the first place.

Even if millets are not a primary livelihood strategy, they may still provide extra income to households at the margin. But millets also still serve as an important subsistence crop as well. India's Public Distribution System (PDS) has done much to improve basic food security, but entitlements under the PDS are not sufficient to satisfy all food needs. Thus, whether sold on the

market or consumed, additional production of millets may still provide valuable additional complements to a broader set of production practices.

Finally, millets, and pearl millet in particular, are a valuable source of fodder. While not all farmers invest substantially in livestock (which often require significant financial capital, sustained access to fodder, and ongoing investments of labor), they are a very important source of income for many households. As one farmer described to us, the economic benefit of keeping livestock far exceeds the returns that he would get from agriculture; as such, he saw the production of millets for fodder to be far more desirable—and less risky—than investing heavily in cash crops.

### **Livelihoods Diversity, State Support, and Structural Vulnerability**

As a large body of literature has shown, rural livelihoods are diverse, calibrated to mitigate risks on multiple dimensions (Ellis 2000, Agrawal 2010). This diversity suggests that, in most contexts, there is no silver bullet strategy to confront climate challenges, but a need to provide support for a range of options that may be viable as a part of broader livelihood portfolios (Fischer and Chhatre 2016). In other words, risk is contingent and contextual, and reducing risk is often far more complicated than substituting one crop for another. The evidence above underscores the importance of considering how crops that have been viewed by practitioner communities as avenues for greater climate security influence farmers' actual ability to confront risk across a broader range of production practices.

At the evidence above suggests, millets serve as an important means to cope with variable rainfall. They are also an important vehicle of diversity—in terms of different crops grown, across livelihood categories (agriculture and livestock), and between market-oriented and subsistence production. Millets are not the sole driver of this diversity—farmers cultivate a variety of other crops and engage in a range of other income generating activities—but millets fulfill several niches in production practices that contribute to the overall security of farmers' broader livelihood portfolios.

Yet, it is important to note that there are limits in the ability of millets to support more climate secure livelihoods. Although millets are regularly grown in rainfed areas, water still remains an important determinant of productivity. Even if they are more drought resistant, many farmers still grow them with irrigation where possible. Moreover—as farmers made very clear to us—in the event of a severe water shortage, all crops would inevitably suffer a loss, millets included.



Indeed, focusing on how millets factors into broader livelihood portfolios also reveals how insufficient millets are—in and of themselves—for building more climate secure agricultural systems in the present context. While it is well known that markets can induce significant precariousness in rural livelihoods, which may likewise exacerbate other forms of climate risk (O'Brien et al. 2004), markets are also an important means to cope with poverty. Today, markets are the means by which farmers in Anantapur perceive their best chances for improving their living conditions and that of their children.

Indeed, farmers' continuing reliance on groundnut, even in the face of significant risk, underscores just how limited many farmers' livelihood options are. To choose between little income and drought resistance on the one hand, and high income and significant risk on the other, seems an impossible choice to bear. Even as millets have served as a means to cope with climate stress, increasing area under cultivation does not constitute more secure livelihoods; it seems to reflect a declining range of opportunities and, most likely, further despair. These are the conditions of structural vulnerability, which are deeper than specific instances of climate risk, that households in Anantapur face (Ribot 2010).

### **State Support and Prospects for Changes in the Millet Economy**

One of the most important lessons that we can learn from the case of millets is that individual crops—and any adaptation strategy for that matter—cannot be expected to achieve significant gains unless they align with the constraints of the broader production context. As the case material above reveals, millets do provide an important means to mitigate climate risk, but in the absence of better price returns and public support, their ability to serve as a cornerstone for a more climate secure regime of agriculture remains limited. Nonetheless, there are two factors that, over the long term, may generate significant changes in millets' marketability.

First, there has been a growing demand for millets in urban areas in recent years as the growing middle class has rediscovered millets—now increasingly recognized as a valuable 'heritage' food as well as a health food (Dittrich 2009). As a result, they are becoming increasingly popular in niche health food stores and even more common pharmacies and supermarkets. A handful of small-scale entrepreneurs in Anantapur have sought to capitalize upon these opportunities by developing facilities to process and package millets while cultivating relationships with suppliers to health food stores in cities such as Bangalore, Hyderabad, and Mumbai. While it may take time for the consolidation of new market linkages in urban areas (and for farmers to gain trust through proven market returns), there appears to be

potential for growth. One well-established trader told us that he is unable to acquire enough millets to supply his growing urban market connections.

