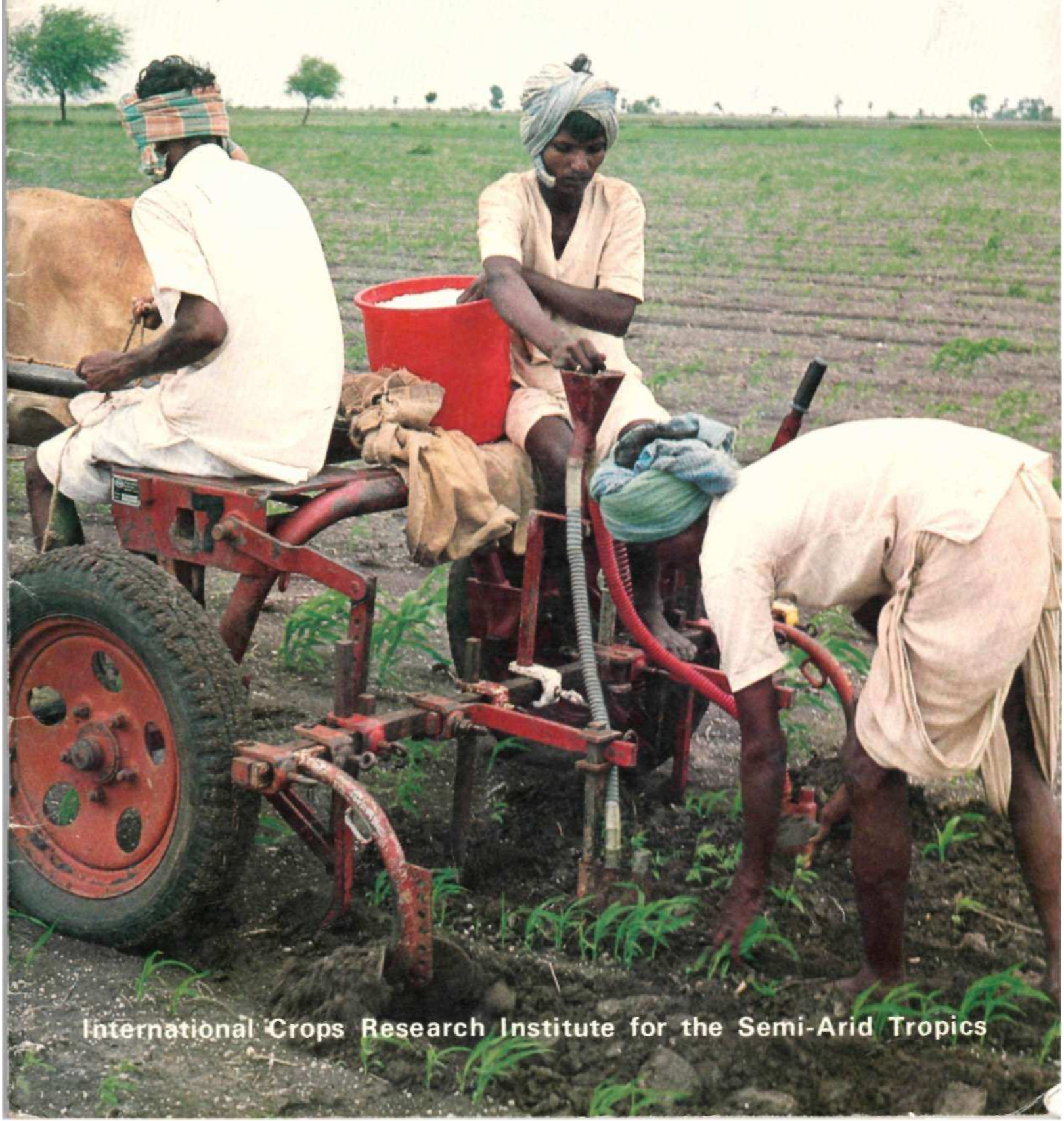
TRAINING NEEDS FOR DRYLAND AGRICULTURE



International Crops Research Institute for the Semi-Arid Tropics

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Cover: A wheeled-tool carrier being used to apply fertilizer, in Taddanpally, Andhra Pradesh.

Training Needs for Dryland Agriculture

with particular reference to

Deep Vertisol Technology

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Preface

Results of the Improved Vertisol Management Technology at ICRISAT Center and on-farm verification trials in the States of Andhra Pradesh, Karnataka, and Maharashtra have shown that Vertisols, in dependable rainfall areas, have a very high crop-production potential and the income of dryland farmers in these areas can be increased by 250 to 300%.

In the past ICRISAT has organized seminars, workshops, and short training programs to provide technical know-how to the policy decisionmakers, extension workers of the various State Departments of Agriculture, and farmers. ICRISAT has now succeeded in:

1. Creating necessary awareness and enthusiasm at different levels for;

   - the need to adopt efficient land-and-water management systems (e.g., land shaping, proper drainage, and moisture conservation);
   - increased cropping intensity through double-cropping or appropriate intercropping; and
   - improved farm implements;

2. Demonstrating that the technology is highly rewarding under close supervision of specific steps and sufficient input supply; and

3. Indicating the overriding importance of location specificity of diverse agroclimatic and socioeconomic conditions.

Considering the importance of location specificity and the vast area of 5-12 million ha of deep Vertisols that has relevance to the improved technology, it is essential to speed up communication of the technology, for extension on a meaningful scale, within a reasonable period.

A workshop on the training needs of dryland agriculture, with particular reference to the deep Vertisol technology, was held at ICRISAT Center, Patancheru, A.P., India, during 17-18 July 1985.

Sixteen Directors of Agriculture, Additional Directors of Agriculture, Joint Directors of Agriculture, Directors of Research and Extension Education from the agricultural universities of Andhra Pradesh, Karnataka, and Maharashtra, as

well as scientists from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Indian Council of Agricultural Research (ICAR), Central Research Institute for Dryland Agriculture (CRIDA), and National Institute for Rural Development (NIRD) participated in the discussions and exchanged views. This was the first meeting in which Directors of Research Services and Extension Education from universities had an active participation. They play an important role in the transfer of improved agricultural technologies through the various training programs they conduct for the agriculture officers and subject-matter specialists (SMSs) training in the training and visit (T and V) system of extension.

The workshop drew attention to the problems of dryland agriculture and discussed the various aspects of improved technologies developed for Vertisols by ICRISAT and for Alfisols by ICAR institutions (including agricultural universities). Emphasis was laid on the management of a watershed as an ecological and functional unit. It discussed the problems and experiences gained in the planning and implementation of watershed-based land-and-water management and crop-production technologies in different States and focused attention on the training needs for effective extension of the improved dryland agriculture technology.

This report presents the resume of the salient points discussed in each session and the recommendations made by the participants for further action.

The discussions focused attention on the various aspects of the improved dryland technologies and attempted to identify the levels of technical skill required and the training needs for imparting those skills, for effective transfer of improved technologies. We hope it will draw the attention of planners, as well as research and development agencies, involved in the transfer of the improved dryland technology.

Session I: Inauguration

Chairman: J. S. Kanwar

J.S. Kanwar, Director of Research, ICRISAT, welcomed the participants. He said that a meeting of policymakers and program implementers was long overdue. This meeting is not aimed at show-and-tell but rather to share experiences in the evaluation of improved technology for Vertisol and Alfisol management in the semi-arid tropics (SAT) of India, to identify training needs, and to develop plans to meet those needs.

Dr. Kanwar pointed out that Vertisols and Alfisols are the two most important soils of the Indian SAT, and the future of agriculture in this region depends on the management of these soils for successful crop production under rainfed conditions.

