FOODGRAINS other than rice and wheat grown and consumed in the country are maize, barley, gram and millets like jowar, bajra, ragi, sawan, cheena, katki, etc. They occupy no small a place in the food economy of the country. While the average annual area under cereals and gram during the last 5 years (1949-50 to 1953-54) was 217 million acres, coarse grains occupied as much as 116 million acres, i.e., more than 50 per cent. Similarly they accounted for about 42.5 per cent of the total production of cereals.

These coarse grains are in no way inferior to the fine grains in nutritive value. Appendix XII examines the relative food value of some of them. It would be seen that while the calorific value (100 grams) of rice and wheat is 345 and 347 respectively, that of jowar, bajra, ragi and maize is 352.9, 350.9, and 342 respectively. The other smaller millets have, however, less calorific value. Rice, again, is the poorest with regard to fat and protein contents. Even wheat which is quite rich in protein has very little of fat, while millets like ragi are superior in this respect. Crops like maize and corn are receiving a good deal of attention even in the advanced countries like USA and Russia and are no longer treated as low grade grains.

In spite of all this, coarse grains are placed at a lower social status and are consumed mainly by the people in rural areas. This along

3. cf., Sir R. J. Russell, World Population, op. cit., p.326; Thomas and Ramkrishna, op. cit., p.403 and the results of prohibition in Salem district, Madras University, 1944. It would be interesting to note that while ragi contains protein of the type known as biologically complete like that of milk and has the maximum amount of fat content from among all the cereals, it has been regarded as "food suitable for poor and ignorant villagers - also as food of prisoners in the jails."
(Rice, Nutrition Research Laboratories, Bulletin No 29, 1940, p.16).
with the fact that many of them are only of local importance, has
resulted in their getting only a lukewarm reception not only from the
government, but also from the cultivator. In the earlier years,
research work was restricted only to cash crops like cotton and sugar-
cane. Then came rice and wheat. Coarse grains remained practically
neglected for a long time. The Royal Commission on Agriculture drew the
attention of the government to them for the first time. Nothing tangible
was, however, achieved till recently. The apathy of the government
would be clear from the fact that while the area under improved varie-
ties in the case of coarse grains was hardly 0.34 per cent in the year
1840, wheat and rice had 8.5 and 5.04 per cent respectively. The
cultivator in the past also paid the least attention in this direction
and devoted his best lands to only fine grains for which he could find
a market outside his village.

This is apparent from the fact that yields of coarse grains are
lower not only when compared with those in other countries, but also
when compared with other cereals in India itself. Appendix IX which
gives all such details, would be of interest in this connection.

The position is, however, fast changing. Much attention is now
being paid to improve the yields of coarse grains. The recent Conferen-
ces on Wheat and Millets held at Calcutta in May, 1956, chalked out a
comprehensive programme for the intensification of research on the
bacterial improvement of millets with particular reference to increasing
the crop yields by the various improved methods of cultivation, exploita-
tion of hybrid vigour and control of insect pests as well as disease


2. It went up to 39 per cent in 1943–44.
(Supplement to the Report on the Marketing of Wheat, op. cit., p.5).

3. Sir E. J. Russell, Science and the Indian Peasant, Indian Farming,
April 1945, p.200.
The Japanese method of rice cultivation is also being applied to jowar and bajra. With this background we may proceed with the assessment of the coarse grains potential in the country.

SPECIAL FEATURES OF GROWTH

Taking all the coarse grains, one by one, jowar which is an important crop in areas of low fertility and precarious rainfall, does not require much water. Its growth is rather hampered where rainfall is high. Bombay and Hyderabad with an average annual rainfall of only about 30 inches, account for nearly 50 per cent of the total area under the crop. Madhya Pradesh and Madras occupy another 25 per cent of the total area.

Bajra requires still less of water. It can grow well on as little as 9 inches of rainfall and can thrive in sandy soils. Rajasthan, UP, Marathwada and the Punjab, share between themselves nearly 50 per cent of the area, while a little less than 50 per cent of the balance goes to Bombay, Hyderabad and Madras. Similarly Ragi, the staple food grain of Mysore, does well under conditions of very low rainfall. It can withstand severe drought, reviving again with a good shower of rain with remarkable vigour.

Barley is localised in UP which covers as much as 70 per cent of the total area; the rest being spread all over the country.

