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LEISA INDIA

Supplement to LEISA Newsletter

Desertification: The New Old Problem

Editorial

At the time of publishing this issue, several states in India are reeling under drought, especially, large areas in Gujarat, Rajasthan and Andhra Pradesh. More than 5 crore people have been affected by the drought. The Government, the voluntary organisations and people are taking some immediate steps to tackle the worsening situation. At the same time, there is an urgent need to look at the issues which led to the present situation, holistically, and evolve strategies for implementation to minimise the scale as well as the frequency of such situations in the future.

In this context, combating desertification assumes increased importance as an issue. Though the issue is recognised and being addressed at various levels ranging from international conventions to local initiatives, the need for a bottom up approach is increasingly recognised as the most appropriate approach for tackling the problem.

In this supplement, we have attempted to put together few experiences of people and institutions both at farm and community levels to tackle the problem.

Desertification is a land degradation process and it deals with the gradual conversion of productive land into less productive or unproductive ones. Thus, the problem is a continuous one. The presence or absence of a nearby desert has no direct relation to desertification. It is the excessive abuse of land in any patch or land under arid ecosystem which can initiate desertification process. (M Nagarajan, CAZRI).

Land degradation is a more acute problem faced by the farmers in the dryland regions, especially the small and marginal farmers. Soil erosion by runoff is the principal cause of land degradation particularly in the rainfed agro-eco regions of India. Consequences of land degradation could be more disastrous in arid and semi-arid areas where the ecosystem is very fragile. Rainfall being the only source of sustaining the entire production system, these areas chronically suffer from low food and fodder productivity due to poor, erratic and unevenly distributed rainfall. The process of land degradation is highly dynamic and complex at times. Unfortunately, more often than not, it goes unnoticed by the very people dwelling in such less-endowed areas which are already marginalised. The people are characterised by low literacy and awareness levels, poor socio-economic status and have low risk bearing ability (G Subba Reddy & others, CRIDA).

Water is an integral part of all facets of life. Water being a critical resource, next in importance only to air, it is essential to ensure that there is enough of it to meet the demand of people for drinking and household consumption, irrigation and other uses (National Water Policy, 1987). But scarcity and misuse of this life supporting resource poses a serious and growing threat to food security, human health and development (Pisani, 1995). The problem arising out of increasing and competing demands for water are becoming more and more acute in terms of availability, quality, management, data acquisition, laws, institutions and investments. More so, the serious aspect of the water crisis is the misconceptions about solutions now proposed (Frederiksen, 1996) (GCS Negi & V Joshi).

In the context of these twin realities, to protect the soil from further degradation and conserve and sustain water resources there have to be renewed efforts. Traditionally, while the policy directives are top down, the efforts to combat desertification begin at the lowest level - at the farm and community levels. The approaches to combat desertification have to be necessarily multipronged as well as should be based on participatory community approaches, shared ownership and shared concern for conservation. Ideally, the concern for conservation should be shared by all those who access the resources. Not only concern, it should evolve into a consensus approach leading to prevention of abuse of resources. Efforts to combat desertification have to begin with local participation and shared commitment (S K Pradhan)(G Ravi Kumar).

About 5 percent of the total agricultural land (80 lakh hectares) is dependent on surface irrigation. 10-15 percent of this land is under threat from salinization which is about 8 lakh hectares. The extent of desertification is also reflected in the areas identified as ecologically fragile zones including Himalayan and desert areas. About 212 districts have been identified for priority action.

Some of the other on-field indicators besides the scientific indicators, of the impending crisis are: Dying of older trees due to lack of enough capillary raise of water which indicates falling water tables in the area - for instance, if there is a need to irrigate mango trees and orchards, it is a sure indication of the alarming situation. Similarly, it is also reflected in the extensive growth of root

CONTENTS

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The Editors have taken every care to ensure that the contents of this Newsletter are as accurate as possible.
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structure and stunted canopies. The degree of land degradation can also be assessed from the increasing population of goats instead of sheep in the area. Because, sheep generally feed on more delicate fodder when compared to goats which can feed on vegetation with high lignin content. Thus, the environment provides enough signals regarding the impending desertification.

In the present scenario, to be able to improve the situation and prevent further deterioration, several experiences reflect that, while improving the vegetative cover is a must, water harvesting practices and improved water management practices are absolutely necessary.

Agroforestry is recognized as one of the efficient land use systems to control desertification. Agroforestry by virtue of its merit has already earned distinct identification of its own and so is commonly used nowadays. Agroforestry may simply be defined as an integrated self-sustaining land management system, which involves delicate introduction and retention of woody components including trees, shrubs, bamboos, palm, etc. with agricultural crops including pasture/livestock simultaneously or sequentially on the same unit of land meeting the ecological and socio-economic needs of the people. (Deb Roy, 1992; 1993) (M Nagarajan, CAZRI). In this context, the advantages of growing Prosopis Cineraria are shared from Rajasthan where some communities value the tree very highly. It offers a better microhabitat below its canopy and also its leaves enrich the nutrient hungry soils. At the farm level too, bund planting of Albizia, neem and teak, block plantation of teak and tamarind and intercropping of agriculture crops with forage crops are the recommended practices for drylands (K M Sivakumar, TNAU).

There is increased discussion on reviving traditional water harvesting systems and efforts to revive the old wisdom. (Book review). At the same time, NGOs with farmers have been introducing innovative ways of in-situ harvesting of rain water. (Dinabandhu Karmakar, Pradan)

Lack of awareness about the process of land degradation and inadequate technological interventions to manage it are the major bottle-necks for community mobilisation against land degradation. It is difficult to visualise the impact of the rain water on soils and it helps if one can precisely observe the effect in simulated conditions to understand the whole process. Rainfall simulator is one such tool that aids action learning process among village communities to understand the complex nature of runoff driven erosion of soil, the chief cause of land degradation. When the rainfall is simulated in real field conditions, farmers can witness the series of consequences of a rainfall event. The velocity of raindrops, their impact on soil particles, the resultant runoff that carries the quintessential soil along, can be observed by the farmers to appreciate the damage done to their agricultural fields in one single storm.
(G Subba Reddy & others)

It is not just enough to create awareness and community actions alone. It has to be reflected in the policies of the Government for the future. It is the vision and voice of the people from the grassROOTS while evolving policies which could truly reflect and address the local realities.

There are many institutions and organisations engaged in fighting desertification. There are also individuals like Premjibhai and Lavkumar Khachar who with their commitment and dedication and crusading spirit have made a remarkable difference in their own way in checking desertification. (The Green Old Man of India; Thorns Redefined). ■

Theme: Integrated Agriculture - Call for Papers

We invite Indian readers who are working on issues of integrated agriculture to contribute to the LEISA India Supplement. The theme is being addressed in the following context:

Farmers in dryland areas face several challenges: the vagaries of nature, fast depleting natural resources, lack of access to resources. Having taken up farming as a livelihood option, they need to grapple with food security and also generate income to sustain the family needs. In the context of increased expenditure and reduced income owing to unsustainable land and water use practices, the situation is more complex. Morever, there is a rapid decline in the vegetative cover and livestock population.

In this scenario too, there are many innovative farmers who believe and practice integrated agriculture. They closely monitor their farm requirements, either have or slowly built up the resources, the enterprise and the management skills to carry out integrated agriculture. They integrate various components of the farming system and manage them optimally in terms of nutrient balance, energy balance, etc., thus improving the sustainability of the farm. Some of them also integrate indigenous strategies including spiritual, social and cultural dimensions in integrated agriculture. There are several others who have integrated some of the components such as : agroforestry; integrated livestock maintenance; fish & ducks as components of paddy ecosystems; energy management including biogas plants, solar powered plants, etc.

For the September issue of the ILEIA Newsletter, we invite initiatives from the Government, academic and research institutions, NGOs and farmers in promoting integrated agriculture - the success stories, the problems and constraints involved in integrated agriculture.

If you know anyone who has done interesting work in this field or might be willing to write an article please let us know or pass on this call for articles. Articles should be about 800, 1700 or 2600 words long (1, 2 or 3 pages in the Newsletter) and should be accompanied, if possible, by illustrations and references. The article should reach us before 1st September, 2000. Articles will be examined for selection by the editorial team and they decide on the inclusion of the full article or selected texts duly acknowledged with the author's consent.

We welcome any information on training, learning opportunities, networks, journals, books, proceedings, reports and videos on LEISA with special emphasis on integrated agriculture.

Please respond to the following address:

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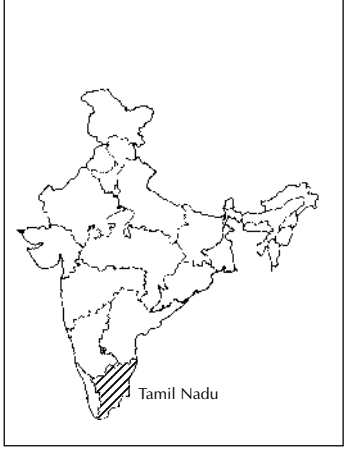
Networking for combating desertification - experiences from Tamil Nadu



G. Ravikumar

Discusses the experiences of ROOTS network in Tamil Nadu in addressing the issues of desertification control.

RIOD (Reseau International Dong sur la Desertification) is a global network of Non Governmental Organizations (NGOs) and Community Based Organizations (CBOs) working towards combating desertification. It was established in 1994 with the mandate of influencing the successful implementation of the UN Convention to Combat Desertification (CCD).The emphasis is to ensure participation of the stakeholders and the civil society in the struggle against desertification.

RIOD's chapter in Tamil Nadu is being promoted by the ROOTS Network. ROOTS is a network of 50 rural NGOs with activities aimed at the development of the Rural Agricultural Ecosystem — through community education, technical facilitation, information exchange and promotion of indigenous knowledge and practices among the small and marginal farmers of the state.

In 1996, the ROOTS network organized a consultation on ***"Environment and Drought Management"***, to explore possible ways to mitigate the effects of drought on the agricultural production system in the dryland regions of the state.The outcome of this consultation (Table 1) clearly indicated that the problems of dryland agriculture in Tamil Nadu are direct causes of the degradation of natural and the human resources of the area.

Thus the network initiated the efforts of combating desertification by forming community organisations. ROOTS has become a natural ally to RIOD when it was initated in the state in 1998.

Table 1 : Outcome of the consultation

Needs identified	Actions/strategies suggested
1. Soil and water conservation	1.Participatory planning / Joint action bndall stakeholders
2. Biomass production / sustainable use	2. Capacity building for direct action
3. Human resources development for direct field level action	3. Networking and sharing information
	4. Influencing policy decisions

The state of land which is unable to support the large number of cattle in a water shed.