He emphasized that, though large strides have been taken to improve the productivity and conservation of these soils by introducing improved technology, the pace was rather slow. The technology needs fine tuning for large-scale local adoption. There is no universal technology, though there are some universal concepts. There are many components of the technology, and only a proper mix of these is useful for a given situation.

The watershed concept has become the main thrust of the Government of India's program on dryland agriculture. However, unless the concept is properly understood and correctly implemented, it may not give the desired results.

Observation of watershed projects in Andhra Pradesh, Karnataka, Madhya Pradesh, and Maharashtra indicate that a number of variations in the concept and practices of watershed management are being tried. There are many issues, some of a technological nature and others of an administrative and socioeconomic nature. The need for training of staff at various levels was evident everywhere. Lack of training of staff in the concept and practice of watershed-based technology is a critical constraint and it must be removed. Frequent transfers of the trained staff are often responsible for the tardy progress of the projects. Direct involvement or participation of farmers in the implementation of the project is vital for the success of the project as well as the continuation and dissemination of the technology.

The transfer of technology is a complex process. It requires a concerted and coordinated effort of research, extension, and governmental development by the State and the

Center. ICRISAT, as an international institute, can only be a catalyst in this process.

Drawing the attention of the participants to the purpose of the meeting, Dr. Kanwar indicated that this two-day meeting was a good opportunity to sit together and share experiences, evaluate performances, identify constraints, and find ways and means of removing these constraints, so that we may succeed in increasing the productivity from Vertisols and Alfisols.

He laid out the following specific objectives of the meeting:

1. To discuss area-specific problems of dryland agriculture and the production potential of Vertisols and Alfisols.

2. To discuss the experience of watershed-based technology and identify training needs.

3. To discuss the training setup/organization for implementing the program.

4. To give feedback to researchers about problems that require solutions and deserve a high priority to increase productivity in dryland agriculture.

Dr. Kanwar again extended a warm welcome to the participants and requested L.D. Swindale, Director General, ICRISAT, to inaugurate the workshop. We reproduce here, in full, Dr. Swindale's inaugural address to the workshop.

Development and Transfer of Improved Dryland Technologies: ICRISAT's Mandate and Institutional Linkages

L D. Swindale, Director General, ICRISAT

First of all, let me add my welcome to all of you. To many of you, I know it is to say welcome back to ICFISAT, but to some it is indeed your first visit to our Institute. We welcome you and hope that you will find time, today and tomorrow, to become aware of the many facets and aspects of our work.

Although the organizers of the program have given me a title to speak on, I am sure they will not mind if I speak about what seems to be uppermost in my mind when I look around the room and realize that assembled here today are senior officials from the areas of the country where dryland agriculture is important. So let me address my remarks to them; let me speak about what is now being achieved or what is possible in India, in the area of dryland agriculture.

The Government in its Sixth Plan has given dryland agriculture or rainfed farming—to me they mean the same thing—top priority. I expect the same will be true of the Seventh Plan.

The Working Group on Agricultural Production for the Seventh Plan has recommended that dryland farming be given a very high priority. We may ask why is this so? First, technologies are now available that will succeed in some of the areas of the drylands, and perhaps many. Secondly, they will succeed because the people who live in the drylands are much in need of help and assistance. In the dryland areas of central India, the per capita income is about a quarter of the national average. The benefits of growth that make the citizens of this country glow with pride and impress the outside world so much have not spread sufficiently to these areas.

There are, however, signs of promise. For example, data on the rate of growth of productivity—that is, yields per hectare—of the major cereal crops over the last 25 years, show that the rate of growth for sorghum *(jowar)* is about the same as that of wheat and much greater than that of rice. In the last 10 years the rate of growth for sorghum has outdistanced that of wheat. If you look further into the statistics, you will see that Maharashtra has been largely responsible for the productivity increases in sorghum, and that the improvements are almost entirely in the kharif (rainy season). Rabi (postrainy

season) *(jo-war)* has contributed very little to increased productivity. Also, the deep black soils (Vertisols), wherever they occur in the world, are recognized as soils of high potential. In India, they still represent an underexploited resource. Your States must help the farmers to "break the kharif fallow", to quote the words of a farmer in Andhura village, Karnataka, who was the first to successfully try the improved ICRISAT technology in his State.

Using the new methods, these soils in the kharif can lead to profits in rainfed agriculture that approximate the profits of highly subsidized, irrigated agriculture, without wasteful use of water. The Working Group on Agricultural Production has analyzed the value of irrigation and concluded that "the role of surface irrigation in the past performance of Indian agriculture is not clearly established to be very significant".

The improvements that are needed to develop rainfed areas are not easy to accomplish. They include having improved varieties of input-responsive crops and the use of fertilizers and other inputs. These the farmer generally understands. The extension services of government—State and Central—and the technical services of private industry are geared to help the farmer make use of these innovations. Progress is evident, perhaps not in all crops in all States and districts, or in all years. I am sure the rate of spread of improved cultivars and fertilizers would increase, if they were always used together. But we can say that these innovations are being accepted and brought into use.

Improved soil-and-water management, however, is an essential part of long-term improvements to overcome surface-drainage problems, to reduce erosion and runoff and, generally, to improve the workability of the soil. To make these improvements, the farmer must often do things which he is not used to doing. He must change his style of farming, grade and shape the land, and install grass-protected waterways, and use more efficient and more expensive animal-drawn implements. His work may be less backbreaKing, but he has to spend more time at it and be careful to do things in the right way and at the right time. Furthermore—and here is the rub—the farmer must share his benefits with his neighbors and the community at large; even with people living many miles away, whose lakes and tanks will not silt up so fast, whose water supplies will be improved, and who will be less subject to flooding from poorly-used, poorly-managed agricultural land.

If the farmer must share the benefits of his work, if the community is to get some of the benefits, then they must also share the cost. But how? Surely the answer is that the government—local, State, or Central—must represent the

community and use tax money to assist the farmer in carrying out public works to improve local and regional drainage channels and waterways. It is also necessary for the government to assist the farmer in soil-and-water management techniques on his own land, land shaping, furrowing, deep-plowing, etc. Greater efforts are needed by government to help extend improved soil-and-water management than to help extend soil- and fertilizer-use at this period in India's development.

The importance of improving the quality and expertise in soil conservation extension is clear. It is my understanding that the Union Minister of Agriculture is of the view that the Government must put more input into soil- and-moisture conservation and management. The beneficiaries will be the farmer and his family, the labor he employs, the employees of companies that supply fertilizer and seeds, the people who build roads, employees in government service, and the general community, of course. All these benefits are worth striving for.

The subsidies that are needed for the use of the improved Vertisol technology are largely those that are normally available, particulary State extension services and loans for soil conservation works. Existing services will, however, need to improve their efficiency. Banks will need to provide longer-term loans instead of loans for cropping seasons alone, as well as loans for the purchase of bullocks and implements. Improved regulated markets are required with greater capacities, flexibility to handle nontraditional crops, and mobility within districts. We have seen, in the short time that we have been involved in on-farm work, that farmers can be disastrously affected by a rapid drop in prices when a sudden increase in production occurs as a consequence of their taking up the new technology, and when nobody has made plans to move the increased production to the market. Where State Departments of Agriculture have planned in advance for the increased production and ensured that it was moved to where it could be used, the prices have held up and so, too, have the improvements in the technology.

Now, how can ICRISAT help and assist in the dissemination of this technology? Ours is an international institute and we have responsibilities to provide technologies to all the countries of the semi-arid tropics—there are 50 of them. ICRISAT was located in India at the specific request of the Government of India because it was recognized that this country would be a substantial beneficiary of whatever research the Institute did. In consequence, we give a great deal of attention to this vast country.

