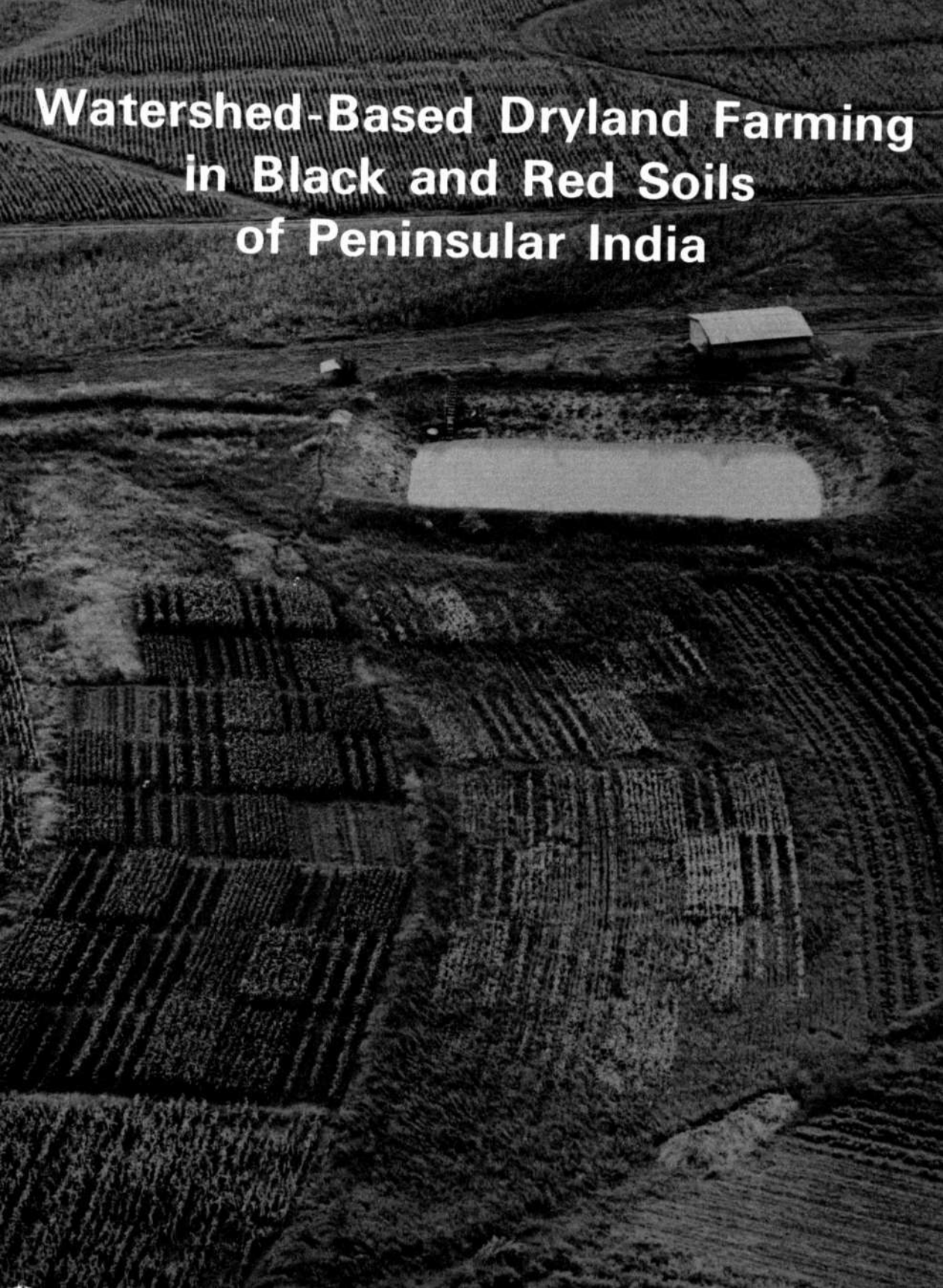
Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India



Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India

Proceedings of a Workshop held on 3-4 October 1983 at ICRISAT Center, Patancheru, A.P.. India

Cosponsored by

NABARD	The National Bank for Agriculture and Rural Development
The Indian Council of Agricultural Research	IGAR
ICRISAT	The International Crops Research Institute for the Semi-Arid Tropics

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Preface

A workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India"—organized jointly by NABARD, ICAR and ICRISAT—was held at ICRISAT Center, Patancheru, AP, India, on 3-4 October 1983. It was in response to a recommendation made by a National Workshop on Dryland Farming held in New Delhi in April 1983.

Seventy-nine senior officials from the departments of agriculture of the Government of India and the states of Andhra Pradesh, Karnataka, Madhya Pradesh, and Maharashtra? ICAR; ICRISAT; NABARD and other lead banks gathered for an exchange of views. Although the present workshop was third in a series begun in 1981, this was the first meeting in which banking and financial institutions participated on such a large scale—and at decision-making levels. The deliberations resulted in a set of accepted recommendations toward an action plan for the development of dryland agriculture.

The workshop focused on improved technologies developed by ICRISAT ana ICAR for management of Vertisols (deep black soils) and Alfisols (red soils). It discussed field-scale experiences gained in the planning, design, and operation of watershed-based improved technologies in the four states; evaluated their credit and technical-support aspects and recommended a well-knit, area-specific blend of credit, infrastructure, and extension support for the wider diffusion/transfer of available technologies.

This report summarizes the proceedings of the workshop. Part I presents a resume of each session and contains the set of recommendations agreed upon for further action. Part II contains extended summaries of the nine main papers presented. Taken together, these reflect the status of the technologies available, field-level experiences with them, and the present thinking on credit.

This report is intended to carry a step further the expressed urgencies of improving dryland agriculture in India on a watershed basis. We hope it will be of interest and use to the policy makers in the central and state governments, bankers, and administrators dealing with agricultural research and development.

Part I

Summary of Proceedings

Summary of the Proceedings

Session I. Chairman: Dr. LD Swindale

Dr. LD Swindale, Director General, ICRISAT, welcomed all the participants. Dr. Swindale said that in hosting the conference, ICRISAT was carrying forward its mandate to help develop improved farming systems that will increase and stabilize agricultural production in the seasonally dry, rainfed Semi-Arid Tropics (SAT), through more effective use of the natural and human resources available in the region.

The technology developed by ICRISAT for deep black soils had been unaer test in Andhra Pradesh, Karnataka, Madhya Pradesh, and Maharashtra. Its performance and progress would be reviewed during the workshop along with that of a technology developed by ICAR for red and related soils.

Referring to the need to promote dryland farming, Dr. Swindale pointed out that the per capita income of the rural people in dryland areas was about one-fourth of the national average. Also, as the growth rate of food production had slowed down and irrigation development had fallen behind targets, a special effort was needed to improve productivity of dryland crops.

Dr. Swindale quoted from progress reports of work done in the four states of India to show that improved technology benefits not merely the individual farmer, but society as a whole, through higher incomes, more employment, and reduced soil erosion and runoff. He also mentioned that farmers visiting ICRISAT had asked for effective programs of price support for dryland crops.

Mr. Sant Dass, Managing Director, NABARD, introducing the workshop, said it would give the financing institutions an opportunity to understand the new technologies so that they could respond to the emerging credit needs, even as it would enable agricultural scientists and administrators to understand precisely what requirements were to be met before the financing agencies could step in.

While agencies for disbursing credit are available all over India, conditions had to be created to ensure smooth flow of credit to the sectors where it is most needed, especially in watershed development and dryland farming, Mr. Sant Dass said.

Mr. Sant Dass asked for attention to pricing support policies for dryland crops, as well as to infrastructural components and arrangements to cover the risks of farmers. An integrated approach to watershed development may well call for organizational innovations, he said.

Mr. Sant Dass also pointed to heavy overdues from farmers on credit already disbursed, and said this limits the resources available for recycling. He expressed the hope that the workshop would develop an action plan so that each participant would leave with a clear idea of what he had to do in relation to others.

Mr. SP Mukerji, Secretary, Department of Agriculture and Cooperation, Government of India, delivered the keynote address. The salient points of his address are as follows.

"This triangle of ICAR and ICRISAT at two ends, and NABARD at the other, is going to be what I would call a green triangle to make our dry areas green. ICRISAT, I am told, is doing good work on deep black soils; ICAR is doing good work on red soils; and NABARD could make black soils as well as red soils green with credit support. I hope this workshop will provide the occasion to solemnize this wedding between money and technology.

I need not emphasize that dryland farming has got great social and economic implications for this country. Some 70% of the cropped area is rainfed. Oilseeds and pulses–vital crops for the national economy involving foreign exchange in import of edible oil–are grown mostly in dryland areas. If these dryland areas are helped to increase production of oilseeds and pulses, it will improve the country's economy to a great extent. About 53 million tonnes of food grains–40% of our total production–are produced in dryland areas.

Any hesitation to provide adequate credit support to dryland agriculture is likely to affect not only our food-grain economy, but the economy of the country as a whole. It is for these pressing reasons that dryland farming has been selected as the first item of the Prime Minister's 20-point national development program.

Admittedly, dryland farming is as different from irrigated farming as is agriculture from industry. The parameters, the norms, the risks in dryland agriculture are very different from those in irrigated areas. Our entire attitude to dryland farming will have to be changed. Dryland agriculture should get preferential treatment in terms of interest rate, subsidy, and repayment period.

Although dryland areas cover 70% of the cropped area, they account for only 15% of the total fertilizers consumed in the country. The irrigated areas, which constitute about 30% of the cropped area, consume 85% of the fertilizers. This impoverishment of nutrients for dryland crops has to be corrected. One way is to bring water to the soil, but it should be cost effective. We have observed that once water is conserved and used efficiently it is easier to promote use of fertilizers in drylands. There are various implements which have been designed; these can put the fertilizer and the seed together at two different depths to complement use of subsoil moisture. Last year, a campaign for propagating the use of seed-cum-fertilizer drills in the country was conducted, and 67 000 such drills were distributed.

With regard to credit where overdues of loans are a problem, these have to be combated with ruthless efforts, but to be over-apprehensive about overdues is not going to help dryland agriculture. We should start with a sense of constructive aggressiveness: a preparedness to take risks, and an anticipation of some failure also. In the dryland farming sector pioneering efforts would have to be made. My ministry has noted that the percentage of borrowing members in the cooperative primary agricultural credit societies is only 27% in Andhra Pradesh, 19% in Karnataka, 35% in Madhya Pradesh, and 25% in Maharashtra. In this

situation our aim should be to reach the loans to the farmers, rather than withhold them on the plea that overdues would mount. We also need to pay greater attention to postdisbursement nursing of credit given to farmers.

I believe a crop insurance program should be taken up in the dryland areas with proper subsidy from the Central and State Governments. There is a centrally sponsored scheme of crop insurance, which should be coordinated in the dryland areas so that NABARD's funds or the lead bank's funds are properly protected if there is a crop failure.

What should be our strategy and action? The first point to consider is land and water management for which watershed approach has been already accepted. This will need a lot of investment and for that investment, NABARD and the banking institutions would have to help in a big way. The second is the problem of inputs. I have identified 7 inputs, which are vital to agricultural production. These are, technology; supplementary irrigation and water availability; seeds; fertilizers; pest management; agricultural implements; and credit. You will be pleased that in the dryland areas also, national input fortnights with these 7 inputs in view are being observed enthusiastically.

A few points for consideration. First, ICRISAT, ICAR, NABARD, Universities and Cooperatives could adopt watersheds for dryland farming in villages. If even one Institute adopts one village, it will have a great demonstration effect. We have launched from the GOI 3 schemes, which are very much related to dryland farming. The first is the small and marginal farmers program. It is a Rs.2500 million program, under which we give to the State Governments Rs.0.5 million per block. I would suggest that this scheme be introduced in the watersheds that you have selected. The next is a 100% central scheme–75% is given as grant and 25% as loan. We are giving Rs.0.84 million per district in 19 districts. The money is to be utilized mainly for water-harvesting structures and demonstrations. In the third scheme also Rs.0.84 million per district is given, but half of it is given by the State and half by the Central Government, and this is for implements and demonstrations. I would suggest that these 3 schemes are taken up in the selected watersheds and districts. On agricultural credit my suggestion is that some amount of institutional finance should be earmarked for dryland farming.

With regard to training under the T & V system, I suggest that training courses on dryland farming techniques should be launched for suDject-matter specialists. This trained staff should then be posted in the focal watershed areas. ICRISAT's presence here should be availed of to get our subject-matter specialists trained on the deep Vertisol technology. The ICAR, agricultural universities, and the state departments of agriculture should also launch training programs for dryland farming suited to different agroclimatic regions.

We now have plans for a viable organization at the national level with branches in the states to purchase coarse grains, pulses, and oilseeds–grown mostly in dryland areas–at previously announced remunerative prices. This, I think, will help the dryland farming economy.

Above, Mp. S.P. Mukerji, Secretary, Department of Agriculture & Cooperation, Ministry of Food & Agriculture, Government of India, delivers the keynote address. Others (from left) are: Mr. Sant Dass (NABARD), Dr. L.D. Swindale (ICRISAT), and Dr. R.P. Singh (AICRPDA). Below, participants at the workshop get a first-hand view of the watershed-based technology at ICRISAT Center.

In terms of the administration of the watersheds, just as we have got command area authorities for irrigated areas, in the dryland areas also we should have a watershed authority officer of the rank of even a commissioner as you have in command areas, and these watershed authorities should fix year-wise and crop-wise targets of cropping pattern, yield per hectare, cropping intensity, production, agricultural credits, coverage by high-yielding varieties, distribution of minikits, tree plantation, and so on."

Mr. Mukerji's keynote address was followed by presentations by Dr. RP Singh and Dr. SM Virmani on the technologies developed by ICAR and ICRISAT respectively. A brief summary of each of these papers follows (for a fuller version of them, refer to Part II of this publication).

Summary of the ICAR paper on "Technology Options for Increasing Crop Production in Red and Black Soils, Credit Needs and Policy Issues": The agro-techniques developed by the All India Coordinated Research Project for Dryland Agriculture (AICRPDA) over the last 12 years have clearly shown the vast scope of increasing crop production in dryland areas. Upto 200% increases in yield are possible for cereals, and 50-75% for pulses and oilseeds. The main components of the improved technology are: early seedbed preparation and timely sowing; use of high-yielding/hybrid seeds and ensuring optimum plant population; use of moderate levels of fertilizers according to recommended timings and methods of application; timely weed control; and effective use of pesticides. Adoption of improved technology can insulate the crops against drought to a considerable extent, but alternate crop strategies have also been developed to meet aberrations in weather. Soil and water conservation is an important component of the technology. Apart from mechanical structures to prevent runoff and soil erosion, means to increase in-situ moisture conservation and reservoirs for storing and recycling runoff water have also been developed.

Cost estimates and credit needs for some soil-water conservation measures and cropping systems are indicated. Alternate land-use systems ana their benerit:cost ratios are also given. The need for strong credit support, infrastructure development, custom service facilities, training of farmers, and price-support to dryland crops—all helpful measures in the development of dryland agriculture—is indicated.

Summary of the ICRISAT paper on "Policy Issues in the Generation and Transfer of Watershed-Based Dryland Farming Technologies in the Black Soils of Peninsular India": A technology has been developed by ICRISAT to increase the productivity of deep black soils receiving dependable rainfall. Such areas are estimated to cover 5 to 12 million ha in India. The main components of this technology are: land cultivation after harvest of the postrainy-season crop; use of graded broadbeds and furrows (BBF); dry seeding before the monsoon with improved seeds; use of moderate levels of fertilizers with improved placement techniques; and timely plant protection. In test watersheds the improved technology has given crop yields 300-500% higher than those from farmers' traditional practices. On-farm verification trials based on this technology are now being carried out in 28 districts of 4 states by

officials of the concerned departments of agriculture. While development costs of the watershed test sites varied from Rs.200 to 1000 per ha, the rate of return on additional investment ranged from 25% to 380%. The minimum additional finance required for the application of this technology may be Rs.1000/ha for a cropping year.

Several policy issues related to technology, credit, marketing, infrastructure, and training are mentioned. Major changes in the quantum and norms of credit disbursement in dryland agriculture may be required. Criteria for the selection of watershed-based project sites have been listed, such as accessibility, coordination with research institutions, willingness of participant farmers, and infrastructural support. There is an urgent need to develop watershed development authorities at the national and state levels to plan, execute, and conduct developmental work in the selected watersheds.

Session II. Chairman: Dr. JS Kanwar

The improved dryland technologies were outlined by Dr. RP Singh, Project Director, AICRPDA and Dr. SM Virmani, Program Leader, Farming Systems Research Program, ICRISAT. It was pointed out that the ICRISAT technology was specifically for the deep black soils in the dependable rainfall areas (> 750 mm per year), and the ICAR technology for the lighter red soils and/or drier regions. Both papers emphasized the need for land and water conservation on small watersheds, involving at least some land snaping or change in land configuration. They described the improved cropping practices being tested and showed the greater crop productivity possible from them in small watersheds. The need for adaptive research in different environments was brought out and infrastructural constraints, especially those of timely availability of inputs and of credit, were focused upon.

It was emphasized that BBF is a critical component of the ICRISAT package: its role is to provide drainage and to allow cropping in the rainy season (kharif)* where it would not otherwise be possible. The improved drainage provides a 200-300% increase in returns from the improved technology package over those from traditional practices.

It was generally felt that there had been a reluctance to invest in dryland agriculture in the past. While dryland agriculture is inherently more prone to risk than irrigated situations, this is something we should be prepared to accept, the speakers urged.

It was emphasized that although carrying out land and water conservation on a watershed basis allowed greater crop productivity and conserved as well as improved the farmer's resource base, it also required investment by farmers in the layout of watersheds which would initially need Government support.