The strategic decision implemented was that both the networks were promoted in such a way that each contributed to the other's activities and achievements by sharing knowledge, infrastructure and human resources.

The experiences in the past have been to adopt an integrated approach to developing and managing natural resources as well as human resources simultaneously. (Based on the recommendations of the 1996 consultation and further activity experiences).These experiences helped in evolving suitable strategies (Table 3). Some of the learnings are:

1. Membership promotion

The RIOD state chapter was promoted as an affiliated body of the national network.Though at first the membership was restricted only to NGOs, based on the needs in Tamil Nadu, the membership was opened (with a reduced rate of subscription) to farmers, individuals, CBOs and resource organizations so as to widen the participation platform.With these facilitating efforts ***(CCD Document, 1998*)*** the membership sharply rose to 210 in one year, to represent many stakeholder sections of the society (Table 2).

Table 2 : The membership pattern

Membership Details *	Number	% to Total
1. NGOs	55	26.2
2. CBOs	70	33.3
3. Farmers	60	28.6
4. Individuals	20	9.5
5. Resource Organizations	5	2.4

** as on Feb 2000*

Table 3 : RIOD T amil Nadu - Activities and experiences

Forms of degradation	Activities	Adaptations made	Contributing factor
I. Natural Resource 1. Deforestation 2. Soil erosion 3. Drought 4. Land alienation **II. Human Resource** 1. Loss of Indigenous knowledge systems 2. Lack of skills in present agricultural system 3. Lack of trained community facilitators	1. Promoting membership	1. Membership opened to farmers, CBOs and individuals 2. Subscription rate reduced for the above categories	Experience in promoting ROOTS network
	2. Decentralizing management	1. District level bodies promoted 2. 25% of total subscription was allowed for the district level use	Experience in promoting ROOTS network
	3. District level facilitation	Done by the state chapter and planned to build capacities of district bodies for the same in future	The learning obtained during the process implementation and the feedback from the members
	4. Networking for knowledge and information sharing	1. The knowledge sources of the ROOTS network were utilized 2. Creating internal resources was planned	ame.The impact of training to ROOTS partners influenced efforts, decisions and plans
	5. Capacity building in SA and watershed management	1. The knowledge sources of the ROOTS network were utilized 2. Creating internal resources was planned	ame.The impact of training to ROOTS partners influenced efforts, decisions and plans
	6. Preparing a policy guideline for activities	A concept summary prepared for an integrated WS management activity was modified and utilized	ame facilitated a training on "SA in a WS" and in the process the concept summary was prepared

2. Decentralizing management

The experience of promoting ROOTS network was very useful in the promotion of the structure. For example, decentralization of members at four zonal levels was tried in the network but was not successful. Based on this experience, the RIOD network was decentralized at the district level and this proved to be effective in delivering the objectives. District level bodies are now functional in 6 districts of Tamil Nadu.

Flexibility was adopted in sharing of the subscription collected from the members. 25 % of the subscription collected was used by the district bodies.

3. Networking for knowledge and information resources

The knowledge and information resources generated for the members of the ROOTS network was also fed to the planning/implementation of RIOD activities.

The networking with biomass actors was instrumental in capacity building of member NGOs and farmers. ame is one important actor who influenced the role and activities of RIOD,Tamil Nadu.

4. Capacity building and creating a team of trainers

The direct impact of a capacity building training facilitated for 12 ROOTS network members *on Sustainable Agriculture* (SA) *in a Watershed* (WS) created interest among the RIOD members. 7 of them were trained in Integrated Crop Management (ICM) with other ROOTS network trainees. Since ICM facilitates the management of all resources in agriculture (natural, human and social), it is seen as a tool to combat land degradation. Training of community facilitators in WS management and SA by utilizing the knowledge resources within the network is also planned.

Plans for the immediate future

The baseline work has been completed and the following tasks are planned for the current year. This plan was prepared for the state chapter as policy guidelines for members to implement desertification management activities.

1. Strengthen the structure from below (from hamlet levels) by facilitating the district bodies in the task.
2. Preparing a resource inventory for Tamil Nadu and facilitating the communities to prepare location specific action plans.
3. Creating vertical and horizontal linkages among all stakeholders.
4. Facilitating farmer based research and the outreach of the impact among higher level actors.
5. Translating available information (including the CCD) in Tamil for sharing with CBOs.
6. Building capacities of farmers and CBOs in need and situation specific action for combating desertification.
7. Promoting a cultural group to disseminate desertification information among rural audience.
8. Facilitating large scale afforestation for biomass production and promoting its sustainable use.

The promotion of the state chapter has been completed with contribution from various factors besides a committed team of volunteers working for it. This accomplishment could have taken more time but for the facilitating role played by an experienced network operating in the area.

References

CCD Document , 1998*, pp 9 Article 3 - Principles (clause b and c). Pub:The Secretariat for the Convention to Combat Desertification (CCD/98/2)

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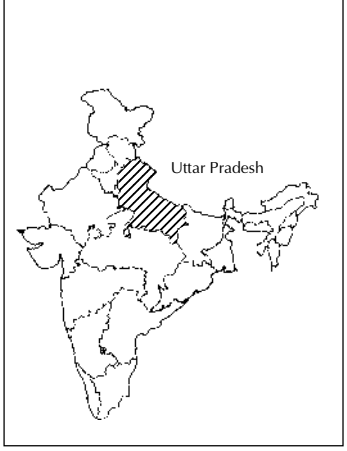
Mobilising communities for reclaiming sodic lands in Uttar Pradesh



S K Pradhan

Describes how local communities were motivated and organised to be actively involved in the implementation of the project.

Introduction

Community Participation is the term commonly used in the parlance of development today. The adoption of participatory approaches in contemporary mainstream development approaches is necessitated by the apparent failure of the normal development models. In the past, there was a vertical division of roles in development process between the development agencies and the beneficiaries. Development agencies were primarily responsible for planning, implementing and evaluating the development programs whereas the beneficiaries had only a marginal role in the process.

In the changing scenario, the communities are also being empowered with adequate knowledge and decision making that in the past were the prerogatives of the development agencies. Owing to the participatory development process these beneficiaries play a more decisive role. Participatory processes imply that organisations at local level are facilitated and sustained so that they have a say in the decisions that effect their own lives.

The agricultural sector has also realised that the major hindrances to people's involvement in agriculture development programmes are not always technical aspects alone but are most often related to management of resources. It is being increasingly acknowledged that skills such as community mobilization, conflict resolution and institutional building are essential in all development processes.

Sodic Land Reclamation

India has around 0.73% of the sodic lands around the world. The state of Uttar Pradesh in India has some 1.2 million ha. of sodic wastelands. Such areas account for 10% of the total cultivable area of the state and about 17% of the salt affected lands in the country.

Firmly believing in participatory approach, UPBSN has initiated the project with the formation of farmers' organisations at village level for men and women separately. The process included installation of minor irrigation infrastructure, building drainage network, chemical amendments of lands and crop/ horticulture production and training in leadership for the local communities.

Since 1993, UPBSN has been implementing World Bank funded "Uttar Pradesh Sodic Land Reclamation Project" in 10 districts of Uttar Pradesh. Seventy five percent of the beneficiaries are small and marginal farmers.

The first phase of the project aimed at reclaiming 68,800 ha. sodic affected lands owned by 2,20,000 families. The farming families and the local organisations are involved right from the beginning in the planning and later in implementing and evaluating the project.

The second phase began from 1st April, 1999 and will continue till the year 2001. During this period too, the project is implemented in the same 10 districts covering an area of 1,50,000 ha. owned by about 3,75,000 farm families.

The Process

Firstly, awareness campaigns were organised with the farmers by the UPBSN/NGO staff on the project objectives, the benefits of reclaiming sodic lands. This includes meetings, staying with farmers, informal consultations and focussed discussions. Once convinced, the farmers in the area got interested in organising themselves into small groups. While micro planning is done at the village level, Strategic Research and Extension Plan (SREP) is carried out with the involvement of NGOs and research inputs from State Agricultural Universities, at the district level.

At the village level, in each village, there is one Site Implementation Committee (SIC). Command area under one SIC varies from 50-125 ha. or more. Under each SIC, there are several Water User Groups (WUG). Small groups of 4-15 members within a land area of 4ha. organise themselves into Water User Groups. In each village, at least one Mitra Kisan (MK) and one Mahila Mitra Kisan (MMK) and animators in other fields like animal husbandry, health and literacy are organised to help farmers reduce their dependency on external agencies to help them on these aspects. All decisions on group formation, implementation, etc. are taken by the farmers. Farmers themselves develop their own constitution based on their traditional institutions.

Project funds towards land development, leaching, irrigation infrastructure and drainage are channelised through bank accounts of the groups. Similarly, SICs also maintain joint bank accounts for maintenance of drainage infrastructure of the village. Agricultural inputs like gypsum, fertilizers, seeds, etc. are also made available to them through the SIC only.

The contributions to SIC accounts in 10 districts have reached Rs. 15.38 lacs, of which utilization is about Rs. 9.62 lacs. This is besides the contribution of free labour for the maintenance of link drains.

As on date there are 16,450 village level organisations and 1061 SICs in 10 project districts. Savings and thrift groups have been in force in 6234 WUGs. The total savings of these groups are in the tune of Rs. 40.22 lacs. The inter loaning of these groups from their own savings is about Rs. 12.39 lacs. Further, the local banks have sanctioned an amount of Rs. 63.67 lacs to 1253 groups besides the individual crop loan, pumpset loan, credit card, etc.

Women members of participating farmers' families have been organised into self-reliant groups popularly known as women self help groups. Up to Dec. '99, there were 2600 groups which have mobilized an amount of Rs. 136.24 lacs through regular savings varying from Rs. 20/- to Rs. 50/- per month. Out of the 2600 groups, 1706 groups have been linked with banks through which loan disbursement amount reached to Rs. 127.29 lacs. The interloaning of these groups is to the tune of Rs. 315.15 lacs.

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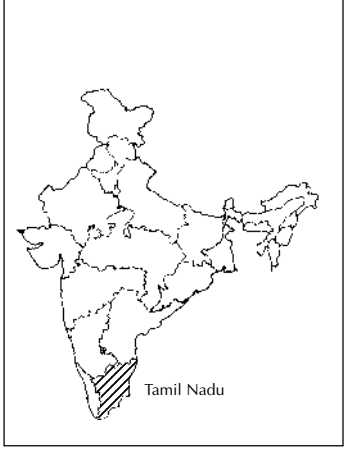
Land use planning for the lands of the north western zone of Tamil Nadu



Sivakumar K.M, Alagesan V and Ramachandran K

Discusses briefly the cropping and agroforestry practices followed in the area

Owing to the minimal rainfall, poor soil fertility and adverse climatic conditions, drylands of this zone increasingly become deserts. Farming under these circumstances appears to be really a gamble for the farmers, who have a chance of sowing/planting only when the raingod shows mercy.