The state could play an important role in reshaping the millet economy as well. While the existing Public Distribution System (PDS) has long provided highly-subsidized access to rice and wheat, civil society actors successfully lobbied for the expansion of entitlements to include millets and other coarse grain cereals in the PDS under the National Food Security Act (2013). However, except for a handful of pilot initiatives, no state has yet to implement this provision on a large scale. The biggest challenge, it seems, is that operationalizing this entitlement would require designing a new system to procure millets from the areas that they are grown, which are geographically distinct from areas for wheat and rice procurement. This challenge is compounded by uncertainty about whether there would be sufficient interest in millet consumption. In our study, we encountered many households with a high level of enthusiasm for millet consumption if they were included in the PDS. While procurement may still be a challenge, we see this as an opportunity to stimulate growth in millet production in areas most in need—places like Anantapur.

Growing markets for government procurement and associated price supports would help incentivize production, perhaps even as a substitute for groundnut. At the time of writing, the Andhra Pradesh state government is planning to operationalize a pilot project in Anantapur, which would provide the opportunity to study the feasibility of scaling up production across a larger geographic territory for the PDS. Should it work, it could provide a novel institutional innovation that pushes existing efforts to promote food security toward a more expansive regime of support for climate secure agriculture.

But even if growing marketing opportunities do make millets more viable over the long term, a range of other support mechanisms would still be needed. Many of the farmers we interviewed report that receiving millet seeds distributed by NGOs and the Agriculture Department was very beneficial; those that did not have access (or were perhaps unaware of these opportunities) indicated that the expense of procuring quality seeds was a major impediment for millet production. In addition, mechanisms to access credit, crop insurance, and other forms of assistance that have long been given to other high value crops should be extended to millets. Such strategic investments in the production of more drought resistant crops could serve to incentivize more climate secure agriculture over the long term.

## **Conclusion**

There is a need to restructure public policy to promote more climate secure agriculture. Encouraging the production of crops that are resistant to climate risks can play an important role in advancing these objectives. Millets may be particularly important, especially in semi-arid regions of South Asia and Africa. However, the above account also shows that, to assess the benefits that may be accrued to livelihoods, it is necessary to understand how new crops will be incorporated within existing livelihood portfolios and the ways that they may serve to mitigate risk across a broader range of production practices. Finally, our study shows the need to undertake broader structural changes in the conditions that make crops such as millets viable, and indeed desirable, if they are to provide more significant long term gains.

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## **7. Importance of Inland Fisheries Promotion for Sustainable Livelihoods in Rainfed Regions of India.**

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Fisheries sector occupies a very important place in the socio- economic development of the country. It has been recognized as a powerful income and employment generator as it stimulates growth of a number of subsidiary industries, and is a source of cheap and nutritious food besides being a foreign exchange earner. Most importantly, it is the source of livelihood for a large section of economically backward population of the country.

According to estimates of the Central Statistical Organization (CSO), the value of output from livestock and fisheries sectors together at current prices was about Rs.2, 82,779 crore during 2007- 08 (Rs.2, 40,601 crore for livestock sector and Rs.42, 178 crore for fisheries) which is about 31.6 per cent of the value of the output of Rs.8, 94,420 crore from Agriculture & allied Sector. The contribution of these sectors in the total GDP during 2007-08 was 5.21 %.( DAHD, 2009). India is now the third largest producer of fish and the second largest producer of fresh water fish in the world. Fish production has increased from 4.16 million tonnes (2.45 million tonnes for marine and 1.71 million tonnes for inland fisheries) in 1991- 92 to 7.12 million tonnes (2.92 million tonnes for marine and 4.20 million tones for inland fisheries) in 2007-08. Fish production during the year 2008-09 was 76.2 lakh tonnes comprising 29.8 lakh tonnes of marine fish and 46.4 lakh tonnes of inland fish. Fisheries sector contributes significantly to the national economy while providing livelihood to approximately 14.49 million people in the country.