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* Throughout this report, kharif is used synanymously with the rainy season, and rabi with the postrainy season, in accordance with terminology common in India.

The bankers asked for a clearer statement of the credit proposals for the improved technology: quantum required, benefit:cost ratios, length of term, etc. It was pointed out that as the technologies are location specific they have to be modified for a given environment. For the dryland technologies being proposed, these modifications were a matter of degree, not requiring any basic changes. Because of this location specificity, it was felt that details of support schemes would have to be worked out on a local basis. It was urged that as far as possible, local bank representatives should be in close touch with the field situation.

Session III. Chairman: Mr. M Gopalakrishnan

Four papers were presented by the representatives of the state governments of Andhra Pradesh, Karnataka, Madhya Pradesh, and Maharashtra. These pertained to the status of dryland farming in the respective states. The main points from these papers are highlighted here, while a fuller summary is given in Part II.

Mr. CS Sastry, Secretary, Food and Agriculture, Government of Andhra Pradesh, described the various dry-farming development programs in AP and the constraints and difficulties in their implementation. He felt that though the results for the last two years have been encouraging, it is too early to evaluate the effects and impact of the Vertisol technology. The important suggestions made by him are:

i. As it may take 2-3 years to stabilize yields with the new technology, production credit for the first year may be treated as a term loan repayable along with the capital cost of land development.

ii. The viability of each technology has to be spelt out clearly, and the districts/areas where rainfall is sufficient to test and expand the technology–in both Vertisols and Alfisols–identified accordingly.

iii. A 50% subsidy and 50% loan be given to all categories of farmers for expenses on land and rainwater management and to subsidize the cost of wheeled tool carriers.

iv. The government should take up community drainage works and farm ponds.

v. The present crop insurance scheme should be extended to larger areas and should include a wider variety of crops.

Dr. J Venkateswarlu, AICRPDA, suggested that the following districts of Andhra Pradesh be taken up for dry-farming development in Alfisols: Visakhapatnam, Srikakulam, Vijayanagaram, and all Telangana districts except Nalgonda. In each of these districts the mean annual rainfall is over 750 mm, and the soil depth more than 20-25 cm. He clarified that profitability in operational-scale research projects in Alfisols has been upto 200% above the traditional practices. Mr. VK

Srinivasan, Commissioner for Institutional Finance, Government of Andhra Pradesh, suggested that the schemes formulated in each district be included in the district credit plans; chronically drought-prone districts like Anantapur should also be covered.

Mr. M Gopalakrishnan, Agricultural Production Commissioner, Government of Andhra Pradesh, suggested that (i) rain gauges may be installed in the watershed areas? (ii) steps may be initiated to grow the suggested crops in the watersheds; (iii) feasibility of a yield-guarantee system may be examined? (iv) training facilities of different institutions may be enlarged and strengthened; and (v) the role of government in capital investment for developing such resources may be clearly defined.

Mr. JK Arora, Secretary, Agriculture, Government of Kamataka, stated that 85 watersheds–covering an area of 42 500 ha–were taken up for the development of dry farming in 1982-83; it is programmed to take up 175 000 ha in 175 taluks in 1983-84. The state is thinking of setting up a Dryland Development Board. As heavy investments are needed by farmers for land and water management, the help of the Government of India as well as the State Government will be necessary. Mr. PR Nayak, Development Commissioner and APC, Government of Karnataka, stated that the Vertisol technology is being tested even in districts where rainfall is less than 750 mm per annum. He sought more details on the economics of farm ponds and on resolving problems connected with waterways.

Mr. GS Sachdev, Additional Director of Agriculture, Government of Madhya Pradesh, described the dryland farming programs in MP. He said that intercropping of pigeonpea with soybean is gaining popularity and kharif fallows are declining. Programs of minor irrigation and water harvesting are being taken up to reduce rabi fallow. He mentioned that 6-year watershed-based master plans for each district are being prepared, and that multidisciplinary committees at the state and district level have been constituted for monitoring the programs, with the agricultural department acting as the nodal point.

Mr. K Rajan, Secretary, Agriculture and Cooperation, Government of Maharashtra, said that 600 comprehensive watershed development programs at 3-4 per village were taken up in 1983-84. Of the total potential of 13.6 million ha in the state, 8.7 million ha were covered so far with land and water management systems. Staff are deployed under the T & V system to help effective transfer of technology. He wanted that the GOI should give financial assistance–on the pattern of IRDP–to all benericiaries in the dry-farming areas. Mr. DV Dixit, Additional Director of Agriculture, Maharashtra, pointed out that there should be effective linkages among the staff involved in land and water management, the T & V system, and suppliers of input for successful implementation of comprehensive watershed development programs.

Session IV. Chairman: Mr. SP Mukerji

A paper was presented by the representative of NABARD. Papers prepared by the AFC and Bank of Baroda and distributed at the Workshop, and also papers presented earlier by ICAR and ICRISAT, formed the basis of discussion.

Mr. Sant Dass, Managing Director, NABARD, presented the NABARD paper. He described three approaches to lending: (1) a farm-family model; (2) a component-wise arrangement in each microwatershed; and (3) a grassroots organizational approach that featured lending to a panchayat, cooperative, or other organization.

Mr. Sant Dass outlined several policies to deal with borrower and institutional credit default. He described the Special Loan Account (SLA) where funds for land development were provided on a project basis in Command Area Development, even if individual borrowers were ineligible. In determining credit eligibility, overdues of up to Rs.1000 are ignored. Moreover, eligible members of an ineligible cooperative could still receive funds from eligible Central and State Cooperative Banks (CCBs & SCBs). Another option, which has been tried in Gujarat, was to have small farmers repay 25% of the overdue to reinstate their eligibility for short-term credit in the forthcoming season. Mr. SP Mukerji wondered if this option could also include long-term credit. Mr. Sant Dass replied that such an arrangement would not be possible at present. He also sought information from the state and central governments on the levels of subsidy required to finance watershed-based dryland agriculture. Mr. Mukerji suggested that if the majority of farmers in a watershed are defaulters, then that watershed should not be developed and the SLA facility should be extended to other regions.

Mr. PR Nayak, Development Commissioner and Special Secretary, Government of Karnataka, made five points in response to the NABARD presentation. First, viability standards for bankable projects in dryland agriculture should be made less rigorous than for irrigated agriculture. Second, crop husbandry activities could be entrusted to the existing T & V system. Third, a statutory authority to borrow and channel funds for compulsory land development activities is needed. Fourth, development activites carried out on farmers' fields should be financed through credit, and similar work implemented on public land should be subsidized by the government. Lastly, public investment in land development in dryland farming can be financed from existing schemes.

Several delegates from different states and banks stated that adequate loans and subsidies should be available for land shaping and leveling, while community works should be carried out by the government.

Mr. K Subrahmanyam, Secretary, Forests and Rural Development, Government of Andhra Pradesh, commented that dryland farming projects were much more difficult to administer than irrigation projects. Administrative competence needed to be improved. He pointed out that a major reason for overdues and ineligibility was that many projects in the past were not economically sound. He suggested, therefore, that in future dryland projects should be confined to areas which have a high production potential and where improved technologies are readily available.

Mr. M Gopalakrishnan, Agricultural Production Commissioner/ Government of Andhra Pradesh, added that a cadre of staff along the lines suggested by Mr. SP Mukerji was needed. Mr. PR Nayak stated that the T & V system should be intensified in dryland areas and the ratio of farm families per extension worker should be reduced from 800:1 to 400:1. Mr. CS Sastry, Secretary, Food and Agriculture, Andhra Pradesh, said that the volume of lending and the amount per beneficiary had increased recently in Andhra Pradesh. Mr. SVSN Raju of the State Cooperative Bank of Andhra Pradesh supported the trend of increased lending. Mr. SP Mukerji suggested that the state governments and banks should monitor the proportion of agriculture credit allocated for dryland farming.

Mr. RC Jain, Secretary, Agricultural Development, Government of Madhya Pradesh, said that before institutional finance of dryland agriculture could be realized on a large scale, appropriate procedures had to be identified and agreed upon by banks and the central and state governments. There is not enough expertise yet to formulate bankable projects on a large scale covering 30 to 40 thousand hectares. According to Mr. B Venkata Rao, General Manager, NABARD, the project approach to microwatershed development facilitated speedier adoption of technologies, as it would enable bankers to select one of the three lending approaches outlined in the NABARD paper for formulating bankable schemes.

Mr. KM Udupa, Divisional Manager, Rural Development Division of the Syndicate Bank in Karnataka, described an innovative scheme. A native resident in the village is the focal point of this scheme. He processes certificates, monitors loans, and provides technical guidance in input and output marketing. A family-cum-total-village approach is emphasized. These "farm clinics" have achieved a loan recovery rate of over 90%. Mr. SP Mukerji said that this experience should be studied carefully to determine its applicability on a wider scale. Mr. AR Patel, Bank of Baroda, Bombay, also reported encouraging results in microwatershed planning and development.

Dr. NS Jodha, ICRISAT, cautioned that project specifications should be adhered to and flexible norms in lending and recovery were necessary.

Mr. BP Sikdar, Ministry of Agriculture, Government of India, recommended that fertilizer suppliers be subsidized so that fertilizer is stocked and made available on a timely basis. He also indicated that projects be targeted in those districts where fertilizer supplies are not a constraint. Mr. SVSN Raju pointed out that scales of finance have to be flexible as unit costs will vary with different cropping systems.

Dr. RP Singh, Project Director of AICRPDA, described the agronomic and economic profiles of several technological recommendations suited to diverse soil and agroclimatic environments. Several participants commended this effort, but felt that more detailed information on input-output relationships and watershed development costs was needed. Mr. PR Nayak stressed that viable zonewise models–with technical, economic, and financial information–were needed.

Mr. Sant Dass assured Mr. CS Sastry that NABARD will have no hesitation in underwriting loans and in supporting the pilot projects in six districts of A.P.

Mr. CS Sastry also inquired whether crop insurance could be implemented in the pilot watersheds with a 50-50 share responsibility between the state and central governments. Mr. K Ardhanareeshwaran, Joint Secretary for Credit, Ministry of Agriculture, GOI, said that in the experimental crop insurance scheme, the proportion between low, medium, and high risk areas covered was slated to be 3:2:1, and this should be sufficient to cover the pilot projects in Andhra Pradesh.

Mr. SP Mukerji concluded the session by making several recommendations to improve watershed-based dryland farming development. These were discussed by the participants and the set of recommendations adopted by the house are given on the following pages as proceedings of Session V.

Session V. Chairman: Mr. Sant Dass

The session was devoted to discussion and acceptance of recommendations. The following recommendations were adopted.

Recommendations of the Workshop:

1. General

1. The workshop recognizes that the interaction among technical and financial personnel and administrators concerned with the development of dryland agriculture has been very useful. It has led to a better understanding of the implications for the adoption of new technologies. It is suggested that such dialogues should be continued at different levels. (Action : States)

2. The various aspects of dryland areas have to be examined in a comprehensive way and a data base built up to advise Governments on appropriate strategies to improve and stabilize production in these areas. It is recommended that the Government of India consider setting up a National Institute on Dryland Farming. (Action : GOD

3. The need to create a suitable authority/organization for dryland areas, on the lines of the Command Area Development Authority (CADA), is recognized. It is suggested that a small group (drawn from the GOI, the States, ICAR/ICRISAT, NABARD, and the banks) may be set up to look into the scope, framework, and functions of such an authority/organization. (Action : GOI)

4. It is suggested that states having large dryland areas may also consider organizing workshops/seminars, such as the one being planned by Karnataka, to discuss the setting up of a Dryland Development Board. (Action : States)

5. The microwatershed should be adopted as a basic unit for transfer of dryland technologies. Conservation/harvesting of water resources on a watershed basis should receive top priority in the strategy for development of drylands. Other components of increased crop production such as improved seeds, fertilizer, agricultural machinery, plant protection measures, etc., should be adopted in coordination with water availability. (Action : States).

6. For the successful transfer of dryland technology certain essential community assets, such as drainage works, farm ponds, water harvesting structures, etc., should be undertaken at government cost. Likewise, bullock-drawn wheeled tool carriers should be subsidized. In the case of works undertaken by the farmers on their own fields for drainage, soil/water management, etc., the subsidy could be 50% of the investment. (Action: States)

7. While crop production would be the main focus of development in dryland agriculture, adoption of complementary land-use systems like agro-forestry, silvo-pastoral, and animal husbandry programs on an integrated basis, would improve the viability of the programs taken up. This objective may be kept in view during formulation of projects for the selected microwatersheds. (Action: States)

8. There should be price incentives for farmers to increase production of pulses and oilseeds. The GOI proposal to ask the Food Corporation of India (FCI) to undertake price support operations for these crops is, therefore, welcome. (Action: GOI)

9. To reduce the risks in investing or providing larger financial resources for dryland agriculture, the feasibility of crop-cum-loan insurance schemes in the microwatershed areas may be examined. In the meantime farmers adopting improved technologies may be given a minimum yield guarantee, based on production under the traditional method of cultivation. (Action: GOI, Ministry of Agriculture)

10. There should also be arrangements to evaluate and compare the investments in dryland agriculture with those in irrigated agriculture, to ensure efficient allocation of resources between the two sectors. (Action: GOI, Ministry of Agriculture)

II. Technical Aspects

1. Areas where dryland agricultural schemes can be implemented with assurance of a fair amount of success should be made known to the financing agencies. Technical support, disbursement of credit, and supervision would be more purposeful if development is taken up in such compact areas. (Action : GOI, States)

2. Water harvesting and recycling technology has been viable in some specific locations. Further research is required on this aspect. Analysis of water harvesting and supplementary irrigation, which will ensure establishment of the postrainy-season crop in double cropping systems, may be taken up. (Action:ICAR/ICRISAT/Universities)

3. Further research is needed for developing dryland farming in environments with low and undependable rainfall. Similarly, there is need for systematic collection and analysis of data pertaining to rainfall and its distribution, to identify areas with the best potential for implementation of dryland projects. (Action:ICAR/ICRISAT/Universities)

4. Studies for improving the efficiency of applied nutrients, particularly nitrogen, in dryland farming require special attention. (Action:ICAR/ICRISAT/Universities)

5. Results from trials carried out in farmers' fields suggest the need for: (i) adaptive research on alternative land-use systems to ensure technology packages tailored to regional needs; (ii) cheaper alternatives to available models of the farm machines, which would suit the animal draft power available locally; (iii) modifications in the broadbed-and-furrow system for higher rainfall environments and for different farming situations; and (iv) steps in the technology experiments to measure the benefits from specific components of the package. (Action:ICAR/ICRISAT/Universities)

6. NABARD may examine the feasibility of assisting, from its Research and Development (R&D) Fund, programs of research needed for adoption of dryland farming technology. (Action : NABARD)

III. Formulation of Projects

1. The formulation of projects for selected microwatersheds may be entrusted to organizations equipped for this purpose (like AFC/Lead Banks/State agency), which may undertake the task jointly with other concerned departments. The projects should be completed within 6 months from the allocation of microwatersheds. Guidelines for the formulation of the projects would be prepared by NABARD jointly with AFC and Lead Banks.

2. In selecting the microwatersheds preference may be given initially to those areas where adequate arrangements for storage, supply of inputs, credit and marketing facilities, etc., either already exist, or can be organized in a short time. Where defaulters of institutional loans are large in number, such watersheds need not be taken up in the first instance. (Action: States)

3. The microwatersheds identified each year by the state governments should be allocated among the LDB/SCB and Lead Banks, according to the organizational capability available with them for formulation of projects. This should be done by a district-level coordination committee set up under the microwatershed project. (Action points 1 to 3: States, NABARD, RPCD, Lead Banks, AFC).

4. It is recommended that one of the following procedures may be adopted for formulation of bankable schemes within each microwatershed, depending on the local situation, after taking into account the subsidy available under various programs and the need for adequate gestation/repayment period:

   i. The program for each farm household for the introduction of improved dryland technologies may be formulated by banks jointly with the project technical staff. Simultaneously, all the community works such as community drainages, water harvesting structures, etc. should be undertaken by project authorities and arrangements for their maintenance made through farmers' groups, panchayats, or cooperatives.

   ii. In those microwatersheds where the general level of adoption of new dryland technologies is fairly uniform, separate bankable schemes for each component may be formulated, e.g. soil/water conservation structures or farm forestry or animal husbandry, etc., to go with crop management programs.

   iii. Once a viable project is formulated, the complete planning and execution of all the works in the microwatershed in a coordinated manner (at Government cost or on behalf of farmers) may be entrusted to a suitable organization or authority set up for a group of watersheds. (Action for points i-iii: States, NABARD, RPCD, Lead Banks, AFC).

IV. Credit and Infrastructural Support

1. Financing of dryland farming has to be viewed differently from that of irrigated farming. The terms and conditions for advancing loans and the funding arrangements for banks/NABARD, as well as the criteria for determining the viability of projects, may have to be different. A clear picture regarding the credit needs for dryland farming would emerge, however, only when some microwatershed development projects are prepared. An Expert Committee may go into these aspects and make suitable recommendations at that time. (Action:NABARD, Banks, States).

