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Vol XXXV
No. 4

ISSN 0019-5014

CONFERENCE
NUMBER

OCTOBER-
DECEMBER
1980

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

(1) The cropping pattern for Hissar zone should have relatively more area under short duration crops followed by medium duration crops whereas in the case of Narnaul zone, the cropping pattern should have relatively more area under long duration crops followed by medium and short duration crops.

(2) Because of high risk involved in dryland farming, it is necessary to develop a combination of farm plans for each holding size based on varying levels of expected net farm income and risk involved. It will provide a good range of choice for the farmers to choose from on the basis of their resource structure, financial position and risk bearing capacity.

(3) In the short run, planning efforts need to be made to improve the existing cropping pattern of the farmers through variety substitution and acreage reallocation based on the farmers' own resources, family needs and income variability of different crops. Introduction of new enterprises may be taken in phases.

(4) In the dry farming areas, livestock of non-descript breed raised mainly on crop residues and by-products is an important supplementary enterprise.

THE SCOPE FOR A NEW SURGE OF AGRICULTURAL DEVELOPMENT IN THE DRYLAND OR DROUGHT-PRONE AREAS OF INDIA

Alfred S. J. Jacob*

It is worth recalling that the Planning Commission's Memorandum on the Fourth Five-Year Plan defined the backward regions as those regions which are also chronically drought affected with mainly rainfed crops. These areas were forgotten in the desperate effort to increase total agricultural production through the Intensive Agricultural Development Programme and the High-Yielding Varieties Programme. It is in these regions that there is an urgent necessity to develop suitable agricultural practices and techniques to raise agricultural production and productivity, so as not to have festering pockets of poverty in the country. The case for development becomes all the more stronger when we observe that even if all of the irrigation possibilities are fully realised in these regions, still half of the cultivated area will continue to face the problems of drought which has largely been responsible for the failure in achieving our objective for self-sufficiency in foodgrains. The crying need for a more realistic approach towards farming in these rainfed dryland areas is felt even more, with the increasing realisation that the occurrence of drought is, more or less, inevitable.

Though a number of hybrids have been developed of short duration and with high-yielding power, they are primarily taken up under the *kharif* season and for the *rabi* season the local varieties are more popular. This is because

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a comparison between the improved varieties and hybrids reveals that hybrids gave a better yield only when sown early (*i.e.*, towards the end of August and not later). The hybrid jowar grown locally in the area studied are mainly CSH-1 and CSH-2 first released in India in 1964. They were sponsored by the Indian Council of Agricultural Research (ICAR) in collaboration with the Rockefeller Foundation. The CSH-1 yielded 5,000 kg. per hectare in co-ordinated trials in various parts of the country and it could withstand the regions of drought and moisture stress better than the local varieties. It matures in 90 to 100 days, whereas the CSH-2 matures in 115 to 120 days, which is also taller than CSH-1.[1] The CSH-1 can yield double the quantity of grain with irrigation facilities as compared to what it could yield under rainfed conditions. The stalks are leafy and remain green even after harvesting.

On the other hand, the local varieties found in the Deccan of Maharashtra are usually grouped under two main catagories according to the character of the ear-head, which may be either loose and elongated, known locally as *maldandi* or it may be compact and more or less rounded, known locally as *dagadi*. Of the *maldandi* varieties M-35-1 is most common in Ahmednagar district. This improved variety was evolved at the Mohol jowar breeding station. It has been found to give a higher yield compared to the other local varieties. It matures from 135 days on deep soil to about 110 days on medium deep and shallow soil.[2] It grows up to a height of about 3 to 3.5 meters. These improved varieties offer the technical possibility of agricultural improvement but are not by themselves sufficient. Additional improved practices are necessary for any substantial increase in crop yields.

Of the major problems the farmer has to face in these regions such as low moisture conservation efficiency, longer duration of existing varieties and low fertility, etc., the most important factor to be considered is that of moisture conservation and its optimal utilization for which the minimum time should be taken for land preparation and seeding. This is especially true if the crop is taken after a *kharif* crop, (*i.e.*, in the *rabi* season also). The *rabi* crop is generally grown on the receding soil moisture under the normal sowing practices. Early sowing is recommended so that the resident moisture of the monsoon showers can be utilized for the seed germination and the September shower can be made available for the plant growth. This can also be considered as additional insurance against moisture loss through evaporation from strong winds and bright sunshine in these regions.