Maize against all these requires sufficient water supply. It is an important crop in Kashmir and the lower slopes of Himalayas where it is grown as a rain crop in rotation with wheat. Even Assam and Travancore-Cochin have small areas under this crop.

---

2. “Water requirements of millets like jowar and bajra are comparatively low and if the losses of rain water are controlled there would be enough moisture for the successful growth of millets,” (E. V. Kamatkar, Dry Farming in India, ICAR, 1944, p.266).
MAIZE POTENTIAL

Nursery experiments on maize have been conducted in UP, Punjab, Bombay and Madras. A high response to nitrogen was obtained at Kamrup by the application of peacock as well as sheep, cow, horse, and pig dung. Sheep dung was found to be the most effective. It was also found that superior to farmyard/in Bombay. According to Dr. Burns yields have gone up to about 3000 lb per acre of grain under good conditions. Present yields are against this are barely 600 lb per acre.

Experiments, with 90 lb of nitrogen from sulphate of ammonia were carried out by H. K. Datta and R. R. Agarwal on the fields of the cultivator in Kamrup and UP respectively. The unweighted average increase per acre worked out to 20.5 per cent. Results of specific experiments with organic manures are not available. We can, however, assume that nitrogen from organic source will yield the same result, if not better.

As for the improved seeds, research schemes in maize have recently been sanctioned by the Indian Council of Agricultural Research. Maize is actually a very prolific crop. The classic example of the success of hybrid maize in America is often quoted as having brought more money to the nation than what it has spent on atomic research. They have increased their yields by about 25 per cent as a result of hybridization of seeds. The little work already done shows the utility of

1. Agriculture and Animal Husbandry Research, Anakita, p. 35.
4. Quoted by Yates, Finney and Farnes, Anakita, p. 35.
6. Re., Appendix XIII to Dr. Doshi's Circular Letter No XI dated August 8, 1954, p. 79.
hybridization in India also. Dr. C. G. Khush has shown that maize is particularly suited in this respect and Mr. Sohi, Son, Director, Vivekananda Laboratory, Almora, UP, has demonstrated the excellent results obtained from hybrid corn in the various parts of the country. According to Burns, increases of the order of 25 per cent have been obtained under conditions of commercial production. The introduction of hybrid maize has all the same yielded as much as 66 maunds per acre in experimental stations in Northern India as against 30 maunds from ordinary seed.

There is a complete absence of combined experiments with the improved variety of seed and optimum quantities of manures. From what has been stated above it is clear that manures and seeds combined along with better cultural practices can easily increase our yields by about 50 per cent. Our standard yield of maize for the quinquennium ending 5-1946-47 for British India (now Part A States) was 986 lb per acre. Production of maize in the base year 1953-54 was 3.0 million tons and in 6 at 50 per cent increase it would work out to 4.5 million tons.

The limiting factor for maize, along with millets, has so far been the unprofitability of the use of manures. This is, however, the first crop to come in the market when the stock of food saved from the previous 'Rabi' is running low. Again, many commercial uses having been found for maize, there is a greater possibility of its becoming more popular.

1. Indian Farming, August 1951, p.220.
2. Indian Farming, October 1960, p.296.
4. Dr. B. N. Sam, Paper, 81st S, p.83.
6. Burns (Report, 81st S, p.26) estimated that average yield could go up to about 1000 lb per acre, this would be too much low when compared with the standard yields.
7. 81sts, Aiyer, Field Crops, 81st S, p. 97.
OTHER IRRIGATED COARSE GRAINS

There are also other crops, which are grown under irrigated conditions. Table XLIV gives all these details.