2. NABARD may set up a separate division to handle dryland farming, open a separate line of credit for dryland farming, and monitor the flow of funds for the purpose. In the meantime, NABARD may

enforce the norms currently applicable to irrigated farming in the dryland areas in a flexible manner, keeping in view the specific needs of each farm household so that adequate credit support becomes available. Credit limits may be fixed on a yearly basis, with facility to operate upon them as cash credits according to the crop requirements. The loan for seeds, fertilizer, insecticides, etc., should be disbursed in kind. Credit should be ensured to nondefaulting and new members where the cooperative institutions are ineligible for assistance from the higher financing agencies. The steps already taken by NABARD in this regard are noted; the organizations engaged in the execution of watershed development projects may be provided bulk finance on the lines of financing LDBs. (Action : NABARD)

3. In each microwatershed for which a project is formulated, the State Government may identify a primary agricultural credit society (PACS). It should strengthen its facilities, resources, and staff to provide all services needed by farmers at one place, and assume responsibilities in program formulation, implementation, and supervision. The society should get a guaranteed supply of inputs and have facilities for handling them as well as for hiring of equipment. Arrangements for supply of inputs should be supported by adequate quality control measures. The PACS could also serve as an agent of FCI for giving price support to the produce of dryland areas and for recovery of loans. (Action : States)

4. State Governments may submit suitable schemes under which, on repayment of a minimum proportion of the overdue loans (25% in the case of small farmers and 40% in the case of large farmers), the defaulting members will be eligible for fresh short-term financial assistance for undertaking programs for dryland farming, the balance of overdues to be recovered along with the loan. Alternatively, GOI and states may consider contributing to a Special Rehabilitation Fund (on the lines of SLA in the CAD areas), which can be used to make defaulting farmers eligible for fresh loans. (Action : States)

5. The state or district authorities should identify the branches of CB/RRB, which should assume responsibility (in addition to PACS) for financing the beneficiaries in each of the watersheds included in the project. The steps to be taken for the preparation and implementation of the farm-family programs may also be indicated. (Action : States)

6. The credit requirements of dryland agriculture should be assessed and incorporated in district credit plans, and annual action plans should be drawn up to ensure adequate credit support to these projects. State Governments may prepare credit cards or pass books to facilitate speedy verification of the title to land owned/leased by borrowers and outstanding dues, if any. (Action : States, Lead Banks).

7. Many small/marginal farmers require training in the adoption of new technologies, including the use of farm implements. Suitable training arrangements may be made for them . The T & V system should be intensified so that the ratio of farm families per field assistant is brought down to 400:1. More subject matter specialists should also be trained. (Action : States/ICAR/ICRISAT)

8. In the selected areas there should be arrangements for providing implements, such as wheeled tool carriers and sprayers, and where feasible bullocks also, on custom hiring basis. Where PACSs are not equipped for this purpose, agro-service centers should be set up. Training of educated unemployed youth under the TRYSEM or some other national program may be undertaken for setting up such centers. (Action : States).

9. There is urgent need for training of staff at various levels for formulation and implementation of financing schemes for dryland agriculture. Programs for training may be organized simultaneously with the formulation of microwatershed development projects, with help from ICAR/ICRISAT and Universities. (Action : States/Banks)

10. Where necessary, CBs should be asked to introduce mobile credit officers, who will provide technical assistance in the preparation of farm-family programs, supervise and monitor their implementation, collect dues, and thus supplement the extension efforts of the government agencies. (Action : Lead Banks).

Part II

Background Papers (extended summaries)

Technology Options for Increasing Crop Production in Red and Black Soils, Credit Needs and Policy Issues*

Introduction

The extent of red soils in India is 60 million ha, while that of black soils is 73 million ha. The estimates of actual area under arable farming are not available for red soils. In black soils, arable farming is done on about 24 million ha.

The black soils are more productive than the red soils. They are deeper, have more clay (30-70%), and hold more water. They are also heavy and tend to erode. The runoff in these soils could vary from 10 to 40 per cent depending on the rainfall and slope. The soils are poor in nitrogen and adequate in phosphorus at moderate levels of production. The reserves of potassium are adequate. Sometimes zinc might be deficient, especially for higher production levels. Surface drainage is important. In shallow soils, rainy-season (kharif) cropping alone is possible. In deep black soils with low rainfall only postrainy-season (rabi) cropping can be attempted. In high rainfall areas double cropping is practiced in large measure. In some flat lands, however, only rabi cropping is practiced. In the medium soils intercropping is recommended.

The red soils are shallow and more weathered. They are low in clay (10-20%). Their fertility and water-holding capacity is low. The soils tend to crust. Runoff could be upto 20 per cent. These soils are poor in N and P. Deficiency of calcium and sulphur may occur. Potassium might become deficient in light soils under high levels of management. These soils are used primarily for kharif cropping. In high rainfall regions with deep soils (e.g. northern coastal Andhra Pradesh) two crops are taken. In medium rainfall regions, intercropping is a distinct possibility.

The agro-techniques developed by the All India Coordinated Research Project for Dryland Agriculture (AICRPDA) over the last 12 years have clearly shown the vast scope of increasing crop production in these drylands. In the following paragraphs, the present setting, the techniques for increasing and stabilizing crop production in drylands, the implications, credit needs, and policy issues are discussed.

The Setting

The average size of holding is 2 ha across India, ranging from 0.5 ha in Kerala to 4.7 ha in Rajasthan. The holdings are fragmented; while 72.6%

* Prepared by the Indian Council of Agricultural Research (ICAR) and presented at the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India," 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

of farmers are small and marginal, they hold only about 23.5% of the area under cultivation.

Agro-techniques for Increasing Crop Production in Drylands

Among other things, the improved practices for increasing yield of dryland crops include:

- early seedbed preparation;
- timely sowing;
- use of high yielding varieties (HYV) or hybrid seed (HYB);
- achieving optimum plant population;
- use of moderate levels of fertilizers;
- timely and effective weed control;
- t avoidance of pests and diseases through agronomic manipulations; and
- use of pesticides where necessary.

With the adoption of the above practices, yield increases in cereal crops upto 200% are possible in drylands. In the case of pulses and oilseeds, the increase would be 50-75%.

It is important to note, however, that the adoption of simple but improved agronomic practices, which fortunately have a low monetary component, is a prerequisite for success in dryland farming. Without efficient management at the farm level, high-cost inputs like fertilizers or HYB/HYV seed alone will not yield the necessary results.

The Components

a) Sowing. Early sowing of kharif crop is important to capitalize on the recuperated soil fertility and to avoid pests and diseases. Similarly, in the south (below 18 ,N), advancing the rabi sowings is a simple and effective means of increasing crop production. In red soils, early sowing is best done through off-season tillage and early seedbed preparation.

b) Seeds. The HYV/HYB seeds of crops generally yield more than traditional varieties of crops.

c) Plant population. Ideal plant population is something like a good

foundation to a building. Examples of bullock drawn seed-cum-fertilizer drills, which aid in achieving a uniform plant stand, available in different regions are:

Seed-cum-fertilizer drill	Red soil region	Black soil region
Shivaji multipurpose farming machine		Deccan
Eenatigorru	Rayalaseema (AP)	
Pora plow (FESPO)	Telangana (AP)	
Deep furrow seeders	Chotanagpur (Bihar)	
Ragi seed-cum-fertilizer drill	Southern Karnataka	

d) Fertilizer use. That the application of fertilizers pays in drylands is now established. However, they need to be applied in moderate doses. It is also necessary to maintain a balance of nutrients, and to avoid deficiencies either in management (e.g. weeding) or in pest control to obtain full benerits from the applied nutrients. Fertilizer efficiency can be enhanced by proper placement. Split application of nitrogen for kharif crops is also useful, as is deep placement for rabi crops.

e) Weed control. Timely weed control is important. The first weeding has to be done by 3-4 weeks for short-duration crops, and by 5-6 weeks for long-duration crops. To facilitate weeding, wide-row planting with the same level of population is found to be useful. Again sweeps, instead of blades, are found to be useful for interculture operations.

f) Pests. Timely sowing helps in avoiding pests and diseases. For instance, shootfly in sorghum can be avoided with timely sowing. Early diagnosis of the pest facilitates the use of a pesticide. For instance, in sorghum the earhead bug needs early control.

Stability of Crop Production in Drylands

The main source of water for drylands are the monsoon rains. Aberrations

in the monsoon are not uncommon. The most frequent aberrations are: i) delayed onset of monsoon; ii) 'break' in monsoon; iii) early withdrawal of monsoon. Adoption of improved crop husbandry can insulate dryland crops against drought to a considerable extent.

For different agroclimatic regions, alternate crop strategies have been worked out. To meet the 'breaks' in monsoon, several midcourse corrections are now available. The HYB/HYV crops, being of shorter duration, evade the effects of early withdrawal of monsoon. Intercropping is yet another way to meet aberrations in weather.

Soil and Water Conservation

In tropics runorf is inevitable. But the accompanying soil loss removes the top fertile soil and reduces the root profile. To contain these problems, the following options are available.

i) Mechanical structures to prevent soil erosion: Contour bunds are suggested for light soils under low rainfall, and graded bunds for all black soils and red soils under medium to high rainfall.

ii) In-situ moisture conservation: The various means are:

Soil type	Rainfall	In situ water harvesting measures
Red Soils	Low	Dead furrows at 3-6m intervals
	Medium	Sowing on flat and ridging later with eventual cultivation
	High	Graded border strips
Black Soils	Low	Contour cultivation
	Medium	Dead furrows at 3-6m intervals
	High	Graded open furrows (0.2-0.3m^2) at 10m interval across the slope

These systems caused an increase of up to 15 per cent in yield of crops at any given level of productivity.

iii) Reservoir for storing runoff water for recycling: Harvesting runoff into reservoirs and recycling this water to the donor area is a recent approach. The size of the reservoir needs to be at least 250m3 per ha of catchment area, but should vary depending on the location, the acceptance of the farmers, and physiography of the situation.

The payoff for a critical irrigation is upto 20kg grain/ha per mm of water applied. But the percolation losses in reservoirs of the red soil region are high. At present soil:cement (8:1), coal tar (Bitumen), and thick plastics overlaid with brick mortar layer are suggested to reduce percolation losses. They are costly and have competitive uses. Cheap sealants, which would be available locally, need to be identified. Similarly, water-lifting and conveying systems should be developed for optimum and efficient use of the runoff water collected.

Resource Management

There is an imperative need for more efficient use of resources at the farm level. The two important resources are land and water (rainfall). Mechanical structures, where needed, should be constructed on these lands to minimize loss of soil. In-situ water harvesting should be encouraged. Storage ponds need to be created in the farms to stabilize crop production.

To achieve these ends, the farmer's participation is very important as he owns the land. Most of the techniques of soil and water conservation can be easily adapted to a given local situation. Even contour survey can be simplified using an A-frame, so that the farmer himself can participate in planning the soil conservation works on his field.

Alternate Land Use

Depenaing on the land-use capability classes, the land should be put under arable crops, agro-forestry, agro-horticulture, silvi-agriculture, silvi-pasture, or farm forestry systems. This brings ecological balance in the region and prosperity to the land owners.

Implications of the New Technology

The new agro-techniques need more funds. The credit needs and payoff for different crop production techniques are as follows:

System	Credit needs (Rs/ha)	Pay off (Re/Re invested)
Sole crop	550-1000	1.30-2.37
Intercrop	600-1200	1.63-2.68
Double crop	800-3500	1.40-2.47

The costing of permanent assets for soil and water conservation needs to be considered on a separate footing since these are used for a number of years. Their costing is as follows:

Component	Cost(Rs/ha)	Pay-back period
Graded or contour bunds	500-600	20 years
Overall development of land on watershed basis	2000	10 years

Several alternate land-use systems are being evaluated, and their beneiit:cost ratios have been worked out as follows:

Farming system	Annuity value (Rs.)	Benefit:cost ratio
Agro-forestry	1117	1.73
Agro-horticulture	17881	5.78
Silvi-agriculture	2364	2.08
Silvi-pasture	1115	2.56
Farm forestry		
a) Casurina	2812	12.33
b) Eucalyptus	1741	18.60

If the whole program is taken up as an integrated system on a watershed basis, it is estimated that about Rs.3500 per ha would be needed (this includes staffing), and that the payoff would be Rs.2.65 per rupee invested over a period of 5 years.

Some Policy Issues

While crop production in the drylands is to be increased, the technologies should be viable. They should be creditworthy and the investment capacity of the farmers enhanced. As an incentive, the farmer's land needs to be developed in terms of water-harvesting structures and mechanical structures. It should be our endeavor to utilize the farmer's contribution as labor while creating these assets on his land. The costs towards sealants and water-lifting devices/systems should be borne by the Government or shared by the Government and the farmer.

Imparting skills to the farmer to improve his capabilities in crop production in drylands is necessary. Custom-hire service of implements for timely operations is also very important in drylands.

A strong credit support is a must. Another approach is to create a revolving fund wnich is kept at the disposal of a cooperative where farmers are participants. The credit could be in kind, with repayment also in kind. Whenever weather is aberrant, the crop credit should be converted to medium-term loans. Differential interest rates is another point for consideration in dryland farming.

To support any program of rainfed farming there is a need to have quality seed supply and seed banks to meet weather aberrations; improvizing fodder banks to mitigate unpredicted shortage of fodder is also important.

Finally, it may be necessary to provide price support to dryland crops, along with adequate marketing and storage facilities. Crop loan insurance also should be thought of for the dryland farmer.

Policy Issues in the Generation and Transfer of Watershed-Based Dryland Farming Technologies in the Black Soils of Peninsular India*

The Deep Black Soil Region

One of the greatest challenges for agricultural researchers, policy makers, extensionists, and bankers is to develop, adapt, finance, and transfer technologies to the deep black soil regions with assured rainfall. We believe that this region has the widest gap between potential and actual crop production of any dryland farming region in India. On deep black soils, scientifically called Vertisols, the farmers[1] traditional practice is to leave the land fallow in the rainy season (kharif) and to raise a crop in the postrainy season (rabi) on residual moisture. Because of kharif fallowing, three months of the cropping season are lost, and runoff and soil erosion are increased. Poor field drainage is an important reason why farmers leave their fields fallow during kharif in much of this region.

The deep Vertisol areas with dependable rainfall (average 750-1250 mm/year) cover large parts of Madhya Pradesh and parts of Andhra Pradesh, Karnataka, and Maharashtra.

Some Prospective Technological Options

Since 1974 research has been conducted at ICRISAT Center, Patancheru, on operational-scale Vertisol watersheds and subwatersheds to enable crops to be grown in both the rainy and postrainy seasons. The six main components of a technology developed from this research are:

- cultivating the land immediately after the previous postrainy season crop has been harvested, when the soil still contains some moisture and is not too hard;
- land levelling and shaping, construction of field and community drains, and the use of graded broadbeds and furrows;
- dry seeding before the monsoon;
- use of improved seed and moderate amounts of fertilizer;
- improved placement of seed and fertilizer; and
- timely plant protection.

* Prepared by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and presented at the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India," 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

Most of these practices are carried out with an animal-drawn wheeled tool carrier. For successful dry seeding, the early rains must be reliable. Moreover, soils should generally be at least one meter deep, so that their water-holding capacity is sufficient to produce two crops in a year without irrigation. The area for which this technology is suited is estimated to be between 5 and 12 million ha (Fig 1).

Technical and Economic Performance

Over the past eight years this technology has performed well at ICRISAT Center. Compared to farmers' practices, the improved technology has increased crop yields from 300 to 500% and has generated profits sufficient to give a 250% rate of return on additional investment. It has significantly reduced runoff and soil erosion.

This promising agronomic and economic performance has held up in on-farm verification trials which were started at one location in 1981-82, expanded to eight sites in 1982-83, and are now carried out at many locations in 28 districts of Andhra Pradesh, Karnataka, Maharashtra, and Madhya Pradesh by the State Departments of Agriculture (Fig 2). The 1982-83 results from these ICRISAT collaborative sites show that the rate of return on additional investment ranged from about 25 to 380%. The development cost of the on-farm watershed test sites varied from Rs.200 to 1000/ha.

More detailed information on the deep Vertisol production environment, on the improved technology, on its performance at ICRISAT Center and in on-farm verification trials, and on policy implications is contained in the papers listed in the references.

Policy Issues

There are a number of policy issues which have to be considered* before the promise offered by the improved technology can be regarded as a real potential.

Technological Policy

Results from the verification trials suggest the need for: • adaptive research on cropping systems particularly in Madhya Pradesh towards a flexible package tailored to regional needs; • cheaper alternatives to presently available models of the wheeled tool carrier; • design modifications to the broadbed-and-furrow system for higher rainfall environments and for crops like wheat; • steps in the technology experiments to measure the benefits from specific components of the

* Many of these are not new and were also raised at the Second Policymakers' Seminar on Improved Vertisol Management held at ICRISAT Center, 8-11 September 1982.

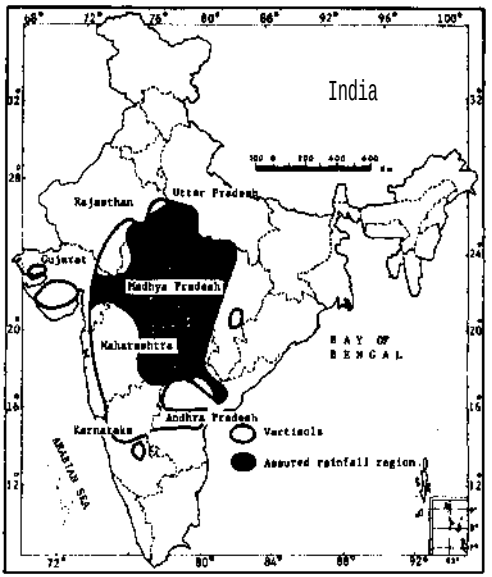

Figure 1. Vertisol areas of India, classified by dependability of rainfall.