Indian agriculture is mostly characterised by monsoon based dryfarming leaving no option to the farmers. More than 65 per cent of the cultivated area in the country falls under this category contributing 40 per cent of the total grain production.

The north western zone of Tamil Nadu comprising three districts namely Dharmapuri, Salem (excluding Tiruchengodu taluk) and Namakkal (including Perambalur taluk), has an unique feature of having semi arid hot climate, undulated topography, red non calcareous coarse shallow soil with poor soil fertility and water retention capacity and low rainfall with erratic distribution. Thus, the crisis facing dryland agriculture has been gradually assuming alarming dimensions.

Prevailing Scenario

The land utilisation pattern of this north western zone reveals that drylands and wastelands comprise more than 34.36 per cent of the total geographical area. If proper care is not taken, the rate of increase in the degradation of cultivable land will result in increased pressure on the farmers to produce food for the ever increasing population.

Of the 840 thousand hectares of net sown area, 608 thousand hectares (72.38%) is under dryland conditions. These lands are marginal where agriculture is practiced only when the rainfall and other climatic factors are conducive. Farmers of this zone cultivate mostly crops like sorghum, samai, horsegram, groundnut, etc. and record very low harvest because of the existing conditions. The harvested produce is not enough even for his own domestic needs, in most cases.

Potential

Even though several hurdles are imposed on the dryland farmers, still there is a ray of hope of thriving better. First, the farmers can think of establishing fruit crops such as mango, ber, West Indian cherry, tamarind, etc. and secondly, they can go for agroforestry practices. In case of Dharmapuri Dt, establishing mango orchards in the drylands is a success story. During 1993-94, the area under mango cultivation was only 19,540 ha whereas the current area of mango cultivation is more than 32,450 ha. Within a span of 5 years the increase is 13,040 ha, that too 95 per cent of the newly established orchards are coming under dryland conditions. A sudden leap in the area under orchards and groves helps in bringing more rainfall with increased rainy days to the district for the past few years. The farmers make use of the rainfall for growing intercrops in the orchards and thereby they get supplementary farm income.

Mainly sorghum, samai and pulses are cultivated as intercrops in young mango orchards. Besides providing extra farm income to the farmers, there are other benefits too. The crop residues are used as cattle feed and cultivation of pulses and fodder legumes in turn enhances the soil fertility. The litter and other leaves falling on the farm enhance the soil fertility which in turn helps in the growth of young orchards. Moreover, it helps in reducing soil erosion and conservation of soil moisture.

Like any other fruit tree crops, tamarind can also be grown in the dry regions receiving scanty rainfall. In the beginning of 1993-94, area under tamarind in the north western zone was only 1791 ha but now it has slowly increased to 2270 ha. In the early stages of tamarind groves, intercropping with pulses, forage crops and cereals could be done.

Agroforestry is gaining momentum recently in this zone. Area under forests in the zone is 535.29 thousand ha and its share is 25 per cent of the total area under forests in Tamil Nadu. Since most of the drylands get low rainfall and in these risky conditions, agroforestry practices appear to be a possible solution.

Bund planting of common tree species of South India like thespesia, delonix, albizzia, neem and teak, border planting of subabul, nuna, teak, tamarind albizzia, vadanarayan and eucalyptus can be thought of.

The agroforestry practices in drylands improve the ecological status of the area through the trees raised along with the agriculture, pastoral and other vegetation grown in the area. The total annual yield for tree and supplementary crop combination is definitely higher than that of yield obtained from dryland crops alone. Since agroforestry requires low initial cost, ensures seasonal income through intercropping and supplies different kinds of raw materials to support cottage industries, tree keeping in the drylands will certainly offset the risky farming under dryland conditions.

Some of the agroforestry practices already practiced in the north western zone are:

* bund planting of thespesia, albizzia, neem and teak
* block plantation of eucalyptus, teak and tamarind
* intercropping of agriculture crops
* intercropping with forage crops

The productivity under agroforestry system remains sustainable in the long run and thereby it reduces soil and water erosion in the zone.

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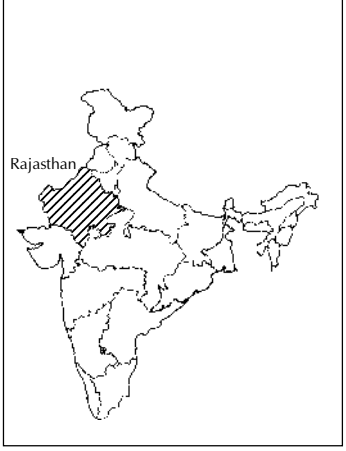

Role of agroforestry in controlling desertification with special reference to *Prosopis Cineraria* (Linn) Druce in arid farming of western Rajasthan

M. Nagarajan

Describes the advantages of growing Prosopis Cineraria as a tree species in the area.

Introduction

Desertification is a land degradation process and it deals with the gradual conversion of productive land into less productive or unproductive ones. Thus, the problem is a continuous one. The presence or absence of a nearby desert has no direct relation to desertification. Excess of land abuse in any patch or land makes it necessary that suitable steps are taken to control desertification in arid regions. In this regard, agroforestry is recognized as one of the efficient land use systems to control desertification. Agroforestry by virtue of its merit has already earned distinct identification of its own and so is commonly used nowadays. Agroforestry may simply be defined as an integrated self sustaining land management system, which involves delicate introduction and retention of woody components including trees, shrubs, bamboos, palm, etc. with agricultural crops, including pasture/ livestock, simultaneously or sequentially on the same unit of land meeting the ecological and socioeconomic needs of the people (Deb Roy, 1992; 1993). In arid regions, comprising sizeable area, the crop production levels are low, which to a large extent are due to low and erratic rainfall and low level of soil fertility. Accordingly, most dwellers raise livestock as a subsidiary occupation and allow trees and shrubs to grow along with cultivated crops to mainly cover the risk and uncertainity of crop maturity. Malhotra et. al. (1985) compiled the data on traditional agroforestry being practised by the farmers in the Rajasthan desert, delineated eight agroforestry zones and described trees, shrubs, grasses and crops in each of the zones.

Among the tree species *P. cineraria* is an important leguminous tree and commonly known as khejri, widely distributed in western Rajasthan. In inhospitable dry climates, properly distributed, this tree growth acts as a foster mother to agriculture. The agrarians well understood that the crop growth under *P. cineraria* based agroforestry system is better than the crops growing without trees in the same management conditions. The farmers of this region know the value of khejri tree. Ordinarily a cultivator hesitates to cut a khejri tree on his own field for fuel and thus one can find varying tree densities on the cultivated fields. Singh and Lal (1969), Aggarwal et al. (1976) and Shanker et al. (1976) have shown that the forage species producing higher biomass under khejri tree canopy was due to high fertility status and thus *P. cineraria* holds an increasingly important place in the economy of Indian desert. The farmers have been traditionally intercropping agricultural crops (til, bajra, moong, guar, etc.) with khejri and observed higher yields of crops, which could possibly be due to the amelioration of harsh climate and the addition of nutrients through leaf fall. Some of the observations made in

Table 1. The microbial and soil C, N in the understorey soils of *P.cineraria*

Month	Microbial carbon ug g	Organic carbon mg 100g	Microbial nitrogen ug g	Total nitrogen mg 100g
March	1469.960	783.333	247.070	100.000
July	491.014	571.612	51.404	87.500

the traditional agroforestry fields are being summarised in this article.

Effect of tree canopy on microbial and soil nutrients

The study of seasonal variation of microbial C, N and total C, N under the canopy also confirms that the tree plays a major role in nutrient buildup and the variations caused by this tree are highly significant. In the month of March, both microbial C, N and total C, N were recorded higher than the other months of the year and the lease recorded in the month of July (Table 1). The role of *Prosopis Cineraria* on microbial C, N and total C, N under the canopy is appreciable. Therefore, it is possible to develop organic farm management practices in tillage with *P.cineraria* which can meet the crop nutrient requirements to some extent. The quantity of available nutrients held in microbial biomass is considerable and it constitutes a transformation matrix for all natural organic materials in the soil and acts as a source and sink of the nutrients.

Effect of tree canopy on crop physiology

The study of eco-physiology of sesame crop grown under and over canopies revealed that photosynthetic pigments (Chlorophyll a and b) were significantly higher in the under canopy crop plants than the over canopy. And though higher carotenoids too recorded in the under canopy plants, the difference is meagre (Table-2). The increased pigment contents of shade leaves has been attributed to the increase in number and size of chloroplast, the amount of chlorophyll pre-chloroplast and better grana development (Boardman, 1977). *P.cineraria* is well known for its ability to enhance available nutrients and water holding capacity of the under canopy soils (Gupta and Saxena, 1978). The higher water status in sesame is associated with higher chlorophyll content in a water stress study (Vyas et al., 1988).

Proline was higher in the leaves of sesame in the under canopy of *P.cineraria* than over canopy. In sesame the plants in over canopy revealed higher soluble sugar than the under canopy, though the variation in insoluble sugar was meagre. (Vyas et al., 1988). Crude protein was higher in over canopy plants than under canopy plants (Table-2). Further studies may ascertain the cause (s), shade, water status or both, for the increased chlorophyll and protein in the under canopy of *P.cineraria* and soluble sugar and crude protein contents of the leaves of sesame in the over canopy.

From the foregoing discussion it is evident that *P.cineraria* provides a better microhabitat below and around its canopy than the open field of the same piece of land. The leaves of *P.cineraria* rich in protein and mineral nutrients also bring the soil nutrients to upper layer. Therefore the purpose of synchronizing the release of nutrients from leaf litter with crop requirements (kharif and rabi cropping season) is to improve the ratio of nutrient uptake to losses by leaching. This in turn, will contribute to the efficiency of nutrient cycling in the nutrient 'hunger' soil. The designing synchronization of demand and supply of nutrients and tree canopy management for optimum benefit of crop yield is a very essential area which needs to be given attention. By doing so, not only will the crop productivity get a boost but also desertification will be taken care of in the extreme arid region.