TABLE XLIV

<table>
<thead>
<tr>
<th>Year</th>
<th>Millets</th>
<th>Maize</th>
<th>Barley</th>
<th>Gram</th>
<th>Total Coarse Crops</th>
<th>Total all Grains</th>
<th>Percentage of Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>1947-48</td>
<td>3.3</td>
<td>0.39</td>
<td>5.0</td>
<td>1.0</td>
<td>8.4</td>
<td>61.2</td>
<td>14.1</td>
</tr>
<tr>
<td>1948-49</td>
<td>3.6</td>
<td>0.47</td>
<td>5.0</td>
<td>1.2</td>
<td>8.2</td>
<td>63.9</td>
<td>14.8</td>
</tr>
<tr>
<td>1949-50</td>
<td>3.6</td>
<td>1.1</td>
<td>3.2</td>
<td>3.0</td>
<td>10.1</td>
<td>65.7</td>
<td>18.1</td>
</tr>
<tr>
<td>1950-51</td>
<td>3.5</td>
<td>0.9</td>
<td>3.4</td>
<td>3.6</td>
<td>10.2</td>
<td>63.5</td>
<td>18.1</td>
</tr>
<tr>
<td>1951-52</td>
<td>3.5</td>
<td>1.2</td>
<td>3.6</td>
<td>2.4</td>
<td>11.0</td>
<td>58.5</td>
<td>19.9</td>
</tr>
<tr>
<td>Average</td>
<td>3.5</td>
<td>0.99</td>
<td>3.3</td>
<td>1.6</td>
<td>9.2</td>
<td>53.8</td>
<td>17.7</td>
</tr>
</tbody>
</table>

It would be seen that coarse grains occupy hardly 9.8 million acres or 17.9 per cent of the total irrigated area of 53.2 million acres.

Deducting 0.99 million acres as the share of maize with which we have already discussed, other coarse grains are left with only 16 per cent. This is equally distributed between millets, barley, and gram. All this shows that irrigation plays only a minor role in the case of coarse grains. Nevertheless we cannot ignore the additional contribution of these areas to the food potential of the country. We have already seen (Table XXIX) that the total area under coarse grains with an assured supply of water may be of the order of 14.3 million acres. This may be reduced to about 13.3 million acres when maize is excluded.
Separate yield data for irrigated coarse grains are not available. Nor are we aware of any experimental results which can give us an idea about the increase in yield as a result of irrigation and improved seeds. According to the estimates of Krishnaswami, however, average yield of millet in Madras may be anything from 100 to 700 lb per acre for the dry crop while the irrigated yields may vary between 1,200 and 1,500 lb.

Post control measures have also proved useful. Gram smut of jowar has been controlled by the use of sulphur dust of a high degree of fineness. The modified dry spray-method of applying formaldehyde to the smutty grain which is employed at the Indian Agricultural Research Institute for controlling covered and loose smuts of oats has been found to be of great practical value. Helminthosporium disease of barley which appears in severe form almost every year has been brought well under control by seed treatment with mercuric compound.

With regard to manurial treatment, H.N. Mukerjee in Bihar and G.S. Agarwal in UP have shown that an application of 50 lb of nitrogen from sulphate of ammonia gave an increase of the order of 45 per cent in the case of bajra, 40 per cent for jowar and 23 per cent for barley. Similar are the results of other experiments on jowar at Akola and bajra at Poona.

With due consideration to all these factors, Burns estimated that irrigated jowar can give us yields between 1,200 to 1,500 lb per acre.

Some results can be obtained in the case of other irrigated coarse grains.

According to the officially accepted yardsticks, irrigation alone gives an additional production of 1/3 tons per acre. Again, while one ton of fertilizer which can be spread over 15 acres provides an additional yield of 2 tons of the grain, the net addition as a result of improved seeds would work out to one-fourth that produced by fertilizer. On the basis of these yardsticks, an acre of irrigated and fertilized area sown with improved seeds will give an additional yield of about 10 pounds of 640 lb. Existing average yield per acre from all the coarse grains combined is much lower than half of this figure. Yields of irrigated coarse grains can under the circumstances be increased to more than 100 percent over those in the dry areas.

Not relying with much on these yardsticks, even if the analogy of wheat is accepted for coarse grains as well, we can safely conclude that irrigated areas when sown with improved varieties of the seed and treated with the optimum quantities of fertilizers/manures will yield double the quantity of crop as compared with dry areas.

Total area under grain and coarse grains other than maize in the year 1933-34 was 122 million acres which yielded about 24.3 million tons of the grain. The area of 13.3 million acres (total irrigated area and coarse grains) in this, would be about 2.6 million tons. As nearly 113 million acres out of the total of 122 million acres is at present an dry area, we can assume that 13.3 million acres of dry areas are at present yielding about 2.6 million tons of coarse grains. With the contemplated improvements, this is likely to become double, which that the contribution of 13.3 million acres of irrigated coarse grains other than maize when intensively cultivated would be of the order of 5.6 million tons.