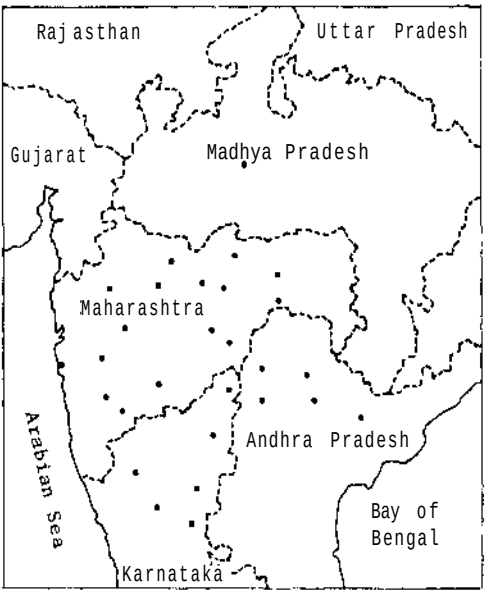

Figure 2. On-farm verification of deep Vertisols management technology in 1983/84 (dots indicate locations).

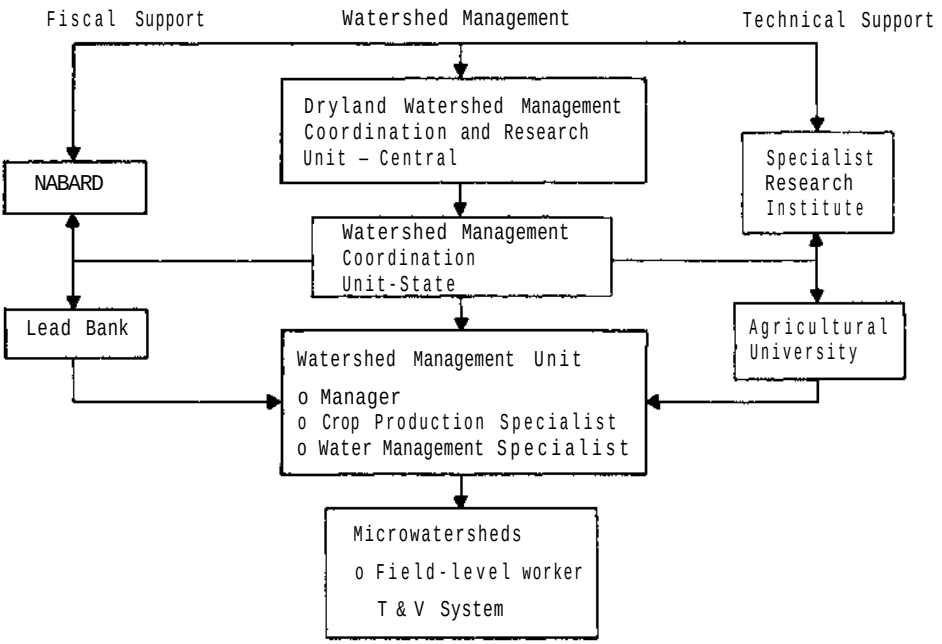

Figure 3. A suggested Flow Chart for administration and support of dryland watershed management.

package; component research on improved weed management, pest resistant crop varieties, and chemical control of pests; and • an analysis of water harvesting and supplementary irrigation to ensure the establishment of the postrainy-season crop in sequential cropping systems.

Marketing and Infrastructure

Several marketing problems have dampened the economic performance of the improved technology. The absence of markets for nontraditional kharif crops like maize in these areas represents a problem in the early diffusion of the technology. Gains from the technology will also be reduced if fertilizer of the desired type is not available when needed. Availability of soybean seed is critical to the expansion of kharif cropping in Madhya Pradesh. Lack of operating sprayers and effective insecticides, and of timely information to control Heliothis pod borer infestations in pigeonpea—particularly in Andhra Pradesh—have been important constraints. Building more all-weather access roads in the principal kharif-fallowing districts of Madhya Pradesh should also stimulate diffusion of the improved technology.

Watershed Development

Watershed development requires grid surveying, land levelling/shaping, and constructing main and field drains. These developments confer differential benefits to farmers as individuals and to watershed participants as a group. How much of the development cost should be borne by farmers and financed with credit, and how much should be subsidized by the State Departments of Agriculture? For example, a full subsidy may be required for community drains because it is difficult to apportion costs to beneficiaries. Those in the upper reaches where drains are smaller stand to gain less than those in the lower reaches where drains are larger and benefits from improved drainage are greater.

Credit

If development costs of the watershed are not totally subsidized by the State Departments of Agriculture, then expenses for land levelling, constructing field drains, and forming broadbeds and furrows will have to be financed through new lines of medium- to long-term credit. Longer term credit is also needed for the purchase of the wheeled tool carrier, its attachments, and spraying equipment. New lines of credit could also be opened to finance purchase of tool carriers for custom hiring, or to manufacture tool carriers and attachments.

For crop loans, flexibility in the scale of finance is required to meet the demands of specific cropping systems in different Vertisol areas. In 1982/83, average "out-of-pocket" expenses of the watershed farmers in the verification sites ranged from about Rs.800/ha in Andhra Pradesh to Rs.2200/ha in Madhya Pradesh. We feel that Rs.1000/ha for a cropping year should be the minimum scale of finance with this technology. The maximum scale depends on the cropping system. For

example, Rs.600/ha may be sufficient to finance a mungbean-rabi sorghum sequential crop in Andhra Pradesh, but it would not be enough to cover the cost of most cropping systems in Madhya Pradesh. Moreover, some cropping systems particularly respond to late-season credit. The failure to protect pigeonpea from pod borer in December–because credit has been exhausted–could have disastrous economic consequences, with a loss of up to Rs.2300/ha.

Loans should be negotiated for both rainy- and postrainy-season crops together within the same agricultural year. One loan with two disbursements is preferable. Because land development and preparation should start as soon as the rabi crop is harvested, the disbursement for the kharif season should be well in advance of the start of the monsoon. It may be prererable to restrict larger farmers' borrowing up to the limit where a registered mortgage is not required, to avoid considerable delays in processing and disbursement of loans.

The agricultural field officers of banks, who process loans in these dryland projects, should be intimately involved at the field level in managing, processing, and monitoring so that non-interest-rate borrowing costs to farmers are reduced and collection efforts correspond to what has actually happened in the farmers' fields.

With the watershed approach, overdues and lack of land titles present additional complications. Technically, it is desirable and in many cases essential, that all farmers participate in the development of the watershed in the first year when the main and field drains are constructed. Should State Departments of Agriculture provide credit to watershed farmers who are defaulters, or who do not have clear titles to land and are therefore not serviced by banks? Can lending procedures be designed to improve loan recovery among farmers who are poor credit risks?

Summing up, the demand for both investment and short-term credit will increase in the deep Vertisol regions particularly in the first year. New lines of credit are required, lending norms should be flexible, and repayment performance will have to be carefully monitored. The main source of risk for lending institutions involves extending the improved technology to regions and areas where poor drainage is not a constraint on kharif cropping and to areas within the deep Vertisol region where little adaptive cropping systems research has been undertaken. Bankers should play an active role in monitoring the verification test results to acquire a better understanding of their economic implications.

Selection of Project Sites

Criteria for selection of project sites were discussed at the Second Policymakers' Seminar. Participants felt that the following criteria were important: • sites should be accessible; • a regional research institution should help design the project and conduct adaptive research as and when local problems arise in the on-farm projects; • a godown should be available or built at the village site; • work should begin at the lower end of the watershed and progress to the upland areas; • little irrigated land should be in the village or nearby; t as far as

possible, areas requiring major shifts in cropping pattern should be avoided; and • farmers should be willing to participate in the project and should not be coerced. Are these criteria still valid in the light of last year's experience? Are there other relevant considerations that have been overlooked?

Scheduling of development activities over time and space also merits discussion. In most project sites started this year, the drainage system has not been completed. Should watershed development be finished in existing sites before the project expands to new sites in the same state?

Need for a National Framework for Watershed Development Authority

The Ministry of Agriculture, GOI has drawn up plans to progressively initiate development of 105 watersheds across the country. Several of these would be located in the deep-Vertisol areas of India. There is an urgent need to develop watershed management authority(ies) at national and state levels to plan, execute, and coordinate development work in the selected watersheds. A preliminary schematic flow chart for the purpose is shown in Figure 3.

Training and Stability of Project Staff

Soil conservation officers have the basic skills in watershed development, but they require training in land and water management specifications on the improved technology. Training of agricultural officers and farmers in the use of the wheeled tool carrier and its attachments is also essential.

The improved technology demands timely and location-specific information and skills. Successful transfer of the technological options is impeded by frequent transfers of extension and soil conservation staff. Such transfers also greatly diminish returns to investments in training of manpower. Once the staff are trained, they must be allowed to stay in position for a specified period, say at least three years.

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Dryland Projects in Andhra Pradesh*

Introduction

About 65% cropland in Andhra Pradesh is under rainfed farming and is vulnerable to the vagaries of monsoon. As a result yields show marked fluctuations, depending on the rainfall over the crop season. The farmers tend to regard dryland farming as risky and a gamble. They are reluctant to invest in costly inputs in the absence of appropriate and tested technology. Apart from weather aberrations, variability and drainage problems of the soil also contribute to disparities in crop production.

The soils are either black or red. The technology developed for deep black soils (Vertisols) at ICRISAT has proved that with adoption of the recommended practices, yields could be raised to 3000-4000 kg/ha. This technology was tried out in 1981/82 and 1982/83 in farmers' fields in Medak district, in the proximity of ICRISAT. Based on this experience, it is being extended in 1983/84 to other districts. The ICAR has also evolved a package of practices for dryland farming in both types of soils. By popularizing these technologies, there exists a great scope for increasing production of cereals, pulses, and oilseeds. While both the ICRISAT and ICAR Vertisol technologies are being tried out in selected districts in 1983/84, the ICAR technology for red soils is being extenaed.

Criteria for Selection of Watersheds in 1983/84

In Andhra Pradesh deep black soils are predominantly found in Medak, Nizamabad, Karimnagar, Adilabad, Warangal, and Khammam districts, covering an area of about 2.5 million ha. Microwatersheds have been selected in these districts keeping in view the following criteria:

- The soils should be Vertisols/Alfisols, with less than 3% slope and average rainfall of 750 mm or more per year.
- The percentage of small/marginal farmers should be substantial and they should be responsive and progressive.
- There should be adequate credit facilities available in the area.
- For Vertisols, there should not be any irrigated areas in the village or atleast the farmers in the selected watershed should not have any irrigated lands. For Alfisols, the irrigated area should not be more than 10% of the total.

* Prepared by the Secretary, Food & Agriculture, Government of Andhra Pradesh, and presented at the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India," 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

The selected Vertisol watersheds should preferably be at least 5-10 km away from the Alfisol watersheds. To the extent possible/ the watersheds could be near the research stations of ICRISAT/ICAR and be on the roadside to produce a better demonstration effect.

Experience with ICRISAT Technology

The ICRISAT technology was tried out in 1981/82 on 15.22 ha in Taddanpally village of Medak district with 14 participating farmers. During 1982/83, two more villages—Sultanpur and Anthwar in Medak district—were also selected, increasing the area of operation under ICRISAT technology to 48.94 hectares, with 29 participating farmers. The cropping pattern followed and the performance of the crops are given in Table 1.

Evaluation of the ICRISAT Technology

Though the results for the last two years have been generally encouraging, it is rather early to evaluate the effects and impact of the program. The impressions of the farmers and their constraints are as follows:

- If summer showers do not occur, preparatory cultivation for the formation of broadbeds and furrows and dry seeding become very difficult.
- Land levelling should be done to near perfection to ensure uniform germination in low-lying patches.
- The cost of a wheeled tool carrier with accessories (about Rs.10 000) is beyond the reach of the average farmer. It should be made available on custom service. The possibility of extending subsidies to farmers intending to purchase the equipment needs to be considered.
- Heavy draft animals are required for the preparation of land with the wheeled tool carrier, which the small and marginal farmer cannot afford.
- Timely weeding or intercultivation is necessary to obtain good yields. At times, these may not be possible because of continuous rains. There can be acute labor shortage for weeding and intercultivation during August when paddy transplantation is at its peak.
- Where a crop like mungbean or blackgram matures for harvesting in August, heavy rains can spoil the quality of seed and hinder preparatory cultivation for the rabi crop.
- Small and marginal farmers require liberal financial assistance for purchase of seeds and fertilizers, without which expected returns will not be possible.

ICAR Technology

The ICAR technology for red soils was also implemented for the first time during 1981/82 in an area covering 37 ha in three villages of Medak district.

During 1982/83 the area of operation was extended to cover 38.9 ha. The rainfed crops grown with ICAR technology gave significant additional yields (Table 2). The farmers learnt that by observing some simple practices they can harvest sizeable yields from red soils too.

Evaluation of the ICAR Technology

It is premature to evaluate the results of the scheme. However, the following general observations can be made:

- Premonsoon preparation of land has helped to advance sowings by 10 days with its fine tilth;
- Use of hybrid seed, combined with application of fertilizers, has doubled crop yields;
- Traditionally, fertilizer in maize was applied at tasseling. Nitrogen application 0 25% alongwith P_2O_5 at the time of sowing and remaining N at 30 to 60 days has doubled the yields.
- Formation of key bunds has controlled erosion and improved the water-retention capacity of the soil in the watershed, supplying much-needed moisture to the crop at the initial stage of growth.

The ICAR technology can be easily adopted by the small and marginal farmers. It does not involve a major shift to agricultural machinery. The 'A' frame for formation of keylines is simple and within the understanding of the farmers.

The constraints that have been noticed are as follows:

- Adequate funds would be needed to meet the additional cost of inputs, such as improved seeds and fertilizers, and implements like FESPO plow. This may be arranged on liberal terms by the financial institutions/government, besides providing subsidy on important practices to the participant farmers.
- Provision of technical assistance for marking the key bunds as guidelines for contour cultivation and alignment of suitable drainage system to dispose the runoff on watershed basis may be made.
- Crop insurance needs to be provided to cover risks in the event of crop failure or seasonal aberrations.

Program for 1983/84

Convinced by the encouraging results of ICRISAT technology in deep black soils and ICAR technology in red soils, the program for 1983/84 has been extended to 5 more districts having similar climatic conditions (Table 3).

The Government of Andhra Pradesh purchased 52 wheeled tool carriers and supplied them free of cost. The amount provided is not sufficient to carry out all the plowing activities required after meeting the cost of wheeled tool carriers. During kharif 1983/84 commercial and cooperative banks have advanced loans for purchase of seeds and fertilizers, in addition to short-term loans given by the Department of Agriculture.

Condition of Crops

For kharif 1983, dry seeding could not be taken up in all the districts and the sowings were completed late in the season. The condition of the standing crops is, therefore, far from satisfactory due to heavy incessant rains. The early-sown mungbean and blackgram crops have been affected badly and very low yields are expected. Sorghum and maize crops were also affected by heavy continuous rains in August.

Difficulties in the Implementation of Program during 1983/84

- Due to the drought conditions of 1982/83, inadequate soil moisture made plowing operations very difficult in April-May. Premonsoon sowings could not be completed satisfactorily due to delay in tractor plowing, late receipt of implements (wheeled tool carriers) and for want of heavy draft animals.
- Financial assistance to the small and marginal farmers was inadequate for the purchase of inputs in time.
- Unprecedented high-intensity rains resulted in overflow of waterways and caused breaches, damaging the broadbeds and furrows. These rains made operations–either manual or with bullocks–difficult for considerably long periods.
- Despite these difficulties, the two technologies have evoked an enthusiastic response from farmers. The departmental functionaries are cautiously optimistic that over the next few years it should be possible to achieve a breakthrough in dryland agricultural production, with the help of ICRISAT and ICAR technology.

Other Dryland Farming Schemes in Andhra Pradesh

Dryland Farming Project. The Integrated Dryland Farming Project at Ibrahimpatnam, Rangareddy District, was taken up with Central Government assistance in 1969-70, based on the research findings of ICAR and APAU. One more project was started in Anantapur District during 1971-72.

Since 1979-80 both these projects have been continued as State Non-plan Schemes. Every year 800 ha are selected on watershed basis under each project. The annual action plan to conserve soil and moisture and to introduce the recommended practices of crop management is formulated in consultation with the scientists of ICAR and APAU, and is implemented with the approval of the Government. The credit requirements are met through the cooperative societies and banks. So far an area of 18 200 ha has been treated by these projects. The outlay for 1983-84 is Rs.1.05 million at Rs.0.52 million per project.

River Valley Project. This is being implemented since 1973-74 in the catchments of Sriramsagar, Nagarjunasagar, and Nizamsagar on watershed basis with the objective of reducing the silt flow into the reservoirs and prolonging their longevity. Every year, management plans on microwatershed basis are prepared, based on a detailed survey, and works such as graded bunds, gully control, retention dams, trenching, and afforestation are taken up with the prior approval of Government of India.

So far, 25 431 ha have been covered at a cost of Rs.16 million. During 1983-84, it is proposed to cover an additional 4632 ha at an estimated cost of Rs.4.3 million. These works not only check the siltation of reservoirs, but also help in getting good rainfed crops by conserving soil moisture.

Drought-Prone Area Development Programme. This program is being implemented since 1975-76 in seven districts viz., Anantapur, Chittoor, Cuddapah, Kurnool, Mahabubnagar, Nalgonda, and Prakasam with 50% Central assistance. The objective is to mitigate the effects of drought through construction of permanent works, besides providing employment to rural labor during off season. Under agricultural sector the drylands are treated on watershed basis with graded bunds, gully control, and waterharvestmg devices on priority basis. Upto the end of 1982/83, a total of 0.29 million ha have been treated at an expenditure of Rs.77.8 million.

Integrated Dryland Project. It is proposed to cover 2000 ha each in the districts of Kurnool and Anantapur on a watershed basis, in collaboration with ICAR and the District Rural Development Authority (DRDA). The preliminary steps to be taken are being worked out.