Table 2. Proline, sugar and crude protein of sesame in agroforestry system (The values are the mean triplicate observations)

Parameter	In under canopy	In over canopy
Plant pigments (mg g^{-1} FW)		
Chlorophyll-a	0.726	0.587
Chlorophyll-b	0.816	0.721
Carotenoid	0.014	0.013
Proline (u mole g^{-1} FW)	1.398259	0.429965
Soluble sugar	28.44308	51.17035
Insoluble sugar	27.83354	28.9868
Crude protein (mgg^{-1} DW)	177.0834	213.5417

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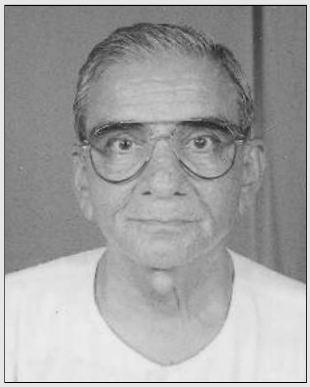
Thorns Redefined

There are many institutions and organisations engaged in fighting desertification. But there are also individuals like Premjibhai and Lavkumar Khachar (see box:The Green Old Man of India) who with their commitment and dedication have made a remarkable difference in their own way in checking desertification.

The parched Saurashtra soils in Gujarat find a friend in *Prosophis Juliphora* trees. Millions of *Prosophis Juliphora* trees provide an evidence of life in the arid Saurashtra which was once touted to be turning into a desert.The man behind this innovative effort is **Premjibhai Patel** of Upleta Village in Rajkot District. Inspired by the story "The Man Who Planted Trees" written by the famous French Writer Jean Giano, Premjibhai has dedicated his life for fighting desertification by planting trees.

Premjibhai Patel, founder of Vrikshprem Seva Trust is known for tree plantation activity in Saurashtra region. In the last few decades he has planted a few million *prosopis juliphora* trees in Saurashtra. Notwithstanding the controversy over his choice of tree species, his concern, dedication and commitment for ecological conservation are widely admired.

Many ecologists and development professionals resent the idea of spreading *prosopis juliphora,* for they believe this species is not good for the ecology. Premjibhai thinks the other way and he has enough examples to prove his point. According to him, the growth of *prosopis julifora* had two fold impact wherever he planted them.The trees helped reduce soil erosion (caused by strong winds) and also decreased ground water salinity to a great extent. He points to the sprouting grass on the land around these trees as an indication of improving soil health.



Premjibhai Patel

Premjibhai Patel has adopted various methods in his effort of greening barren lands of Saurashtra. Initially it was one man's obsession. He used many creative and also hard ways for planting the seeds in large numbers. "In 1980s at the age of 55-60 he travelled 1, 40,000 km on a motor cycle to plant seeds in the villages.He identified and gathered a couple of committed individuals who can assist him in this task. He would give them a bagful of seeds and ask them to plant on both sides of the road. Later on he developed an innovative mechanical blower for wide and speedy broadcasting of seeds.This blower which can blow seeds to a distance of 15 km was developed and gifted to him by his son. Now he has two machines of this kind.They are mounted on the back of two jeeps and used to broadcast seeds on the sides of roads and railway tracks" (Chokkakula, 1996).

He combined this activity with environment education by involving school children to plant trees in their school compounds. He formed a network of eco-clubs in Saurashtra region for environmental conservation and supplied huge quantities of seeds to them. Inspired by his teachings and activities, school children and eco club members in this region have taken up the responsibility of distributing seeds to the schools and youth associations in the district.Apart from this, he has also motivated village committees to plant fruit trees on revenue wastelands in the villages. He supplies fruit tree seeds at 50 percent subsidy.

His fighting against desertification amidst the environment of corruption and wide spread cynicism has only the assistance of 3 volunteers employed by him.The finance for this amazing activity was also borne by him.

At the age of 68, Premjibhai continues his untiring efforts of greening barren lands of Saurashtra.

Apart from tree planting and awareness building, he has also done phenomenal work in addressing the problems of salinization and water conservation by promoting low cost community watershed development.

This write-up is based on N Hari Krishna's (Editorial team, Leisa India) interactions with Premjibhai Patel during a visit to the area of his work in 1998. Premjibhai can be contacted at: Vriksha Premi Seva Trust, Phulara Meel Gowdown, Furniture Galli, Rajmarg, Upleta, District Rajkot, Gujarat-360490. Phone: 02826-20130.

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Ficus Bengalensis... the preferred tree species

V.R.Karoshi, G.N.S.Reddy and R. Kantharaju

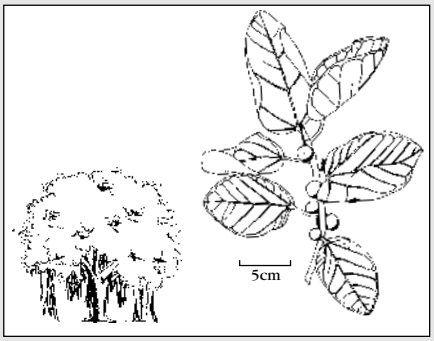
In Mandya district of Karnataka, the preferred tree species by farmers is *Ficus bengalensis*. Farmers in this area have proven that *Ficus bengalensis* which requires least tree-crown manipulation, can be best utilized as an agroforestry species without affecting the yield of crops.

Benefits

- Ficus trees have helped in better soil and water conservation.
- Easy decomposition of fallen leaves has improved the organic matter
- Crop growth was better beneath the trees (eg.Sugarcane,Ragi)
- Birds have helped in controlling the insects/pest population.
- One Ficus tree (15-20 years old) can provide fodder for 30 sheeps/goats for a month. (One herd of sheep (30 noÆs) provide 3500 kg of manure every year.)
- A 20 year old Ficus tree can be sold for about Rs. 5000/-(for firewood) to Rs. 15000/-(for timber wood).

Approach

- Planting of 6 feet tall stump of pole size on the field bunds.



- Accommodating about 25 trees of *Ficus bengalensis* per acre.
- Growing usual crops like Ragi, Sugarcane, Sesame, etc.
- Crown manipulation by way of light pruning of foliage, which is being utilized as a fodder for sheep and goats.
- Avoiding the overlapping of crowns of adjacent trees.
- Planting of at least one sapling / stump during auspicious days/festivals.

Recommended practices

1. Heavy pruning of side branches to stimulate growth in height and to avoid shade effect to the maximum extent.
2. Lopping (cutting of branches and twigs) should be attended at a particular time so as to obtain higher quality and better yields of fodder and fuelwood without affecting the growth of trees.
3. Pollarding (removing of branches at 3-4 m above the ground level) is to be done to increase the diameter of trees and also to avoid grazing loss. Pollarded shoots can be utilised for fodder, fuelwood etc.
4. Thinning may be practised to maintain optimum number of trees per unit area to reduce competition for light, moisture, and nutrients.

Editor's note:*Authors are looking for more information on performance of the tree species in drylands vs irrigated lands; performance in polyculture systems vis a vis monoculture systems, information on fodder value.Those interested in sharing the information may send it to the authors.*

■

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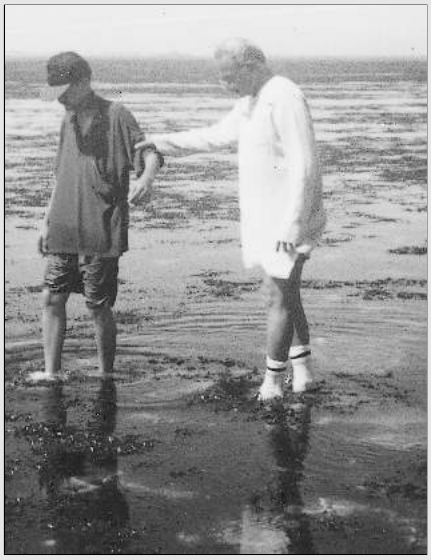
The Green Old Man of India

Pranav and Sangeeta T rivedi

Thirty years back, environmental education was an unheard phrase. So was the idea of taking children and youngsters out into the wilderness. But, there was one person who strongly believed in this kind of exposure to mother nature. He believed that children have to see, understand and experience what is nature to help them understand why it is so important. "It has been my experience that once a seemingly frightening exposure has been lived through, a remarkable change occurs in a child's personality ....any individual wanting to introduce children to the joys of nature should do so only after undergoing a very serious effort of going through a personal cleansing of the generations of fears...the cause of wildlife and wilderness conservation cannot be carried forward by individuals imbued by subconscious fears."These are the words of **Lavkumar Khachar** the pioneer of environmental education in India.

Hailing from the royal family of Jasdan, he himself had gone through such exposures and experienced the joys and wonders of nature in his childhood and youth. This early learning convinced him of the crucial importance of introducing children and youth to the elemental forces of nature. He is undoubtedly the first person in India to have designed a sequential programme of outdoor exposures for young people. It was under his leadership that the Nature Clubs of India movement - a youth programme of WWF-India was started in 1975. His name is almost synonymous with nature education in India. Initially, as a teacher of geography at the Rajkumar College he helped many children understand and relate the existence of clouds to soil in our lives through his outdoor exposures. He has guided thousands of young people to the world of nature and many environmental educators/ nature enthusiasts of today are a product of his programmes. His contagious enthusiasm and unwavering commitment led to creation of three important Protected Areas in Gujarat viz. the Marine National Park in the Gulf of Kachchh, Hingolgadh Sanctuary and Khijadiya Bird Sanctuary.

Being an outstanding naturalist and a great visionary he believes that changing our own lifestyles is the most important task if we are to halt further degradation of the natural environment. His actions speak louder than his words and probably that is why he conceived the idea of ecologically restoring two degraded natural areas in Gujarat: Bakore in Panchmahal District and Beyt Dwarka in Jamnagar Dist. at the mouth of the Gulf of Kachchh. Both the sites were highly over used areas with tremendous human pressures around. Today, the Bakore site is a lush forest and Beyt is showing vigorous growth of *Acacia arabica* and the mangroves. They are now excellent campsites to introduce children to nature. Nowhere has he interfered with the laws of nature. He just allowed nature to take its own course giving the necessary protection and supplemental care. Both these experiments only reflect his faith in the resilience of natural systems.



Lavkumar Khachar with a student

Living with few needs and traveling by public transport as far as possible even at seventy, he is a source of inspiration and motivation for many young environmentalists. Lavkumar Khachar has achieved so much all alone. If more dedicated people extend their support to this field, the result would be a miraculously green one. ■

Continued from page 6

At the district level, farmer interest groups constituting interested farmers tackle the issues of production, procurement and marketing of produce at the district level under the Strategic Research and Extension Plan indentified for each district.

Lessons Learnt

Experiences of the last 5-6 years during implementation are increasingly showing that when people are encouraged to form groups and their knowledge is sought and incorporated during planning and implementation, they are more likely to continue activities after project completion. If people have responsibility, feel ownership and are committed, then there is likely to be sustained progress.