Our job, however, is not to serve the farmer directly. That is the job of the ICAR, the State agricultural universities, and the extension services of government. We have to be aware of the

farmer's needs so that the research we do can be useful at the end of that chain, when results reach him. Certain types of technologies that we work on are closer to the farmer for application than others. This has always been true of our work in farming systems and resource management, where the very nature of the work takes it out onto the farm and generates an interest at the farm level. At the same time, we are reminded by our donors and our Board of Governors that we are an international institute and cannot substitute for national or local services. Thus, we have tried to work out policies to guide our activities and maintain the appropriate balance.

We believe we should be involved to a sufficient degree in the verification of the technologies that we develop, to be able to determine whether in fact they are sound or not and, if not, why not, and what we can do about it. This level of involvement at the farm level to test, verify, and check what we have done, is an important and natural activity for us. Furthermore, this enables us to ensure that what we are doing is steered in the right way to farmers with few inputs available to them, and to the resourceful farmers in the rainfed area. In collaboration with ICAR, we are entitled to work, and have for many years been working, in a small number of villages, to gather base-line data about these villages and their needs, and also to do a certain amount of diagnostic and testing research at the same time.

We are able, very definitely, to be involved in training activities and are producing at least precursors of extension types of publications, which are a natural outgrowth of our work. As an example of the latter, I may mention the Tropicultor manual which has been handed to you. After a lot of preparative research on extension communication, a set of diagrams and photographs were developed for it, along with a text in English and Telugu, that can very easily be replaced with a Hindi or Marathi or even a French text. All that is required to be done is to change the text without changing the page layout. So that type of activity, the preliminary planning, design, and the production of the manual for others to copublish is, indeed, a permissible activity of the international institutes, including ICRISAT. So, too, in helping the State departments to utilize the technologies that are developed to improve their abilities to provide extension services in soil conservation and soil/water management, through training, meetings, etc.

This, I think, is where we are today. We are looking, as I understand it, not only at a particular technology that, in some senses represents a model, but a model that we use to explore training needs for the spread of innovations in the rainfed areas. We will learn what training needs they are and we will be able to indicate what ICRISAT can do to help. Obviously others will also be involved in this, probably to a much greater extent

than we are, but I want you to know that we do expect to be involved in some of the subsequent training that is identified, and we are looking forward to know what those needs are.

I hope that it is an enterprising and interesting session, and I look forward to being part of it. Thank you.

Session II: Dryland Technology

Chairman: J. S. Kanwar

Dryland Agriculture-Issues, Problems, and Production Potential

Vertisols

R.P. Singh, Program Leader, Farming Systems, ICRISAT, discussed the issues, problems, and production potential of dryland agriculture in Vertisol areas. He pointed out that about 22% of the total area of India is under Vertisols. Almost all Vertisols in India are rainfed and currently produce only 500-800 kg ha-1 per annum of foodgrains. Maharashtra has the largest area under Vertisols, followed by Madhya Pradesh, Andhra Pradesh, and Karnataka.

Vertisols are hard when dry and sticky when wet and, therefore, difficult to manage. After saturation they have low infiltration and thus are prone to waterlogging. Vertisols have been divided into two zones: those with dependable rainfall (750 mm and above), and those with undependable rainfall (less than 750 mm). The traditional system of fallow during the rainy season and growing of crops on the conserved soil moisture in the postrainy season utilizes only 41% of the total rainfall potential. As such, at present, these soils produce 92% of the sorghum, 88% of the groundnut, and 56% of the pigeonpea production in India.

He emphasized that the improved technology for the management of Vertisols evolved at ICRISAT is based on sound principles of soil-and-water management. The experience in the management of microwatersheds has shown that with suitable land treatment (broadbed and furrow, abbreviated as BBF) and an improved crop-management system, soil loss could be reduced to 1.8 t ha-1 as against 6.62 t ha-1, in the case of traditional flat fields kept fallow during the rainy season.

The experiment station results, from various regions and at ICRISAT, indicate that Vertisols have a high crop-production potential of 4-7 t ha-1 under conditions of dependable rainfall and about 2 t ha-1 in the undependable rainfall areas of Sholapur and Bijapur.

Discussing the various components of the improved Vertisol management technology, Dr. Singh continued that the different

components should be applied properly, giving considerations to the local conditions in the farmers' fields, for optimum results. For example, he said, strategically one should not go in for dry seeding with small seeds unless there is a 70% probability of getting 20 mm of rainfall in a particular week.

He indicated that there is a considerable need for research on weed control, effective land-treatment alternatives, stability of BBF under various rainfall conditions, effective water-harvesting systems, and low-cost implements.

Alfisols

J. Venkateswarlu, Project Director, Central Research Institute for Dryland Agriculture (CRIDA), dealt with the issues, problems, and production potential of dryland agriculture in Alfisol areas. He pointed out that Alfisols generally have poor physical characteristics and suffer from very low fertility and soil-moisture availability restricted to a very limited postrainy period. Experimental results have shown that timely tillage, use of improved short-season crop varieties, optimum plant population, proper fertilizer use, and effective plant protection result in an increased production potential of about 2.5 t ha-1 in rainfed Alfisol areas with 600-700 mm of rainfall in contrast to 0.6-0.7 t ha-1 being harvested by the farmers using traditional practices.

He further emphasized that the high diversity of soil characteristics in Alfisols are responsible for varying crop production constraints in different regions or spatially-distributed patches, which require location-specific land-use systems and production practices, such as agroforestry, grassland development, and appropriate cropping systems. A systematic inventory of Alfisols and their agroenvironments is necessary to develop and apply improved agricultural practices. Soil-and-water conservation aspects are basic to all situations and appropriate land treatments should receive major emphases, with a consideration to the various determinants of runoff and soil loss. Farmers should be trained to appreciate the problem and take simple proven measures to avoid erosion and soil loss, he said.

Considering the erratic rainfall pattern in SAT areas and poor soil moisture regime of Alfisols, drought stress is not uncommon. These uncertainties and losses need to be checked through midseason amendments in cropping systems and meeting the distress seed-demands through seed banks, he added.

Dr. Venkateswarlu laid considerable stress on the need for simple low-cost implements for seeding and fertilizer application

to ensure proper plant stand and observed that efficient fertilizer use is essential for increasing crop production under most conditions.

Watershed Management

K.L. Srivastava, Agricultural Engineer, ICRISAT, described the watershed as an ecological, management unit and spoke of the relevance of the ICRISAT deep Vertisol technology.

He explained that a watershed is the land area from which surface water drains to a single outlet. It is bound by a ridge line and forms an independent land unit for surface hydrology. Since the different parts of a watershed are interlinked as components of a single hydrologic unit, the interfarm and intrafarm development activities need to be planned and executed in a coordinated manner.

A watershed may include lands suitable for annual cropping, trees, pasture, etc. The integral land-use planning is an important aspect of watershed management. The management plans should invariably include soil-and-moisture conservation, ground-water recharge, development of productive and protective afforestation, agriculture production, grasslands, and horticulture.

Giving an example of a hypothetical watershed, Mr. Srivastava emphasized that the recommendations for the upper part of a watershed may include forestry, horticulture, pasture development, controlled grazing, graded furrowing, trenching, bunding, percolation tanks, etc. These measures are likely to sustain production and improve hydrologic balance in the upper part and increase productivity in the middle and lower parts. In the middle and lower parts, runoff control and safe disposal of excess water should be stressed with appropriate choice of crops and cropping systems capable of using available soil moisture at these levels.

Mr. Srivastava indicated that the middle and lower parts of the watershed are likely to have a 3% slope and more than 90-cm-deep soils. ICRISAT's deep Vertisol technology may be relevant to these subwatersheds for increasing cropping intensity and productivity.