1. J.S. Sarma, Statistical Assessment of Grow More Food Campaign, Agricultural Situation in India, February 1933, pp. 400-502. (These figures are works out to about 154 manures for 3 acres.)
2. Dr. Deshmukh's Circular Letter No XII, dated, p.128.
3. Partially revised data, Agricultural Situation in India, August 1939, p.322.
4. Yardsticks are normally for fine grains.)
CROP COMPETITIONS

It would perhaps not be out of place to mention here that given proper incentive, our cultivator has already shown his skill at the plough. Crop competitions which have been organized since 1949-50 have been extended to some of the coarse grains like jowar, bajra and maize. The results during 1951-52 and 1952-53 as given in Table XLV will speak for themselves about the marked difference in the average and the records set up by these national heroes.

**TABLE XLV**

**RESULTS OF CROP COMPETITIONS DURING 1951-52 AND 1952-53.**

<table>
<thead>
<tr>
<th>Crop/State</th>
<th>1951 - 52</th>
<th>1952 - 53</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highest yield Average</td>
<td>Not Increase</td>
</tr>
<tr>
<td></td>
<td>Crop Competition</td>
<td>in the State</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Bombay</td>
<td>27</td>
<td>2.21</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>49</td>
<td>7.73</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>33</td>
<td>3.48</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>29</td>
<td>7.59</td>
</tr>
<tr>
<td>Vindhya Pradesh</td>
<td>32</td>
<td>4.54</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>30.30</strong></td>
<td><strong>5.12</strong></td>
</tr>
<tr>
<td>Punjab</td>
<td>15</td>
<td>7.97</td>
</tr>
<tr>
<td>Bombay</td>
<td>20</td>
<td>1.23</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>24.33</strong></td>
<td><strong>2.80</strong></td>
</tr>
<tr>
<td>Punjab</td>
<td>20</td>
<td>10.05</td>
</tr>
<tr>
<td>Punjab</td>
<td>21</td>
<td>9.59</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>40</td>
<td>9.11</td>
</tr>
<tr>
<td>Bihar</td>
<td>40</td>
<td>6.61</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>38.78</strong></td>
<td><strong>8.01</strong></td>
</tr>
<tr>
<td><strong>Average for three crops</strong></td>
<td><strong>39.63</strong></td>
<td><strong>8.89</strong></td>
</tr>
</tbody>
</table>
The net increase in each case bears no relation to the average yields. At times it has gone up as much as 36 times. Such heavy yields obtained by some of the progressive farmers in various states are but a result of sound agricultural practices which have stood the test of time and judicious use of manure and fertilizers. The net income and expenditure worked out in each case shows a profit besides the price won by the 'krishi pandits'. All the same it seems impossible for many farmers to put up with the required amount of patience and labour.

We may not be able to touch the targets set by the but the examples set by them will add to the number of progressive farmers so that our food potential gets a further fillip.

1. Jahl Singh of village Khurora, Tehsil Sirhind, PEPSU, who got the highest maize yield in the year 1983-84 in PEPSU was contacted. He stood first in his Tehsil the previous year and even otherwise gets higher yields than other farmers in the area. While the produce about 25 mounds an acre, normal yield in the area is about 15 to 20 mounds. The secret of his success lay in ploughing his field 3 times while others did it twice; adding 33 cart-loads of compost manure weighing 20 mounds each against 5 to 6 cart-loads by others; a lesser seed rate; 4 hoeing instead of once and addition of 30 seers of ammonium sulphate. The area entered was one acre. The extra expenses incurred by him worked out to extra labour for ploughing = Rs. 50/-; hoeing = Rs. 30/-; price of ammonium sulphate = Rs. 10/-; extra manure = Rs. 30/- and total = Rs. 110/-. Additional production against this expenditure was about 25 mounds, which at a minimum of Rs. 8/- per mound would fetch about Rs. 200/-. This leaves a net gain of about Rs. 64/- for one acre of the cultivated area.