Water Harvesting Technology Projects. It is proposed to take up a dryland farming project during 1983-84 with emphasis on water harvesting technology in selected watersheds of Jogipet Taluk, Medak district, with the financial assistance of Government of India. This selected area will be used for testing soil and water conservation measures, improved crop husoandry, utility plantation of fruit and fuel plants, and the surface runorf will be harvested. An area of 702 ha is proposed to be covered at a cost of Rs.2.5 million. The project report is being finalized.

Development and Popularization of Seed-cum-Pertilizer Drill. Under this scheme 1600 demonstrations of 0.5 ha each will be organized, giving a financial assistance of Rs.400/- per demonstration towards the cost of seeds and fertilizers. It is proposed to implement this scheme with 50% Central assistance during 1983-84 in Medak District. It is also proposed to supply 1000 seed-cum-fertilizer drills at subsidized rates. In the

current kharif season 300 demonstrations have been organized already with seed-cum-fertilizer drills and FESPO plows.

Development of Microwatersheds under the New 20 Point Programme: Under this program, it is proposed to develop 250 microwatersheds by pooling the available funds of ongoing schemes under different sectors. It is proposed to supply minikits of oilseeds and pulse crops, develop minor irrigation and pastures, and to raise fruit and fuel plantations.

World-Bank Aided Rainfed Farming Project: It is proposed to take up a World-Bank Aided Rainfed Farming Project in Rangareddy District on a watershed basis in red soil areas covering 25 331 ha of geophysical area, of which 10 294 ha are cultivated. The watershed areas will be subjected to soil and water management, forest and grassland development, and improved crop husbandry and livestock improvement, in a phased manner over a 7-year period at a total outlay of Rs.39 million. This project is likely to be implemented from 1984-85.

Table 1. Performance of crops under ICRISAT and traditional methods of management in indicated villages of AP, 1981/82 and 1982/83.

Watershed selected and area	Cropping pattern	Yields obtained (kg/ha)			
		Project area (ICRISAT method)	Neighboring area (Traditional method)	Additional production	Percent increase in yields
			1981/82		
Taddanpally (6.98 ha)	Sorghum/ Pigeonpea	2180+ 375	1400+ 220	935	58%
Taddanpally (1.92 ha)	Maize + Chickpea	2007	920	1087	118%
			1982/83		
Taddanpally (3.45 ha)	Mungbean + Sorghum	454+ 519	245+ 395	333	52%
Taddanpally (2.03 ha)	Sorghum/ Pigeonpea	2136+ 593	1353+ 230	1146	72%
Sultanpur (13.50 ha)	Sorghum/ Pigeonpea	1922+ 481	1268+ 215	920	62%
Anthwar (9.60 ha)	Sorghum/ Pigeonpea	2358+ 926	1408+ 385	1491	83%
Anthwar (1.80 ha)	Mungbean + Sorghum	600+ 875	260+ 410	805	120%

/ = intercrop; + = sequential crop.

Table 2. Crop performance under ICAR technology in three villages of Medak district, Andhra Pradesh, 1981/82 and 1982/83.

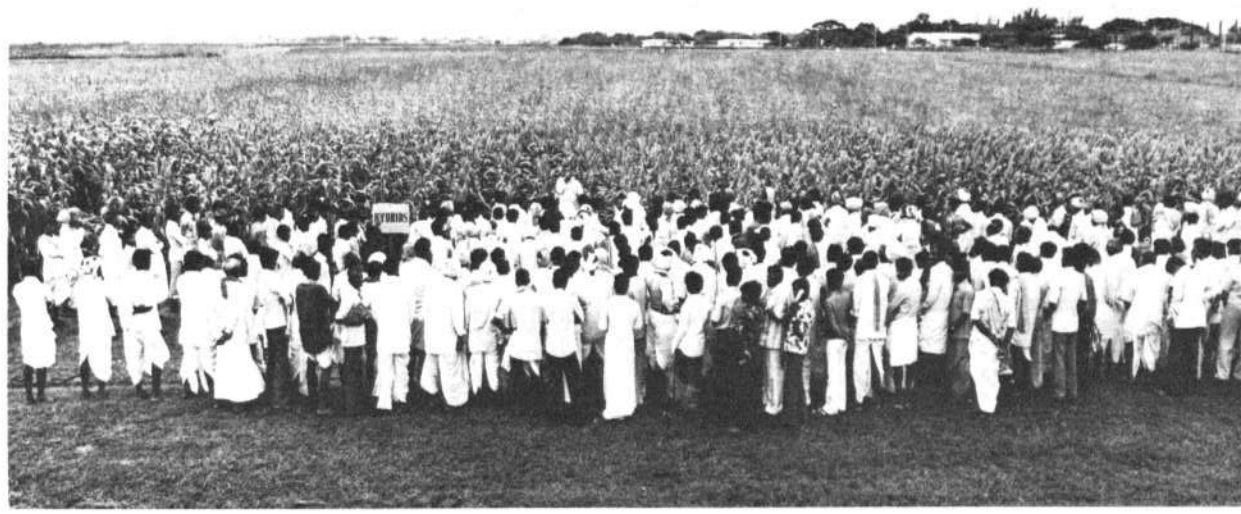
Village (year)	Cropping Pattern	Yields obtained (kg/ha)			Percent increase in yields
		Project area	Neighboring area	Extra yield	
Sultanpur (1981/82)	Pure Maize	1380	920	460	50%
Mulug (1981/82)	Maize/ Pigeonpea	2380+	1025	1490	145%
Sultanpur (1982/83)	Pure Maize	2607	920	1687	183%
Takapally (1982/83)	Pure Maize	2218	1250	968	77%

/ = intercrop.

Table 3. Area targeted and covered (ha), district-wise, under ICRISAT and ICAR technologies in Andhra Pradesh, 1983/84.

District	ICRISAT technology		ICAR technology			
	Black soils		Black soils		Red soils	
	T *	A *	T	A	T	A
Medak	100	128	50	68	100	110
Nizambad	100	100	50	50	100	100
Khammam	100	100	50	50	100	100
Adilabad	100	90	50	32	100	78
Karimnagar	100	100	50	50	100	96
Warangal	100	96	50	31	100	100

* T = Target; A = Achievement.



On-farm testing of ICRISAT's technology for deep black soils with assured rainfall moved ahead with the active cooperation of the agricultural departments of Andhra Pradesh, Karnataka, Madhya Pradesh, and Maharashtra. Clockwise (from top): a cropping systems study in progress at Phanda farm near Bhopal, MP; a sorghum/pigeonpea intercrop, the combination found most profitable at several locations; training of extension workers by an ICRISAT agronomist at Gulbarga, Karnataka; farmers visiting ICRISAT Center for a look at the results of the watershed-based technology; waterlogging in a farmer's field at Anthwar, AP, caused by incomplete preparatory work on drains before the onset of monsoon rains; farmers in Begumganj, MP, listening to a point made by a state extension official and an ICRISAT technician; and the poor stands typical of dryland farming contrasted with the rich crop under ICRISAT's technology in neighboring farmers' fields at Anthwar, AP.

Dryland Farming Programs in Karnataka*

Introduction

Development of dryland farming was taken up in 85 selected watersheds covering 43 579 ha during 1982/83. The taluks receiving less than 850 mm rainfall were taken up for development. The objective was to increase yields by adopting technologies evolved by the University of Agricultural Sciences, Karnataka, ICAR, and ICRISAT, and by using the experiences of integrated dryland development projects. Some of the main strategies advocated are outlined here.

Proper Soil and Water Conservation Measures

These consisted of contour bunding, graded bunding, interbunded area management practices, compartment bunding, scooping, and land smoothening.

Cropping Systems, Implements, and Input Credit

Cropping systems were recommended to suit the local conditions. The crops recommended were generally drought resistant, high yielding, photo-insensitive and of short duration. Improved implements were distributed to the farmers at subsidized rates. For timely supply of input requirements including credit, cooperative institutions, banks, KAIC, KSSC, and KSCMF have been actively involved to increase the number of sale points.

Other Strategies Adopted

To ensure high returns, the use of quality seeds, application of optimum doses of fertilizers, and effective plant protection measures were advocated. Planting of Pongamea, Glyrecidia and castor was taken up all along the bunds. Subabul (Leucaena leucocephala) was introduced on a large scale so as to meet fodder, fuel, and timber requirements.

Program for 1983/84:

Impressed by the progress achieved during 1982/83, it has been decided to extena this technology over all the 175 taluks in the State at the rate of 1000 ha per taluk (total area 175 000 ha). Dryland agriculture technology is advocated in the 106 taluks receiving less than 750 mm rainfall, and rainfed farming technology in the 69 taluks receiving more than 750 mm rainfall.

* Prepared by the Secretary, Food & Agriculture, Government of Karnataka, and presented at the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India," 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

Dryland Development Boards

Formation of Dryland Development Boards in the 4 Revenue Divisions of the State is proposed, to tackle the problems of the dryland farmers. A seminar-cum-workshop will also be organized wherein scientists from ICAR, UAS, ICRISAT, the concerned national crop research program, and the resource personnel of the Department of Agriculture and allied departments will be invited to chalk out programs based on the latest technology.

Broadbed-and-furrow (BBF) Technology in 1982/83

Another dryland agriculture technology for management of Vertisols, evolved by ICRISAT, was introduced in Farhatabad watershed (16.8 ha), Gulbarga district, and in Andura watershed (8 ha), Bidar district. The wheeled tool carrier was used to lay out broadbeds and furrows. This technology helped in conserving the rain water and making efficient use of it during the crop-growth period, besides improving drainage.

The important cropping systems followed in this technology were an intercrop of sorghum and pigeonpea, or mungbean followed sequentially in the rabi by sorghum, safflower, or chickpea. Both systems gave good results, with a cost:benefit ratio of 1:3 in some instances.

BBF Technology for 1983/84

Encouraged by the results achieved during 1982/83 this technology has been extended to the districts of Raichur, Bellary, Belgaum, and Dharwad, in addition to Bidar and Gulbarga districts. It has been programmed to cover 500 ha in 50 blocks. By August 1983, 277 ha had been covered and survey and planning completed for 1354 ha.

As the BBF technology is meant primarily for dependable rainfall areas, it has been introduced in dependable and highly dependable rainfall areas.

Other Projects in the State

- A State-financed pilot project on watershed management is being implemented over 866 ha in Mysore district.
- A watershed of 29 803 ha in Bangalore district is programmed to be developed under World Bank assistance over 7 years.
- A pilot project, sponsored by the Central Government, on water conservation/harvesting technology is being taken up over 700 ha in Mysore district. Similarly under DPAP it is proposed to develop one more watershed of 1000 ha in Kolar district.
- One watershed each in Bellary and Bijapur districts have been programmed to be developed with NABARD assistance.

Some Notes on Watershed-Based Dryland Farming in Black Soil Regions of Madhya Pradesh*

In Madhya Pradesh, 87% of agriculture is dependent on rain. The area affected by erosion is 20.6 million ha or 15.6% of the all-India figure. Area unaer the plow is 18.8 million ha, of which 79% is under kharif cropping, and 42% under rabi cropping, with 21% cropped more than once (based on estimates for 1982-83). The major crops grown in the state are shown in Table 1.

Table 1. Crops grown in Madhya Pradesh, by season.

Major crops	Kharif	Rabi
Cereal crops	Rice, Sorghum, Maize, Pearl Millet, and Minor Millets	Wheat, Barley
Pulse crops	Pigeonpea, Blackgram Mungbean	Gram, Peas, Lentils, Lathyrus
Oilseed crops	Groundnut, Sesamum, Niger (recent introduction Soybean)	Linseed, Rapeseed, Mustard
Commercial crops	Cotton, Sugarcane (Cashewnuts introduced, coconuts under trial)	
Fruit trees	Mango, Citrus, Guava, Pine-apple, Custard apple, Ber, Papaya, Banana, Jackfruit (used as vegetable)	

Dryland Farming under Various Soil Types

1.Black soil areas. As much as 48.4% of the cultivated area in MP is under black soils. Most of this area grows crops–such as sorghum, cotton, maize, pigeonpea, and minor millets–during the kharif season. These soils are constantly undergoing a process of depletion due to erosion by runorf water. Malwa Plateau, Nimar Plains, Jhabua Hills,

* Prepared by the Department of Agriculture, Government of Madhya Pradesh, and presented at the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India," 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

Satpura Plateau, a part of Wainganga Valley, and a part of Vindhyachal Plateau present this situation.

The other big region of black soils consists of the monocrop rabi areas of Narmada Valley and Vindhya Plateau where the fields remain fallow during the kharif season. The areas of discharge in this case are eroded and subjected to drought. The areas of recharge, especially the bunder fields (a typical example is the Haveli tract of Narmada Valley), suffer seriously from problems of drainage which stand in the way of kharif cropping.

Identification of problems in growing crops on black soils and experience with soybean have provided a very encouraging direction to the management of these regions. Several steps are under way, aimed at increasing productivity and intensity of cropping under all soil types in general and under black soils in particular. Some observations that may be of interest are as follows:

- Soybean has caught up in most of the traditional rabi areas as an additional crop which is rainfed during kharif. In three out of five years, the rainfall permits a normal rabi crop after the soybean.
- Use of organic matter in black soils permits a short-duration paddy crop during kharif in traditional rabi areas.
- Program of drainage and harvesting water simultaneously is being tried on a watershed basis to afford a stable base to the dryland farming technology.
- Intercropping of wide-row crops like sorghum, pigeonpea, maize, etc., with suitable pulse or oilseed crops, especially soybean, is gaining popularity.
- Use of improved agricultural implements, especially seed-cum-fertilizer drills, has been found to be beneficial in moisture conservation and for better efficiency of applied nutrients.
- The ICRISAT technology for Vertisols, with its accent on broadbeds and furrows is under trial at two locations : Begumganj (Raisen district) and Phanda (Bhopal district). The technology is obviously sound. Further testing is needed to determine large-scale application.

The area under kharif fallow has declined during the last five years. This is a technological breakthrough. As shown in Table 2, decline in kharif fallow is much more than the corresponding increase in rabi fallow. Programs of minor irrigation and water harvesting will soon curb the increase in rabi fallow.

Table 2. Extent of fallow land in Madhya Pradesh, by year and season.

Year	Kharif fallow (million ha)	Rabi fallow (million ha)
1978-79	5.18	10.5
1979-80	4.54	11.1
1980-81	4.64	11.0
1981-82	3.53	11.1
1982-83	3.80	10.8

2.Red and yellow soils. Chhatisgarh and the adjoining areas, the "rice bowl" of the state, cover about 29.5% of the cropping area in the State. These soils are more depleted than eroded. Levelling and bunding of paddy fields, increased use of organic matter and programs of water harvesting on watershed basis are identified as the foundation items for developing these areas.

3.Skeletal soils. About 9% of the cultivated area comes under skeletal soils where cultivation is practiced on marginal and submarginal lands in the tribal belt of Mandla, Jhabua, etc. Cultivation is uneconomical in some of these areas. The areas are prone to heavy erosion by water and suosequently to drought. Besides protecting areas through soil conservation measures, efforts are under way to encourage social forestry, horticulture, and pasture development in the undulating lands.

4.Mixed red and black Soils. Areas of Kymore plateau and Bundhelkhand cover about 8% of the agricultural land. Districts of Rewa, Satna, Panna, Katni Tehsil of Jabalpur, Chhatarpur, Tikamgarh Datia, and part of Shivpuri district fall in this region. Problems of these areas can be solved through soil conservation measures, by introducing soybean, by water harvesting, and in general through dry-farming technology on watershed basis.

5.Alluvial soils. About 5% of the agricultural land is comprised of alluvial soils, half of which has already turned into ravines in Chambal and Gwalior divisions. Special schemes for developing these areas, in view of their being prone to the dacoity menace, are under consideration.

Watershed-Based Dryland Farming

Significant efforts were started during 1982-83. About 620 microwatersheds were identified for planned development. Detailed project reports were prepared for more than half of the identified sites. During 1983-84 these areas are getting more pointed attention. The quality of effort will improve with experience. Development of watersheds has been taken up in three ways as under:

1. Work has been taken up on land development, minor irrigation, and water harvesting. About 3.7 million ha of agricultural land has been subjected to soil conservation measures. Such work has

so far been scattered and isolated from improved agronomical practices, a situation that will be improved by the watershed approach.

2. Application of dry-farming technology, use of improved seeds, introduction of an additional crop like soybean to increase intensity of cropping, intercropping, use of fertilizer, proper placement of seeds and fertilizers with improved seed-cum-fertilizer drills, etc., in areas not treated by soil conservation measures, is already under way.

3. Application of dry-farming technology as above is also under way in areas developed by soil conservation measures–old as well as newly developed areas.

Land development work is so far confined to private lands because the cost is recoverable in 20 years. Government is actively considering a proposal to subsidize 25 to 30% of the total expenditure on community works like providing drainage, protection of public lands against erosion, development of pasture lands, etc.

Multidisciplinary Approach

The Additional Chief Secretary and the Agriculture Production Commissioner coordinate activities of various departments, namely Agriculture, Forest, Veterinary, Horticulture, etc., at the state level, so that all the departments join their resources for the development of selected watersheds.

At the district level the Collector is the Chairman of the Watershed Management Committee, so that activities of various departments could be combined on watershed basis.

The Department of Agriculture is the nodal department from the state level to the project level. An Officer of the rank of Additional Director of Agriculture is the Nodal Officer at state headquarters for monitoring the watershed-based dry-farming program. He is also incharge of the Soil Conservation Program.

Long-Term Soil and Water Management Program

For every district a master plan of Soil and Water Management for a period of 6 years (including the last year of the 6th Plan and the 7th Plan period) is expected to be ready by the end of 1983. Guidelines for such a master plan were issued by the Secretary, Agriculture Department, Government of Madhya Pradesh.