He also emphasized that the intrafarm measures such as improvements in tillage, cropping systems, fertilizer application, etc. should go hand in hand with interfarm improvement programs because the utility of field drains may be limited, if there is no community drainage network. Also, a community-based moisture conservation or drainage-improvement

program may not be economical in the absence of efficient cropping systems, proper tillage, and improved seeds and fertilizer inputs on the individual farms.

Finally, he stressed that the watershed management programs should combine socioeconomic as well as ecological concerns. We have to consider how these community programs can be effectively financed and implemented.

Experience of On-Farm Research

D. Sharma, Coordinator, On-farm Research, ICRISAT, described the ICRISAT experience of on-farm research verification of Vertisol technology in different States. He explained the background and the conceptual framework of ICRISAT's on-farm research setup and its functioning to realize the Farming Systems Research Program objectives of "developing improved production practices that will optimize the use of agroclimatic, biological, and socioeconomic factors, and increase and stabilize crop productivity."

He emphasized that small SAT farmers with their variable-resource base react differently and are unable to provide ideal experiment-station conditions. Therefore, it is essential that the new technological options are adjusted to meet specific local needs. On-farm research is a multidisciplinary process directed at problem-solving field experimentation, with more emphasis on adoption possibility of the treatments than a description of the biological response curve. Exploration, verification, and demonstration are the different stages of on-farm research, but the order in which they should be taken up depends on the institutional setup, scientists' and extension agencies' perception of the problems, and the technological developments. They are in a way cyclically interrelated, one leading to another.

ICRISAT's on-farm verification of the deep Vertisol technology, initiated in 1981 in the villages of Taddanpally and Sultanpur (Medak district, Andhra Pradesh), showed that in general, production and profits were markedly higher under the improved technology, resulting in a 244% return on the added expenditure of Rs.586/ha, said Dr. Sharma.

These encouraging results extended the verification of the technology during 1983-84 to 28 locations and about 2000 ha involving 1406 farmers in the states of Andhra Pradesh, Karnataka, Maharashtra, and Madhya Pradesh. Dr. Sharma discussed the results and observations from the ICRISAT-scientist-managed projects or from the projects closely observed by the TCRISAT scientists, in each of the States and concluded that:

1. Vertisol verification trials have been carried out under highly diverse agroclimatic conditions (erratic to dependable high rainfall). With changing agroclimatic conditions, perceptions and the implementation of the technology have varied considerably and, therefore, the response to the technology has been variable.

2. In general, the technology has been identified with the wheeled tool carrier and the BBF. In Karnataka, the system has been viewed as an effective measure of soil-and-moisture conservation. Therefore, the actual implementation is confined to marking the ridge and the key lines, and preparation of the BBF. Development of community drains, grassed waterways, and outlets has not been possible because of social factors, as they cross property boundaries.

3. Most of the sites selected for the implementation of Improved Vertisol Management Technology (IVMT) do not suffer from the problem of waterlogging. Therefore, the absence of waterways and main drains has not caused serious problems. Thus, the advantages of the BBF are difficult to appreciate.

4. Observations from different locations indicate that all the components of the technology may not be necessary. In certain cases, the components such as dry seeding or shaping of the land into BBF may not be essential. Cropping systems are location- and area-specific, while land-and-water management treatments need to be determined according to the soil and land characteristics, the rainfall pattern, and the crops to be grown.

5. Verification trials on the farmers' fields have succeeded in:

   a. Creating necessary awareness and enthusiasm at different levels for the following:

      - Need to adopt efficient land-and-water management (land shaping, proper drainage, and moisture conservation).

      - Increase in cropping intensity through double or appropriate cropping.

      - Improved farm implements.

   b. Demonstrating that the improved technology is highly rewarding under close supervision of the specific steps if sufficient inputs are supplied.

c. Emphasizing the overriding importance of location specificity under diverse agroclimatic and socioeconomic conditions,

d. Adoption of plant protection practices based on pest monitoring and the use of controlled droplet applicator (CDA) assembly, by the Farhatabad farmers in Gulbarga district, Karnataka, indicates that the farmers are highly receptive to problem-solving, economically-viable, technological options.

In this background, Dr. Sharma pointed out that location specific adjustments of the technology require good technical support and an effective training program for the field staff. The initial training, organized at ICRISAT, worked well in terms of necessary background and exposure to the basic elements of the technology. However, the experience now of various aspects of the technology under specific situations of the region indicates a more well directed training, at the project level.

In order to make necessary adjustments in the technology to suit specific conditions, it is essential that principles behind a particular operation receive emphasis rather. than a particular operation per se. Often emphasis on an operation of a technological package results in a symbolic implementation of that particular operation and the desired results are not obtained.

ICRISAT, with its limited resources, is unable to meet the demand for area-specific training for a large number of watershed projects planned in different States.

To speed up communication of the technology, so that it can be extended to a meaningful audience in a reasonable time, it is essential that the Research and Extension Directorate of the agricultural universities play an important role in the transfer of improved agricultural technologies, through their various training programs, to the agriculture officers and subject-matter specialists (training) in training and visit (T and V) system of extension.

Discussion

E. Raghava Rao: Can the ridge-and-furrow method replace BBF and is it equally useful?

R.P. Singh: It can be done depending on the local situation. However, planting on ridges by bullock-drawn seeding equipment is problematic.

E. Raghava Rao: Have other methods been compared with the BBF?

K.L. Srivastava: At ICRISAT Center, flat, ridge-and-furrow, and BBF methods were compared as land-management treatments for the maize-chickpea system, keeping other things constant. Runoff was lowest in BBF and yield was 15% more than that on the flat-on-grade system. Although yield of maize was similar in the BBF and ridge-and-furrow plots, the stability of the ridge-and-furrow system was low. The flexibility of the cropping system is limited in the ridge-and-furrow system. We are now comparing the flat-on-grade and furrow-on-grade with BBF in the farmers' fields for other cropping systems.

D.V. Dixit: What is the exact figure (area) of black soils in Maharashtra? Broad-based bunds were tried out in Maharashtra but were not quite successful. Any comments?

R.P. Singh: The exact area under black soils in Maharashtra is not available. Broad-based bunds were tried out in the Operational Research Project (ORP), Indore. The success of this measure depends on the rainfall.

J. Venkateswarlu: The broad-based bunds were tried out in Bellary. They do not work in low-rainfall areas.

K. Krishnamurthy: Has ICRISAT tried dry seeding extensively?

R.P. Singh: For dry seeding to be successful, it is necessary that there should be at least 70% probability of getting 20 mm rainfall in that week. Dry seeding is done at a depth of 5-7 cm. Small-sized seeds have a limitation in this regard and, as such, only large-sized seeds should be dry seeded. Suitable seeding implements are a limitation for seeding at a desirable-seeding depth.

T. Ganapathy: In Tamil Nadu, cotton is dry seeded. Farmers do not want to keep the BBF permanently. What about cracks in the BBF?

R.P. Singh: Cracks do occur, but they do not pose a serious problem in any of the operations. Beds have to be re-formed every 3-4 years.

K.A. Jalihal: The techniques are much too generalized and cannot be applied everywhere and to every type of soil.

R.P. Singh: Soil and water conservation are very important aspects of the technology. The principles are the same, whatever be the situation. The approach should be related to the problem.

K.A. Jalihal: In Dharwad, a very good crop in rabi (postrainy)

season is taken, for example, tobacco in Nipani, after a kharif (rainy season) crop.

J.S. Kanwar: That is why the rainfed areas have to be divided into zones of dependable and undependable rainfall.

Approaches to watershed development by the different State governments differ widely. In some States, even ordinary land-smoothing and tillage operations are done by the State government agencies. The moment subsidy and assistance are withdrawn, the technology collapses.

K. A. Jalihal: The technology has to be refined. Are we not hurrying to test things in farmers' fields rather than testing them in local research stations first?