When asked why he would not like to compete for all India 'krishi pandit' certificate, his reply was that all this calls for a good deal of botheration and labour. This explains why improved practices have not been adopted by many. The number of competitors is, however, increasing every year. This is likely to have a profound effect on our average yields.
Areas with an assured water supply for coarse grains being limi
ted chances of improving upon the existing yields lie in practising dry
farming methods. Bombay has already gone ahead in this respect. A
Millet Breeding Station was also established at Coimbatore as early as
1922. The importance of these methods which involve the ploughing of
land with a turn-wrest plough once in three years, bunding or terracing
of land, repeated harrowings during monsoon months, repeated stirring of
the surface soil by bullock-hoes worked between the rows, sowing with
a moderate seed rate of 4 to 5 lb per acre and the addition of cattle
manure, was reiterated at the recent Conference of Workers on Millets
held at Kolhapur in May 1936. Large scale trials of the Bombay dry
farming system for 'ram' jowar have recorded high increases over the
local method. In Kharif areas strip cropping has pushed up the yields
from 36 to 79 per cent at Malegaon, 151 per cent at Jaur and by 66 per
cent at Chas. New methods have been evolved at the Rohtak Research
Station in the Punjab for cultivation under low rainfall conditions.

For a proper appreciation of the whole system, a detailed study
of the various experiments conducted will be fruitful. Besides bunding,
mowing and following which we will discuss in detail, other cultural
1. Dry Farming methods were first discovered in the USA where there are
defensive areas receiving less than 30 inches of rainfall per annum
and have poor irrigation facilities. Experiments in India were,
however, conducted by Dr. Harold Mann only in the Bombay Presidency
in 1923-24. The experimental stage having passed, five research
stations were established during 1933-35 at Shelapur and Bijapur
in the Bombay Presidency, Gaichur in Hyderabad State, Bagari in
Madras and Rohtak in the Punjab.

At., R.V. Kanthar, Modern, pp.3-4 and Indian Farming, January 1940
pp. 29-31.
4. At., The Hindustan Standard, New Delhi, December 3, 1932.
practices include deep preparatory tillage, surface tillage during monsoon, intercropping, rotations and mixtures and a proper seed rate. Research workers on dry farming have observed that a reduction in seed rate increases crop yields. Congestion of plants in the field prevents tillering or throwing out of many sprouts from the same root. Inadequate moisture in the case of dry farming stands in the way of proper flourishing of the plants. A reduction in seed rate goes to counteract these ill effects.

There are also other useful lessons which we can profitably learn from other countries. In the United States, for example, stubble mulching has been practised with remarkable success in areas of low rainfall, and it consists of sub-surface cultivation, leaving the soil on the surface. Then the Chinese have used a pebble mulch on their dry lands for many years. These pebbles allow the water to pass down the mulch and trickle into the soil. William Macdonald who recommends a loose dry soil mulch for dry farming quotes the example of bleak, wind-swept country of Caithness, in the far north of Scotland, where numerous small pieces of slate and stone when removed from arable lands, caused a decrease in yield. Mulching is helpful because rainwater on bare surface tends to clog up the surface which the presence of mulch prevents.

These are also indirect methods like planting of trees as wind breaks which help to reduce evaporation in fields that are to the

1. Mc., Mayadas, 8amkia, p. 73. He quotes the experiments conducted by Dr. S.B. Singh in UP.

2. Mulch has been defined by William Macdonald in Dry Farming - Its Principles and Practice, London, 1909, pp. 61-63 as "any material which is spread upon the soil to shade the surface from the sun and to break the connection between water-bearing sub-soils and the exposed evaporating surface. In gardening operations, leaves, manure, coarse hay, straw, grass clippings, etc., are commonly used."  

3. Mayadas, 8amkia, p.75.
trees break the force of the wind and also prevent the soil being 1 2
away — a protection against wind erosion. We are said to be short 8
2,000 acres of trees, in India. Each tree planted will accordingly be
a step forward towards reducing erosion as well as floods and will
increase fertility.

BUNDING — The first and foremost essential to conserve moisture in the
dry areas is to preserve as much of the rain water that runs off as
possible. It has been estimated that some 30 per cent of the total
rainfall is lost by surface run off in the scarcity tracts of Bombay
and Madras. The position in other parts of India may also be the same.
The easiest and the cheapest method to save this huge loss is a sy-
division of the cultivated holdings into compartments by erecting suita-
bunds. The only cost involved in the process is that of labour for the
first year, which the cultivator will not hesitate to contribute if he
can be convinced of the beneficial results.

Bunding experiments were tried for four years from 1935 at the
Bagari, Madras, Research Station. The results as shown in Table XLVI
indicate that the average yield of sorghum during four years in the
plots was 94 per cent higher than that of the unbunded ones. The actual
average increase was 96 lb of grain per acre. Only in one year of good
rainfall there was a slight decrease in grain yield in bunded plots.