India is known for its inland fishery resources and once with rich indigenous fishery resources with great biodiversity. The poor inland fishers and rural community depended 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. Lakes and derelict waters (0.79 million ha), offering tremendous scope for fish production.(DAHD&F, Ministry of agriculture Govt. of India, 2009). The capture fisheries in the rivers, lakes, channels, flood plain water bodies, tanks and ponds, were always the rural livelihoods and food security base. The developments in composite fish culture in the past few decades shifted the importance to producing Indian major carps and selected exotic carps. Simultaneously the degradation of different water bodies due to various reasons had affected the biodiversity, the quality and quantity of fish obtained from the water bodies. But the overall inland fish production now highly dependent on aquaculture of Indian

major carps. Carps constitute 87% of the inland aquaculture production. Fish seed production during 2007-08 was 24143.57 million fry.

Even if we look at contribution of fishery in revenue generation in smaller states, data suggest fishery has wide potential in rainfed agriculture system. E.g. in Jharkhand state in 2008-09 Rs. 960.00 lakhs revenue is collected from all sources.

### **Fishery statistics doesn't count local breeds:**

This invisibility in statistics could account for their poor recognition in fisheries and aquaculture development policies. Considering the extent to which small indigenous species of freshwater fish play a role in providing nutrition to the rural poor and in maintaining biodiversity, it is important to consider promoting sustainable use of small indigenous species in both capture and culture fishery systems.

Significant production of small indigenous fish species of freshwater origin, from culture and capture fisheries, is reported from several water bodies. That these species tend to sold and consumed locally could be one of the reasons why they remain invisible in national statistics—such statistics are largely based on catches reported at large/major landing centres (Halwart, 2008; Roos, 2007).

Though the Indian major carps and other exotic carps would have gone up in production and found its way to distant markets, the indigenous variety remained the income source of traditional fishers in the rural area mainly catering to subsistence, or local markets. In Bundelkand area of Madhya Pradesh, when fish is harvested from the village tanks, the smaller fishes are taken by the women of the traditional community, Dhimar to sell it in the local markets after slightly roasting it (Mathur and Pacholi, 2006). Another study done by Neena Koshy (2009) in Orissa with selected fish farmers show that many farmers prefer to culture indigenous species such as mola with the major carps realising its medicinal and nutritional value, local preference for domestic consumption and local market demand, often harvested by family members themselves. The other supporting factors are local preference, local availability, self-recruitment, low cost maintenance and high market preference. The best example of the degradation of the indigenous species can be found in Kolleru lake area in Andhra Pradesh where the lake encroachment and pollution has eliminated most of the indigenous species and the lake itself. Within the tanks, which follow intensive carp culture there is very little scope for

any other species. The capture fisheries in the lake and the livelihoods based on them have all but collapsed. About 18 species of fish are said to have been disappeared from the lake (Muralidharan, 2003).

It is, however, important to locate these efforts within specific cultural and socioeconomic contexts, looking also at critical issues of ownership and access rights over water bodies, and to formulate relevant strategies, as appropriate. If such factors are taken into consideration, the objectives of nutritional security, promotion of employment and conservation of biodiversity can be better met especially in some of the most disadvantaged areas of rainfed agriculture area, showing poor human development indicators. While there has been considerable Institutional financing of activities in marine fisheries and fish processing over the last four decades, that in inland fisheries and aquaculture has been largely through middlemen, merchants and traditional money lenders. This is also a major concern for achieving the projected growth rates. Enhancement of credit flow is the need of the hour. For this purpose, suitable mechanisms need to be developed. For example, most fishers and aqua-farmers cannot provide security in terms of land/water holdings and several banks do not have the requisite manpower to evaluate the proposals. There is need to throw light on sustainable use of small indigenous fish species, their role in food security, employment, income, poverty alleviation and conservation of biodiversity.

### **State policy looks fishery only as source of revenue:**

Fishery is a State subject and as such the primary responsibility for development rests with the State Governments. The major thrust in fisheries development has been focused on optimizing production and productivity, augmenting export of fishery products, generating employment and improving welfare of fishermen and their socio-economic status. In Indian context fishery is considered as state subject and most of the central assistance is provided towards marine fishery and for managing central institutes. Even the subsidy portion towards inland fishery has sharing of 75% from center and 25% from state govt. but even the central assistance part is very minimal that doesn't fulfill needs of this sector. E.g. the DAHD, India govt has released sum of Rs.12.84 crore during the financial year 2007-08 and Rs.13.60 crore during 2008-09 to the various states and UTs for achieving the target of covering 40,000 ha water area under fish culture & training of 27,000 fish farmers.