To prepare the land for early sowing small tractors could be efficiently used to cover the area faster than what a pair of bullocks would have been able to cover. Additionally, the stony soil, which helps to conserve moisture, makes bullock ploughing very difficult. The land having been prepared for cultivation, it is generally recommended that improved implements especially

1. A. R. Khan: Scientific Farming in India, Orient Longmans, Bombay, 1968, Chapter 6, p. 109.
2. N. Ganga Prasad Rao: Sorghum Production Programme, AFPRO Publication No. 32, Action for Food Production, New Delhi, 1974, p. 94.

the economical bullock-drawn mechanized seed drill can be introduced. The conventional seed drills give a very defective and un-uniform crop stand. The result may be that the plant stands too thick and sometimes too sparse adversely affecting the yield in spite of following other improved practices.

In India the dry region starts longitudinally from Punab in the North till Tamil Nadu in the South, each region having its own peculiar rainfall and soil condition. As a sample the district of Ahmednagar in Maharashtra was chosen for study. From 22 villages 722 landowners were surveyed in 1974. Slightly more than half the farmers interviewed were willing to be initially involved with a programme to improve dry farming technology through such inputs as mechanization. This was additionally confirmed by an independent survey of 1,000 farmers of Ahmednagar district recently conducted by another researcher.[3] Such a heavy response from cultivators usually decried as 'traditional' or 'backward' prompted the further analysis of the technical feasibility of an improved agricultural technology programme for this district.

The district of Ahmednagar in Maharashtra State receives the south-west monsoon and also a substantial quantity of rainfall from the north-east monsoon, that is why the rainfall chart shows two peaks which are more or less of equal heights. The cultivators in these regions prefer to go in for *rabi* crop rather than *kharif* where the rainfall is less reliable. This tends to minimize the farmers' losses even if they have to gamble on the rains. Another important feature of the region is that of the various dry crops, jowar (sorghum) is the main crop in this area.

As there is a dry spell after the germination of seeds during this plant growth, there are various solutions to combat it depending on the length of these dry spells. They are:

(1) Surface mulching.

(2) The run-off or excess rainwater could be stored in small ponds covered by straw mats to prevent evaporation and the same could be used for even one life giving irrigation to the plant. This system is known as water harvesting.

(3) Rattooning which means cutting the crop in such a way as to leave the roots and a lower part of the main stem in the soil, so that when the next rain comes, the plant starts growing again.

(4) In extreme cases, mid-season correction can be resorted to. Another crop can be taken up in the same season after the next shower. A sunflower crop could be taken up to save the farmer from total loss during that cropping season. The farmer would have some modest produce rather than face a desperate season without income.

Because the switch-over from dry to dry-irrigated crop almost doubles the yield in value but the cost does not increase to any significant effect, it is possible that through sprinkler irrigation water could be distributed in a way similar to natural rain. By the use of reliable and economical pumps

3. Rex Mark Edwards, American Institute of Indian Studies Fellow. This was part of a research project on the study of one hundred years of agricultural experience in Maharashtra.

water could be supplied at the required times, in required quantities and relatively evenly on the plants. The following is the observation made by the Sholapur Dry Farming Station (1973-74).

Treatment	Yield (quintals/hectare)	
	Grain	Fodder
1. Control (unirrigated)	13·5	45·4
2. One irrigation by sprinkler	21·5	65·6
3. One irrigation by contour furrow method	18·0	53·7

But even with these improved dry farming techniques disease is a major obstacle. As far as the pest and disease control is concerned, it is generally not practical in rainfed areas on an extensive scale, but pests and disease could be controlled through carbofuran seed treatment and inter-cultural operations. Another common problem, that of shoot-fly on jowar could be minimized when the crop is sown within ten days after the first soaking showers. An equally problematic pest is the ear-midge, which could be prevented if jowar of a comparable maturity range is grown in large blocks instead of growing short and long duration jowar in scattered fields.