1. Ibid., p. 74.
2. K. N. Munshi, Broadcast from All India Radio on December 8, 1954.
   The Indian Express, December 9, 1954.
4. Ibid., p. 258.
TABLE XLVI

YIELD OF SORGHUM IN BUNDING SERIES AT MAGARI
(Mean yield in lb per acre)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Rainfall in inches</th>
<th>Yield</th>
<th>Control</th>
<th>Bunded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>1933-34</td>
<td>23.49</td>
<td>Grain</td>
<td>825</td>
<td>711</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straw</td>
<td>1,404</td>
<td></td>
</tr>
<tr>
<td>1937-38</td>
<td>18.45</td>
<td>Grain</td>
<td>55</td>
<td>1,468</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straw</td>
<td>822</td>
<td></td>
</tr>
<tr>
<td>1938-39</td>
<td>22.99</td>
<td>Grain</td>
<td>632</td>
<td>828</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straw</td>
<td>1,482</td>
<td></td>
</tr>
<tr>
<td>1949-40</td>
<td>31.30</td>
<td>Grain</td>
<td>522</td>
<td>522</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straw</td>
<td>1,482</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>20.60</td>
<td>Grain</td>
<td>306</td>
<td>401</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Straw</td>
<td>1,343</td>
<td>1,343</td>
</tr>
</tbody>
</table>

MANURES—Cultivators in these areas of scanty rainfall have a general prejudice against the use of cattle manure or farmyard manure as they believe that manure dries up the crop. Keatings quotes the example of Atoni Taluka of Belgaum District where the rainfall is scanty and "cow dung which is not used for burning is simply thrown outside the village and wasted". The use of fertilizers may not be advisable under dry farming, but the addition of organic manures has given very encouraging results.

Memorial experiments were conducted on gram and various coarse grains, at Manjri, Sholapur, Bijapur, Magari, and Rohtak dry farms. At Manjri, the average annual increase as a result of six years experiments was 5.7%.

This is not peculiar to India. Farmers of the Middle East also hold the same view. E.G., B.A. Keen, The Agricultural Development of the Middle East, 1945, London, p. 61.

2. Agricultural Progress, March, p. 86.

3. This will, however, also require further research. Emeritus Professor Hilde of the University of Berkeley, California, has for some years been successfully demonstrating the use of manures and fertilizers under semi-desert conditions where the rainfall is under 10 inches per annum (Quoted by Nayadan, March, p. 71). Nayadan himself gives examples of the beneficial effects of the use of fertilizers under dry farming.
th 5,000 lb per acre of farmyard manure, increased the yield of sorghum by 17.9 per cent. Similarly an annual application of a moderate of farmyard manure, supplying about 25 lb of nitrogen per acre gave an average increase in the grain yield of sorghum by 23 per cent at Sholapur. Bijapur experiments for six years from 1936-36 to 1940-41 were a little more complicated. Two methods were adopted for the application of farmyard manure, which was applied at the usual rate of 5,000 lb per acre. In one case it was incorporated by harrowing and in the other by ploughing. The addition of more farmyard manure gave an average annual increase of 37 and 56 per cent of sorghum grain and straw respectively over the control. Grain yield became double over the control when farm manure was incorporated by ploughing. 'Samai' green manuring at 2,000 lb gave an average increased yield of as much as 94 per cent over control.

Bum sweepings and poudrette when used as alternative to farmyard manure have also been found to give very much the same results, the former being rather inferior to farmyard manure, and the latter markedly superior. According to Kestings, a single heavy dressing of crude night-soil would double the output of crops for several years in Khandesh, increase it by 50 per cent over a period of 16 years in Curut and double 4 the jowar crop in Bharwad. It was further observed that dressing of farmyard manure upto 10 tons per acre enhanced the yields by 60 lb of jowar, 180 lb of 'karni' and 15 lb of cotton seed, per ton of manure added per acre. The general inference derived was an increase of 25 per cent by fairly good dressings of manure.