Dryland Farming in Maharashtra*

The National Commission on Agriculture has estimated that the total irrigated area in Maharashtra would not exceed 30% of the cultivated area even after irrigation is developed to its full potential from all sources. It is, therefore, obvious that the state will have to depend primarily on dryland agriculture in order to meet its full requirement of fooa. Since 88.5% area of Maharashtra depends entirely on rainfall, it is essential that soil and water are properly conserved for achieving sustained and optimal agricultural production.

Conserving and optimizing the use of rainwater, so that it stays in the soil profile for a longer duration and is released slowly through the drainage line in that area, thus becomes an important constituent of improved dryland farming. This would also make the streams in the area perennial or semiperennial for irrigating crops whenever needed, and raise the yield level. Thus integrated development and management of watersheds naturally becomes the prime solution to the problem of dryland farming.

Strategy for Dryland Farming

The strategy so far followed to improve food-grain production was to change from traditional crop varieties to hybrid and high-yielding varieties. This led to a quantum jump in agricultural production. A stage has now been reached where increase by this method will be more or less marginal, as most of the potential areas have been brought already unaer hybrid and high-yielding varieties.

The strategy for dryland farming now adopted comprises broadly of:

- Provision of basic land-development infrastructure on a watershed basis, so as to enhance the capacity of the soil profile to retain moisture (this may be called the hardware component).
- Adoption by farmers themselves, with logistic and extension support from Government, of appropriate cropping systems and agronomical practices based on soil type, use of seed of improved variety, and use of improved implements, optimum use of fertilizers, plant protection, etc., in order to minimize the risk inherent in dryland farming (software components).

* Prepared by the Directorate of Agriculture, Maharashtra, and presented at the NABARD-ICAR-ICRISAT Workshop on "Watershed-based Dryland Farming in Black and Red Soils of Peninsular India," 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

The three organizational streams of the Agriculture Department, i.e., land and water management, T & V extension, and inputs supply wing provide the linkage between hardware and software components of technology.

Hardware Components

An amount of Rs.200 million has been spent annually on these works. The various works done till March 1983 are shown in Table 1.

These activities have definitely helped in soil and moisture conservation and also helped increase crop production to some extent. These programs were carried out individually in a scattered manner till last year. It was more a tool for providing employment to rural unemployed, underemployed, and to people affected by scarcity, rather than a meaningful program to develop land and raise its productivity. During the scarcity of 1982-83 the following special programs were introduced, in addition to the above activities, as a long-term measure for mitigation of drought in future.

Land Shaping and Grading: This is taken up as an interbund treatment where contour/graded bunding work has been carried out. The technology includes reducing the main slopes to 0.8 - 1.0% and lateral slopes to 0.2 - 0.4%. This helps the in situ conservation of moisture.

On Farm Dry-Land Development (OFDLD): This program comprises of pasture-cum-tree cropping on shallow soils under land capability classes V to VII where arable crops cannot be grown. Leguminous grasses like Stylo hamta and Stylo scabra are planted with suitable tree crops.

Broadbeds and Furrows: This program consists of laying the whole land alternately into beds of 105-cm and furrows of 45-cm width at a gradient of 0.2% to 0.4%, depending on the soil type. The technology evolved by ICRISAT is found particularly useful in deep black soils in the assured rainfall zone of Maharashtra, where drainage becomes a problem and often interferes with tillage operations.

Progress of operations carried out in the identified watersheds is shown in Table 2. With the introduction of interbund treatments, the State Government has now decided to implement soil conservation measures on a comprehensive watershed development basis (COWDEP). The soil conservation works are now being carried out in an integrated manner on a watershed basis, which increases moisture conservation by the soil. Combined with propagation of better agronomical practices through intensive extension, this will go a long way towards stabilizing crop yield under rainfed farming. The work is now in progress in several watersheds. Table 3 indicates the number of watersheds selected for the program; many of these watersheds are now under implementation.

Linkage with Extension

Government have also drawn up a scheme for comprehensive linkage of land development work with professional extension. Extension staff would be

userul for assessing the farmers' response to land development works, motivating them to go in for land development themselves, and for ensuring optimum utilization of the infrastructure created in farmers' fields by backing them with necessary extension support for adoption of improved agricultural practices.

Necessary arrangements for such backing up have also been made by providing T & V extension staff in the villages. It has also been ensured that an outlet for supply of critical inputs, as far as possible, is opened in the village itself or within a reasonable distance from the village.

The success of the entire scheme will depend on the involvement of small and marginal farmers, who constitute a large number of the farming population. The farmers are being motivated to switch over to the use of improved and hybrid seeds, and to apply fertilizer initially even in small doses, through the seeds and fertilizer minikit trials.

The major constraint for adoption of improved technology on a large scale would be the availability of short-term credit. As of now most of the small and marginal farmers, being defaulters, are not eligible for any kind of fresh credit. The issue was, therefore, taken up with the NABARD, who have shown willingness to consider providing short-term credit to small-farmer defaulters, considering the high technological content of the scheme.

The scheme has created a lot of interest among farmers and it is expected to yield spectacular results over the next few years. More and more watersheds will be covered every year.

Table 1. Status of Land Development work in Manarashtra.

Activity	Unit	Poten-tial	Work done till March '83	Balance	Target for 1983-84
Contour/Graded bunaing	Million ha	12.57	8.72	3.85	0.22
Terracing	"	0.87	0.19	0.68	0.01
Land Develop-ment-cum-Horticulture	"	0.53	0.10	0.43	0.003
Reclamation of ill-drained soils	"	0.07	0.02	0.05	0.002
Drain bunding	Nos.	44941	36209	8732	3575

Table 2. Work done in Maharashtra under shaping and grading of drylands, pasture development and afforestation on private lands, and broadbeds and furrows in identified watersheds during 1982 and 1983.

District	Shaping & grading of drylands (ha)	Pasture development and afforestation on private lands (ha)	Broadbeds and Furrows (ha)
Ahmednagar	2568	393	6
Pune	2239	389	—
Solapur	1601	1226	—
Nasik	6093	655	—
Dhule	1262	84	19
Jalgaon	566	143	11
Satara	417	181	6
Sangli	1213	99	6
Aurangabad	520	69	25
Jalna	88	17	1
Beed	918	67	—
Parbhani	—	—	107
Latur	714	54	—
Osmanabad			
Nanded	—	—	79
Amravati	907	*66*	338
Akola	268	170	161
Buldhana	243	102	229
Yeotmai	—	58	53
Nagpur	207	43	—
Bhandara	—	38	—
Chandrapur	—	—	--
Gadchiroli	—	—	—
Wardha			117
Total	19824	3854	1158

Table 3. Watersheds selected in Maharashtra for integraated development (1983/84 to 1986/87).

District	No. of Watersheds selectee under				
	COWDEP (Normal program)	WGD	DPAP	Krishi Pandhari Watersheds	Total
Nasik	6	62	15	13	96
Dhule	2	10	8	9	29
Jalgaon	4	—	15	13	32
Satara	1	68	10	11	90
Sangli	2	4	8	8	22
Kolhapur	4	44	—	12	60
Nagpur	17	—	—	13	30
Bhandara	18	—	—	13	31
Chandrapur	18	—	—	10	28
Gadchiroli	8	--	—	8	16
Thane	4	11	--	13	28
Raigad	2	28	—	14	44
Ratnagiri	1	53	—	9	63
Sindhudurg	1	103	—	7	111
Ahmednagar	7	—	23	13	43
Pune	6	12	14	13	45
Solapur	14	—	30	11	55
Amravati	3	—	—	13	16
Buldhana	5	—	4	13	22
Yeotmal	6	—	—	14	20
Parbhani	21	--	--	7	28
Wardha	2	—	—	7	9
Aurangabad		—	14	8	22
Osmanabad	—	—	6	6	12
Beed	—	—	6	7	13
Akola	14	—	—	13	27
Jalna	—	—	—	5	5
Nanded	—	—	—	8	8
Latur	—	—	—	5	5
Total	166	395	153	296	1010

COWDEP = Comprehensive Watershed Development Programme
WGD Western Ghats Development
DPAP Drought-Prone Area Programme

AFC Experience in Project Formulation for Watershed Development in Dry Zone-Issues*

Introduction

The Agricultural Finance Corporation (AFC) has assisted state governments in different areas in the preparation of watershed management projects. The Government of Madhya Pradesh had called upon AFC to prepare a project outline for two areas to decide on the norms for funding by multilateral agencies.

In consultation with the Department of Agriculture, MP, the AFC selected two watersheds. These were the Chhoti Kali Sindh Watershed in Barod and Agar blocks of Shajpur district (Project Area-I) and Johilla watershed in Pushparajgarh block of Shahdol district (Project Area-II). The salient features of the agricultural and socioeconomic profiles of these watersheds are available with AFC. The components most suitable for development of dryland agriculture in the project areas have also been identified in consultation with scientists/engineers of AICRPDA and experts of the departments of agriculture, soil conservation, horticulture, and forestry.

In this paper, the approach, project components, agronomic review, project outlay, and credit requirements and issues with reference to the two project areas are discussed. The methodology adopted for planning such a model watershed included the following:

i. detailed physical survey to assess all available resources–land, water, and manpower;

ii. socioeconomic and farm studies;

iii. study of land tenure aspects;

iv. survey/investigation with regard to infrastructure requirements and simple water-harvesting schemes;

v. land-capability and land-use classification;

vi. subsidiary activities for employment;

vii. suggesting appropriate management of the project;

viii. preparation of implementation schedule; and

ix. preparation of a banking plan.

* Paper prepared by the Agricultural Finance Corporation (AFC) and circulated for discussion at the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India," 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

Specific Development Requirements

Crop planning. Major changes in the cropping pattern and intensity have been proposed, which can raise cropping intensity from around 80% at present to 125% or so in these areas.

Agricultural implements. Improved bullock-drawn and power-operated implements are proposed to be introduced (22 260 new implements in Project Area I, and 3610 new implements in Project Area II).

Soil and water conservation measures. Suitable measures for moisture retention in the soil and storage of runoff water for recycling have been recommended for both the project areas. Construction of water harvesting tanks, stop dams, field drains, drop structures, and pasture development are proposed as community items to be implemented by the Government. Other items would be implemented on individual farmers' fields.

Minor irrigation development. In Project Area I, about 2470 dug wells irrigate 2560 ha at present. Various measures to renovate existing structures and to develop new ones would irrigate an additional 5720 ha. There is negligible irrigation facility in Project Area II. The new measures proposed would irrigate 860 ha in this area.

Horticultural development. With a view to increasing horticultural production and income in Project Area I, 350 ha is proposed to be brought under horticultural crops. In Project Area II, no significant horticultural program exists. It is proposed to bring 200 ha under guava, mango, and jackfruit.

Farm forestry development. Of the 11 400 ha of fallow and pasture lands in Project Area I, 2500 ha is proposed to be covered under farm forestry by means of bamboo plantation and introduction of fodder grass in individual farms. In Project Area II, of the 3800 ha of fallow and pasture lands, 1000 ha is proposed to be covered under a farm forestry program.

Subsidiary activities development under animal husbandry. There is no significant scheme in Project Area I for development and rearing of male cattle for draft purposes. Each of the 600 selected farmers in the project is proposed to be provided with two male calves for rearing from birth to normal working age of 3 years. These animals can then be either used by the farmer or sold as draft animals.

As per the needs of the region around Project Area II, it is proposed to provide 50 farmers with units of 200 poultry birds (layers) each for egg production, to be organized into two cooperative societies of 25 units each. All inputs will be provided at cost to the farmers out of assistance from financing institutions and subsidy from Government. One hundred piggery units, consisting of one boar and two sows each of improved breed, are proposed to be provided to 100 selected individuals/farmers under a piggery development program. A cattle breeding/rearing program is proposed to be developed by setting up a cattle breeding farm as a community item (to be implemented by the State Government) and by providing two male calves each to 350 selected farmers for rearing up to the working age.

Project Outlay and Phasing

The financial requirements for various components have been worked out on the basis of the prevailing cost of inputs, materials, construction, implementation, labor, and machinery/equipments. The physical and financial outlay of all the components proposed for development for both the project areas are given component-wise in Appendix I.

The total financial outlay for implementation of the proposed program would be Rs.195 million for Project Area I and Rs.71 million for Project Area II. The phasing of total investment cost is proposed to be 10% in the first year, 15% in the second, 20% in the third, 25% in the fourth, and 30% in the fifth year. The cost of the project works out to Rs.4330 per ha of culturable command area, or Rs.3515 per ha of cropped area including horticulture, for Project Area I and Rs.3823 per ha of culturable command area, or Rs.2970 per ha of cropped area including horticulture, for Project Area II.

Credit Requirement

The component-wise credit requirements have been estimated for the project areas. Of the total cost of cultivation 65% has been considered as credit requirement. Credit for agricultural implements has been estimated by substracting subsidy available from Government and a 10% margin to be 'provided by farmers from the total investment cost. For soil and water conservation measures, about 75% of the cost has been taken as credit for individual items considering the composition of scheduled caste/tribe, small/marginal, and other farmers in the project area and the subsidy available to each category. For community items, it is assumed that the State Government would spend 50% of the cost and the remaining 50% would be credit. For minor irrigation development, it is assumed that 25% of the scheduled caste/tribe farmers, 50% of the small farmers, and 25% of other farmers would avail the loan. It has been worked out that 75% of the total cost of this development would be required as loan. For horticulture and forestry development, 75% of the cost would be credit and 25% would be margin contribution. For development of subsidiary activities under animal husbandry also, 75% of cost would be credit.

Thus the total credit requirement has been estimated at Rs.132 million for Project Area I, and Rs.48 million for Project Area II. The credit required would be phased over a period of 5 years in the proportion described above.

Organization and Management

The project would be implemented under the overall supervision, guidance, and support of the agriculture department of the Government of Madhya Pradesh. A monitoring and evaluation cell would have to be set up in the Department of Agriculture at the state level for periodical appraisal and monitoring of the implementation of the project.

The Collector of the District should be the Project Coordinator with the staff assistance of functional departments especially the Tribal Development Department, For successful implementation of the project, it would be advisable to set up committees at the microwatershed level. The exact composition of the committee would be decided by the Collector of the District, Project Executive, and other concerned authorities. The organizational structure in the project areas should be as per the actual requirements and workload. However, a suggested pattern of organization for each of the two project areas is given in Appendix I I .

The success of such a project depends mainly on effective extension activities and education of the farmers for adoption of improved technological practices. Suitable extension machinery with adequate staff and facilities would have to be provided in the project areas, both at the block and grass-roots level, for motivating the farmers to participate effectively in the project. Training programs would have to be conducted for the development staff and financing institutions to ensure effective implementation.

Benefits and Conclusions

Productivity and income would increase substantially when the project is successfully implemented. The total annual agricultural production from the two project areas would be about 103355 tonnes after implementation of the projects, as against present production of 36005 tonnes. Total annual net income expected to be generated from all activities in the project would be Rs.88.4 million, as against the present figure of Rs.14.2 million (see Appendix III).

Implementation of the project would also generate substantial additional employment potential in both the project areas and in the district in the distribution and supply of inputs, cultivation, harvesting, processing and marketing of agricultural produce, construction, operation and maintenance of irrigation/soil conservation measures, servicing and repair of pumpsets, engines, agricultural implements/machinery, and allied activities.

Project Formulation-Issues

Watershed management has been accepted as an approach to the Integrated Area Development Programme, which signifies development of all resources for planning and implementation in a unit area. The State Government would identify potential watersheds and codify them on the basis of its priority. Development and supervision of credit in a compact area would be better than scattered financing.

Infrastructure development is essential and should be taken up as a priority item. This would facilitate participation by financial institutions. The development component would be demarcated into community items and individual items. State budgetary resources would be utilized for infrastructure development and bank finance would be on the

basis of individual and group schemes identified. The major issues in planning and implementation of a dryland agriculture project are:

- cadestral and aerial maps are not available;
- socioeconomic data of farm holdings are not available;
- inventory of land and resources are not readily available;
- water-harvesting structures for storage of water for recycling are inadequate;
- allied activities, especially cattle and poultry development, are inadequate due to nonavailability of infrastructure and suitable livestock;
- unit cost for implementation of the project is comparatively high in dryland areas;
- officers experienced in land-use management, soil conservation, and agronomic planning are not readily available at the project level;
- village-level workers are not exposed to working on an integrated development basis;
- motivation to take up the watershed development program with new package of practices is lacking;
- timely and adequate supply of inputs is required;
- an appropriate network for marketing of additional produce is needed;
- flow of credit is inadequate;
- § documentation procedure is cumbersome, leading to poor availability of land and revenue records;
- there is a shortage of trained personnel for implementation and management of projects;
- constant monitoring and evaluation of such integrated projects is required.

Appendix I: Physical and financial outlay of the two project areas in Madhya Pradesh

Components	Project Area I		Project Area II	
	Physical outlay	Financial outlay (million Rs.)	Physical outlay	Financial outlay (million Rs.)
1. Crop management with improved dry farming technology and use of agricultural implements.				
(a) Cropped area per year after full development (ha)	55000	75.7	23800	27.6
(b) Agricultural implements (total number)	22260	3.03	3610	0.63
2. Soil and water conservation/management measures and pasture development:				
(a) Individual items (cumulative area proposed for treatment) under various measures (ha)	69700	3.43	22900	18.4
(b) Community items (cumulative area proposed for treatment, in ha)	45700	25.4	18400	9.93
3. Minor irrigation development				
(a) Individual items (area proposed to be irrigated, in ha)	4750	38.1	860	5.61
(b) Community items (area proposed to be irrigated, in ha)	450	1.98	--	"
4. Horticultural development (total cropped area proposed, in ha)	350	4.76	200	2.51

Contd.