D. Sharma: Quick transfer and dissemination of improved technology are important. If we test a technology again in a research farm, we may be able to obtain similar results as that of the ICRISAT experiment station, as long-envisaged physical factors are similar. The farmers' participation is necessary in order to have an idea about the socioeconomic influence and viability of the technology within the range of management levels at their disposal.

Session III: Technology Transfer and Training

Chairman: L.D. Swindale

The ICAR Network for Technology Transfer: Approach and Methodology

C. Prasad, Deputy Director-General, Indian Council of Agricultural Research (ICAR), described the many levels of organization of extension work in India, consisting of the extension systems of the ICAR, the Ministry of Agriculture, State Departments of Agriculture, the Ministry of Rural Development, and nongovernmental organizations (voluntary agencies).

The ICAR extension system is the "first line" extension carried out by research institutes. Agricultural universities, by organizing demonstrations and training on a limited scale, have considerable influence on other extension systems/subsystems, Dr. Prasad explained.

In India, the extension system has to deal with 81.5 million land holdings and about 500 million farmers, who include women, youth, and agricultural laborers. Any extension system/subsystem, however vast, cannot reach them quickly. Therefore, multiplicity of extension agencies, training institutions, input organizations, etc., is natural. However, there is a considerable need for developing a strong functional relationship and for playing complementary and supplementary roles in the dissemination and transfer of improved technology for increased agricultural production, Dr. Prasad added.

He mentioned the special ICAR projects, such as those run by agricultural universities/institutes, in association with the Department of Agriculture, on transfer of technology; national demonstrations; operational research projects; and the lab-to-land program.

In addition to these projects, 47 model watersheds have been selected by the ICAR, the Ministry of Agriculture, and the Department of Rural Development. Thirty watersheds are being implemented through the Dryland Agriculture Project (CRIDA), Hyderabad, and 17 through the Central Soil and Water Conservation Research and Training Institute, Dehradun, according to Dr. Prasad.

While discussing the role of these different projects in job training and extension of the improved technology, Dr. Prasad

emphasized the need for improved training in technological skills on one hand and extension methods and pedagogy on the other. This implies drastic changes in the extension curricula of the agricultural universities and allied institutions. The extension activities of the ICAR system should be imaginative and creative, so that the feedback mechanism could be effective in influencing both the research system as well as the State Departments of Agriculture, the main extension agencies. Constraints analysis of the transfer of technology activities is another important aspect that needs the attention of the extension scientists. To have an effective technology transfer, the extension workers should be trained in the subject matter and, reciprocally, the subject-matter specialists (SMSs) should be trained in extension methods.

Discussion

K.A. Jalihal: The movement of information from research to the extension agencies through the ICAR institutions and agricultural universities should be regarded as a first-line system. The adoption of technology by demonstrations to the farmers should be the responsibility of the State Agricultural Department.

C. Prasad: I agree. Activities of the ICAR, agricultural universities, and other institutes are confined to areas around the institutions though they should be expanded. Large-scale extension work should be expanded and be the responsibility of the Agriculture Department. Then there would be no duplication of efforts.

L.D. Swindale: ICRISAT's basic purpose is verification of improvements in technology, in order to evaluate its strengths and weaknesses. In the process, we are involved in influencing the farmers and extension workers. So we are now trying to identify training needs for transfer of technology.

C. Prasad: Conducting adaptive trials is the responsibility of the State agricultural departments but they were found to be very weak. So the ICAR institutions and their scientists were being pressed into action. Ultimately, large-scale adaptive trials should lead to demonstration and transfer of technology by the extension workers.

T. Ganapathy: In Tamil Nadu, the Agricultural Department is conducting adaptive trials as fixed at the annual meetings with the university scientists. The data are supplied to the scientists at the end of the crop season and satisfactory items are transferred back to the extension workers for conducting demonstrations.

Glimpses of the Meet

ICRISAT Director General L.D. Swindale inaugurates the two-day meeting.

Participants discuss the functioning of a fertilizer-cum-seeding device.

Participants examine and discuss the functioning of a controlled droplet applicator spray assembly mounted on a Tropicultor.

Participants observe and discuss agroforestry experiments at ICRISAT Center.

T.s. Khuspe: Reasons for ineffective transfer of technology (to Dr. Prasad) may be several. What are the views of the ICAR?

C. Prasad: This is the weakest area in ICAR's extension program. The adaptive trials conducted by the scientists and the university extension staff should not be compared with the trials conducted by the village-level worker. The scientists are doing an excellent job and are required to identify the facilitating factors, linkages needed, constraints, etc. This is not possible for the State agricultural departments. However, the SMSs need extension training and the extension specialists need subject-matter training.

Experience in Technology Transfer and Training at the National Institute of Rural Development (NIRD)

O.P. Bhatnagar, Director, Extension and Transfer of Technology, NIRD, informed the group that his institute has completed 25 years of existence and its mission and mandate consists of training, research, and consultancy.

The training is research-cum-resource oriented and is directed at apex-level planners, policy makers, chief executives, civil servants, input suppliers, voluntary agencies, and academicians, he said.

The Extension and Transfer of Technology (ETOT) unit of the institute is being shortly upgraded as a National Centre for Management of Agricultural Extension, with World Bank assistance. It will serve a number of countries, particularly those who have adopted the training and visit (T and V) system of extension, according to Dr. Bhatnagar.

After a brief description of the research and consultancy activities of the institute, Dr. Bhatnagar discussed case studies related to "planning and management of pilot watersheds and problems in their replication". The study of a watershed, in Chitradurga district, Karnataka, indicated that the planning of the pilot watershed was systematically done through surveys of topography, land-use capability, socioeconomic conditions, soil type, ground-water availability, and recommendations related to the agronomic practices and livestock. The full contingent of the project team was posted for this work, which included management of the credit and its periodic evaluation. However, the farmers were not sufficiently educated about the long-term

benefits of soil conservation by bunding. Hence, they were indifferent to the maintenance of the bunds. Good work was done in the case of afforestation, which checked soil erosion but the inhabitants were unhappy as their cattle were not allowed to graze in that area. However, no efforts were made to educate the farmers as to why this was necessary.

Animal husbandry activities were not undertaken as envisaged in the project, in spite of the fact that 39% of the small farmers indicated their desire to supplement their income from these activities. Dr. Bhatnagar noted.

At the field level, many farmers adopted the recommendations of the dryland farming practices which resulted in an increase of 10-15% in crop yield. The term watershed was known to all officers, but they lacked basic knowledge of how it operated in the field. Thus, integration of the activities was not evident, resulting in poor coordination at all levels, Dr. Bhatnagar pointed out.

In another study entitled "People's participation in watershed management", conducted in Hazaribagh district, Bihar, it was observed that the farmers were not at all aware of the long-term goals of watershed development and were unable to relate it to their socioeconomic conditions and goals. After completion of the soil conservation works (engineering structures), no follow-up was done to improve the crop productivity. Local institutions played no part in the entire program, he added.

Citing these case studies, Dr. Bhatnagar emphasized the need for a proper educational process essential for the success of any project.

Dr. Bhatnagar listed the following constraints and problems in technology transfer identified during the discussions, in the training programs of NIRD:

1. Though technologies were available in the vicinity, they were not applicable and useful, because they were too sophisticated and not adequately simplified. Bulk of the technologies were unsuitable to the agroclimatic and socioeconomic conditions of the people and these factors restricted its further transfer to the needy. Rarely was the absorption of need resources considered.

2. The various kinds of demonstrations were mere efforts in the direction of a technological push rather than a sincere effort at technology transfer. In this process, the extension agencies of the Department were ignored. This

enlarged the area of organizational conflict and egocentricism.