The process of establishing groups at local level must be an organic one and should not be forced or done too quickly. It needs external catalyst or facilitators and should focus on building the capacity of people to develop new ways of learning and new forms of leadership. The grassROOTS NGOs involved play an important role in the whole process.

The sustainability of sodic land reclamation process depends not just on the motivation of individual farmers but on the collective action by the groups and communities as a whole.

Challenges Ahead

Key elements in the participatory process of phase II of the project include: Involving various government departments and non government organisations (grassroot and intermediary) and farming communities in integrated land reclamation activities towards all round human development; land tilling rights for landless farmers; mainstreaming gender concerns; assured benefit generation through increase in agricultural production; capacity building of the local NGOs towards sustainable agriculture.

The entire programme will be monitored by SIC through a core team consisting of group leaders of water user groups along with Mitra Kisan and Mahila Mitra Kisan. As part of withdrawal strategy the team will prepare post reclamation management plan for maintenance of assets and continuation thereof in a sustainable manner involving the Department of Agriculture and other line departments, besides bankers, etc.

Note : Opinions expressed here are of the author only and are not necessarily of the funding or implementing agencies. ■

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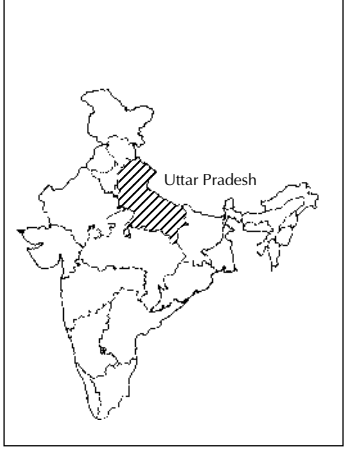

Water management and sustainability of agriculture in the Himalayan Mountains : An overview

G.C.S. Negi and V. Joshi

Describes the indigenous methods of water conservation and irrigation water management in the region.

Water management in the central Himalayan agriculture is confronted by too-much and-too-little water syndrome. Monsoon pattern of rainfall leads to runoff, washing away soil and nutrients from the tiny terraces, leaving rest of the year dry. This situation limits rainwater management in the rainfed agriculture. Under the irrigated agriculture, however, people practice intensive water management. The government-instituted irrigation schemes largely fail to utilize the vast potential of water resources of this region.

Introduction

Water is an integral part of all facets of life. Water being a critical resource, next in importance only to air, it is essential to ensure that there is enough of it to meet the demand of people for drinking and household consumption, irrigation and other uses (National Water Policy, 1987). But scarcity and misuse of this life supporting resource pose a serious and growing threat to food security, human health and development (Pisani, 1995), The problem arising out of increasing and competing demands for water are becoming more acute in terms of availability, quality, management, data acquisition, laws, institutions and investments. More so, the serious aspect of the water crisis is the misconceptions about solutions now proposed (Frederiksen, 1996).

The Garhwal Himalayan region of U. P. state (29° 26'- 31° 28' N Lat. and 77° 49°- 80° 6'E Long.) is spread over 30,090 sq. km, with only about 10% of area under agriculture. This region receives about two-thirds of the annual rainfall (150-250 cm) during monsoon season (mid-June to mid-September). This region is a storehouse of enormous renewable water reservoirs of snow and ice. Many important rivers of northern India originate from this region. The annual flow of the Ganga river with headwaters in this region has been computed to be 23,900 million cubic metres/year (Valdiya, 1987). Despite the vast potential of water resources, only about 15% of the agricultural land is irrigated in the mountainous tract of this region (Action Plan for Himalaya, 1992). The present paper deals with a state-of-art-report of the irrigation practices and some management options in this region

Outlook on agriculture

Agriculture is the primary occupation of inhabitants in the central Himalayan region. On an average, only 0.8 ha land is available per household of 5-6 family members. About 85 percent of which is rainfed. The small parcels of land distributed over rugged hill slopes generate low yields relative to inputs. In the rainfed cropfields, three crops are grown in two years time, whereas in irrigated fields two to three crops are grown in one year time; yet the agronomic production is very low (1 t/ha/yr), and meets only about half of the demand of the people (Singh and Singh, 1991). In a nutshell, present form of agriculture of the region is unsustainable both ecologically and economically.

Traditional practices of irrigation water management

In this region flood irrigation is the major mode of irrigation, which is confined to valleys where perennial streams flow near the cropfields. The irrigated cropfields are intensively managed to achieve food security. Irrigation is managed mostly by diverting stream water through cement lined canals or mud lined canals (gul or kuhl). Although other methods of irrigation are also in use, they are feasible only under certain conditions, and irrigate smaller areas. The guls are mostly community managed. Peasants determine irrigation schedule keeping in view the availability of water, types of crops and area to be irrigated. Some indigenous methods of irrigation water management are summarized in Table 1.

In the rainfed cropfields, rainfall is the only source to replenish the soil moisture. As rainfall is highly seasonal, most of the rainwater runs away in the form of overland flow from the outward sloping tiny cropfields in the want of water management and conservation devices, causing sheet erosion and gully development and consequent losses of top soil (Negi and Joshi, 1996). On an average, the soil loss has been measured to the tune of >10 t/ha/yr from the agricultural watersheds of this region. Peasants employ in-situ water conservation measures (Table 2), and cope with the problem of soil moisture by cultivating drought resistant crops which are regarded as low risk crops from yield stability point of view in rainfed land. Farmers have developed local varieties of wheat and paddy (the staple food crops) for the rainfed and irrigated conditions after long periods of selection and, trial and error. Given these complexities of farming conditions, peasants have become less responsive towards crop varieties introduced by the Government agencies which require irrigation and fertilizers (Negi, 1994).

Bottlenecks in irrigation W ater management

There are two types of canals in this region. Large canals (> 1 km length) are constructed and operated by the Government Irrigation Department and small canals (guls) and other irrigation structures (e.g., tanks, hydram, hauj, pump sets, etc.) by the minor irrigation department and other developmental agencies. The large canals are supervised by Govermnent employees for irrigation scheduling, cleaning for silt and minor repairs. The guls and other minor

irrigation means once built by the Government are handed over to the user community for water management and maintenance. In general, most of the canals in the mountains are dysfunctional and do not irrigate the entire command area (data not presented). Many factors are responsible for this situation: Diminishing discharge in the streams due to hydrological imbalances (Valdiya and Bartarya,1991) and water use for purposes other than agriculture in the populated urban centres. Among the other factors, seepage and other losses, siltation of canal, low availability of funds to repair the canals, use of canal water for domestic purposes, encroachment for building and road construction thereby choking the canals by debris deposition, loss in community feeling to regulate and ration the use of water and general apathy of people are responsible. Furthermore, tax levied on irrigation is very low which does not permit major investments on these canals from the Government side.The community managed minor irrigation schemes also suffer from the above disorders. In the absence of any vigil from the Government, the structures once damaged are hardly repaired. Social conflicts for water present another frustrating aspect of this problem. People have now realized the uncertainty attached with the irrigation water and they are either compelled to cultivate water stress tolerant crops (which yeild low compared to crops sown under irrigated condition) or abandon cropfields, in the want of water.

Future prospects

There is ample scope to tap the numerous small perennial streams for flood irrigation in this region. Realizing the gravity of the problem, various developmental agencies, research and voluntary organizations have now started to focus their efforts to design and advocate new technologies and ways of water management to help farmers to cope with the shortage of water for irrigation. Many devices such as low-cost poly-pits, rain water harvesting (Kothyari *et al.,* 1991), drip irrigation, sprinkler irrigation, in-situ moisture conservation methods, etc. are coming up. However, these devices are often not feasible and success of any such measure is yet to be witnessed. Despite all these concerns peasants struggle not only for irrigation water but also for drinking water (Negi and Joshi, 1996).

Table 1. Indigenous methods of irrigation water management in the central Himalayan agriculture

Water source	Management practices
Rainwater	Rooftop water is guided to fall to supplement moisture to kitchen garden crops
Spring water	Springs which are not tapped for drinking water are locally used for irrigation
Reuse of waste-water	Around townships, municipal waste water is used to irrigate vegetables and other cash crops
Ponding	Ponding of water is done raising mud and stone built wall in the stream and used to irrigate downstream cropfields or transported as head loads

Table 2. Indigenous methods of water conservation in the central Himalayan agriculture

Measures taken	Advantages
Reduced tillage in rainfed cropland	Evaporation loss from soil is reduced
Tilling cropfields immediately	Soil moisture gained through rainwater is conserved in situ after rains and leveling the soil
Cultivation of drought resistant crops varieties	In rainfed conditions this helps to reduce the water demand and avoids risk of crop failure
Maintenance of cropfield	Cropfield bunds support growth of grasses and act as barrier bunds (usually 0.5-1 feet high towards overland flow of water from the fields.)
Mulching cropfields with crop residue	Rarely practised in vegetable fields to check moisture evaporation
Seed sowing after dipping in water overnight FYM application	Water demand from soil for seed germination is minimized Continuous FYM application increases moisture holding capacity and release properties of soil

Acknowledgements

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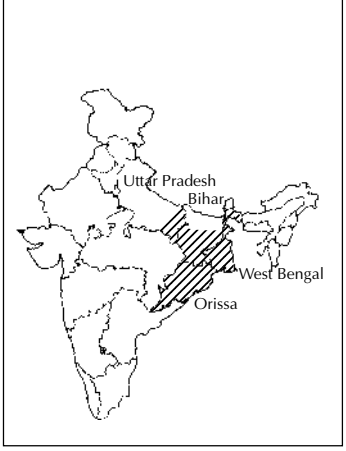
Jaldhar model of in situ rain water conservation

Dinabandhu Karmakar



Describes Jaldhar 30x40 model, a technique for water conservation in sloping terrain

Introduction

East Indian Plateau and its adjoining areas comprise of thirty odd districts of south Bihar, western West Bengal, eastern Madhya Pradesh, northern and northwestern part of Orissa. The landscape is undulating. Agriculture is primarily rain-fed and dominated by monsoon kharif paddy cultivation. The region receives an average yearly rainfall in excess of 1000 mm in most places. However, distribution of rainfall is very erratic. Water holding capacity of soil in general is low except in the valley which receives lot of silt from the upper catchments.

Depletion of vegetative cover (forest and the like) at the upper regions has reduced the rate of moisture recharge drastically at the ridge areas. All these factors have resulted in frequent agricultural droughts affecting upland-paddy crop in this plateau.