In the year 2007-08, Rs.86.45 crore was provided for various research and central institutes like CIFNET, CICEF, NIFPHATT, FSI, NFDB, Rs.41.49 crore for marine fishery whereas

only 12.84 crore was earmarked for inland fishery sector. the situation doesn't look healthy if we look at state level budgetary allocations. Jharkahnd state has utilized only Rs.4.19 crore against budget outlay of 22 crore by the end of Nov.2009 in Andhra Pradesh (which ranks first in fish production and revenue generation), The Fisheries sector has contributed 2.31% to the Gross State Domestic Product during year 2008-09. But, program towards development of inland fishery and aquaculture has Budget Estimate of Rs.85.00 Lakhs for Year 2009-10, that Rs 75.00 Lakhs as Central Share and Rs10.00 Lakhs as State Share. The inland fishery development program at state level is mostly dependent on central share. Nearly all the state looks at fishery sector as source of revenue but investment and subsidy for the fish farming is not promoted as policy directives.

Madhya Pradesh Govt. has enacted fishery policy in year 2008 that incorporates subsidy and support to fish farmer and fishery was given equal status as agriculture. But the field level implementation of policy statement is again a question mark. Because, central assistance is not sufficient to meet out needs of fish farmers.

#### **Access to production system and resources:**

The fisheries being a state subject in India, the most relevant policies are the respective inland fisheries acts or leasing and licensing policies of water bodies. The origin of all the acts have the base in the historical Indian Fisheries Act 1897 which proposes the states for prohibiting destructive fishing by use of dynamite or poison. Further the state can prohibit or regulate fishing by certain fixed gears or the size or type of nets to be used, construction of weir etc. It also gives authority to Governments to close a particular area of the water body or a particular season for fishing. These regulations help in the conservation of fishes and their habitats. Licensing and leasing rules for inland water bodies for capture and culture forms the core area of most in land fisheries policies. The Tamil Nadu Inland Fisheries lease and licensing rule 1972 frames separate regulations for each major river, reservoir and tank. In most other states it's only specified for different types or size of water bodies.

Most state policies gives first priority to fishermen cooperatives for lease and licence. Unfortunately many of the so-called cooperatives are defunct. For example in Assam there is reported to be about 200 registered cooperatives of which 7 are operational (Upare, 2007). In most of the states, in the absence of the capable fisher cooperatives, the water bodies get leased out to others, more on commercial lines. This alienates the water resources and fisheries

from the local community especially the traditional fishers.

The now well-known intensive fish culture practices in and around the famous Kolleru lake in Andhra Pradesh is the best example of how the local communities get gradually alienated from the local resources. Not capable of investing in aquaculture, the locals started leasing out the area to entrepreneurs from outside. Now the outsiders take up the entire aquaculture operation and the locals live on the annual lease amount. The encroachments of the tanks to the lakebed and the pollution had cut off the any limited access of the local fishers had to the indigenous species.

The West Bengal leasing policy looks into the financial capacity of the fisher cooperatives before leasing out. Though important to ensure economic utilisation of the water body for fish culture, the fisher cooperatives loss an opportunity to get access for want of financial resources.

May be the recent Inland Fisheries policy (2008) of Madhya Pradesh is unique in that the first preference is given to traditional fishing communities followed by scheduled tribes, scheduled caste, and backward class. It has also come out clear definition for fishers. The MP policy allocates ponds 1 -1000ha to registered fisher cooperatives or groups, which will get registered soon. They insist on 33% women members in new fisher cooperatives formed.

The lease amount could be another hindrance for local fishers to go for lease. The MP policy had made the lease amounts very reasonable and made constant for 10-year lease period. In licences issued for fishing in reservoirs in Tamil Nadu, fishers are to share the catch of bigger fishes between fishers and government in 1:2 ratio while it is 1:1 for smaller fishes. This gives a better share of SIS to fishers involved.