3. Based on the studies at the research stations and in-field trials outside these stations, a package of practices were recommended to the extension workers. But all these were based on field-test situations rather than on tests "in farmers' life situations".

4. Inputs and credit/subsidy were not within easy reach of the farmers. Often the technology transfer is linked with aids, subsidy, and loans causing considerable side affects. There is a symbiotic relationship with credit and corruption. Leakage and wastage were also found to be common.

5. Communication of the technologies is faulty. In some cases, conflicting messages flow from different overlapping agencies, which confuses the farmers a great deal. In the name of communication efforts, there is more of information overloading without any consideration for the target beneficiary. Training is rarely need-based. Even in the good training programs, there is more emphasis on theoretical knowledge than on the development of technical skills. Thus the need for an effective trainers' training program should get priority.

He concluded by stating that appropriate technology, extension, and training are the stepping stones for the successful transfer of a technology.

Discussion

L.D. Swindale: As pointed out in this paper, the subject-matter specialists (SMSs) are drawn fron. different agencies at different stages in the development process. To start with, the SMS of land development will be needed, followed by those of crop production, economics, and so on.

O.P. Bhatnagar: It is a very important question. We have now been looking into what type of specialists are needed at the different stages of development.

C. Prasad: It is an interdisciplinary need. Team work among SMSs is unsatisfactory.

L.D, Swindale: Agricultural-production teams must work on a project-basis.

Watershed Management and Village-Level Training

N.K. Sanghi, Zonal Coordinator (Lab-to-Land program), ICAR, discussed the experiences of village-level training related to the management of Chevella-Pothulboguda watershed in Medak district, Andhra Pradesh. He said that the watershed program deals with an integrated development of three major components, i.e., land-use system, soil and water conservation, and management of dryland crops. The training program should, therefore, emphasize not only the individual components but also deal with the interrelationship between these components. Watershed development also includes a number of community activities such as social forestry and water harvesting. Therefore, involvement and training of farmers are essential.

Dr. Sanghi emphasized the importance of need-based training and made the following suggestions for a successful farmers' training program:

- A problem oriented approach: For this a detailed survey of the farmers and their fields is needed. The farmers have to be categorized into small homogenous groups based on similarity of their problems. For example, in a watershed, if only 30% of the farmers face soil erosion problems, training on soil erosion should be directed to these 30%, and possibly in two groups, one of small-holding farmers and another of large-holding farmers.

  Reasons for an inefficient land-use system among small- and large-holding farmers are different and therefore require specific remedies. The two groups should be handled in two different training programs.

- Alternate technological options: The technological options presented often suffer from the biases of the resource person and the supporting research organization. With this approach, the main focus remains on the technology rather than on the production problem. Consideration of more than one technological option for each production problem avoids undue bias towards a particular technology and is more practical as different options may suit the different management capabilities of the farmers.

- Skill development: Most training programs impart good knowledge about improved technology but a majority of the participants are not able to. apply the information under their own field conditions. This can only be improved by laying emphasis on the practice and development of the skills.

- Avoid information overload: Training programs should be conducted in small steps. The choice of practices at each step should be based on their relative payoff and operational feasibility under field conditions.

- Repeat contact with participating farmers: There is a need for establishing contact at critical stages of the operations, which are preseason training, midterm follow-up, and postseason review.

Discussion

T.S. Khuspe: Can you suggest an approach or any other methodology for watershed development?

N.K. Sanghi: The methodology keeps changing with the stages of development and people. Of course, we are (in general) not in the habit of using the experience gained.

C. Prasad: Where is the place/opportunity to incorporate the experience gained in the system? Discussions involving the State Agricultural Departments, the agricultural universities or other related linkages never take place.

K. Krishnamurthy: There is an efficient network after the National Agricultural Research Project (NARP) was introduced in the State agricultural universities. We conduct a workshop under the auspices of the research council, consisting of related development departments, farmers' representatives, etc. This is a systematic effort. Sanghi should have written to the Director of Research or Director of Extension, Andhra Pradesh Agricultural Univesity (APAU) about his watershed experience.

D. Sharma: At ICRISAT, different research programs who have their input in technology generation, respond to the problems and try possible alternatives. For instance, the socioeconomic problems are referred to the economics program which provides, for example, a cost-benefit analysis to modify our recommendations. Technological problems are referred to the crop-improvement programs. Problems reported in introducing the wheeled tool carrier have been looked into by engineers. Low-cost and efficient alternatives are being tested. Land-and-water management had problems in introducing the broadbeds-and-furrows (BBF) system. Alternate systems like graded bunds or furrows are being tested. This goes on continuously in our on-farm research.

C. Prasad: Referring to the NARP, before and after its introduction, its coordination leaves much to be desired. The

structure may be good but how well it functions is more important.

N.K. Sanghi: Some feedback is taken care of by the scientists when, for example, they adopted a problem-oriented approach in training. Another feedback used was the need for suggesting several alternatives to the farmer instead of one. Though the farmers desired the loan payment in kind, the banks continued to pay in cash.

K.A. Jalihal: (to Sanghi) Some sort of force is needed to involve all farmers in a watershed to accept land shaping. Other areas of work should be through motivation.

L.D. Swindale: We had experience of working without subsidies in our effort to transfer technology in the watersheds.

N.K. Sanghi: Land shaping can also be implemented without force and through educational efforts.

R.P. Sandge: It is not possible to execute a program like watershed development without use of a certain compulsion.

D.V. Dixit: Land treatment (hardware, capital-intensive) is done by the agricultural department up to the stage of pasture development in some cases. Though the farmer wants the benefit, he resists government intervention. The software such as fertilizer use, can be best applied through education.

D.L. Oswalt: The basic requirement is a viable technology before we can transfer it. The well-being of the individual (as in the Japanese extension system) is an important goal. The use of subsidies or loans will not work as the farmers know that they will be excused in due course from repayment. Sociologically, children of farmers want more out of the agricultural profession. The need for technology must be felt; only then will it be sought by the farmer. Instead, we are going to him. Drainage is not a community problem if water conservation is done on each parcel of land. If his family welfare improves by the adoption, he will adopt it. We have to create the need for the adoption of the technology before we can effectively transfer it.

K.A. Jalihal: There is a basic misconception in the approach. We used to start working with people who are willing but now we select an area and force people to accept what we think is good for them (with World Bank aid).

R.P. Sandge: Each component of the package or the alternatives should be offered to the farmer for him to choose from.

Session IV: Training Needs

Chairman: C. Prasad

C. Prasad initiated the discussion by indicating that there is a need to identify the different levels at which training in dryland-agriculture technology should be organized. Training at the ICAR institutes and agricultural universities provides the necessary research backup for improved technology and constitutes the first-line of the training program. This is responsible for developing the basic skills of the technical staff at different institutes and for the flow of information on the new technology to the technical staff of the development and extension agencies. For effective transfer of the technology to the farmers, it is essential that the extension workers responsible for the technology transfer should be well trained so that the necessary skills, in turn, are passed on to the farmers through on-location training programs.

Dr. Prasad emphasized that the training required at different levels has different elements and requirements, that should be properly identified and attended to, in order to make the program a success. Though training setups and organizations do exist, considering the vast need for such bodies, they are highly inadequate. He requested the Directors of Extension Education of the universities to discuss the training setup and its requirements in the different States.

H.N. Byra Reddy, Director of Extension Education, APAU, described the existing setup of the extension education and indicated that the staff for training the subject-matter specialists (SMSs) is highly inadequate and that the facilities such as a trainees' hostel are lacking. He emphasized the importance of imparting training in skills and practical operations and pointed out that facilities of field and implements are insufficient.