Techniques for water conservation

There is very little development of irrigation infrastructure in these areas. Otherwise too, it is simply not possible to protect paddy crop in such wide spread undulated area, through irrigation. This paper describes a simple technique: *Jaldhar 30 x 40 model.*

Jaldhar 30 x 40 model is the technique for treating more sloping lands including smaller hillocks. Such lands were earlier under forest, either privately owned or under forest department. Presently these lands are highly erosion prone and have very little or no top soil. "30 x 40 model" is used to stop further erosion and increase moisture regime. The technique is claimed to be user friendly and within the reach of the poor farmers. It also has large-scale replication potential under various poverty alleviation programmes (e.g. EAS, JRY, DPAP, NWDP etc.) of the government. Another model practised in the area is: 5% model* , originally designed to save paddy crops only and later being used to reclaim wastelands (having less than 2% slope) too.

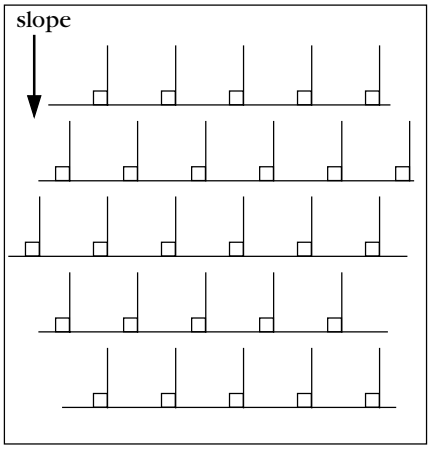
Description of the technique - *Jaldhar 30 x 40* model

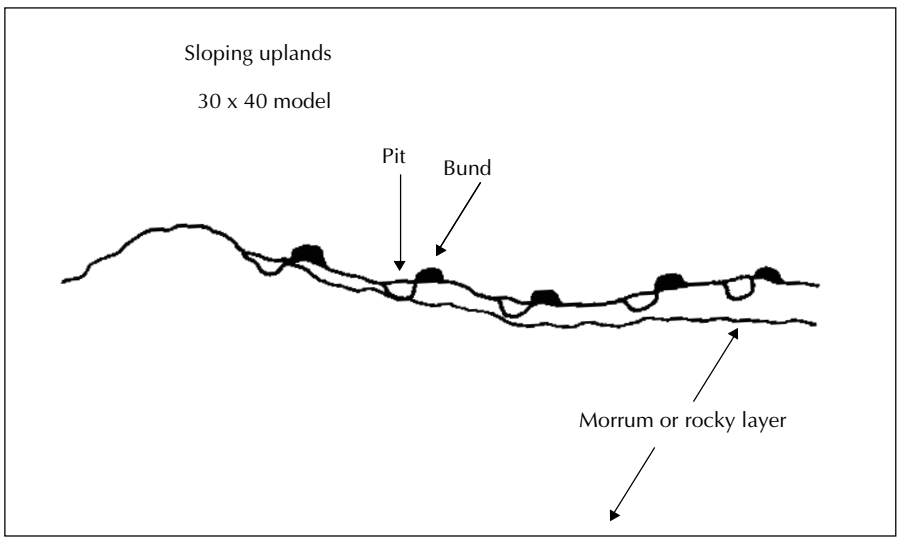
The core idea employed is, plotting of unterraced and unbunded lands and creating water collection pits in each plot so that plots resist rush-off of water and pits collect them to soak. The water percolated from a large number of such plots travel below the earth, downstream to recharge the moisture regime.

The design principle

It involves plotting of uplands into smaller plots and digging collection pits in each plot. When the slope of the land is more than 8%, the design needs some modification. In this design elaboration we shall limit our discussion to lands having an average slope of 3% to 5%. Each plot is maintained at 30-35 ft x 40 ft. 30-35 ft (along the slope) x 40ft (across the slope). Hence the area of each plot will be 1200 to 1400 sq. ft. The volume of each collection pit is kept 100 to 110 cubic feet. The earth excavated from the pit is used to construct the bunds of the plots. The pit should be at the lowest point of the plot. The depth of the pit should be within 3 to 3.5 feet. The pit area should be within 3% to 4% of the individual plot. The layout of the plots should be such that they are arranged in a staggered fashion so that the pits are also staggered as far as possible. This is done to facilitate uniform seepage of water collected in the pits across the slope.

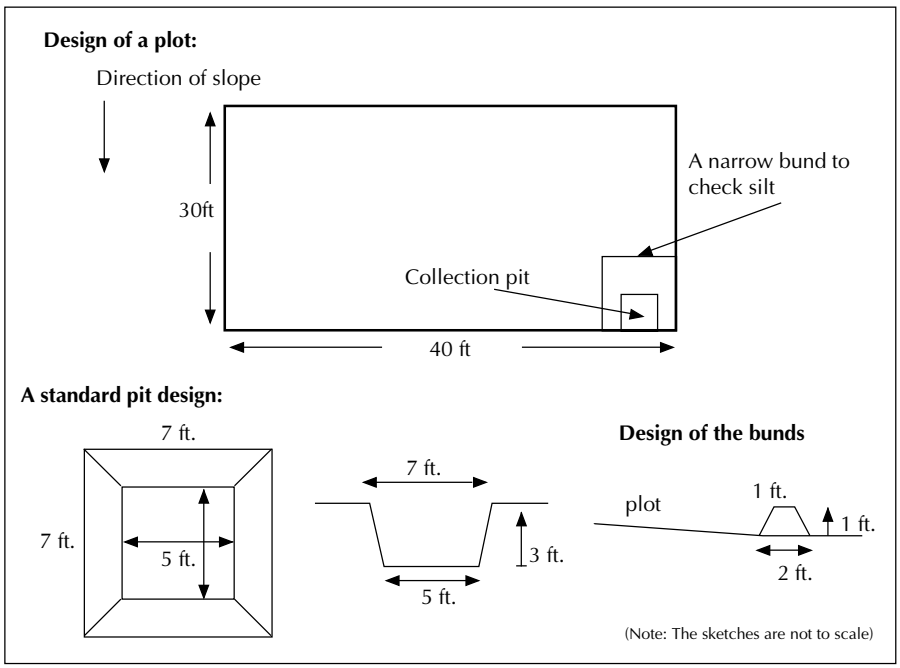
Layout





The amount of soil required to prepare the bunds of each plot (30 ft + 40 ft) is equal to 70 x (2+1)/2x1 or 105 cubic feet. This is equal to the volume of earthwork from the pit. More soil should be placed on the bunds across the slope because it will get more pressure of run-off water. Along the slope, bunds merely act as run-off divider between individual adjacent plots. The lower half of these bunds needs to be thicker than the upper half of the bund as shown in the figure given below. Pit should be dug at the lowest point of the plot.

In estimating the volume of the pit and plot size, attention should be given to the following factors :



a) The whole patch should be self-carrying, i.e., no run-off from outside the treated patch should influence it.

b) Slope of the land and its local direction.

c) Porosity, permeability, water holding capacity, existence of impervious layer down below the topsoil.

d) Pick rate of rainfall and such other physical properties of soil need to be considered.

(The above does not mean that an individual farmer has to examine all these before treating the land. These are relevant only when the technique is sought to be replicated in a completely different geo-physical terrain).

How this technique helps

Where depth of soil is more, as we stop run-off loss through collection pits and bunding, soil gets sufficient time to absorb moisture to get saturated. But in most places, in sloping fallow lands of the plateau, top soil depth is very less and it is porous. Often, there is a semi impervious layer below it. A 1200 sq.ft. of plot having a soil depth of, say, 3 feet has a maximum water holding capacity of 1220 cubic feet (considering one part by volume of water can saturate 3 to 4 parts by volume of soil (typical to plateau red-lateritic soil).

After rain stops, the water held by the soil mass starts moving down. Total gravitational waters (about 60% to 70% of the maximum water holding capacity) gradually moves along the slope. This increases moisture regime in the down stream. With this kind of intensive moisture conservation, wastelands have been brought under productive use on a permanent basis (through agro-forestry, fodder cultivation or even crops like vegetables, pulses and upland paddy).

Conclusion

The ideas narrated above evolved, based on experiences of working in small geographical pockets of Purulia district of West Bengal. Within 5 years of their birth, these techniques spread to many other districts of Bihar, Orissa, Madhya Pradesh and Andhra Pradesh. This necessitates more innovations and experimentation to make these locally appropriate keeping the basic principles in mind. ■

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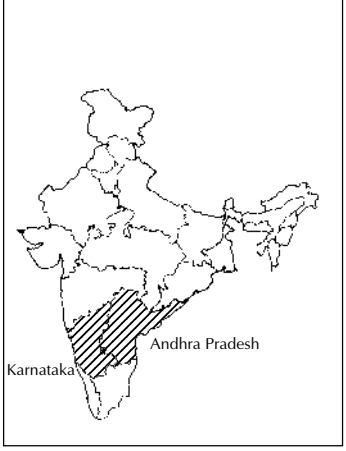
[*Editor's note: Interested readers may write directly to the author for information on the 5% model]

Portable Rainfall Simulator - A participatory action learning tool to understand desertification process



G. Subba Reddy , H.P.Singh, Christine King and Sreenath Dixit

Describes how the rainfall simulator helps the farmer to observe the velocity of raindrops, their impact on soil particles and the resultant runoff, in real field conditions.

Soil erosion by runoff is the principle cause of land degradation particularly in the rainfed agro-eco regions of India. Consequences of land degradation could be more disastrous in arid and semi-arid areas where the eco system is very fragile. Rainfall being the only source of sustaining the entire production system, these areas chronically suffer from low food and fodder productivity due to poor and erratic rainfall. The process of land degradation is very dynamic and complex at times. Unfortunately, more often than not it goes unnoticed by the very people dwelling in such less-endowed areas which are already marginalised. The people are characterised by low literacy and awareness levels, poor socio-economic status and have low risk bearing ability. Lack of awareness about the process of land degradation and inadequate technological interventions to manage it are the major bottle-necks for community mobilisation against land degradation.

In the past, government interventions for combating land degradation without people's involvement have failed miserably. There is now a greater realisation about the need for people's participation in such endeavours. People's participation in any community based development activity involves a considerable element of community education. Such efforts should take into consideration the principles of adult learning and involve simulations of real life situations so that the learning is easy and quick. Once the community is convinced about their role in the programme the rest will follow suit at a fairly fast pace. Rainfall simulator is one such tool that aids action learning process among village communities to understand the complex nature of runoff driven erosion of soil, the chief cause of land degradation. The principle involved in action learning through rainfall simulator is simple. Hardly any farmer takes the opportunity to watch the effect of rain water impact on soil when it rains for one would run for shelter the moment it starts raining! Therefore, when the rainfall is simulated in real field conditions, farmers can witness the series of consequences of a supposedly 'harmless' rainfall event. The velocity of raindrops, their impact on soil particles, the resultant runoff that carries the quintessential soil along, can be observed by the farmers to appreciate the damage done to their agricultural fields in one single storm.