### **Increasing production and productivity**

The development plan of different states gives top priority for increasing production and productivity from culture fisheries and stocking in reservoirs, beels and other water bodies by supplementary stocking. Though not specified in each case the Indian major carps and the 3 exotic carps are preferred. There is very little mention of conserving and enhancing other indigenous species. But none of the policy recommends to look at inland fishery sector from point of socio economic and environmental development of local community members. That is why, the input and investment by govt. is not been taken up properly. Even, the market facilitation and market development from inland fishery sector is directly controlled by middle



man and traders. The control entire value chain of fish market i.e., seed supply upto transportation and market consumption. None of the state govt or centre govt discusses how fish production system can be liberated from clutches of cooperative dept and

### **Is the policy working?**

The policy provisions are very old in most states and there has not been a comprehensive updating of the policy. There are positive elements that support conservation of indigenous species or socioeconomic justice scattered in different state policies though each specific state policies are not comprehensive enough. Most of the provisions in the policy are hardly enforced for want of community participation in management. The current policy and development plans give priority to increasing production and productivity and lesser importance to conserving the indigenous species and promoting the socio-economic benefits derived out of it. Fisheries and aquaculture are multi-stakeholder enterprises. Existing laws and regulations with regard to water, environment and natural resource management have high implications on the activities. Further, the country is also a signatory to several international agreements, mostly in marine fisheries. While fisheries is a State subject like agriculture, it is necessary to develop a broad framework for harmonising the various acts under which fisheries is administered. This would enable addressing international issues such as WTO matters on fisheries, Illegal Unregulated and Unreported fishing, quality control of fisheries products, land leasing, seed availability, monitoring of patterns of subsidy and related aspects. Also, the measures to deal with issues like minimum wages, long working hours, illiteracy, exposure to high risk without protection, etc. could be incorporated in the national level policy document.

### **Recommendations for comprehensive policy that protects resource base and resources in Rainfed area for promotion of fishery sector**

- Develop national inland fishery policy for resource sustenance and promotion of fishery related livelihood
- Update the Inland fishery policy of each state through a stake holder based approach.
- There is also scope for learning from each other state's policy. At present the legislations are ad hoc and piece meal. There is a need of a comprehensive policy.
- Shift priority to bringing more water resources under fish production with equal importance to indigenous species, from just increasing production and productivity of major carps and exotic carps. Emphasis should be given to ecosystem protection, biodiversity and above all socio economic benefit. Equal importance to be given to

capture, capture cum culture and culture fisheries.

- Research to look into promoting more multi species composite culture shifting from the 3 species or 6 species system to 10-16 species system as in China or Bangladesh and review the relevance of strict eradication of “weed” and predatory fishes. Maybe stocking of advanced fingerlings may take care of the problem to some extent. Importance of SIS in local food security and nutrition to be recognised and the concept promoted just not through the department of fisheries, but also through department s of health, women and child welfare.
- More research and extension work on small and indigenous species (SIS) culture and its role in nutrition livelihoods to be strengthened including its auto stocking possibility of hatchery production. As in the Madhya Pradesh policy, the traditional fishing communities and their Cooperatives to be given all priority for leasing and licensing in inland capture and Culture fisheries. Increase lease period of water bodies for culture to 10 years as in Madhya Pradesh so that the leaseholders feel more responsible to maintain the resources sustainably.
- Environmental flow requirement of all river systems to be worked out and the enact policy that ensure minimum environmental flow. The irrigation departments will have a major role to play in coordination with the departments of fisheries and environment.
- Measures to be taken to ensure to symmetrically collect and mange inland fish production data, including capture and culture of all species including SIS. This will help take better policy decisions.
- Genuine inland fisher cooperative societies to be promoted, strengthened and necessary financial support given for taking up culture and capture fisheries.
- Women role in inland fisheries and fish marketing to be recognized and to insist 33% membership of women in newly formed cooperatives.
- Create an enabling situation and promote fisheries co management in capture and capture cum culture fisheries.
- Increase budgetary allocation for inland fishery program, and fishery dept should be made independent of cooperative and other dept. periphery.
- Proper market development support, financial support and value chain development support needs to be provided.