1. Kanithar, bidas, p. 272.
2. ibid, p. 274.
3. ibid, ibid, pp. 272-274.
4. G. Kestings, Agricultural Progress, bidas, pp. 100 to 101. For similar experiments refer to N. Burns, bidas, pp. 63-64 and Agriculture and Animal Husbandry Research, bidas, p. 305.
The results of all these experiments give a conclusive proof of
the fact that an addition of farmyard manure at about 5,000 lb per acre
would give an increased yield of about 20 per cent over an unmanured
All this should be sufficient to allay the fears harboured by our culti-
vators in areas of scanty rainfall, about the use of manure.

FALLOWING - Fallowing is a process by which soil is allowed rest from
exhaustion. Such a rest is more important in respect of poor soils and
those where rainfall is scanty. This is because the chief object of
this practice is to ensure sufficient supply of soil moisture received
from rainfall during two seasons instead of that received in one, and
time to secure a crop even in an year of drought.

Modern science has no doubt succeeded in securing the advantages
of fallow by the introduction of catch-crop-cover crops. According to
Nayadas, a partial fallow effect can be created by suitable rotations
after a proper study of the root system of each crop and widening the
spacing of rows from 12 to 18 inches. It would all the same take time
before we succeed in totally doing away with the practice of fallow.
Certain areas where the cultivator is at a net gain as a result of less
his land fallow, may also continue to follow this practice.

Experiments have been conducted at Manjri, Bijapur, Balmur, Bagari
and Rohak to find out the effect of fallowing on crops. The Manjri
experiments which were carried out for three years from 1930-31 to 19
showed an average increase of 37 and 56 per cent in the grain and straw
of sorghum respectively. It was calculated that even if the loss incurred
as a result of one year's crop is taken into consideration there was a
gain by the process of fallowing.

1. Kanitkar, Shali, p.28a.
2. Shali, Chapter VI, p. 111-112.
It was found at the Bohtak dry farm experimental station, Punjab, that increases in the yield after leaving the land fallow were more than double.

Again, at the Rothamsted experiment station in England there is a field (the famous Broadbalk wheat field) which had had no manure since 1853 and which has grown a wheat crop every year since 1843. In 1936, this field gave 24.8 bushels per acre, but one section of it which had been fallowed in 1937 gave not less than 39 bushels per acre.

All this should be sufficient to prove that fallowing, though a wasteful practice, has its beneficial effects in certain areas of scanty rainfall.

Combined Experiments - Having examined the effect of bunding, sowing, and following in dry farming practices, it would be of advantage to study the combined effect of all the improved practices.

Field scale trails on sorghum were carried out continuously for a period of 7 years from 1934-35 to 1940-41 at Sholapur. The seasons during the period varied tremendously. The "noteworthy feature, however, was that in the local method, the yields in all types of soils were less than 50 per cent of those obtained by the Bombay dry farming method."

Yield data are also available in respect of certain experiments carried out at the Sholapur and Bijapur Experimental Stations continuously for a number of years. The increase as a result of dry farming method (Table XVIII) varied from 2 to more than three times over its local method.

1. Indian Farming, September 1935, p.415, Article on "Fallow" by W. Burns. An experiment on sorghum at Bijapur has been quoted by Burns. For more experiments on sorghum refer to Kanthar, A., in "Indian Farming, September 1935, p.418.


3. Kanthar, A., Sholapur, pp.387-388. In all these experiments rotation and following which would have given further additions, were not resorted to.

TABLE XLVII

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Dry Farming Method</th>
<th>Local cultivator's method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grain ( in lb )</td>
<td>Straw per acre</td>
</tr>
<tr>
<td>1934-35</td>
<td>285</td>
<td>554</td>
</tr>
<tr>
<td>1935-36</td>
<td>324</td>
<td>549</td>
</tr>
<tr>
<td>1936-37</td>
<td>187</td>
<td>340</td>
</tr>
<tr>
<td>1937-38</td>
<td>187</td>
<td>68</td>
</tr>
<tr>
<td>1938-39</td>
<td>204</td>
<td>570</td>
</tr>
<tr>
<td>1939-40</td>
<td>27</td>
<td>243</td>
</tr>
<tr>
<td>1940-41</td>
<td>479</td>
<td>828</td>
</tr>
<tr>
<td>Average</td>
<td>192</td>
<td>439</td>
</tr>
</tbody>
</table>

The jowar crop was seriously affected by seedling blight, due to soil drainage and hardening under most unfavorable climatic conditions. But on an area of 3.75 acres grain crop was grown after the failure of sorghum and this gave a yield of 119 lb of grain per acre.