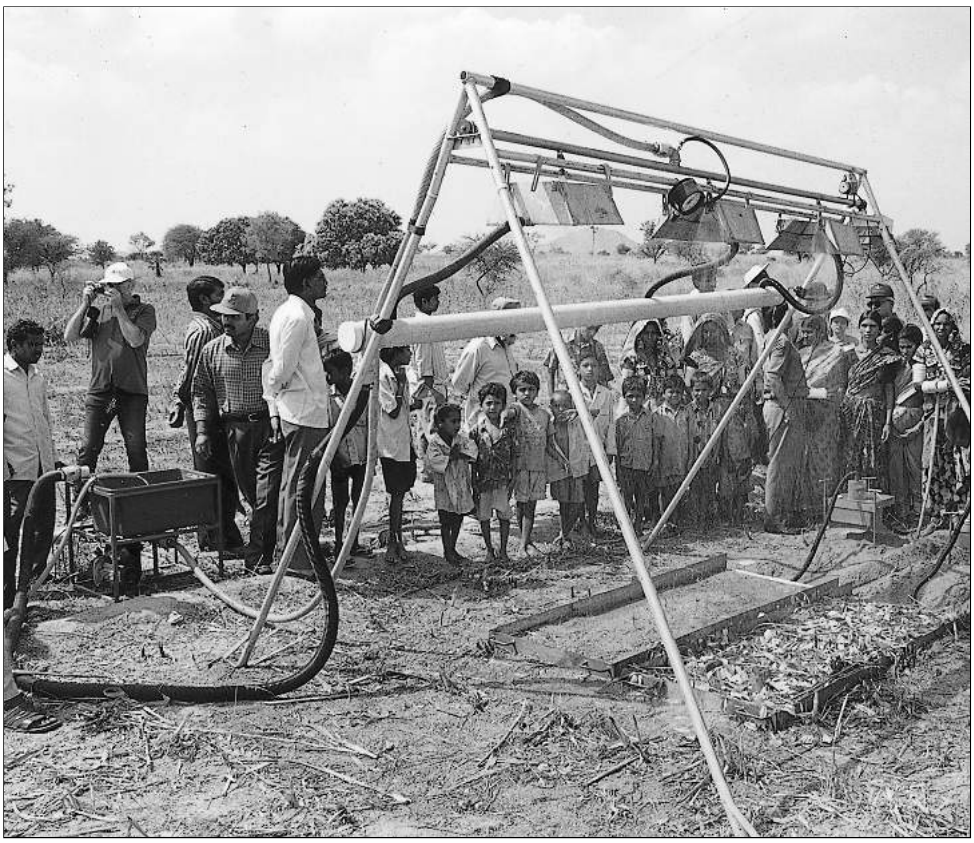
Rainfall Simulator - An action learning tool to understand land degradation

The rainfall simulator is a mobile gadget developed by the Australian Centre for International Agricultural Research (ACIAR) that produces rainfall with a drop size and energy similar to that of

Table 1. Observations recorded with the help of farmers in rainfall simulator demonstration(summer)

Centre	Comparisons	Parameters	
		Wetting front of soil (cm)	Runoff volume (l)
Nallavelli, Hyderabad	Bare soil Paddy straw mulch	11.63 17.65	54.43 38.96
	Grazed grass cover(60%) Non-grazed grass cover (85%)	21.26 18.60	31.88 6.77
	Furrows along the slope Furrows across the slope	11.8 12.7	43.31 20.56
Pampanur Anantapur	Ploughing and harrowing along the slope Ploughing and harrowing across the slope	26.6 39.3	21.5 17
	Ploughing across the slope + No FYM Ploughing across the slope + FYM(10 t/ha)	17.5 22.6	16.5 5.2
Madhubavi, Bijapur	Straw mulch (95% cover) Straw mulch (100% cover)	20 23	35.6 16.6
	Ploughing and harrowing along the slope Ploughing and harrowing along the slope	21.0 22.0	40.3 39.5

natural rain. Rainfall is applied to two adjacent plots with two different but comparable treatments (Fig. 1).The plots are separated by a barrier to maintain independence between the treatments. Rainfall is usually applied at a known rate so that it can be measured for the duration of the activity. Runoff collected at the bottom of each plot is vacuumed into measuring tank where it can be easily seen and measured.Thus the device can be effectively used as a demonstration tool to promote initial interest among farmers about adverse impact of rainfall on soil, and motivating them about the need for capture and storage of rainwater in the soil.As an action learning tool, it can increase the farmers' knowledge about soil and water relationships, allow them to use their experience in this context, test and review options through selection of treatments. In all, it is a multi-purpose and multi-outcome action learning tool. Following steps are normally adopted in involving the farmers through the action learning process by using the rainfall simulator.



The process

The key elements in the process of simulating rainfall include (1)multi - channel publicity prior to the event, (2) participants nominate the treatments(plan), (3)participants actively construct the treatments chosen (act), (4) rainfall is applied (act), (5)monitoring of the effects by the participants(observe), (6) small group discussions (reflect).The process of self learning among participants is facilitated by the scientists.

Planning and execution

The action learning groups under the leadership of CRIDA, Hyderabad, used the rainfall simulator as an action learning tool at Nallavelli, Pampanur (Andhra Pradesh) and Madhubavi(Bijapur district of Karnataka).The key concept of the field process was to ask the farmers to suggest the treatments, to enrich their participation by constructing the treatments and, set-up and discuss the cause and effect of events. Scientists acted as facilitators to help farmers learn for themselves the working of rainfall simulator and the process of runoff and soil loss.

Farmers' participation

- The Rainfall Simulator attracted both farmers and farm women.The participants liked the opportunity to participate, test their ideas particularly with respect to traditional practices.The tribal farm women involved themselves actively in selecting the treatments. Modifications were carried out after a good deal of debate. In fact, the selection and application of treatments always inspired positive and willing debate
- Farmers were encouraged to suggest other strategies as per their choice to test with rainfall simulator.The equipment created lively discussion on management practices to control soil loss and improve soil water intake.
- Farmers measured infiltration by using a metal probe or digging with a shovel/ mattock.
- Farmers measured runoff by comparing amount and level of water in vacuum drums.
- Farmers took the colour of water as an indicator of sedimentation and soil loss in vacuum drums.
- Farmers and scientists both learned by way of watching the visual impact of the raindrops on soil.
- Farmers enthusiastically helped set up rainfall simulator as well as implementation of treatments.
- The Rainfall Simulator as a tool proved successful in creating thorough discussion on management practices to control soil loss.
- Farmers found it interesting to vary rainfall intensity during the activity in order to replicate rainfall patterns.

Limitations

- Provision of water at farmers fields is a limitation.
- Planning the best time to hold the activity is critical eg., avoid time clashing with important social, farming and household requirements practices (such as picking children up from school).
- Since considerable time for networking with participants is required, advance planning is necessary.
- Facilitating a reflection period among the participants at the end of the activity is warranted.
- It is often hard for scientists to operate in facilitation mode and not impose their own ideas on selection or design of treatments.

Reflections

- The experiences using the Rainfall Simulator revealed that it is a powerful extension tool. It motivates farmers to screen various technological options for sustainable soil management and allows them to test their own ideas in a group participatory process.

▶

Table 2: Results of Rainfall Simulator in standing crops during rainy season

Centre/ Place	Test crop	Comparisons	Wetting depth (cm)	Runoff (%)	Soil loss 10^{-2} t/ha	Deep drainage (mm)
Hyderabad, HRF	Castor	Farmers' practice	10.9	47.8	62.0	26.1
		Gliricidia mulch	28.0	47.5	26.0	26.3
		Greengram incorporation	12.56	26.3	12.0	36.8
Nallavelli, Hyderabad	Sorghum + Pigeonpea	Farmers' practice	20.7	37.2	33.0	31.4
		Conservation furrows	28.0	13.4	28.0	43.3
		Gliricidia mulch	32.7	3.5	4.0	48.3
Anantapur RRS	Groundnut	Farmers' practice	19.8	26.58	49.0	36.7
		Gliricidia mulch	24.6	21.8	24.0	39.1
		Conservation furrows	28.0	21.0	3.6	39.5
Anantapur, Pampanoor	Groundnut	No FYM	26.0	8.5	35	45.7
		FYM @ 5 t/ha	28.0	21.0	3.6	39.5
Bijapur, RRS	Rabi Sorghum	Farmers' practice	17.32	86.28	20.70	6.86
		FYM @ 5 t/ha	28.00	55.42	7.50	22.28
		Sunhemp incorporation	25.3	23.99	14.70	26.01
		Sorghum stubbles	24.66	21.77	7.00	39.42
Madhubavi, Bijapur	Rabi Sorghum	Farmers' practice	30.33	76.3	48.7	7.85
		Sunhemp incorporation	28.00	46.77	18.3	26.62
		Tied ridges	31.5	65.44	41.2	17.03

- The key factor to the success of the action learning process with the rainfall simulator as a decision making tool was to avoid the domination of the activity by scientists, and allowing farmer participants to work it out and learn for themselves.
- The Rainfall Simulator needs to be supported by other extension processes and activities. When used as an extension tool on its own it does not consider a systems approach but focuses on soil surface treatments, runoff, infiltration and land management.
- Crop stubble may have a good impact on increasing infiltration and reducing runoff, but may not be available with most farmers due to competing use for animal husbandry.
- Farm yard manure may be a valuable source of mulch and useful in decreasing runoff by increasing infiltration besides improving soil fertility. But the quantity required to achieve this may not be available.
- The results from the rainfall simulator are applicable to small plots only. This often means farmers try and replicate whole field conditions on a small scale, which limits the validity of results.
- Farmers can find it frustrating as they are unable to consider changes in fallow treatments over a greater period of time and their inability to modify rainfall intensity to more accurately reflect the storm conditions.
- There is good potential for further action learning in extension programs. This hypothesis is supported by the fact that active involvement of farm women was obtained in all the rainfall simulator activities conducted so far. Such activities need to be sensitive to sociological issues in each community.