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Source: Importance of Inland Fisheries Promotion for Sustainable Livelihoods in Rainfed Regions of India by Neelkanth Mishra December 2010

## 8. Livestock Production Systems

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There are very few studies planned exclusively to understand livestock production systems (even farming systems in general) of the underprivileged rural families. The livestock production systems of the underprivileged families are different from those of resource-rich farmers since they aim at optimizing use of the limited available resources (material and labour) and minimizing external inputs and avert risks, as against maximizing profit by the resource rich. Thus 'diversification and internalization' are the main features of their production systems. Based on the review of available reports and extensive observations, some shared characteristics of the livestock production systems of the rural underprivileged families are as follows:

### Features of livestock production systems

- ❖ Mixed farming system and diversified crop and livestock activities are common.
- ❖ Low external input–low output and highly internalized system making maximum use of available resources like crop residues, feed, labour, animal waste etc.
- ❖ Extensive grazing with limited supplementary feeding in semi-arid/arid areas and limited grazing/semi-stall feeding in other areas.
- ❖ Local breeds of livestock/poultry preferred over 'improved' stock as part of risk management, except in areas where there is organizational support.
- ❖ Traditional systems of livestock management and feeding are preferred and adoption of scientific recommendations or technologies is very low.
- ❖ Livestock output is low but represents major share of daily cash income to family.

Women play a major role in livestock production and sale of produce.

### Diversification

Crop–livestock production diversification is one way of optimizing outputs from limited land and reducing risks. Reports from some rainfed, semi-arid districts of central Rajasthan indicate that some farmers have as many as 27 crop and 7 livestock activities (milk, meat, wool/hair, eggs, animal sale, transport, and farm work). Diversification is more common in areas with erratic rainfall and frequent crop failures. Farmers from such areas, based on their innate wisdom, use a mix of crops (with different moisture requirements) and livestock so that subsistence is assured even if rains fail or disease occurs. Moreover, livestock production is less

severely affected by drought than crop production and it becomes the main source of income during years of poor rainfall.

### **Factors Influencing Production Systems**

Production systems are a result of the interplay between agro-ecology, stage of overall development of the area, farming situation, market demand, organizational support, resources of the farmers and social factors and thus systems appropriate for specific situations are adopted by farmers in general.

An important characteristic of the underprivileged families is 'preference for assured subsistence over risky productivity' and hence changes in production systems and adoption of technologies or improved animals are slow (till farmers are convinced that change is not risky and is beneficial). Some of the factors influencing livestock production systems adopted by the underprivileged families are discussed next to elucidate the points mentioned above.

- ❖ Agricultural and overall development of the area: In developed areas the livestock production systems of the underprivileged families are more productive than in other areas. For example, in tribal belt of Rajasthan, Gujarat and Maharashtra, the efforts of the district co-operative milk union and Bharatiya Agro Industries Foundation (BAIF, a major livestock NGO) have considerably improved dairy and crop production systems of thousands of tribal families, while tribal families from other parts of the country continue subsistence farming. Landless livestock owners have developed innovative systems to secure green fodder for their animals from farmers' fields as part of labour wages or in exchange for dung. Most animals (including goats) are stall-fed or grazed in a limited area or in harvested fields. Animal owners get organizational support and services, well established in these areas, (livestock services, processing and marketing of produce, credit etc.). Access to reliable input and output markets aided by the motivation from observing the results achieved by progressive farmers in these productive areas are the key to success.
- ❖ Agro-ecology and farming systems: There is large variation amongst livestock production systems between various regions of the country. For example in the Himalayan ranges, livestock production can be said to be forest-based, it being the main source of fodder (through grazing and cut and carry system). However, in the Indo-gangetic plains crop residues are the major source of fodder for livestock and majority of animals are stall-fed

or only partially grazed and there is hardly any migration. Another example of influence of agro-ecology on farming systems is the variation observed in livestock production systems, predominant animal types, cropping pattern and dominant social groups by drawing a transect from North-west to South-east Rajasthan. One can see a shift from livestock of defined breeds to non-descript animals, from pastoralist dominated society to tribal dominated society and from dry farming to assured rainfall system. A similar relationship can be seen between agro-ecology, social structure and crop–livestock production in most other states. Studies from arid, semi-arid and mountain areas, that are ecologically fragile, sparsely populated and inaccessible to markets, show the need for an approach different from conventional approach. The holistic and resource-based 'niche approach' that considers farmers' needs is strongly recommended. Considering the variability that exists in the country, such studies are essential for the planning of development programmes suitable to the conditions prevailing in an area.

- ❖ Women in livestock production: The role of women in livestock production varies amongst underprivileged groups and between regions. In tribal communities, women play a major role in livestock production as well as in the sale of produce, while pastoral women are generally involved in looking after the new born and sick animals. Amongst most of the other backward communities, women have a greater role with small animals and backyard poultry, while men manage large animals. There is poor awareness regarding ways of improving livestock productivity to improve livelihoods—a consequence of weak public extension support for livestock. There is need to strengthen extension and it is crucial that women's involvement in livestock research and development (R&D) is promoted.