Appendix I - contd.

Components	Project Area I		Project Area II	
	Physical outlay	Financial outlay (million Rs.)	Physical outlay	Financial outlay (million Rs.)
5. Farm forestry development (total area proposed to be covered, in ha)	2500	9.63	1000	3.85
6. Subsidiary activities unaer animal hunsbandry programme:				
(a) Cattle breeding farm (25 bulls for servicing buffaloes (community item)			1	0.48
(b) Cattle rearing for draft animals (units of 2 male calves each)	600	1.65	350	0.96
(c) Poultry development (units of 200 layers each)	--	--	50	0.62
(d) Piggery development (units of 1 boar and 2 sows each)			100	0.71
Total:		194.4		71.3

Appendix I I : Suggested pattern of organization for the two project areas in Madhya Pradesh.

SI. No.	Category/Staff	Number/Unit
1.	Project Manager (In the rank of Deputy Director of Agriculture with adequate accounts and establishment staff)	one
2.	Assistant Project Manager (In the rank of Assistant Director of Agriculture)	One
3.	Agronomist	One
4.	Agricultural Economist-cum-Statistician	One
5.	Soil conservation sub-divisions under the charge of Assistant Soil Conservation Officer	One unit for every Rs.2 million expenditure
6.	Extension Officer	One for every 6 VLWs or 3 officers per block
7.	Village-Level Workers	one for every 300 farm families

Appendix III: Present and expected benefits from the two project areas in Madhya Pradesh.

Items of Benefit	Project Area I		Project Area II	
	Present	Proposed	Present	Proposed
Number of villages benefitted	115	115	45	45
Total cropped area (ha)	35224	55000	15905	23800
Cropping intensity (%)	78	123	85	127
Total agricultural production (tonnes)	29936	78480	10069	24875
Productivity per hectare (tonnes)	0,73	1.43	0.63	1.05
Kharif season:				
Area (ha)	30812	39700	10976	15900
Production (tonnes)	15988	41755	7605	17225
Rabi season:				
Area (ha)	4254	14950	4929	7900
Production(tonnes)	5208	22725	2463	7650
Oilseeds:				
Area (ha)	982	9525	3100	5625
Production (tonnes)	552	8830	730	3550
Pulses				
Area (ha)	3155	9675	1640	4795
Production (tonnes)	1753	6930	820	3180
Fruits:				
Area (ha)	137	350		200
Production (tonnes)	599	2330		2150
Total Net income (Rs. Millions)	8.91	61.2	5.24	27.2

Problems of Financing Drylands*

The Government of India has recognized that development of dryland farming is most essential for ensuring national food security, narrowing down regional imbalances, and creating rural employment, etc. A two-pronged strategy has been adopted for this purpose: (i) the extensive approach, covering all dryland areas, where all ongoing programs and resources would be utilized optimally and the available technology disseminated for increasing the productivity of dryland agriculture; and (ii) the intensive approach, under which microwatersheds of 2000 to 3000 hectares each would be taken up in selected blocks for intensive development through multidisciplinary approaches including crop production, horticulture, social forestry, pasture development, water harvesting, pest control, use of modern implements like seed-cum-fertilizer drills, application of improved seeds and fertilizers, etc.

The Government of India had decided to take up a dryland farming program in 3824 microwatersheds covering a total of 7 to 11 million ha during 1982-83. Small watersheds with an area of 2000 to 3000 ha, treatment of which is practicable and manageable, have been proposed to be taken up increasingly during the Sixth Plan. The plan aims at a target of 7.1 million ha over the base level of 23.4 million ha. These microwatersheds should serve as focal areas for demonstrating the benericial erfects of intensive watershed development programs and provide models on the basis of which intensive development of other areas could be taken up in subsequent phases.

Effective implementation of these programs involving the concept of the microwatershed, has to be planned carefully and scientifically providing for an efficient coordination mechanism. A good deal of research on various aspects of dryland farming has been done in the problem areas under the All India Coordinated Research Project for Dryland Agriculture (AICRPDA). Pilot projects have also successfully demonstrated the beneficial effects of research results to farmers. Thus, field officers of banks, government departments, and the panchayat administration should now appreciate these developments and resolve without delay the problems of smooth flow of credit under this program.

Experience With ICRISAT Technology-A Case Study

A project on the the transfer of ICRISAT technology was initiated in February 1981 at Taddanpally village, Medak district, AP. Agricultural engineers from ICRISAT and the Government of AP surveyed the land and

* Prepared by the Bank of Baroda and circulated for discussion at the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India," 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

planned the watershed, leaving in place the property boundaries. The farmers did the land smoothing work with their own animals and equipment, but used the ICRISAT-provided wheeled tool carrier behind their bullocks for most operations. It did not take long for the farmers to get used to the equipment. Although the farmers were willing to install drainageways on their own land, they were not willing to work collectively to install community drains to connect the watersheds to the existing main drainage system. Consequently in the very heavy rains in the early part of the year the watershed did not work properly and the lower parts of some fields were flooded. When the farmers saw this and saw how this did not happen at ICRISAT Center, they were persuaded to undertake construction of the community drains. The State Department of Agriculture paid the labor costs to put the drains in place. Since then, even in a year where rainfall has been 70% above normal, there have been no further problems of waterlogging or drainage.

ICRISAT and other research agencies recommended the most suitable crops, but farmers made their own choices. In consequence, on this 15-ha watershed with 14 farmers there were nine different crop combinations. With one exception, the crops have done well and far exceeded production elsewhere in the region. Not surprisingly, there have been some problems. The farmers are not used to growing crops during the rainy season, nor are they used to obtaining such high yields. Threshing and storage are new problems for them, accentuated by a very wet year when it was not possible to dry the grain in the field. Average yields in the 23 separate fields (some farmers divided their fields to try different crop combinations) have been 2000 kg/ha for sorghum grain, 7500 kg/ha for sorghum dry fodder, 1700 kg/ha for maize grain, 3600 kg/ha for maize dry fodder, and 490 kg/ha for mungbean. Based on market prices, farmers have already recovered their direct costs, including the cost of land smoothing and shaping, and made a profit. In addition, they could also take up postrainy-season crops. Most of the adjoining farmers, having fallowed their land in accordance with traditional practice, did not reap either additional grain or income.

Bank Finance

Credit institutions do provide loan facilities in general for the development of various agricultural activities. While different types of loans are available for improving dryland farming, the banking system has not been able to pay undivided attention to this very important area. The experiences of field officers in this respect reveal that this may be due to one or more of the following factors.

- Lack of sufficient appreciation of the dry-farming technology evolved by scientists and its potentialities to create significant impact in vulnerable areas.

- Lack of expertise at the bank/branch level to formulate location-specific schemes and projects that are bankable/viable.

- Inability to coordinate and pool available technical expertise at the district/state level for developing soil and moisture conservation and other schemes on watershed basis. This is

obviously reflected in their conspicuous absence in the District Credit Plan (1983-85) and Annual Action Plan (1983) prepared jointly by the Banks and State Government officials.

- Most of the rural bank branches either are understaffed or have staff who are inadequately trained. The field officers are overburdened with routine banking work.

- The problems of defaulters in cooperatives, non-issuance of 'No-dues Certificates', and otherwise ineligible borrowers have aggravated the situation, specifically in the chronically drought-prone areas.

- It is doubtful whether all banks/branches are aware of the dryland farming program undertaken in over 3800 microwatersheds and the progress it has made.

The problem of providing adequate and timely finance under dryland farming may have to be approached from the angle of transferring the available proven technology through provision of the management input and marketing services. The banks have no expertise in this field and have not done much in this area. There is urgent need to initiate the following steps/measures.

- Identifying the microwatersheds and understanding the type and nature of activities which could be taken up there.

- Formulating schemes which are technologically feasible and economically viable. Such schemes, should inter alia incorporate all the important/ relevant information on the availability of needed infrastructure, gaps in the existing infrastructure, as also on backward and forward linkages, all of which have a direct bearing on the success of the schemes.

- The physical requirements of each activity, such as horticulture, social forestry, pasture development, and their credit needs, subsidy/margin to be provided, financial outlay, refinance available, etc., should be quantified.

- A need-based credit plan, with full details of the budget, activity-wise, should be prepared and these funds should be sanctioned/committed by the participating banks in the respective microwatershed areas and incorporated into the Annual Action Plan as a part of the District Credit Plan.

- The beneficiaries should be motivated by organizing frequent village-level meetings and the urge for development should be instilled in them. All details should be explained and possible misconceptions/doubts should be clarified through various communication media. Now that the Union Government has advised the State Governments and banks to set up block-level advisory committees, these committees should endeavor to resolve the grass-roots problems through frequent discussion and people's participation.

- A simplified lending policy should be evolved with procedures to ensure that all loan proposals emanating from the microwatershed area are sanctioned promptly,

- Like the District Rural Development Agency (DRDA), an organizational set up to provide the management input in the successful implementation of the schemes should be provided.

Adoption of a full package of practices requires the organization of operational research and pilot projects at the village level. The key to success of such projects is the interest and involvement of the farmers, and the constant and dedicated attention of trained, motivated, and resourceful extension staff. These should be backed up by production and management specialists. Field-level workers from the government/ panchayats and banks should work on the lines of the T & V System.

- A time-bound PERT Chart should be prepared so as to ensure effective coordination amongst various agencies and to complete the development task in time and reduce cost escalation.

- Beneficiaries, field officers of the banks, extension workers of the government, local leaders, and voluntary associations should be provided adequate practical training. Training may preferably be organized in the areas where these activities have already been successfully conducted as also at the Research and Training Institutes.

- The 'input supply and marketing system' should also be considered as a part of the development program; credit/loan facilities on liberalized terms should be provided for this and refinance facilities extended.

Conclusion

There is fairly good evidence to show that the ICRISAT technology would be profitable for about 8 million of the total area of 22 million ha of deep black soils in India. It is, therefore, most urgent and necessary that this available and proven technology should be transferred to the farmers' fields.

Credit Support for Dryland Farming and Watershed Development*

Introduction

The National Workshop on Dryland Farming organized by the Government of India in April 1983 called upon NABARD to organize workshops jointly with ICAR and ICRISAT on a regional basis on the financing of dryland farming.

Framework Laid

The strategy for the implementation of a massive program of dryland farming under the 20-point program, spelt out by Government of India, provides for an intensive approach and an extensive approach for spread of technologies. The intensive approach involves the integrated development of each selected microwatershed covering, on an average, an area of about 1000 ha. It calls for a multidisciplinary effort. Of the 4200 microwatersheds identified in the country, about 1100 are in the four states of Andhra Pradesh, Karnataka, Madhya Pradesh, and Maharashtra, involving an area of about one million ha. Outside these watersheds, another one million ha are to be covered under dryland farming technologies in the 4 states in 1983-84. Under this program, all known technologies of dryland farming are to be disseminated amongst the farmers for adoption.

Funds for carrying out the different programs in each microwatershed are to be earmarked by the Government of India and the states concerned. Under the centrally sponsored scheme for increasing agricultural production, small/marginal farmers will get a subsidy assistance (shared equally by the Central and State Governments) ranging from 25 to 50% of the investments for minor irrigation and construction of water harvesting structures. In the case of community-based water harvesting structures ana drains, the National Workshop has already recommended that they should be done at Government cost. Under the centrally sponsored scheme Rs.50000 per block is available for providing subsidy for agro-forestry programs.

The success of the dryland farming program depends essentially on the viability, acceptability, and "availability of technologies to farmers, and on how the concept of integrated development of microwatersheds is translated into bankable programs.

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* Prepared by the National Bank for Agriculture and Rural Development (NABARD) for the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India", 3-4 October 1983, ICRISAT Center, Patancheru, AP, India.

Technology and Its Adoption

Through its All India Coordinated Research Project for Dryland Agriculture (AICRPDA), ICAR has conducted valuable research in various agroclimatic regions. Based on such research, ICAR is reported to have formulated a number of projects for watershed development. ICRISAT has also been doing valuable research for increasing and stabilizing the productivity of 5 major crops grown in the semi-arid tropics of this country. These technologies have been tested in the 4 states represented at this workshop. A technology base is now available for (a) crop management, (b) soil and water management, and (c) equipments to be used in the dryland/rainfed farming areas (about 105 million ha).

In red soils (Alfisols) as well as in deep black soils (Vertisols), farmers have a choice of different cropping systems, each of which is associated with specific soil/water management practices and use of implements. For the deep black soils (Vertisols) the technology developed by ICRISAT is considered suitable for 5-12 million ha. The application of technologies, though in limited areas so far, has resulted in increased yields and incomes to farmers. The benefits to small/marginal farmers, and additional employment in the rural areas, are also evident. Some studies have also brought to light a number of constraints in their adoption. Broadly speaking, the following types of constraints/limitations have been noticed in relation to finance:

- Adoption of improved technologies in the first instance appeared directly related to the availability of heavy subsidies. Withdrawal of subsidies has led to declining interest in the continued use of new technologies.
- Voluntary community action is not forthcoming where community water-harvesting structures, drainage works, etc., are involved. These are essential parts of the technology.
- Arrangements for supply of fertilizer, seed, pesticide, etc., are not adequate. Marketing and processing arrangements are also inadequate.
- Price incentives are inadequate, especially for pulses and oilseeds, so that farmers are not sufficiently motivated to grow these crops while adopting new technologies.
- There are no agencies to hire out wheeled tool carriers, bullocks, or sprayers. Suitable arrangements to provide these on hire basis are needed.
- Farmers who have not repaid earlier loans are ineligible for fresh loans if they want to adopt new technologies. Recovery of loans is generally low. Banks are hesitant to finance dryland agriculture because of the risk of default.
- Often the recommendations for improved practices do not take into account the type of soil or resources or the farmers' capability to adopt the technology. This exposes farmers to risks. Crop insurance should be provided to cover such risks.

While the soundness and profitability of the technologies, as observed in the operational research centers and in some other areas, appear established, their adoption in larger areas has to be made feasible and economically viable. This calls for removal of constraints. Positive steps are needed for promoting the adoption of the available technologies on microwatershed basis.

For adopting any available technology the first requirement is a microwatershed project report, which would set out the various alternatives available for introducing the technology on a viable basis. It would cover components relevant to improved crop management practices, alternative land use systems, animal husbandry and infrastructure support consisting of extension, input supply, marketing, and processing. This would be a multidisciplinary effort to be undertaken by an agency which has already, perhaps, developed expertise in that regard. The watershed schemes prepared or being prepared by the ICAR can, perhaps, form the basis for such integrated projects. There seem to be three ways of translating the watershed approach into developmental programs. These are:

The farm-family approach. The program, to be prepared jointly by the financing bank and the project technical staff, would cover the dryland technology that the farm family would adopt. The program would be specific to the family's situation and tailored to its resources position. It would take into account the willingness of the farmer to exert himself to improve his income. For the small/marginal farmers, arrangements would have to be made to supply equipments and, where feasible, bullocks also, either through the primary agricultural credit societies or through unemployed educated youths trained under TRYSEM, willing to set up custom hiring units for the purpose. Such units could also undertake work like distribution of improved seed, fertilizer, pesticides, etc., required within the watershed areas. These units can be provided financial assistance. Community works like drains and common water-harvesting structures, etc., would need to be done by the project authorities at government cost, as already provided for, and the maintenance thereof entrusted to a group of farmers who would derive benerits from the structures.

The component-wise approach. Under this approach, there would be 3 or 4 schemes in each watershed. One scheme would cover all the farmers willing to undertake improved crop management systems, together with or indepenaently of soil and water management measures and improved equipments. It could be for a group of farmers having similar soil conditions or receiving benefits from a given community facility, such as a common drainage or common water-harvesting structure. Another scheme could be for adopting alternative land-use systems (i.e. agro-forestry, silvo-horticulture), and a third for animal husbandry, etc. For the credit institutions, this would be similar to the present schematic approach.

The community approach. An organization at the grass-root level would have to be given overall responsibility for executing the works

(including providing infrastructure) other than those the farmers would carry out by themselves. It would receive funds from banks/government for the work done for the farmer, and from the government for community items. It could be a panchayat or a cooperative or even a voluntary organization. The advantage in this arrangement is that banks would not deal with the individual farmers but with the organization set up for the farmers, which would work jointly with the Project Officer and his staff for executing the program and effecting recoveries. This method needs to be tried out on a pilot basis.

The preparation of watershed projects may be entrusted to the AFC or lead bank. They may undertake the task jointly with the Department of Agriculture, Animal Husbandry, Forests, etc., making use of watershed plans prepared by ICAR/ICRISAT. Depending on the allocation of districts in each state among the lead banks, the microwatersheds can be allocated among the lead banks, the state cooperative banks, and state land development banks (LDBs), and a banking plan prepared for each state.

Viability, Subsidy, and Risk Aspects

For facilitating flow of institutional finance, the viability of the technology and its accessibility to farmers are important. In the presentations by ICAR and ICRISAT, the technical and economic aspects of the new technologies have been discussed. The economic viability of the technologies may need further evaluation under different conditions before they find wider acceptance.

Various levels of subsidy have been indicated for different items of investment, and even for current expenditure, in order to motivate farmers to adopt the technologies and minimize the loan burden, and in the process to improve the viability of the investment. The merits and demerits of subsidies have been debated from time to time. For instance, the association of institutional loans with subsidies has tended to blur the distinction between the two, to the disadvantage of financing institutions, which can be avoided if their respective roles are clearly explained to the beneficiaries.

The unit cost for various items of work in dryland/rainfed farming varies widely from place to place. Items with a high unit cost may not be easy to promote at the farm level. While preparing the project report for each watershed, it has to be examined whether methods of undertaking the works of soil and water management, spraying, drainage construction, etc., are cost effective, and whether costs could be reduced if they are done on a community basis by a panchayat, voluntary agency, or cooperative organization.