The fields on which these experiments were carried out measured 14.65 acres and 3.5 acres for the dry farming and the local methods respectively. They consisted of two types of soils, viz., medium deep and deep in proportion of 2:1. The total area of the farm however, was 20 acres. Kharif Bajri and ‘tur’ were grown on the remaining areas.

Table XLVIII gives an idea of about the economics of the two methods.

TABLE XLVIII

<table>
<thead>
<tr>
<th>I. Item</th>
<th>Dry Farming Method</th>
<th>Local Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Land assessment on 20 acres</td>
<td>10 - 10 - 0</td>
<td>10 - 10 - 0</td>
</tr>
<tr>
<td>2. Concentrated feed for bullocks</td>
<td>30 - 13 - 0</td>
<td>30 - 13 - 0</td>
</tr>
<tr>
<td>3. Farnyard manure purchased for 10 acres only</td>
<td>10 - 0 - 0</td>
<td>11</td>
</tr>
<tr>
<td>4. Land development interest and capital repayment in 10 equal instalments</td>
<td>20 - 8 - 0</td>
<td>21</td>
</tr>
<tr>
<td>Total Expenditure</td>
<td>80 - 14 - 0</td>
<td>81</td>
</tr>
</tbody>
</table>

Income:

Sale proceeds of grain and straw | 241 - 2 - 0 | 186 - 10 - 0 |

1. Ibid., p. 320. For still better results at Bijapur refer to pp. 317-21.
This would show that there was a net business income of Rs. 174/- by
the dry farming method as against Rs. 77/14/- by the local method. The
gain under the improved method would thus work out to Rs. 96/4/- annually.

The results of all these experiments over long years will prove
that not only yields by these improved methods can go up by about 50
per cent but income also increases by about the same percentage. We
do not know the extent of the area on which improved methods are being
practised. Many of our Indian peasants are fully aware of the
of the improved practices and have developed their own systems of culti-
vation. "The whole world", says Col. Wilks, the historian of Mysore,
"does not exhibit a cleaner system of husbandry than that of the culti-
vation of ragi in the home fields of Mysore."

India's basic industry - agriculture - has so far remained sti-

Rather it appears to languish. Whatever the conditions in the past, we
have now entered into a new era of hope. India is bound to march
forward. We can safely assume that if not more, at least 50 per cent
of our existing dry or what have been termed as 'problem areas' may
come under the improved methods within the coming 10 or 15 years and
increase our yields by about 50 per cent on that area.

Total dry areas under millets, barley and gram in the year 1933-34
were about 108 million acres. We have concluded that nearly 50 per cent
of this may be brought under improved dry farming methods. This will


2. This does not call for any explanation. But the charts prepared by
Daniel Thorner, on agricultural promotion in his paper on "Indian
Economic Development since 1850", for the Social Sciences Research
Council Conference on Economic Growth in Selected Countries held on
25-27 April, 1988, would be of interest in this respect.

3. Total area under gram and coarse grains other than maize was 122
million acres. About 13.3 million acres out of this has already been
accounted for under irrigated coarse grains.
work out to about 56 million acres. On the basis of a production of 34.3 million tons from an acreage of 125 million, the share of this 56 million/dry area would be 10.7 million tons. With the introduction of improved methods, it may possibly also go up to about 16 million tons. The remaining unirrigated areas may continue to contribute the balance of 10.7 million tons of these coarse grains. This, it may be assumed, will remain as constant.

TOTAL COARSE GRAIN POTENTIAL

The net position with regard to coarse grains may thus be summarised as in Table XLIX.

<table>
<thead>
<tr>
<th>TABLE XLIX</th>
</tr>
</thead>
<tbody>
<tr>
<td>COARSE GRAIN POTENTIAL</td>
</tr>
<tr>
<td>( in million tons)</td>
</tr>
<tr>
<td>1962-63</td>
</tr>
<tr>
<td>Maize</td>
</tr>
<tr>
<td>Other irrigated coarse grains</td>
</tr>
<tr>
<td>Improved dry farming areas</td>
</tr>
<tr>
<td>Other dry areas</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

The calculations made in the preceding pages would lead us to the conclusion that the production of coarse grains by the year 1970-71 may roughly be of the order of 36 million tons, which marks an increase of about 35 per cent.