Epilogue: Control of land degradation i.e. desertification - whether through runoff, wind action, chemical factors or land abuse by farmers - is central to the sustainability of rainfed agriculture in India and many other developing countries. Many a times, the small land holders who constitute the dominant section of farmers in these regions, are either unaware of appropriate management options or are desperate in causing degradation for instance by cultivating marginal lands, or removing natural vegetation for meeting their fodder and fuel requirements. Development of technological option must therefore consider both the process of degradation and socio - economic conditions of the land holders. In order to realise this, farmers' involvement as equal partners from the word 'go' is absolutely necessary. Farmers must see for themselves the magnitude of land degradation (eg. soil erosion) and learn the gravity of the situation. Portable Rainfall Simulator has proven tobe strong and effective tool in this context and can thus act as a stepping stone for farmers' willing involvement in on-farm research/ development programmes in a real participatory mode, for sustainable watershed management in rainfed areas. ■

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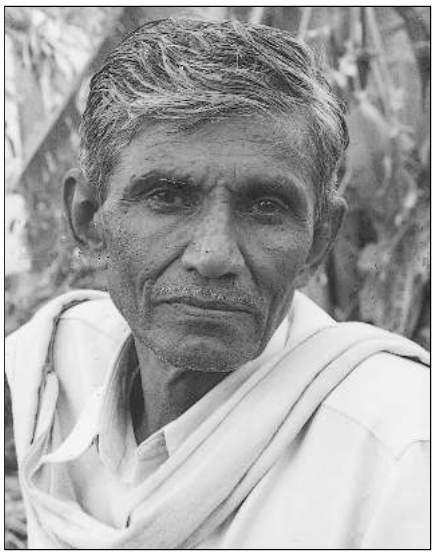
Farmers' role in combating deforestation



During the last 40 years, as a result of deforestation, the amount of rainfall has come down, streams and rivers have dried up, even the underground water table is falling fast, which has caused anxiety among all of us and farmers in particular. But they could successfully combat the negative effects of deforestation for their survival. Erecting checkbunds, gully plugs, planting perennial grasses like Khus grass, Napier, Agave, Lantana, etc. to check both water and soil erosion and help in gradual raising of the underground water table. Wherever necessary they could build contour bunds and dig tunnels to check soil and water runoff. They can plant trees like Neem, Jack fruit, Mango, Jambul, Sapota, Casuarina, Cashew, Gliricidia, Drumstick, Sesbania Grandiflora, Subabul, etc., on these bunds to get the best of the benefits from the same area, like income from the yields like fruits, fuel, fodder and manure. They can very carefully breed animals like cattle, buffalo, goats, sheep, chicken, pigs, etc. so that they can utilise the grasses and green fodders from their own farm. Farm ponds dug at the lowest point of the farm even at 10^m X 10^m X 3^m size could hold much of the runoff water and the fertile top soil, and this water could be efficiently used for cattle, to grow some vegetables, fruit trees particularly on the 4 sides of the farm pond, to raise nurseries and use for spraying against pests and diseases of their crops. More than the above said benefits, if such farm ponds are dug and maintained on all the farms of the area, the dried up streams and rivers would get water through the recharged aquifers, through the raise in seepage water from the farm ponds. This encourages the growth of grasses and trees which produce fodder, fuel and timber in a bigger area and increased quantity. Also, water from these open wells could be utilised for protective irrigation to save their crops. After about 5 or 6 years the whole area looks more green and the farmers stop migrating to cities in search of jobs.

The local leadership should be given the liberty to use the government aids and funds without much hindrance from the officials. The modalities have to be designed according to the local situations and needs than some common design made at the capital. More and more indigenous tree species can be planted which provide green fodder, manure, food, fuel and timber that could be shared among the whole population as per the decision taken by the grama sabhas rather than as per the decision taken by a handful of elected members. Such checkbunds and gully plugs shall be carefully selected so as to collect the maximum amount of runoff water and top soil. At least 35% of the work has to be contributed by the beneficiaries in the form of labour (shramadhan). Once the work is completed on these structures, the local people take the responsibility of maintaining them by desilting occasionally and repairing them well before the start of the monsoon.

Once the streams and rivers get water for more than 9 months the local people have to be permitted to breed fish rather than contracting to some outsiders by the Government, or else the local people will lose interest in maintaining the check dams and gully plugs.

Even some easy and cheaper structures for collecting roof water have to be evolved and popularised wherever possible so that many families could have water during the critical summer months. ■

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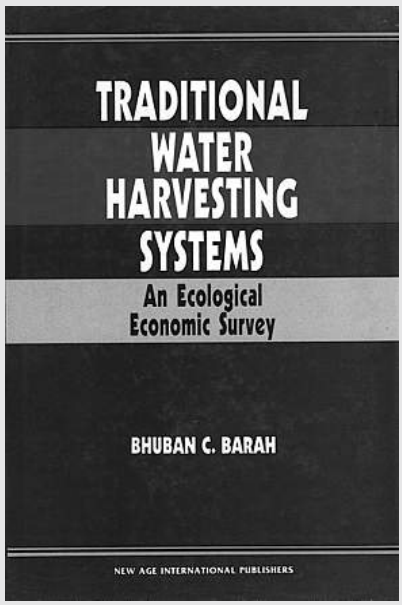

Traces the existence of traditional water harvesting systems. Discusses various diversion systems, flood plain systems, storage structures, drinking water supply, and traditional water lift devices.

Chapters:

1) Traditional Water Harvesting Systems in India 2) The ERY Systems of South India 3) "KUDIMARAMAT" 4) Medieval Period Tank :The Vijayanagar Empire 5) Tanks : Major Problems in Minor Irrigation 6) Decline of Traditional Water Harvesting Systems 7) "KHADIN" - An Ancient Method of Runoff Farming in Indian Desert 8) The Indigenous Irrigation Organisation in South Bihar 9) "GUHLS" - A Traditional Irrigation System in Garhwal 10) PHAD System of Western Maharashtra 11) Water Management in Areas Irrigated by Tanks 12) Chittaur Kept Head Above Water in Drought

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Technology worth trying...

Ecofriendly methods for controlling Eriophyid Mite on Coconuts

M S Rao,K Ravi and Eshwari Kumar

The pest problem caused by eriophyid mite,Aceria gurrerronis (Keifer) on coconut has reached alarming proportions threatening the very survival of the coconut industry in South India.

In India, this pest was first reported in later part of 1997 from Ernakulam district of Kerala. Within 2 years, it has spread to most of the districts in the states of Kerala,Tamil Nadu and Karnataka. During the same period it was reported to have been found in Sri Lanka too. Though, presently, the major coconut growing countries viz.,Malaysia, Indonesia, Philippines and some Pacific Islands are comparatively free from its infestation, there is a potential danger of the pest spreading to these countries in the future.

The factors or the combination of factors responsible for its entry and spread in India are not yet clear.They could be:

- low population of pest existing earlier which later multiplied into large numbers owing to a breakdown of an existing control mechanism or a sudden change in ecological factors
- inadvertent introduction of the pest into India from other countries
- excessive usage of chemical pesticides resulting in the elimination of parasites and predators of mites leading to the resurgence of the pest

Symptoms of the attack...

Feeding of adults and nymphs in the meristematic region under the perianth causes physical damage. The earliest symptom of attack on the buttons is a triangular patch, yellow in colour, emerging from underneath the perianth. Later the surface becomes necrotic and suberised. Uneven growth results in distortion and stunting of the coconut leading to reduction in coconut yield. Losses are compounded by the losses in husk quality and additional labour required for dehusking. It seems that mites can kill seedlings by feeding on their meristamatic tissues at the growing point, however, so far, damage to coconut seedlings by the pest has not been reported in India.

Control measures...

A number of control measures recommended by some of the agricultural universities involving the aerial application of Dicofol and wettable sulphur, stem injection or root feeding of monocrotophos or triazophos are not eco - friendly and affect the activity of predators and parasites adversely.There were cases reported relating to ill-health and in few cases death of those who consumed the coconuts. One of the primary factors for the ill health were identified as high concentrations of toxic residues.This was caused by the early harvesting of the produce after the application of the pesticide without waiting for the prescribed period.

Based on their research studies, there are few individuals and institutions who are recommending ecofriendly alternatives. Some of them are: Department of Entomology, College of Agriculture,Trivandrum; Kerala Agriculture University;T Stanes and Company Limited and Vittal Mallya Scientific Research Foundation.Their suggestions have been summarised below.

1) Neem oil + garlic + soap emulsion (2%)
2) Neem oil + garlic + soap emulsion (2%) + wettable sulphur (4%)
3) Pongamia oil + garlic + soap emulsion (2%)
4) Pongamia oil + garlic + soap emulsion (2%) + wettable sulphur (4%)
5) A homeopathic preparation (20 ml) for stem injection
6) A herbal preparation (Sanjeewak - 20 ml of 50%) for stem injection
7) Use of a bio control agent - T. Stanes and Company Ltd., Coimbatore, developed a technology for mass production of a biocontrol agent of this mite - a fungus known as Hirsutella thompsonii developed as a water dispersible wettable powder formulation containing 1 x 10 7 spores/g, commerically named as BIO - CATCH.
8) Another powder - a product " Solu Neem" powder (product to be registered) for stem injection for the management of coconut mites developed by Vittal Mallya Scientific Research Foundation, Bangalore.

ame has initiated a research project in the areas of its operation where the coconut plants are threatened by the mite.The conditions are slightly different in terms of choice of varieties, soil properties and cropping practices (choice as a monocrop; planting density; intensity of the infestation of the pest).The above mentionted treatments as well as few other location specific alternatives are being tested. Based on the results of the PTD experiments, ame intends to promote technologies for the sustainable and integrated management of coconut mites. ■

How the mite looks and its life cycle...

The Eriophyid mites have vermiform, elongated body distinctly divisible into a cephalothorax and a long ringed and tapering abdomen and only two pairs of legs situated near the anterior end of the body both in the adults and in the two immature stages.This mite possesses two long sinuous setae arising from the posterior end of the body. Mouth parts are adapted for biting, piercing and sucking. Sex dimorphism is lacking.

A female mite lays about 20 - 100 eggs during its lifetime.The eggs are glossy, transparent and hatch in two days. The first instar nymph moults after two days and becomes the second instar nymph which becomes adult in two to three days. The nymphal stages are usually sedentary. The nymphs and adults feed on the sap from the meristematic tissues of the growing point of the developing nuts. The mite completes life cycle in 10 - 12 days and is capable of multiplying many fold within a short period of time according to Dr. Mohanasundaram, Kerala. When the population increases the adults move out of the perianth and are blown off by wind.

In coconut tree, the mites inhabit in clusters on the basal portion of the inner perianth and also at the region of attachment of the ovary with inflorescence stalk which is tender and soft.

Selected references:

1. **G. Madhavan Nair and others** *Infestation and management of coconut mite Aceria Guerreronis (Keifer) in Kerala - an overview.* (Indo-UK Workshop on Innovative... transfer, Chennai, 10 - 11, March, 2000).
2. **Pestology issues** Vol. XXIV nos 1 & 2 January & February 2000

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