K.A. Jalihal, Director of Extension Education, University of Agricultural Sciences, Bangalore, pointed out that the National Agricultural Research Projects (NARP) and operational research projects (ORP), attached to the universities, have helped in strengthening the training facilities at the universities. However, there is a need for improving the training methodology, since the scientists working in different research projects, often do not have adequate experience in pedagogy and field-level training. There is a need to imbibe appropriate extension methodology for the transfer of technology in our training programs.

T.S. Khuspe, Director of Extension Education, Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, Maharashtra, informed the group that in his university, extension training is being imparted by the extension units of NARP and Krishi Vigyan Kendras (KVK). This university is setting up a separate training cell while hostel facilities for the training are under construction,

G.K. Sangle, Director of Extension Education, Marathwada Agricultural University (MAU), Parbhani, Maharashtra, informed the group that, as such, his university does not have any formal structure for training in improved technology. The Director of Extension Education is supported by four agronomists, who are in charge of two districts each. They organize monthly and seasonal training programs for the officers of the Department of Agriculture. These SMSs (agronomy) supervise trials on the farmers' fields and provide necessary feedback to the scientists. At present, the major thrust is on the technology for the irrigated projects. For these areas, recommendations on improved crop varieties, fertilizer doses, and plant protection methods are available. Efforts are being made to convey them to the farmers. He emphasized that in case of dryland agriculture, specific recommendations are lacking and there is a need to have information on effective low-cost implements and weed management. Farmers require improved technology that matches their resources. In the case of watershed-based dryland agriculture, there is a need for integrated technological recommendations dealing with the various operations from tillage to postharvest, covering cropping systems, agroforestry, animal husbandry, farm finances, crop insurance, etc. Farmers' training and their role in watershed development, therefore, needs to be well-defined.

S.N. Dubey, Director of Research Services, Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKW), expressed satisfaction on the development of the regional research and extension setup of the JNKW with the help of the NARP projects. The regional research setup of the NARP caters to the needs of the 5 crop zones and 12 agroclimatic zones. However, he felt that research in dryland agriculture needs to be strengthened and emphasized. The results obtained in the Indo-British dryland operational projects are very encouraging. These are being extended to other areas with similar problems. He was of the opinion that the new improved technologies should be first tried out in the operational research projects of the university and, if found suitable, transferred for general implementation in the farmers' fields.

Discussion

T.S. Khuspe: University SMSs, who are the scientists working on various subjects, train the training and visit (T and V) staff. Since the scientists from various fields are discipline-oriented

in their approach, integration of the training on the subject of dryland as a technology is often a problem.

S.N. Dubey: Agricultural university scientists and the agriculture department officers meet and identify potential training areas.

D.V. Dixit: Common messages for field-level training are synthesized during the program planning meetings at the division and district level for the T and V system and the recommendations developed at that level are used for training village-extension officers (VEO).

H.N. Byra Reddy: Watershed-based development of dryland agriculture requires a multidisciplinary approach. However, SMSs (agronomy) should synthesize an integrated message.

R.P. Singh: For training on dryland technology, it is difficult for a scientist from any single discipline to synthesize all the aspects of the dryland agriculture technology. An integrated approach is required. Scientists from universities and ICAR institutes should train the officers of the Department of Agriculture within their region of influence. The scientists from the national institutes and ICRISAT should interact to exchange information on problems and technological solutions.

D. Sharma: Watershed-based technology of dryland agriculture has a high degree of location specificity and requires close multidisciplinary interaction to solve the problems on various aspects of agriculture. Often scientists themselves require a better understanding of the situations and problems for suggesting appropriate improved alternative solutions. To tackle the problems of vast diverse areas, it will be desirable to identify the respective role of each of the international/Central/State level institutes and develop effective linkages.

C. Prasad summed up the discussion with the following observations:

- Integration of the SMS messages is often a problem. However, at the farmer-level training, it is desirable that one person communicates the message rather than have each SMS talk about his subject only.

- There is a need to improve the number of the training setups and the contents of the existing training programs. Extension training programs should be strengthened by developing the necessary infrastructural facilities. The ICAR and the World Bank can help in improving the institutional setup.

- The thrust on dryland agriculture is recent and, therefore, the training programs are rather weak. Even the existing technology, capable of doubling agricultural production in dryland areas, has not reached the beneficiaries. There is a need to improve the training level of the trainers, Basic training in dryland agriculture should be imparted at the undergraduate and graduate levels in the agricultural universities and colleges.

- Research institutes should emphasize constraint analysis and development of relevant practical technologies.

Role of Subject-Matter Specialists' (SMS) Training in Transfer and Implementation of the Vertisol Technology

The Directors of Agriculture and the Directors of Research Services reported their experiences and observations on the role of SMSs' training in the transfer and implementation of the Vertisol technology.

P. Ramakanth Reddy, Director of Agriculture, Andhra Pradesh, mentioned that in the past, dryland agriculture received little attention of planners, though drylands contribute 40% of the total grain production in the country. If the country's productivity has to cope up with its growing population, due attention should be paid to the agricultural development of dry rainfed areas, that would constitute up to 60% of the cultivated land, when the full irrigation potential of the country is realized.

The facilities for dryland agricultural research in Andhra Pradesh Agricultural University (APAU) are limited as there is neither a single research station nor any instruction on the problems related to Vertisols. It is essential that appropriate technology is generated in the assured-rainfall areas as well as for different types of soil and rainfall conditions. Actually from the socioeconomic and human point of view, Alfisol areas with low-erratic rainfall have a greater need for the technology, that can help in improving the land productivity, alleviating human suffering due to shortage of food and nutrition, Mr. Reddy observed,

Mr. Reddy pointed out that the quality of training at the farmers' level is very poor, as the VEOs, who are supposed to

train the farmers, have a low educational level (class X or a diploma) themselves. There is a pressing need to train and educate village-level officers in agriculture at a vocational school, leading to an appropriate diploma, or by stipulating higher educational qualifications for the job.

M. Jyothi, Additional Director of Agriculture, Karnataka, informed the group that the agricultural university scientists train the agriculture department SMSs and, in general, the training is good up to the level of the Assistant Directors of Agriculture. Some attempts are being made to organize location-specific training on the watershed-project sites of late. The ICAR dryland-research program at Bellary has been a great help in conducting these training programs. Besides the training of the field-level functionaries, training for the watershed team leaders was organized at ICRISAT Center, Patancheru. In general, training in cropping systems and preparation of crop plans are adequate. However, major emphasis needs to be given to the various aspects of soil moisture conservation, hydrology, and on-ground water usage.

Dr. Jalihal added that attention is being paid to the training of women and youth at the farmers' training centres.

R.K. Nigam, Deputy Director of Agriculture, Madhya Pradesh, pointed out that 87% of the cultivated area in Madhya Pradesh is rainfed and 40% of this is under Vertisols. He felt that due to highly diverse socioeconomic and agroclimatic conditions of the different regions in the State, there is a need for location-specific appropriate technology. In the absence of location-specific improved technology, training programs dealing with general aspects of agricultural production are not very effective. Constitution of dryland boards have been initiated but what they intend to do is not very clear.

D.V. Dixit, Additional Director of Agriculture, Maharashtra, pointed out that in his State major emphasis is being laid on soil conservation in watersheds. Since the program is fully financed by the Department of Agriculture, considerable progress has been made. However, the progress in the crop production practices is not marked. Often the farmers' perspective and their problems are not appreciated by the scientists.

N. Athimoolam, Director of Agriculture, Tamil Nadu, informed the group that 52% of Tamil Nadu is dryland, a third of which is under Vertisols. The problems in the Alfisols are more serious than in the Vertisols. He suggested that ICRISAT should pay attention to the problems dealing with Alfisols and should help in the training of the departmental officers. Attempts are being made to develop the infrastructure for the development of

agriculture on a watershed basis. Appointments of an Additional Director of Agriculture and other staff to look after the work have been proposed.