Our farmers generally apply only compost manure for *rabi* jowar, but experiments have proved that with modern seed drills either tractor mounted or bullock drawn, we can sow the seeds and also apply fertilizer at a certain depth to ensure proper contact between the seed, soil and fertilizer, and for more economical operation.

The following observation gives us the result:

Treatment	Yield of jowar (kg./hectare)
1. No fertilizer	1,500
2. 80 N + 40 P_2O_5 (Broadcast)	2,050
3. 80 N + 40 P_2O_5 (Placed)	3,120

This is necessary because the drylands are particularly deficient in nitrogen and phosphorus. The drylands are not only thirsty, but hungry as well.

It has been observed by the Sholapur Research Centre that in dry farming, there must be a more than adequate plant population. As the soil moisture recedes the soil starts cracking resulting in root injury and to the death of the plant thereby reducing the plant population.

The following table shows the yield of sorghum as affected by different plant populations:

(quintals per hectare)

Plant population (thousand per hectare)	R-16	M-35-1
45	13·52	15·45
90	13·58	17·20
135	13·66	17·58
180	17·71	14·84

Source: Sholapur Dry Farming Station, 1974-75.

For M-35-1 100,000 per hectare is the optimum, for a short variety like R-16 it is generally more advantageous to keep a higher plant population.

The following chart shows the effect of plant population density on the yield of jowar:

(quintals per hectare)

Population	40	48	54	70	100	128
M-31-1	30·2	36·0	37·9	39·2	63·5	44·3
R-16	33·7	36·5	39·0	47·2	49·5	59·5

Source: Bellary Research Centre, 1972.

N. K. Umrani and N. D. Patil of the Sholapur Dry Farming Research Station, Sholapur, after a series of experiments conducted on the farms, have come up with a package programme adopting non-monetary and monetary practices, which have been termed as "New Technology" by them. These are:

(1) Early sowing in the first week of September.
(2) Improved variety of M-35-1 or R-16.
(3) Seed treatment with carbofuran in 1.10 ratio
(4) Plant population at 100,000 per hectare.
(5) Use of fertilizer: N at the rate of 50 kg. per hectare and P_2O_5 at the rate of 25 kg. per hectare at sowing.

With the above methods, the results were as follows:

(Yield grain quintals per hectare)

Sr. No.	Package	Variety	1973-74	1974-75	Mean
1.	Local	M-35-1	1·58	6·71	4·15
2.	Improved	M-35-1	9·75	17·48	13·62
	Per cent increase	M-35-1	517	160	228

The above experiments were carried out on the Centre's farms, and when they were tried by individual farmers, it resulted in an increase of their yield of up to 147 per cent.

The management of farms which employ new technology in agricultural production under dry farming conditions is a complex process, where a farmer has to take a number of different decisions right from the preparation of the land till harvesting. The timing and quality of decisions reflect on the efficiency of the input and the final profitability of the venture. Hence the need for expert advice in farm management. The present system of extension services has resulted in failure as they are not equipped to do the job. The system of extension service at present is such that the extension workers are more preoccupied with the management of input supplies than with practical services. Moreover, the staff is constantly being transferred so that by the time the extension worker has built up rapport with the people in the area, he is transferred and another person comes who has to start all over again. Secondly, there is a big gap in the communication between research and extension work. If this problem is solved it will go a long way in maximizing the returns to farm investment.

Conclusion

We can see that there is both the technical and the attitudinal potential for improved dry farming technology. But the development of technology has far outpaced the necessary social changes to implement such a programme. Currently, the wealthy farmer rules. As a result, resources are concentrated on those areas of assured water supply and especially by those able to support cash crops such as sugarcane or grapes. Even within dry areas the necessary changes to insure a commonality of interest have not occurred. Therefore, such ideas as watershed planning and mass planting of a single variety of a crop are rendered impractical. Moreover, if a poor farmer can't afford fertilizer he can hardly afford other inputs. The first action for improved agriculture in dry areas will have to be a broad programme of land, irrigation and credit reform. This, combined with the political mobilization of the majority of farmers to demand their share of administrative, technical and financial resources, is the first step in technological progress.