**Within this context of livestock production systems, three hypotheses are suggested:**

1. Under rainfed conditions diversified crop–livestock production systems in which livestock and crops 'niche well' together, are the best way to improve the livelihoods of the underprivileged on sustainable basis.
2. Improving the knowledge and skills of women about how improving the productivity of livestock and the greater involvement of women in livestock research and development would bring in a short time quantitative and qualitative improvements in the livestock production of the underprivileged and
3. More productive livestock production systems can be adopted by the underprivileged working in developed areas and wherever they have access to organizational support.

## **Impact Of Livestock Development Programmes**

Some economists clearly showed that agricultural and rural growth reduces poverty drastically while industrial growth has very little effect on poverty. Smallholder livestock production has a special role in this regard since the majority of the poor are involved in livestock production and it is labour intensive. Other factors favoring smallholder livestock development are sustained growth in demand for livestock products and low value of 'Gini Coefficient' (0.16 against 0.65 for crop production) indicating that income distribution through livestock is more equitable than from crops'

The experiences from livestock development programmes suggest three hypotheses:

1. Livestock development is most likely to be effective as 'a pathway out of poverty for underprivileged rural families' and enable them to compete with commercial producers provided:
  - a. Organizations planning and implementing livestock development programmes are sensitive towards the needs, resources, production systems and perceptions of the families;
  - b. Livestock development is a part of 'integrated development programme' that incorporates natural resource management and development of producers organizations to provide credit and services (backward and forward linkages) and help to improve efficiency and quality of livestock produce;
  - c. Technologies, recommendations and services are developed on the basis of 'needs assessment' and are pre-tested for being beneficial to the resource poor farmer;
  - d. Livestock extension is strengthened and targeted to the underprivileged families particularly the women.
2. Livestock production by resource-poor farmers can be more economic provided they have access to adequate techno-economic support; and
3. Integrated livestock development can improve all five 'capital assets' within the sustainable livelihoods framework.

## **Recommended Strategies**

It is proposed that inter-disciplinary and action-oriented livestock development programmes should be planned and carried out to improve the livelihoods of the underprivileged families in India should target the following:

- ❖ Livestock production systems of underprivileged communities in contrasting agro-ecozones in Central, Eastern and North-Eastern India with priority given to small-stock, specifically pigs, goats and backyard poultry;
- ❖ Research should address the livestock-livelihood issues of the different social groups of the underprivileged categories (as given by Government);
- ❖ Research should start by ensuring a shared understanding between the research-for-development teams and their clients—the underprivileged communities—of the preferences of the communities for specific types of livestock, their perceptions (particularly of the women) about the roles and functions of the livestock in livelihood strategies, and what, from their perspective, constitutes improvement;
- ❖ Subsequently action-oriented participatory research with individuals, households, communities and villages will identify, characterize and prioritize constraints and interventions for improved production and marketing; and
- ❖ Action plans should then be agreed and implemented based on the outcomes of the iterative interactions amongst the social groups and the technical teams regarding the ways to increase livestock productivity and profitability and to improve the non-market functions of livestock at household, community and village levels.

Obviously this approach will require a change in paradigm from the conventional reductionist, animal-level research to people-centred, participatory and holistic methods. It will be iterative research-for-development programme that is inter-disciplinary, multi-institutional and, ideally, multi-locational (for cross-site lesson learning).

It is recommended that the core research for development teams (with a minimum of two women members) will include animal production and health scientists, a sociologist, an anthropologist and an agricultural economist and that the team will draw on water, crop and soil scientists and human health specialists (as and when need arises). It is proposed that either the National Centre for Agricultural Economics and Policy Research (NCAP) or the Indian Veterinary Research Institute (IVRI) should act as the local coordinating agency and integrate into the iterative research-for-development process state agricultural universities, specialist research centres or NGOs (experienced in livestock development) from respective regions.

If these recommendations are accepted and acted upon, important outputs of the programme will be the strengthening of the capacities of the collaborating organizations to

undertake participatory, inter-disciplinary research in support of sustainable livestock-based development, with the concurrent strengthening of extension capacities and greater involvement of women.