S. Mehboob Ali, Director of Research Services, APAU, indicated that the research facilities for dryland agriculture, particularly on watershed management, are not adequate at the APAU. Lack of funds has restricted development of appropriate land-and-water management systems even on the experiment stations. They have somewhat limited experience from the ORPs. However, there is a need to have a proper follow-up evaluation, during and after the project period, in order to develop a proper understanding of the functioning and benefits of these projects. At present, the APAU does not have infrastructural facilities to take up the work effectively on the Vertisol management technology.

He emphasized that the training of the project staff should stress the practical aspects of land-and-water management and crop production practices relevant to the farmers' resources. It will be desirable to train the project staff on the project site itself.

K. Krishnamurthy, Director of Research, University of Agricultural Sciences, Bangalore, stated that despite good efforts in research and availability of improved technology, precious little has been achieved in terms of the transfer of the technology to the farmers. He stressed the need for developing and adopting proper methodology for the transfer of improved technology. The SMSs should be trained not only in the technological aspects, but in the methodology for transfer as well.

R.P. Sandge, Director of Research, MPKV, Rahuri, Maharashtra, informed the group that in Maharashtra, scientists from the four agricultural universities and the officers of the Department of Agriculture meet to exchange views and information on the various aspects of improved-technological advances. However, little has been added to the information available from the experiments done and the practices developed at Sholapur for deep Vertisols in the Parbhani region.

He felt that the trainers engaged to train the farmers, should have a good background of the practical aspects of the farmers' practices and the proposed improved technology. In his opinion, there is a need to improve the communication techniques. Also, he suggested that the ICAR manual for dryland-agricultural practices should be updated, both for the Alfisols and Vertisols.

Discussion

N.K. Sanghi: I feel there is a considerable need for training in watershed planning. Our experience is somewhat limited in this area, A well-prepared, detailed development plan is a must for proper implementation and the success of a watershed project.

K.A. Jalihal: ORPs provide the necessary feel and the needed experience for the extension of the improved technology on a large scale.

J.S. Kanwar: Model work plans for each of the watersheds are important to take up the developmental activity in a given watershed. 1CRISAT is extending technical support in two or three watershed projects in each of the Vertisol and Alfisol areas. ICRISAT scientists have an interest in the development of the improved technology and their activities can be catalystic in nature. Each watershed project should have the necessary technical input from the university or ICAR institute scientist, along with the agriculture department staff, who have the responsibility of working in the project. ICRISAT should help in training the leaders of the watershed projects.

C. Prasad summed up the discussion and made the following observations:

- There is a need to develop the necessary training facilities and to hasten the recruitment of the training staff.
- Close coordination between the scientists of the national and international institutes involved in dryland-agriculture research and the Departments of Agriculture is important.
- Training needs in terms of the content and methods for different levels should be worked out for effective implementation of the training programs.

Session V: Adoption of Recommendations

Chairman: D. L. Oswalt

D.L. Oswalt, ICRISAT, initiated the discussion by emphasizing that realization of felt needs and motivation for change are important conditions for the success of any training effort.

Training programs should be developed as a problem-solving process, that is, identification of the need, appreciation of the problem, and identification of alternatives (technologies). In the case of watershed management we need a systems approach. Generally, developmental agencies are used to a package approach, noted Dr. Oswalt.

At this stage, N.K. Sanghi pointed out that for effective watershed management and development, detailed planning within a watershed is essential. There is a great need to train for planning within a specified watershed.

P. Ramakanth Reddy mentioned that though there is an emphasis on integrated watershed development in dryland areas, the staff working in the projects did not fully appreciate the concept of integrated watershed development. Often coordination of the activities of different departments is difficult.

The group adopted the following recommendations:

1. Watershed characteristics and physical elements are area- and location-specific and, therefore, emphasis should be laid on watershed-specific management and technology generation.

2. Infrastructural facilities and staff for conducting the training in existing technologies are inadequate at different levels. Training setups should be strengthened.

3. Research resources for generating the relevant, improved-dryland technology for a particular region should be strengthened through:

    a. Augmentation of discipline-oriented resources and problem-solving research.

    b. Postgraduate training and research in dryland agriculture and watershed management.

c. Development of instructional watersheds and course curricula in dryland agriculture and watershed management at the B.Sc. Agriculture degree level, in the agricultural universities.

Efforts should be made to undertake research on methodology for the transfer of technology, diagnostic analysis, and evaluation.

National institutes, agricultural universities, and ICRISAT should develop strong collaborative projects on the development of improved dryland technology and watershed management as well as organize training programs for new improved technologies at the appropriate levels.

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Program for Meeting on Training Needs for Deep Vertisol Technology

WEDNESDAY, 17 JULY

0830-0900	Registration
Session I:	**Inauguration**
	Chairman: J.S. Kanwar Rapporteur: D. Sharma
0900-0910	Welcome address and objectives of the meeting: J.S. Kanwar
0910-0940	Inauguration: L.D. Swindale Development and transfer of improved dryland technologies: ICRISAT's mandate and institutional linkages
0945-1045	Field visit: K.L. Srivastava and Sardar Singh
1045-1100	Tea/Coffee
Session II:	**Dryland Technology**
	Chairman: J.S, Kanwar Rapporteur: S.K. Dasgupta
	Dryland agriculture-issues, problems, and production potential
1100-1130	Vertisols: R.P. Singh
1130-1200	Alfisols: J. Venkateswarlu
1200-1230	Watershed-an ecological unit and a unit of function and ICRISAT's deep Vertisol technology: K.L, Srivastava/D. Sharma/R.P. Singh/ R.C. Sachan
1230-1400	Lunch
1400-1430	The ICRISAT experience of on-farm research verification of Vertisol technology in different States: D. Sharma

Session III: Technology Transfer and Training

Chairman: L.D. Swindale
Rapporteur: A.S. Murthy

1430-1500 ICAR network for technology transfer-approach and methodology: C. Prasad

1500-1515 Tea/Coffee

1515-1545 Experience in technology transfer and training and NIRD: O.P. Bhatnagar

1545-1615 Watershed management and village-level training: N.K. Sanghi

1615-1630 General discussion

1900 Cocktails and dinner

THURSDAY, 18 JULY

Session IV: Training Needs

Chairman: C. Prasad
Rapporteur: M.S.S. Reddy

0845-1030 Training setup and need for improved dryland technology in different States: Andhra Pradesh, Karnataka, Maharashtra, and Madhya Pradesh- Directors of Extension Education

1030-1045 Tea/Coffee

1045-1230 Role of subject-matter specialist training in transfer and implementation of the Vertisol technology: panel discussion and recommendations- Directors of Agriculture and Directors of Research

1230-1400 Lunch

Session V: Conclusion

Chairman: D.L. Oswalt
Rapporteur: D. Sharma

1400-1500 Conclusions

1500-1515 Tea/Coffee

Acronyms and Abbreviations Used in the Report

APAU	Andhra Pradesh Agricultural University
BBF	Broadbed and furrow
CDA	Controlled Droplet Applicator
CRIDA	Central Research Institute for Dryland Agriculture
ETOT	Extension and Transfer of Technology
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IVMT	Improved Vertisol Management Technology
JNKW	Jawaharlal Nehru Krishi Vishwa Vidyalaya
KVK	Krishi Vigyan Kendra
MAU	Marathwada Agricultural University
MPKV	Mahatma Phule Krishi Vidyapeeth
NARP	National Agricultural Research Project
NIRD	National Institute for Rural Development
ORP	Operational Research Project
SAT	Semi-arid Tropics
SMS	Subject-matter specialist
T and V	Training and Visit
VEO	Village-extension officers

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