With large investments that the technologies involve, the farmer runs greater risks if there is crop failure. Crop insurance has been suggested to safeguard the interests of farmers undertaking new dryland technologies. This is an issue within the purview of the Government of India. Insotar as banks are concerned, the schemes of The Deposit Insurance and Credit Guarantee Corporation (DICGC) are intended to protect their interests in respect of their financing of agriculture. The adequacy of the existing arrangements needs to be discussed.

It has also to be recognized that unless the necessary supporting arrangements are made by the state governments–a process that may become easier if a project approach is adopted for each microwatershed–other efforts toward ensuring the viability of technologies may prove futile. Further, to enable the technologies to be tested on a wider scale, expertise needs to be built up in the financing agencies and concerned government departments for formulation of appropriate schemes, even as demonstrations or training programs are organized for farmers.

Institutional Credit Support

Institutional credit support needs to be designed for dryland farming keeping in view not only the strategy adopted by the Government of India for dryland/rainfed farming, but also the possibility of a World Bank Project for the purpose, starting with one designed for 4 states, likely to materialize in the near future. For this purpose two aspects should be taken care of; one, organizational arrangements, and the other, the framework of policies and procedures.

Under the multiagency system it would be possible to ensure that one or the other financing agency, namely, the cooperative, PACS/PLDB, commercial bank branch or RRB branch takes care of each of the selected microwatersheds. The agency should provide all the types of credit and related services needed by farmers as far as possible at one place. Preterence will have to be given by states for developing PACSs serving microwatershed areas to suit the specific needs of dryland farming. Simultaneously, the PACSs have to be assisted in acquiring storage facilities to handle various agricultural inputs. The National Workshop recommended that the DCCB concerned may earmark an officer to coordinate these functions, and that GOI may consider meeting the cost from the Cadre Fund.

Cooperative Banks have to understand the implications of their participation in dryland farming in terms of expertise, additional technical staffing required, delegation of powers for sanction of schemes to branches, and simplification of procedures. The State Government/Apex Bank/LDB may provide assistance to selected PACS for strengthening their staff for preparing family-oriented programs. NABARD can assist RRBs for appointing technical personnel for formulation of schemes, supervision, etc. Appropriate training programs also need to be organized for such staff, and sponsor banks may have to take the initiative for this.

Policy and Procedure for Financing

The policies currently followed by the financing institutions for providing credit assistance, with NABARD refinance, cover all the purposes for which either short-term credit or term credit would be required under dryland/rainfed farming and watershed development (Appendix I). Short-term production credit is provided by PACSs on the basis of scales of finance fixed for different crops from time to time. The loan for inputs is generally advanced in kind. From time to time, improvements/relaxations are being made by NABARD in the matter of sanction and disbursement of credit for cooperatives so that flow of

funds for production is not interrupted. Thus, small/marginal farmers having overdues up to 10% are treated as eligible for fresh finance.

In the context of dryland schemes sanctioned by NABARD in Medak district (AP) on the basis of ICRISAT technology, certain refinements have been made in the loan terms. Production credit advanced in the first year is allowed to be capitalized and recovered over a longer period along with the term loans. Refinance assistance is provided up to 95% of the loan amount covering the first year's expenditure, including on-farm investment. Under the Reserve Bank's instructions, security need not be insisted upon for loans up to Rs.5000.

Crop management practices that are being propagated under dryland farming have to be location specific and relate to the soil and water management measures contemplated, to be considered technically feasible. The technology associated with each of the farming systems involves new practices. These call for greater skill and application on the part of the farmer. He also needs more frequent and intensive support from the input and credit delivery systems. The technical guidance and extension support needed would also be much greater than under traditional farming.

In the light of these needs, it has to be considered how best the present system of fixing a credit limit for each member can be improved to facilitate flexible operation on the credit limit by farmers to suit double cropping or intercropping. It has also to be considered whether a cash credit type of account (as recommended by various Committees), which can also take care of the ups and downs in crop yields and the dryland farmer's need to save for the rainy day, would be more suitable.

Term loans would be available from the financing agencies on a scheme basis, with refinance from NABARD for all purposes relevant for dryland technology, according to the terms and conditions currently in force. The purposes include minor irrigation, soil conservation, water harvesting/moisture conservation, renovation/deepening of ponds, bunding, terracing of different types, etc. NABARD has formulated model schemes for a variety of purposes including minor irrigation, animal husbandry, social/farm forestry, horticulture, etc.

Financial assistance can be made available for family-based programs, or component-wise schemes on the basis of the microwatershed project, taking into account their viability and supporting arrangements. A proposal is being considered by NABARD for banks to provide bulk finance to any organization authorized to raise funds, entrusted with the tasK of executing the entire project and empowered to recover costs (as recommended by the National Workshop).

In the context of watershed development, however, what is immediately required is strengthening of the field staff of the financing agencies for the formulation of the schemes jointly with the government's technical departments. Banks with NABARD assistance can also finance service centers, which might be set up in the microwatershed areas, so that they can acquire equipments (wheeled tool carrier, spraying equipments, etc.), and provide various inputs and custom services to farmers. Where agro-processing units are set up, especially where they are linked with production programs, NABARD would be in a position to

assist them, if suitable schemes are formulated as part, or independently of, the watershed development projects in the dryland areas.

Stabilization Arrangements

Since 1954, arrangements exist in terms of which farmers affected by widespread and successive crop failures, as well as the institutions which were providing assistance to them, could be provided relief so that the channels of credit remain open and the farmers are enabled to continue their production activities. Over the years considerable assistance has been provided by RBI/NABARD under these stabilization arrangements. Under the NABARD Act now, loans can be extended up to a maximum period of 7 years in areas affected by crop failures. However, it has been observed that institutions are not availing these facilities to the full extent, resulting in their showing an inflated picture of overdues. What supplementary arrangements are needed to ensure flow of credit to rainfed/dryland areas? The matter is being examined in the light of experience gained so far.

Overdues

Broadly speaking, the immediate credit demand in the watershed areas for dryland farming/watershed development is not likely to be of such an order as to create credit bottlenecks. The major bottleneck in the way of extending credit support for dryland farming schemes is the problem of overdues. In the 4 states represented here, the overdues have been quite high in recent years (see Appendix I I) , in respect of short-term as well as long-term cooperative credit structures. As a result, the eligibility of the institutions–for refinance assistance from NABARD and for making fresn loans–has been considerably reduced. The recovery position of commercial banks is no better.

There is, therefore, need for ensuring prompt repayment of loans by farmers in order to promote larger inflow of credit assistance for dryland agriculture. There is need for prompt action by the institutions, supported by the state authorities, for recovery of dues from wilful defaulters. If there is adequate evidence to show that the earlier defaults were for genuine reasons and there was institutional failure to provide relief, perhaps a rehabilitation scheme could be formulated by the concerned state government (as in Gujarat), under which the overdues are spread out for repayment over a period and the farmers are made eligible for fresh loans for cultivation. While attempts should be made to provide relief to farmers in genuine difficulties, there should also be an organized effort to arouse social consciousness in favor of prompt repayment.

This is what NABARD is trying to do through the Vikas Volunteer Vahini, launched by it in 1982. The object is to spread the principles of development through credit among farmers, with the help of small/marginal farmers who have themselves benefited from proper use of credit. In the microwatershed areas the program of training could also cover education of farmers in the proper use of credit.

Appendix I: Types of credit available from NABARD.

The following types of credit facilities are available from NABARD:

- short-term credit, with a stipulation that a specified portion should be disbursed to small/marginal farmers;
- for marketing of crops;
- for procurement, stocking and distribution of chemical fertilizers;
- for marketing and processing activities of dairy cooperatives;
- for medium-term credit for project type investments;
- for conversion of short-term loans to medium-term loans;
- rephasement and rescheduling of medium-term loans/investments;
- long-term investment credit.

Some data on the schemes for Dryland farming sanctioned and/or under consideration of NABARD are given in Appendix III.

Appendix II: : A statement of loans isssued and recovered (Rs. in million) by the Central Cooperative Banks in four States during 1981-82

State	No. of banks	No. of offices	Member-ship societies	Loans issued	Loans reco-vered	Loans over-due	% of overdues to demand
Andhra Pradesh	*21*	392	15445	2033	1368	800	38.6
Karnataka	19	545	13216	2017	1172	739	46.5
Madhya Pradesh	44	741	9916	2218	1758	798	37.6
Maharashtra	26	1845	37911	10107	5986	1573	37.6

Appendix III: Schemes for dryland farming approved/under consideration

State	District	Area covered (in ha)	Financial assistance (Rs. in million)	Refi-nance	Financing Bank
Andhra Pradesh	Medak	85	0.17 (for 1st year's program)	0.16	State Bank of India
	Karimnagar & Khammam		Details to be finalized		State Bank of Hyderabad
	Rangareddy		-do-		State Bank of Hyderabad
	Adilabad		-do-		Andhra Bank
	Nizambad		-do-		Syndicate Bank
	Warangal		-do-		Central Bank of India and Canara Bank
Karna-taka	Bangalore	513	Financial outlay at the rate of Rs.2000 per ha.		Canara Bank
	Bellary	100	Financial outlay on land development Rs.820/ha. Production cost ranges from Rs.690 to Rs.ll25/ha depending on the crop.		Syndicate Bank
Madhya Pradesh	Rewa	683	Financial outlay at the rate of Rs.2525 per ha.		Not finalized
	Indore	378	Financial outlay at the rate of Rs.1900 per ha.		Not finalized
Maha-rashtra	Akola		Program yet to be finalized		--

Appendix:

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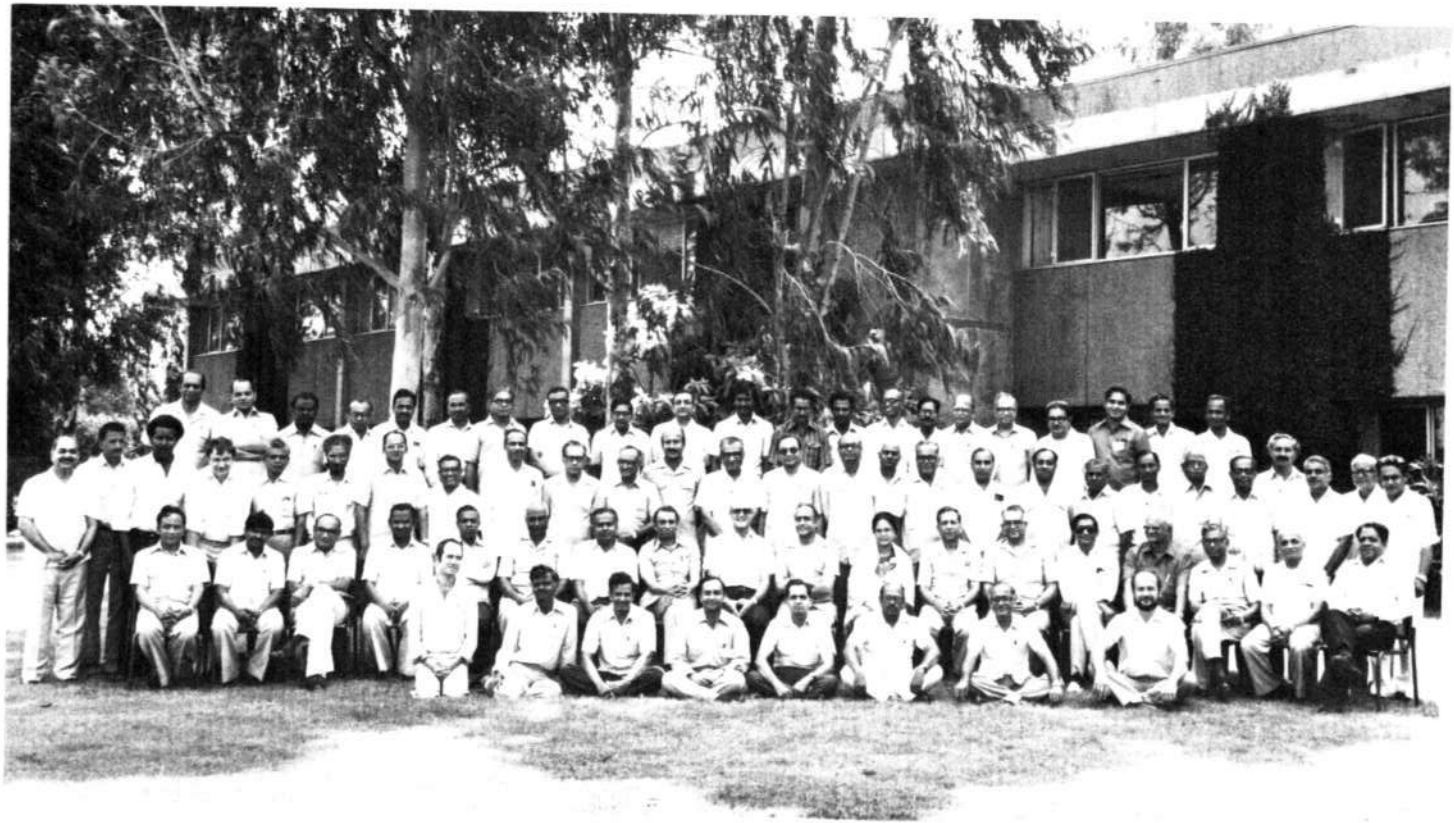

Participants at the NABARD-ICAR-ICRISAT Workshop on "Watershed-Based Dryland Farming in Black and Red Soils of Peninsular India" held at ICRISAT Center, Patancheru, 3-4 October 1983.

NABARD-ICAR-ICRISAT WORKSHOP ON WATERSHED-BASED DRYLAND FARMING IN BLACK AND RED SOILS OF PENINSULAR INDIA
3-4 October 1983
ICRISAT Center, Patancheru

Program

SUNDAY 2 OCT 1983

Arrival of participants

MONDAY 3 OCT 1983

0900 Registration - Main Lobby

0930 ICRISAT Field Tour

1030 Tea/Coffee - Academic Court

Venue : AUDITORIUM

SESSION I

Charrman : Dr. LD Swindale, Director General, ICRISAT

1050 Chairman's remarks

1110 Introduction to Workshop - Mr. Sant Dass, Managing Director, NABARD

1130 Keynote Address - Mr. SP Mukerji, Secretary, Department of Agriculture and Cooperation, Government of India

1150 Presentation by ICAR on technology options and implications for red and related soils

1220 Presentation by ICRISAT on technology for black soils

1250 General Discussion

1330 Lunch (hosted by NABARD) - 204 Canteen

SESSION II

Chairman : Dr. JS Kanwar, Director of Research, ICRISAT
Rapporteurs : Dr. RW Willey /Dr. RT Hardiman

1430 Discussion on ICAR/ICRISAT presentations

1600 Tea/Coffee - Academic Court

SESSION III

Chairman : Mr. M Gopalakrishnan, Agricultural Production Commissioner, Govt, of Andhra Pradesh

Rapporteurs : Dr. SM Virmani /Mr. NA Naidu

1620 Presentation by States of Andhra Pradesh, Karnataka, Maharashtra, and Madhya Pradesh on the adoption and diffusion of dryland technologies

1720 Discussion on presentations

1900 Cocktail/Dinner at ICRISAT Center - 204 Snack Bar Area

(hosted by Dr. LD Swindale)

TUESDAY 4 OCT 1983

SESSION IV

Chairman : Mr. SP Mukerji, Secretary Department of Agriculture and Cooperation Government of India

Rapporteurs : Dr. TS Walker / Dr. M von Oppen

0900 Presentation by NABARD on credit support for development of dryland agriculture

0930 Discussion on presentations

1030 Tea/Coffee - Academic Court

1100 Discussion on presentations

1330 Lunch - 204 Canteen

SESSION V

Chairman : Mr. Sant Dass Managing Director, NABARD

Rapporteurs : Mr. B Venkata Rao /Dr. RP Singh

1430 Adoption of recommendations of the Workshop

1600 Closing remarks

1615 Tea/Coffee - Academic Court

List of Acronyms and Abbreviations used in this Report

AICRPDA	All India Coordinated Research Project for Dryland Agriculture
AFC	Agricultural Finance Corporation
APAU	Andhra Pradesh Agricultural University
AP	Andhra Pradesh
APC	Agricultural Production Commissioner
BBF	Broadbed and Furrow
CADA	Command Area Development Authority
CB	Cooperative Bank/Commercial Bank
CCB	Central Cooperative Bank
COWDEP	Comprehensive Watershed Development Programme
DCB	District Cooperative Bank
DCCB	District Central Cooperative Bank
DICGC	The Deposit Insurance and Credit Guarantee Corporation
DPAP	Drought-Prone Area Programme
DRDA	District Rural Development Agency
FCI	Food Corporation of India
GDI	Government of India
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDLAD	Integrated Dryland Agricultural Development
IRDP	Integrated Rural Development Programme
KAIC	Karnataka Agro-Industries Corporation
KSSC	Karnataka State Seeds Corporation
KSCMF	Karnataka State Cooperative Marketing Federation
LDB	Land Development Bank
MP	Madhya Pradesh
NABARD	National Bank for Agriculture and Rural Development
OFDLD	On-Farm Dryland Development
PACS	Primary Agricultural Credit Society
PLDB	Primary Land Development Bank
RBI	Reserve Bank of India
RPCD	Rural Planning and Credit Department
RRB	Regional Rural Bank
SCB	State Cooperative Bank
SLA	Special Loan Account
T & V	Training & Visit
TRYSEM	Training Rural Youth for Self Employment
UAS	University of Agricultural Sciences, Karnataka.
WGD	Western Ghat Development

RA-0083

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

ICRISAT Patancheru P.O.

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